



**ISASINDIA**

*Newsletter*

*Vol 20, No. 10*

*October 2020*

### **From Editor's Desk**

At the outset, I welcome you warmly, to this issue of ISAS Newsletter.

The whole world is currently undergoing through crucial situation, due to the unfortunate spread of COVID-19 pandemic. This pandemic has brought about heavy loss of human life and many obstructions to economic activities all over the world. Let us hope that the scientific community will succeed in bringing out a vaccine and effective cure, that would solve the pandemic problem, very soon.



These disruptions, to some extent, caused delay in bringing out the ISAS News Letter as well. However, ISAS has been keeping active with regular communications through a dedicated Official WhatsApp Group, Web Meetings, Webinars, etc.

A dynamic high quality Webinar Series Phase 1, enlisting the participation of carefully chosen experts in various Scientific, Technical and Development Strategic Sectors, organised by ISAS, was a grand success. 12 such very impressive Webinars were conducted. The ISAS Webinar Series 2020 was inaugurated by Dr. A. Ajayghosh, Director, CSIR-NIIST, Thiruvanthapuram on 4th, July, 2020. These Webinars, entitled as "emerging technology and methodologies in analytical science", was continued on every subsequent Saturdays, at 7 pm, upto 19th September, 2020. Excellent participation by a large audience was a High Index of the popularity of this ISAS Webinar Series. The Phase 1 of ISAS Webinar Series was concluded on 26th September, 2020 in a glittering Valedictory Webinar, with Dr. Dinesh Srivastava, Chairman and Chief executive of Nuclear Fuel Complex, Hyderabad as Chief Guest, who delivered an impressive talk on Aatma Nirbharata attained in the Nuclear Fuel Sector by DAE. On this occasion, all the twelve Eminent Scientists/Technologists/ Development Strategists (1. Dr. R. B. Grover, 2. Dr.K.N. Ninan, 3. Dr. R. Gopalan, 4. Dr.R.Rateesh 5. Dr.V.P.Venugopal, 6. Dr.V.Balaram, 7. Dr.M.R.A. Pillai, 8. Dr. A. P. Jayaraman, 9. Dr. R.S.Jayasree, 10. Prof. G. Anikkumar, 11.B.Vijay Kuma and 12.Dr V.Avinash V. Bharati) who participated in Webinar Lectures, were conferred with the "ISAS Certificate Of Honour" by the Chief Guest. Further, Seven Eminent Experts who made Land Mark Professional Contributions (1. Dr. R.B.Grover, 2. Dr. K.N. Ninan, 3. Dr. R.Gopalan, 4. Dr R. Ratheesh, 5. Dr. V. P. Venugopalan, 6. Dr. V. Balaranan and 7. Dr. M.R.A.Pillai) were Awarded Honorary Fellowships of ISAS, by the Chief Guest.

Congratulations and appreciations to Chairman and all the other Members of ISAS Webinar Committee, for Planning and Executing such a High Quality Webinar series.

Congratulations to Chairman and all the other Members of ISAS Fellowship Committee, for selecting the Awardees of ISAS Honorary Fellowship. Congratulations to the ISAS Webinar Team for their Excellent Performance. Congratulations to Prof. V Joseph, Co-ordinator of ISAS Webinar Committee, for being awarded the ISAS Certificate of Performance Excellence.

Congratulations to Dr. Raghaw Saran for reviving Nagpur Chapter of ISAS and placing the Chapter on a dynamic track, by conducting a Webinar on Post COVID-19. Dr. Saran has also compiled an article on COVID-19 pandemic management covering prevention, care and cure, and submitted to Niti Ayog, which has enhanced the visibility of ISAS as professional forum that is strongly committed to the National Causes.

Congratulations to Dr. Raghaw Saran and Prof. Sriman Narayanan for reviving Chennai Chapter, which has been now renamed as Tamil Nadu Chapter, of ISAS.

The Executive Committee of ISAS, lead by our dynamic President, deserves a special applause for all the Vibrant Activities of ISAS.

ISAS congratulate Dr.V.R.Nair, for receiving "REAI Life Time Achievement Award 2019", instituted by the Rare Earths Association of India. Dr. V. R. Nair, Former Chief General Manager (Corporate R&D), Indian Rare Earths Limited, recieved this National Recognition for his Pioneering Contributions, as a leading National Expert, towards the development and execution of Rare Rearth mining, separation, utilisation and R&D. He is past National President of ISAS, past Chairman the Kerala Chapter of ISAS and Member of current EC of ISAS, Chairman of the ISAS Webinar Committee and Chairman of ISAS Fellowship Committee.

Inspired by the comment of a little boy, life and contribution of an unsung Indian astronomer, Venkatesh Bapuji Ketkar, has been compiled in one article. Excitingly, Ketkarji predicted the existence of Pluto, much before its discovery was made by western astronomers. The Editorial Committee, eagerly looks forward to your contributions and valuable feedback in improving the content and quality of ISAS News Letter. Wish A Happy Navrati, Dussehra and Diwali to every one.

Dr. Pradeep Kumar

Chief Editor & Vice president ISAS

E-mail: [pradeep\\_barac@yahoo.Com](mailto:pradeep_barac@yahoo.Com)



Dr. Emmanuelle Charpentier

Dr. Jennifer A. Doudna

Congratulations to Nobel Prize Winners in Chemistry, 2020



## Message from President ISAS

### **My sincere Greetings to the ISAS Community.**

I am happy to see that the October 2020 Issue of ISAS News Letter is ready. This issue of ISAS News Letter carries a wide range of interesting information that projects an impressive image of performance by ISAS, by including mentions about organisational activities such as Revival of ISAS Chapters, Important Chapter Activities, Exemplary Quality Technical Presentations made at the Highly Acclaimed "ISAS Webinar Series Phase 1", a very special article highlighting the contributions of the Indian astronomer Venkatesh Bapuji Ketkar, etc.

I congratulate the Editorial Team and Dr. Pradeep kumar, Chief Editor for their excellent efforts in bringing out this impressive issue of ISAS News Letter.

Let me take this opportunity to wish the ISAS Community, A Happy Dussera and A Happy Diwali. My dear colleagues, please ensure to follow all Safety Instructions Issued by The Government, from time to time, and Stay Healthy along with your family, during these trying times of Covid 19 Pandemic.

My Best Wishes And Warm Regards to all esteemed Members of the ISAS Family.

**(Dr. P.P. Chandrachoodan)**

**President ISAS, Mumbai**



Formation of ISAS Advisory Board	6
Dr. V. R. Nair Receives REAI Life Time Achievement Award	7
"ISAS Certificate Of Honour" , "ISAS Honorary Fellowship	8
E-mail from ISAS President to Balram Bhargava (Director General of ICMR)	9-10
Revival of Nagpur Chapter (Dr .Raghaw Saran, Vice President ISAS)	11
National Webinar on Pandemic Perceptiveness in the Post COVID-19 India (ISAS Nagpur Chapter)	12-18
Letter from ISAS Nagpur chapter to Neeti Ayog, ISAS Nagpur Chapter)	19
COVID-19 Pandemic management -Prevention, Care and Cure Dr. Raghaw Saran, Vice President, ISAS	20-37
Indian Mars Orbiter Mission, ( Dr. K.N. Ninan, Former Dy. Director Vikram Sarabhai Space Centre.	38-52
Emerging Trends in the Application of Nuclear Medicine for the Diagnosis and Therapy of Cancer ( Dr. M.R.A. Pillai )	53-61
Venkatesh Bapuji Ketkar, Eminent Indian Scientist ( Dr. Pradeep Kumar, Vice president ISAS, and Senior Scientist BARC, Mumbai)	62 -67
Nuclear Power for Clean , Green and Sustainable Energy, ( B.Vijay Kumar )	68-78
Sustainable E-waste recycling in India: Challenges and Opportunities (R. Ratheesh, Director, C-MET, Hyderabad)	79-89

## Formation of ISAS Advisory Board

In order to formulate and give a practical momentum for Impact-Making Programmes by ISAS, which is a national scientific and technical expert's body, an ISAS Advisory Board has been constituted, with the approval EC of ISAS, as follows:

1. Dr. R. K. Bhandari, (Former Director, VECC, DAE), Chairman.	2. President, ISAS, Ex-Officio Member.	3. Dr. V. R. Nair, Member.	4. Dr. N. K. Pillai, Member.
5. Dr. K. N. Nainan, (Former Dy. Director, VSSC), Member.	6. Dr. R. Gopalan. (Regional Director, ARCI, Chennai), Member.	7. Dr R. Ratheesh (Director, C-Met, Hyderabad), Member	8. Dr. V. P. Venugopalan. (Former Director, Bio-Sciences
9. Dr. V. Balaram. (Emeritus Scientist, NGRI, Hyderabad) Member.	10. Prof. G. Anilkumar, (VIT, Vellore) Member.	11. Dr. D.K. Singh Secretary, ISAS,	

The ISAS Advisory Board will meet periodically and formulate, review and suggest midcourse corrections on programmes to be pursued by ISAS, vigorously to give results that make impact on various aspects of national development.

The recommendations of the ISAS Advisory Board will be placed before EC of ISAS for further processing.

Secretary,  
ISAS.  
01.10.2020

## Dr. V. R. Nair Receives REAI Life Time Achievement Award



Dr. V. R. Nair, Former Chief General Manager (Corporate R&D), Indian Rare Earths Limited received, "REAI Life Time Achievement award 2019", instituted by the Rare Earths Association of India. Rare Earths Association of India (REAI) is a premier association in the country comprising of scientists, technologists and academicians formed with the objective of promoting research, development, application and technology of rare earths and related materials by exchanging, promoting, communicating and disseminating information in this field. REAI also organises conference every year to promote activities related to rare earths and also confer "Lifetime Achievement Award" to the individual who has contributed immensely in the field of Rare Earths. Considering the noteworthy contributions in rare earths processing made by Dr Nair in this field he was selected for lifetime achievement award for the year 2019 by REAI. This award was conferred on him by President REAI & CMD, IREL (India) Limited, Shri D. Singh , during the inaugural function of STAR 2019 conference on 5th December 2019, held at DAE Convention Centre, Anushaktinagar, Mumbai, presided over by Dr Srikumar Banerjee, Former Chairman, Atomic Energy Commission, and Secretary, DAE. Dr V R Nair was national president of ISAS during 2008 - 11. He was chairman the Kerala chapter of ISAS for two terms and organized many national and international conferences. Currently he is patron of ISAS, permanent invitee to the EC meetings, chairman of the organizing committee of ISAS Webinar series 2020 , chairman of the ISAS award selection committee and member of the newly constituted advisory board of ISAS.

**"ISAS Certificate Of Honour"** was conferred to following persons:

1. Dr. R. B. Grover,	2. Dr.K.N. Ninan,	3. Dr. R. Gopalan,
4. Dr.R.Rateesh	5. Dr.V.P.Venugopal,	6. Dr.V.Balaram,
7. Dr.M.R.A. Pillai,	8. Dr. A. P. Jayaraman,	9. Dr. R.S.Jayasree,
10. Prof. G. Anikkumar,	11.B.Vijay Kuma and	12.Dr V.Avinash V. Bharati

**"ISAS Honorary Fellowship"** was conferred to following persons :

1. Dr. R.B.Grover
2. Dr. K.N. Ninan
3. Dr. R.Gopalan
4. Dr R. Ratheesh
5. Dr. V. P. Venugopalan
6. Dr. V. Balaranan and
7. Dr. M.R.A.Pillai



## **E-mail from ISAS President to Balram Bhargava**

**(Director General of ICMR)**

Dear Prof. Balram Bhargava

Director General of Indian Council of Medical Research

Greetings to you, from Indian Society of Analytical Scientists (ISAS), Mumbai.

The entire nation is proud of you and thankful for the outstanding manner in which your expert handling is piloting the nation, through the perils of Vovid19.

Thanks, also, for the authentic information network.

It is reasonably well, and convincingly, communicated that Covid19 cannot be transmitted through air, except in the close vicinity of the infected, through micro-droplet aerosols. This is because, the virus-bearing droplets drop down, by gravity, to the ground surfaces. And that is the reason for emphasis on avoiding contacts, hand cleaning and related hygiene, keeping safe distance, lock down, etc.

However, in cities and slum areas, where Particulate Emission/Dust Levels are high and these micron level Solid Particulate Matters are moving about along with the wind, the Virus Bearing Droplets could get settled by adsorption on these Particulate Matters/Dust and such Contaminated Particulate Matter could spread along with Air (Wind) Movements into larger population.

Thus, these Airborne Particulate/Dust could be a Potent Vector and a significant parameter to be monitored, through a quick study, in order to strengthen our Nation Wide Efforts to contain Community Spread of Covid19.

I am bringing this IMPORTANT POINT, to your kind attention, personally, in view of the volatile nature of the issue.

We will be happy, if you could kindly direct some of the connected institutions under ICMR /CSIR to take up a quick study on war-footing and propose an action Model, to Contribute and Strengthen the National Efforts, that are going on.

With our great appreciation and best wishes to you and your team, who are doing the best to tackle this National Exigency, and our sincere prayers for a grant success in this endeavour, in which our entire Nation is united as One.

-P. P. Chandrachoodan

President, ISAS, Mumbai.

[ Prof. Dr. P. P. Chandrachoodan PhD; FISNT ],

Advisor, Total Knowledge Management (Impact-Making R&D,  
Innovation and Neighbourhood Development);

Former Member, Kerala State innovation Council (KSInC);

Former Senior Scientist, BARC and Senior R&D Programme Officer,  
BRNS, Department of Atomic Energy, Government of India;

Expert in: R&D, Innovation and Total Knowledge Management.

Impact-Making R&D Projects and Management of R&D Strategy,  
Neighborhood Development, Social Responsibility Programmes,  
Marine and Terrestrial Radio-Ecological Surveys.

(Mobilisation and Monitoring of Multi-Disciplinary, Multi-Institutional  
Impact-Making R&D Projects - In Basic/ Directed-Basic Sciences and  
Engineering Branches; Development of Advanced Technologies and  
Engineering Processes / Products; etc).

Specialist in NDE ( Planning, Academic and Applied R&D, and QA/QC  
Monitoring /Advisory Functions).

Expert in Environmental Science and Technology (Planning, Academic  
and Applied R&D and Monitoring / Advisory Functions).

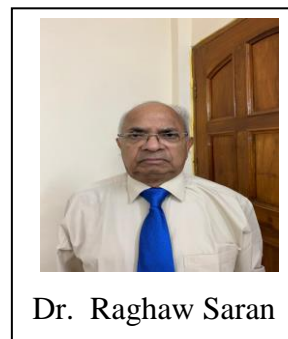


## Revival of Nagpur Chapter of ISAS

Nagpur chapter of ISAS had a remarkable colourful history since it's inception in around 2002. But due to certain unfortunate, untoward incidents, the chapter became nonfunctional since year around 2007 & was revived on 30 th of October 2019, as per the decision of the newly formed exe. Com. Of the society resuming charge in 2019, under the able guidance of the president, ISAS, Dr. P. P. Chandrachoodan.

The revival was planned to realise by retaining the old stalwart, the old life members of the society and enthusing new blood in the veins of the chapter by enrolling new members for the sustained dynamism & vibrance.

The soul purpose of the chapter is realizing the aims & objectives of the society, Indian Society of Analytical Scientist, of propagating science from the grass roots level , providing an interface among academia, R &D, industry, to provide a common forum to scientists & technologists to share the novel scientific ideas pervading there mind through symposia at different levels, invited talks etc.



Dr. Raghaw Saran

The GBM of ISAS Nagpur Chapter held on November 30, 2019 got concluded successfully constituting the Executive Body of the Chapter with Dr. Raghaw Saran as observer on behalf of the President and EC of ISAS (HQ).

The unanimously elected body of the Society of the Chapter is detailed under.

### Adviser Dr. Raghaw Saran (ISAS)

Chairman	Vice Chairman	Secretary	Jt. Secretary	Treasurer	Jt. Treasurer
Dr AV Bharti	Dr. Dilip Ranjan Kanukgo	Dr. Chandrashekhar Pandhurnekar	Dr. Indrani Das Sarma	Dr MG Shinde	Dr. Shashikant Kahu
RKN Engineering College	Indian Bureau of Mines (IBM)	RKN Engineering College	Jhulelaal Institute of Engineering & Technology	AMD(Ex)	IBM

### Executive Members:

Dr. Ravin M Jugade	Dr. Pranav Nagarnaik	Dr. SK Jain	Dr. Jyoti Shrivastav	Dr. Deepika Sachin Brijpuriya	Dr. Upendra Singh	Dr. Richa R. Khande lwal
RTM Nagpur University	NEERI	AMD	IBM	GH Raison College of Engineering	JNARDDC	RKN Engineering
Dr. Manoj D Barsinghe	Dr. Sanjeev Kumar Singh	Dr. M Karmakar	Dr. Vaishali P Meshram	Dr. Shubhojeet Halder	Dr Suraj S Butoliya	
JBCollege of Science Vardha	NEERI	SFS College	Dharmpet MP Deo Science College	Hislop College	RKN Engineering College	

# **National Webinar on Pandemic Perceptiveness in the Post COVID-19 India.**

## **Nagpur Chapter**

### **Indian Society of Analytical Scientists (ISAS)**

#### **Chaired By**

**Dr. Raghaw Saran, Vice President, ISAS**

**Held On 4<sup>th</sup> July, 2020**

No. of Resource Persons : 4

No. of participants registered : 682

#### **About ISAS and the Organisers**

Indian Association of Analytical Scientists, (ISAS) Nagpur Chapter, organized a webinar on Pandemic Perceptiveness in the post COVID-19 World on 4th July, 2020 between 10.00 am to 1.00 pm. Webinar was started with opening remark by Dr. Avinash V. Bharati, Chairman, ISAS, Nagpur Chapter and convener of the webinar followed by Dr. Raghaw Saran, Advisor, ISAS on activities of ISAS, Nagpur Chapter. Dr. Chandrachoodan, National President of ISAS gave the presidential address. Dr. Jyotsna Meshram, Professor, PGTD of Chemistry, RTMNU, Nagpur and Coordinator of Webinar told about the concept of webinar.

#### **About Chairman of the Webinar**

The Webinar was chaired by Dr. Raghaw Saran, Former Senior Scientist (Director Grade) AMD / Department of Atomic Energy and Vice President, ISAS.

#### **About Resource Persons and Topics deliberated by Them**

1. Dr. Sudhir Meshram, Former Vice Chancellor, North Maharashtra University and Founder director, Rajiv Gandhi Biotechnology center, Nagpur, in his lecture focused on the impact of biological warfare against in post COVID-19 world. He gave an insight on impact of biological warfare agents.
2. Dr. M.K.N Yenkie explained the consequences of using excessive chemical sanitizers and disinfectants.
3. Dr. G. S. Saini, Former Director national Fire Service College and National Civil Defence College, Nagpur emphasis on personal protection of community during pandemic.



#### Webinar in Progress at Nagpur

4. Shri K. M. Nadayal, Former Director National Civil Defense College, Nagpur make aware about relevance of community preparedness during pandemic situation. He also told about the precautionary measures to be adopted in the current scenario. The interactive session at the end of the webinar focused on challenges of post post covid-19 and on preparedness of post covid-19 with question answer session.
5. In his Concluding remark, Chairman Dr. Raghaw Saran briefed the findings of webinar and requested the audience to take utmost care and precautions to control COVID -19.
6. Around 678 participants from different part of the country and 5 participants from abroad also participated and benefited from this event.
7. Dr. Indrayani Das Sharma, Joint Secretary, ISAS Nagpur Chapter and Dr. Vijay Tangde assistant Professor, PGTD of Chemistry, RTM Nagpur University took lot of efforts for the success of the Webinar.

## B. FINDINGS

1. Sanitizers with alcohol base dissolve the lipid envelope & inactivate the virus of any type including SARS CoV-2, causing pandemic Covid -19, the most worrying one in the present & post pandemic scenario.

Excessive use of Chemical sanitizers *\*must be avoided\** as it contains ethanol(80% v/v) or 2-propanol(75%v/v), a volatile component which vaporizes taking heat from the surface applied on. The skin may get dry although glycerol present in it (1.45%,v/v) moisturizes skin to some extent.

Further, the sanitizers also contain hydrogen per-oxide(0.125%,v/v), an oxidant, that too may have an adverse effect.

Basically, pin shaped soap molecules with a hydrophilic (water loving) head and oleophilic (oil loving )tail is most useful in rendering the virus inactive.

Tail with high affinity for and competes with the lipids in the virus envelope. Besides, tail changes the shape, denatures the mushroom shaped spiked protein structure (Encapsulating the virus), helping the virus to bind to human cell and entering into the cell. Chemical bond holding the virus is not very strong, the long oleophilic tail gets inserted into the envelope and breaks the envelope with a crow bar effect. Tail also competes with the bond with RNA lipid envelope, dissolves the virus into its components and is removed by water. *\*Sanitizers should be used only if we don't have access to water & soap can't be used.\**

2. Sanitizers are not effective if hands are visibly greasy or dirty. In such cases, excessive amounts of sanitizers have to be used which is not advisable (discussed above).

3. Even if we have used sanitizer, at the very first opportunity, we should wash our hands with soap to remove inactivated virus, sticking to hands/ sanitized surface.

4. SARS-CoV-2 spreads primarily person to person through airborne respiratory droplets. But it may be possible for the virus to spread on surfaces and various other places in present scenario through airlines carrying Covid-19 patients, making use of disinfectant inevitable to inactivate SARS CoV -2.

Disinfectants are used alone or in combination (e.g. hydrogen peroxide and peracetic acid), alcohols, chlorine and chlorine compounds, formaldehyde, glutaraldehyde, ortho-phthalaldehyde, iodophors hydrogen peroxide, peracetic acid, phenolics, and quarternary ammonium compounds.

Alcohol-based products disintegrate the protective lipids. Quarternary ammonium disinfectants commonly used in health-care and food-service industries attack protein and lipid structure. Bleach and other oxidizers swiftly break down virus essential components.

70% alcohol or chloroxylenol (4.5-5.5%,v/v) /benzenealkonium chloride or any other suitable disinfectant may be used to wipe down the surfaces like metal. Freshly prepared 1% sodium hypochlorite is used as disinfectant usually by municipal authorities.

5. Spray of disinfectant (usually 1% sodium hypochlorite solution) in tunnels or chambers to disinfect people suffering from covid -19 or even otherwise, passing through them is not advisable. The disinfectant cannot inactivate the corona virus inside the body, even it may not be very effective for clothing.

Besides, the disinfectant may enter in the body through pores in the skin and may cause more harm than advantage.

\*Disaster management plan for post Covid community preparedness is based on several parameters. Government leadership, health sector, non-health sectors, communities, civil society organizations, individuals and families play a very important role in disaster management.

Broadly, it has two main components

1. Passive Management

2. Active Management

1. Passive management mainly involves prior preparedness of men, material and resources to face the disaster as and when the need arises, efficiently.

It is mainly keeping abreast with day to day happenings /news and visualizing a fore coming disaster, making arrangements beforehand to keep requisite infrastructures ready at hand in order to face the need based situations during the disaster.

Government may form regulations to deal with a situation but it cannot ensure their compliance by public. To ensure following of the regulations dependence on military /army should be avoided to the utmost possible extent.

On the contrary, an adequate force of large number of volunteers, helping agencies, NGOs, government officials etc. should be made ready by imparting suitable adequate training. The task force should come forward to assume the responsibility. The task force may also involve in preparedness efforts and their expertise be harnessed to help communities prepare for and respond to pandemic.

Active management is facing the situation during the disaster efficiently which depends in to how well we had prepared our resource component i. e. men in form of volunteers, NGOs etc., material and resources.



More we are prepared for a situation better we would handle.

It's advisable to make prior preparations to face a situation as and when arises.

For example, to cope up with the existing and daily increasing number of covid-19 patients, to increase the capacity of health services, we have to arrange additional beds and associated facilities such as adequate washrooms, workers to maintain cleanliness, paramedical staffs such as nurses, ward-boys, Doctors, medicines etc. Arrangement of healthy food is very essential for patients. Proper care to serve the food (with observing all hygiene) in time is equally important. In case of quarantine / isolation besides these, some people responsible to ensure observing personal hygiene including respiratory etiquette, washing hands with soap properly/ if not feasible using proper sanitizer(with alcohol content at least 60%,V/V) are essential. Volunteers, social workers, NGOs etc would be great help in such cases. Government official's meager number even with their best of motives may not suffice at all.

\*Personnel protection for community during and post Pandemic is of immense concern.

Personal protective equipment encompasses the specialized clothing or equipment worn by workers for protection against health and safety hazards. Personal protective technologies include the protective equipment as well as the techniques, tools, and materials that support to control COVID-19.

The healthcare personnel's, PPE kit may include respirators, face masks, gloves, eye protection, face shields, gowns, and head and shoe coverings. Respirators provide respiratory protection. The products are designed primarily to provide a barrier against microbes/corona virus contacting the skin or mucous membrane surfaces.

Airborne precautions include a well fitted high-filtration mask to be reserved for aerosol-generating procedures.

It's not very convenient to wear PPE kit due to being cumbersome although it is must for health care personnel during their services in health centers. It is of vital importance to observe social distancing of 1.8 meter preferably (3 ft, WHO recommendation) with suitable face mask (N 95 or any other well fitting) which should be immediately disposed after use. Touching mouth, eyes or nose by hand must be avoided as hands can pickup viruses on coming in contact with an infected surface. Besides, respiratory hygiene like covering mouth or nose, with bent elbow or tissue while coughing or sneezing, must be observed.

\* Awareness regarding biological warfare in post covid-19 world too, is of significance. Framing of new laws to tackle the situation is essential to avoid the recurrence of biological warfare



i.e. use of biological toxins or infectious agents such as bacteria, viruses, insects, and fungi to kill or incapacitate humans, animals or plants as in past like mustard gas, yellow rain and several epidemics. It won't be far ahead to think of establishing microbiology labs with state of art techniques to expose well in time any such act which may incapacitate or kill lives on earth.

Work on supramolecular material with excellent application from quantum dots to biomedicine and bioinformatics should be persuaded as a futuristic mindset.

### C. Recommendations By ISAS

1. The unprecedented Pandemic of Covid 19, due to Corona V2 is a major Public Health Challenge, till the vaccine and Cure are found out.
2. Government of India and, and under its guidance, all designated agencies in the country are doing the best to tackle this bolt from the blue.
3. However, since the virus is going to stay for longer time and, like in the Spanish Flue Pandemic, return wave of this virus infection or pandemics of this sort to other viruses (like the new strain of H1N1 having detected, again in china, with potential to break out as a new pandemic), it is very essential to practically equip our nation with a dedicated **National Pandemic Management Mission**, much more empowered than the pattern of Disaster Management which is currently in vogue.
4. *Essential Ingredients* of **National Pandemic Management Mission**:
  1. Directly operating under the Government of India and linked to every Panchayat/Municipal Ward, through District Administration, all over the nation.
  2. Quick mechanisms to reach out the entire citizens through this network, in case of all exigencies, which necessitate active understanding and total participation of each and every citizen in the implementation of the remedies.
  3. Review, updating and up-keeping (in terms of beds, medicine, staff of etc) all primary Health Centers, Government Hospitals, Medical Colleges, etc for dealing with Pandemics at short notices.
  4. Provision for Integration of all Private Hospitals and doctors in to the stream to manage Pandemics.

5. Provision for CSR Funds from All Industries, Private Hospitals, etc to support part of the expenditures related to management of Pandemics.
6. Directions to AYUSH for making regular studies for the validation of time-tested Ayurvedic/Herbal Systems, so that these India Systems can come forward with effective cure, rather than helplessly remaining just as onlookers, defeating all the very claims of their excellence.
7. To take care to avert fire/personal/fire/environmental/health hazards of various kinds of sanitizers being used in a massive scale. Many sanitizers have high alcoholic content, which make them prone to major fire hazards, when used in enclosed spaces like Aeroplane, AC Buses/Trains, Offices with centralized AC etc. Many chemicals such as nascent chlorine being used have extreme health hazards. Therefore, Principle of Green Chemistry and Industrial/Public Hygiene, Fire Hazard, etc become utmost important issues, especially when, massive manufacture and uses of these hazard-prone compositions are contemplated.
8. Media propagating sensational news creating a Parallel Pandemic Of Panic need be strictly prohibited enacting specific laws that make such actions as punishable offences.
9. A National Nutritional and Immunity Programme need be part of the **Pandemic Management Mission**.
10. Every Citizen of India need be made AWARE of his/her **CONSTITUTIONAL DUTIES TOWARDS THE NATION**, so that they are made accountable for a **RESPONSIBLE PARTICIPATION** in the **Pandemic Management Mission**, as part of it, rather than always harping only on their Constitutional Rights.

**Dr. A. V. Bharati**

**Convener (Chairman, Nagpur Chapter)**

**Dr. Raghaw Saran**

**Chairman Vice President (National)ISAS**

**Dr. P. P. Chandrachoodan**

**President, ISAS**

## Letter from ISAS Nagpur chapter to Neeti Ayog



# Indian Society of Analytical Scientist

## ISAS - Nagpur Chapter

(Established in 1983 at Bhabha Atomic Research Centre, Mumbai)

[www.isasnagpur.in](http://www.isasnagpur.in)

email id : [reviv.ngp@isasnagpur.in](mailto:reviv.ngp@isasnagpur.in)

### Adviser

**Dr. Raghaw Saran**

Vice-President,  
ISAS (National)

**Dr. A. V. Bharati**

Chairman

**Dr. D. R. Kanungo**

Vice-Chairman

**Dr. C. P. Pandhurnekar**

Secretary

**Dr. (Ms.) I. D. Sarma**

Jt. Secretary

**Dr. M. G. Shinde**

Treasurer

**Dr. S. Kahu**

Jt. Treasurer

### Executive Members

**Dr. R. M. Jugade**

**Dr. P. Nagarnaik**

**Dr. S. K. Jain**

**Dr. J. Shrivastav**

**Dr. D. S. Brijpuriya**

**Dr. U. Singh**

**Dr. M. D. Bansinghe**

**Dr. S. K. Singh**

**Dr. M. Karmakar**

**Dr. V. P. Meshram**

**Dr. S. Haldar**

**Dr. S. S. Butoliya**

**Dr. R. R. Khandelwal**

Dear Sir,

Dated : 18<sup>th</sup> July, 2020

- Sub: 1. Report By ISAS - On Post Covid-19 Scenario Management in India.  
2. Evolved After a Comprehensive Webinar on 4th July, 2020.  
3. Recommendation to institute a National Pandemic Management Mission.  
4. Offer of Expertise for Implementation of above (Sub 3).

Greetings from ISAS, a leading National Professional Body of Scientists, Technical Experts and Academicians, spread all over India and these technologies forming active part of practically all the sectors of national development.

As a national professional body, we are committed to contribute to the various national development issues. As part of this policy of ours, we have conducted this Webinar on, "Post Covid-19....."

We are enclosing a Report, indicating our recommendation, focused upon regular and long term solution for dealing with the Post-Covid 19 Pandemic.

We recommend the formation of a "National Pandemic Management Mission".

We strongly feel that, it is essential for our eminent planners for our great nation, to take care of these issues aptly, seriously and execute "preparedness at short notice" and "rapidly reach out to the ordinary citizens" of India.

This will also be a feather in the cap of Niti Aayog and our great democracy, by lifting it to the top of all democracies in the world.

We will be happy to associate with the efforts of Niti Aayog in implementation of these recommendations, as part of the apex body.

With best wishes, we say Jai Hind.

Enclosure: ISAS Report, as above.

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## COVID-19 PANDEMIC MANAGEMENT - PREVENTION, CARE AND CURE



**Dr. Raghaw Saran**  
**Vice President, ISAS**

Dr. Raghaw Saran is Ph.D. in chemistry. He served as senior scientific officer for 35 years at Atomic Minerals Directorate for exploration & Research, Department of Atomic Energy. His academic acquisition is IBC Leading Scientist of the World,(2013), International Biographic Centre, Cambridge, England, L.M. Institutions of Chemists, F.I.C. (Fellow of Institution of Chemistry, F.I.C.S. Fellow of Indian chemical Society. He is founder of Shillong Chapter and Nagpur Chapter, ISAS. Currently He is Vice President (National), ISAS, advisor Nagpur Chapter, ISAS and Vice Chairman (Webinar Committee), ISAS. He organised National Webinar on Pandemic Perceptiveness in the post Covid-19 World ISAS, Nagpur Chapter – 12<sup>th</sup> July, 2020 and webinar Series on Emerging Technologies and Methodologies in Analytical Science on every Saturday commencing from 4<sup>th</sup> July, 2020. He was recognized guide for PhD at i) Gauhati University ii) Indian Institute of Petroleum (IIP), Dehradun. Dr. Saran is Former Member of co-ordination committee of RSIC (Regional Sophisticated Instrumentation Center), Former Member of NECC (North Eastern Council co-ordination committee), Served as expert of several appointment committees for recruitment of Scientific Officers & staff. He organized about 12-13 national & international symposia besides several workshops, Training Programs, etc. Completed several projects under BRNS (Board of Research in Nuclear Sciences), Manipur Government, ICAR (Indian council of Agricultural Research) etc., Collaborated with RSIC Shillong, NEHU (North Eastern Hill University), Guwahati University. Former Guest faculty at Gauhati University. He is Responsible for establishing field chemical laboratories in tough terrains in areas like Domiasiat in Shillong, Meghalaya etc. ,Mobile field laboratories under United Nations Development project in Sarguja District, M.P., Modernization of base chemical laboratory at Shillong with state of art techniques like ICP OES etc. He has served for 35 years in field of Analytical Chemistry in various capacities. Forty-nine (49) solution oriented research papers have been published in several Journals of International and National Repute.

## ABSTRACT

- The outbreak of coronavirus (n) disease, COVID-19 in December, 2019 in Wuhan, China as epicenter spread in more than 100 countries across the world makes it a pan-epidemic threat to global public health.
- Mandatory quarantines/isolation has effected millions of life with far reaching consequences on the world wide economy.
- For an effective management of Covid-19,the present scenario makes it pertinent to have an insight into the zoonotic virus and it's other aspects such as spike structure, genome sequencing, the spike bio molecule associated that binds to and infects human cells causing the disease COVID-19, symptoms, high transmissibility making quarantine mandatory to prevent the spread.
- More than 500 patents show the extent and urgency of R & D work utilizing four biological classes such as therapeutic antibodies, cytokines, RNA therapies and vaccines to treat and prevent SARS and MERS but getting a drug or vaccine through all necessary steps required for regulatory approval and subsequent commercialization will take time.

## VIRUS

Virus are very tiny particle of RNA or DNA genetic code, protected by an outer protein wrapper. All viruses in the world weigh more than all the living matter in the world. 10% of human genome are derived from virus DNA. They are incredibly small to an extent that 100 million virus particles of novel corona virus can fit on a pin head and billions can float on tiny droplets.

Virus particles try to insert themselves into living cells in order to multiply, infect other cells and other hosts, introduce their genetic material as part of their replication cycle to reproduce, actually, they act like parasite, hijack living cells, force them to make more viruses and sends out hundreds of thousands of copies of itself. They often kill the hijacked cell.

Virus gets into a living cell if right receptor is available for it like a key and key hole. Most of them are blocked by our immune system or if we don't have right receptor. 99% of them are harmless to humans.

## CORONAVIRUSES

These are relatively large viruses. In new corona virus, the genetic information is stored in single strand, positive sense RNA genome, like all other corona viruses contrary to, human genetic

information coded in double strand DNA. Positive sense (5-' to -3') signifies – the direct translation of Viral RNA sequence into its protein for replication. Coronaviruses are encapsulated with a membrane envelope, studded with glycoprotein spikes giving them corona (crown) like appearance.

New virus's RNA genome has <30 thousand bases. In contrast human genome contains - Around 3 billion base pairs tightly packaged inside the nucleus of each of their cells. Shorter sequence codes for 29 proteins makeup the virus SARS CoV-2.

- (i) protects the pathogens.
- (ii) helps it to attach to host cells.
- (iii) enables it to replicate.
- (iv) the structure of protein helps developed small molecules antibodies and other therapeutics which can disrupt the protein functions of the virus

Classes of corona viruses

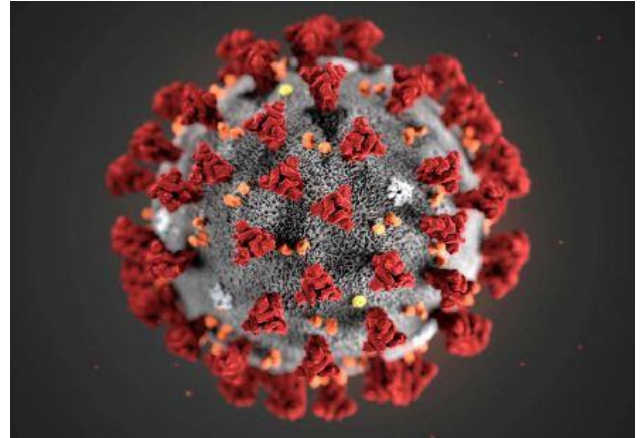


Figure 1 – Coronavirus

There are four classes of Corona viruses- alpha, beta, gamma and delta.

Beta corona virus class includes

- i) Severe acute respiratory syndrome (SARS) virus (SARS-CoV).
- ii) Middle East respiratory syndrome (MERS) virus (MERS-CoV).

Covid-19 causative agent SARS-CoV-2.

SARS-CoV-2 attacks lower respiratory system similar to SARS-CoV & MERS-CoV, causing viral pneumonia but also affect gastrointestinal system, heart, kidney, liver and central nervous system, leading to multiple organ failure.

However, it is one of the weakest family of viruses, kills 1 – 2 % of infected people, WHO (World Health Organisation) puts a higher figure of more than 3%, some references put the figure to be around 3-8%, *provided due precautions are taken.*

Corona virus (n), SARS – CoV2 appears like a tiny strand of spaghetti, wound up in a ball, packed inside a shell made of protein. Shell has spikes that stick out and make it look like the corona from the sun. The family of viruses have similar appearance. They all look like corona.



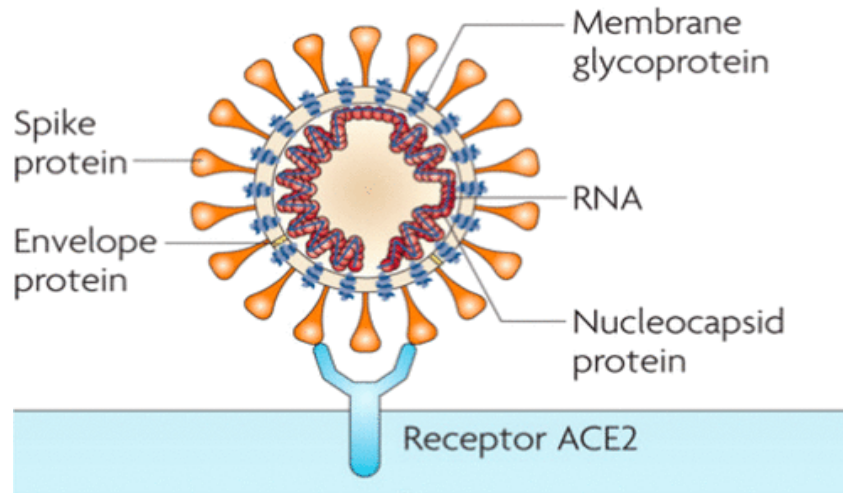


Figure 2 - Coronavirus Structure and Viral Receptor ACE-2 On The Host Cell Surface

Seven corona viruses have human to human transmission. Four out of them generate mild cold but three of them can be deadly, including viruses causing SARS, MERS and new corona virus SARS-CoV2. Human immune system has been evolving for 2 million years. Novel just means i.e., Specific virus is new to human system and there has been no opportunity for human being to develop immunity for the virus. Lack of immunity, ability of Coronavirus to spread easily and relative lethality, all these parameters make together SARS-CoV2, highly disturbing.

## IMMUNITY

Blood is mixture of cells and plasma. Heart pumps blood, through arteries, capillaries & veins to provide oxygen, nutrients to every cell of the body. Blood also carries away waste products. Main role of plasma, the liquid portions of blood, is to transport nutrients, hormones and proteins to the parts of the body that require it.

Cellular portion of blood contains red blood cells (RBC), white blood cells (WBC) and platelets. Blood cells are produced in bone marrow. In childhood most of our bones produce blood but with age, production of blood is restricted to just bones of spine sternum, ribs, pelvis and small parts of the upper arm and leg. Bone marrow actively producing blood cells by Hematopoiesis is called red marrow. Yellow bone marrow does not produce blood cells, it's important for fat storage. RBC round and flat, shape- bio-concave disc like a shallow bowl, has no nucleus and can change shape without breaking. It squeezes single file through capillaries. WBC or leukocytes are parts of immune system, helps our body to fight infections and are circulated in the blood and transported to an infected area. Infection somewhere in body increases the number of WBCs in our blood.

There are mainly five types of WBC

i) Neutrophils, (ii) Eosinophils, (iii) Basophils, (iv) Lymphocytes and (v) Monocytes.

Neutrophils, Eosinophils and Basophils also called granulocytes due to granules in their cells – containing digestive enzymes. Each type of WBC performs given specific defense task to fight against foreign objects. Neutrophils – are the body’s main defense against bacteria & kill them by phagocytosis, the process by which a cell uses its plasma membrane to engulf a large particle giving rise to an internal component called phagosome; it is a type of endocytosis. Eosinophils kill parasites & have a role in allergic reactions. Basophils function in allergic reactions. Monocytes enter the tissue, become larger, turn into macrophages. They can phagocytize bacteria throughout the body, also destroy old, damaged and dead cells in the body. Lymphocytes are complex cells – direct the body’s immune system. T-lymphocytes (T cells) – Responsible for all mediated immunity. B-lymphocytes responsible for humoral immunity or antibody production. Lymphocytes are different from other WBCs, they can recognize and have a memory of invading bacteria and viruses. Ratio of cells in normal blood is as – 600 RBC for each white blood cells & 40 platelets, 7 to 8% of person’s body weight. Approximately, in 5 L of blood, 2.75 to 3 L of blood – is plasma, rest cellular portion. There are about a hundred trillion bacteria and viruses on our body. All of them do not cause disease. But some of them are able to get inside our bodies to multiply, and this can make us ill. Our immune system is quick to recognize them as invaders. This is because the proteins or sugars on the bacteria’s surface have different shapes to any of the ones in the human body. They trigger a complex chain of events involving many different types of white blood cells working together.


One type of white blood cell is able to make antibodies to fight the invaders. Antibodies can stick to the proteins or sugars on the bacteria’s surface, and this kills the bacteria or disables them. However, not all antibodies will work against these bacteria. They have to be exactly the right shape – a bit like a key fitting a lock. Our bodies have a library of billions of white blood cells, each of which can make just one shape of antibody. Only a few of these antibodies will match the invading bacteria. Producing antibodies of the right shape can take several days. By this time there could be billions of disease-causing bacteria in our body. Once the right cells are activated, they quickly divide and turn into a production line, making masses of antibodies that stick to the bacteria. Eventually our body gets rid of all the bacteria and we recover. Antibodies remain in the blood, and some white blood cells may also become ‘memory cells’. Those specific bacteria, if invade the body again, the immune system will respond so quickly that one won’t get ill. Many coronaviruses – zoonotic i.e., they are transmitted from animals to humans. SARS coronaviruses – Thought to be an animal virus from an as-yet-uncertain animal reservoir. Perhaps bats that spreads to other animal (civet cats). First humans infected were in Guangdong, Southern China in 2002. MERS coronavirus passed on to humans from dromedary camels



in Saudi Arabia in 2012. There is evidence that SARS-CoV-2 has also been transmitted from bats. Spike protein of novel corona virus shares 98% sequence identity with spike protein of bat.

## Closely related to SARS

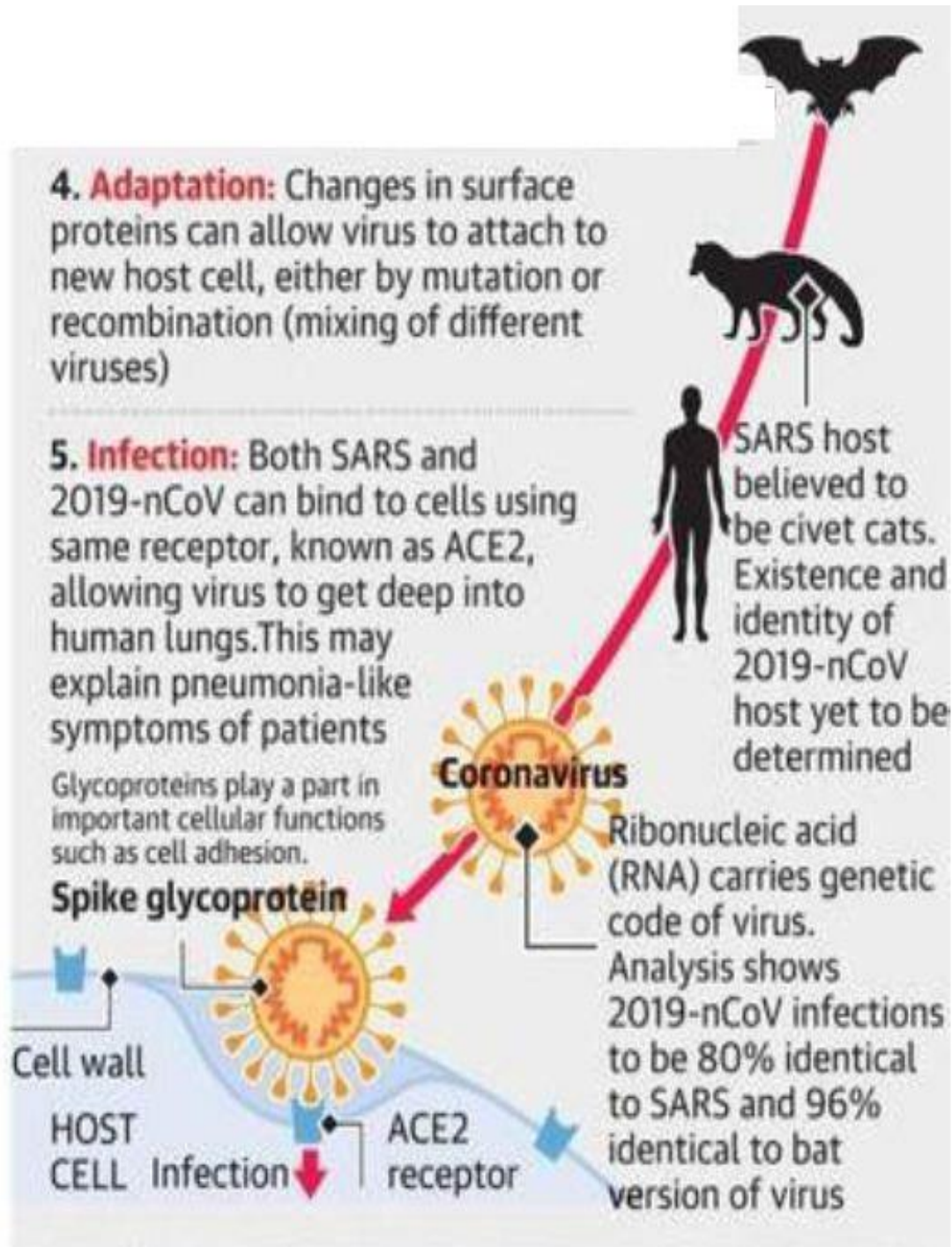
The new coronavirus first identified in the Chinese city of Wuhan appears to be similar to the one that caused severe acute respiratory syndrome (SARS), and there is evidence it originated in bats



**HORSESHOE BAT**  
Many coronaviruses are zoonotic diseases, meaning they are transmitted between people and animals

- 1. Animal disease reservoir** Bats thought to be original host of SARS - which caused 2002-03 epidemic - and new virus, named 2019-nCoV
- 2. Intermediate host** Other animals infected by blood, saliva, urine or faeces of bats
- 3. Transmission to humans** Virus "jumps" species barrier, possibly via close contact with infected animals, and may then be spread person-to-person

Spike (s) glycoprotein of SARS-CoV-2 (causing COVID-19), Binds to cellular receptor angiotensin converting enzyme 2 (ACE-2), which serves as the entry point into human cells. Cryo-EM structure (samples cooled to, -200 degree C, using liquid nitrogen embedded in vitreous water, applied to grid mesh plunge frozen in liquid ethane or mixture of liquid ethane and propane) revealed that spike protein of the novel corona virus binds to the cell receptor with much higher affinity-10 to 20 fold higher.



## HIGHER TRANSMISSIBILITY

High affinity 2019-nCoV S for human ACE-2, causes apparent ease to spread from human to human. 3D map of S-protein helps to design new anti virals to stop the virus from binding and infecting human cells. The atomic level structure of 2019-nCoV spike allows additional protein efforts to improve antigenicity and protein expression for vaccine development.

Novel SARS-CoV-2 is different from earlier known coronaviruses in four critical ways.

- (1) Many infected people have no symptoms for days and can infect others unknowingly.
- (2) 80% of the time, COVID-19 is a mild disease like minor cold or cough needing no isolation, which causes infecting others.
- (3) Symptoms are easily confused with flue.
- (4) Most importantly, the virus is very easy to spread from human to human,

In the early stages it is concentrated in the upper throat.

The throat is full of viral particles, with cough or sneeze billions of these particles are expelled and transmitted to another person.

## SPREAD OF DISEASE

SARS-CoV-2 is believed to spread primarily person-to-person through airborne respiratory droplets, by touching infected surface or object by the virus and then touching own mouth, nose or eyes. It may be possible for the virus to spread on surfaces, too. Viruses expelled into the air by coughing, breathing, or speaking can settle on surfaces. One study carried out in a hospital, found that similar corona viruses can persist on hard surfaces like glass, metal, or plastic for up to 9 days. They can linger in an active state for days, protected in a cozy covering of mucus. Although it's not confirmed yet how long the novel corona virus remains active on a surface. Airlines, massive sports stadiums, etc. makes it easier for diseases to spread rapidly. Mobile devices like smart phones can pick up germs from contaminated hands. They offload the germs later on to spread in a new location. People of all age but people aged 70 or above, are at highest risk of dying due to COVID-19. Victims of the virus, with pre-existing medical conditions such as cardio vascular disease and diabetes, have higher fatality rates. Victims with poor immunity succumb to the virus easily.

## SYMPTOMS OF THE DISEASE

COVID-19 patients suffer SARI (severe acute respiratory infection) with a history of foreign travel or close contact with another COVID-19 patient. COVID-19 patient may present with mild, moderate or severe illness which includes severe pneumonia, ARDS (Acute Respiratory Distress Syndrome), sepsis and septic shock.

### Asymptomatic;

Unfortunately, many infected people show no symptoms for the early days and then a mild cough and low fever shows up, opposite to SARS, where patient has clear symptoms for a few days but were contagious only when sick.

## Assay Techniques and Test Development for Covid-19

COVID-19 tests currently fall into two major categories.

1. Molecular assays for detection of SARS-CoV-2 viral RNA using polymerase chain reaction (PCR)-based techniques or nucleic acid hybridization-related strategies.

2. Serological and immunological assays that largely rely on detecting antibodies produced by individuals as a result of exposure to the virus or on detection of antigenic proteins in infected individuals.

Two categories of tests serve overlapping purposes in management of the COVID-19 pandemic.

Testing for SARS-CoV-2 viral RNA identifies SARS-CoV-2-infected individuals during the acute phase of infection. Serological testing subsequently identifies individuals who have developed antibodies to the virus and could be potential convalescent plasma donors. It also furthers the ability to conduct contact tracing and monitor the immune status of individuals and groups over time. Timely diagnosis, effective treatment, and future prevention are key to management of COVID-19.

## COVID-19 RT-PCR TEST

A real time reverse transcription (conversion of RNA to DNA) polymerase chain reaction (rRT-PCR). PCR monitors the amplification of a targeted DNA molecule during the PCR (i.e., in real time), not at its end, as is done in conventional PCR. The test may be quantitative or semi – quantitative using fluorescence detection of nucleic acid from SARS-CoV-2. Upper and lower respiratory specimen (such as nasal, nasopharyngeal or oropharyngeal swabs, sputum, lower respiratory tract aspirates, bronchoalveolar lavage (BAL), nasopharyngeal wash / aspirate or nasal aspirate) etc. is collected.

The RT-PCR starts with laboratory conversion of viral genomic RNA into DNA by RNA-dependent DNA polymerase (reverse transcriptase), the reaction relies on small DNA sequence primers designed to specifically recognize complementary sequences on the RNA viral genome and the reverse transcriptase to generate a short complementary DNA copy (cDNA) of the viral RNA.

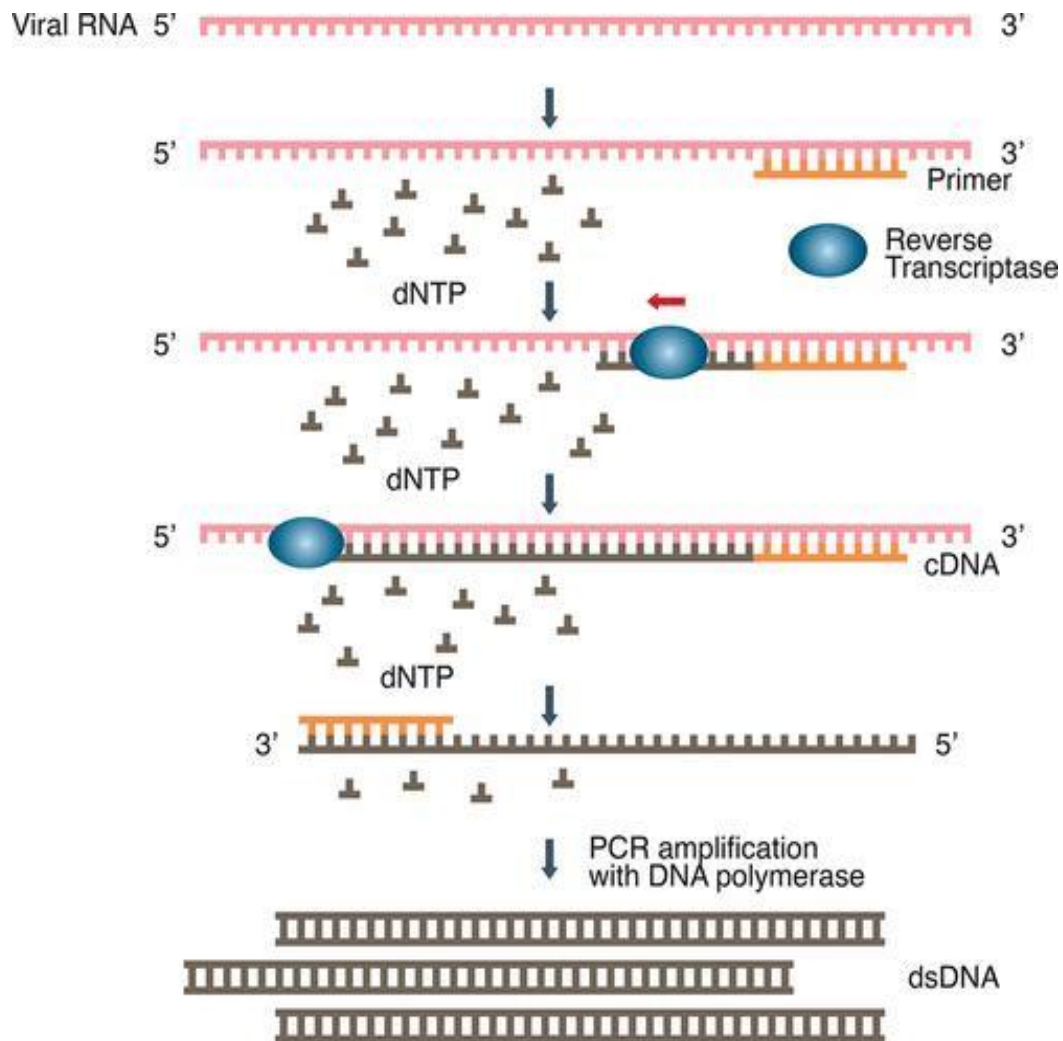


Figure 1. Reverse transcription-polymerase chain reaction (RT-PCR).

In real-time RT-PCR, the amplification of DNA is monitored in real time as the PCR reaction progresses, using a fluorescent dye or a sequence-specific DNA probe labeled with a fluorescent molecule and a quencher molecule, as in the case of TaqMan assays. An automated system then repeats the amplification process for about 40 cycles until the viral cDNA can be detected, usually by a fluorescent or electrical signal. cDNA copy of a specific segment of the viral RNA, which is converted to dsDNA (double stranded DNA) that is exponentially amplified. RT-PCR has traditionally been carried out as a one-step or a two-step procedure. One-step real-time RT-PCR uses a single tube containing the necessary primers to run the entire RT-PCR reaction. Two-step real-time RT-PCR involves more than one tube to run the separate reverse transcription and amplification reactions, offers greater flexibility and higher sensitivity than the one-step procedure.



## ISOTHERMAL NUCLEIC ACID AMPLIFICATION

RT-PCR requires multiple temperature changes for each cycle, involving sophisticated thermal cycling equipment. Isothermal nucleic acid amplification is an alternative strategy that allows amplification at a constant temperature and eliminates the need for a thermal cycler.

Several methods based on this principle have been developed.

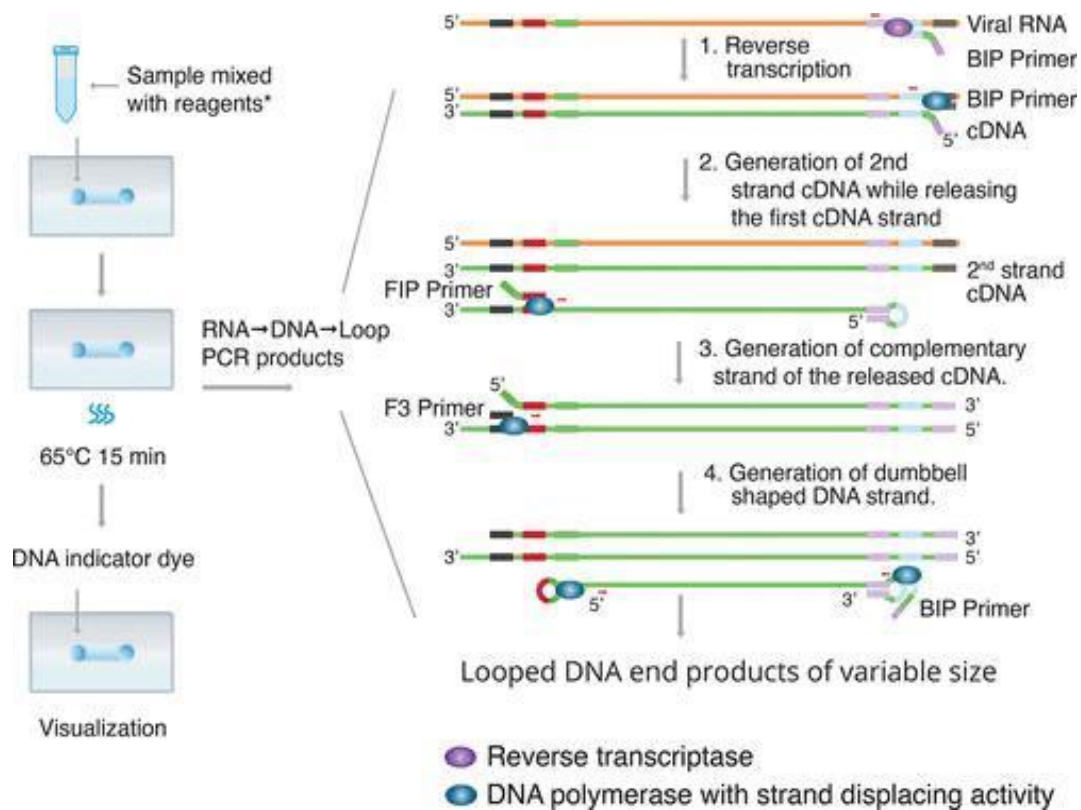
### Reverse Transcription Loop-Mediated Isothermal Amplification (RT-LAMP)

RT-LAMP requires a set of four primers specific for the target gene/region to enhance the sensitivity. The method combines LAMP with a reverse transcription step to allow for the detection of RNA.

The amplification product can be detected via photometry, measuring the turbidity caused by magnesium pyrophosphate precipitate in solution as a byproduct of amplification.

Real-time RT-LAMP diagnostic testing requires only heating and visual inspection.

Simplicity and sensitivity make it a promising candidate for virus detection.



## Reverse transcription loop-mediated isothermal amplification (RT-LAMP).

**Step 1:** At the 3'-end of the viral RNA, reverse transcriptase and BIP primer(short, single stranded DNA sequence) initiate conversion of RNA to cDNA.

**Step 2:** At the same end, DNA polymerase and B3 primer continue to generate the second cDNA strand to displace and release the first cDNA strand.

**Step 3:** The FIP primer binds to the released cDNA strand and DNA polymerase generates the complementary strand.

**Step 4:** F3 primer binds to the 3' end, and DNA polymerase then generates a new strand while displacing the old strand.

LAMP cycling produces various sized double-stranded looped DNA structures containing alternately inverted repeats of the target sequence as detected by a DNA indicator dye. Reagents\*: Primers and master mix containing reverse transcriptase, DNA polymerase with strand displacing activity, dNTPs (deoxyribonucleotide triphosphate), and buffers.

Other methods in use:

Transcription mediated amplification (TMA)

CRISPER Based Assays (Clustered regularly interspace short palindromic repeats).

Rolling Circle Amplification.

Nucleic Acid Hybridization using Microarray.

Amplicon – Based Metagenomic Sequencing.

Serological and immunological test.

Enzyme – Linked Immunosorbent Assay (ELISA).

Biosensor Test - Rapid Antigen Test etc. in samples collected from individual suspect of COVID-19. Test can easily tell if someone harbors the virus.

In India, 52 labs belonging to the Viral Research and Diagnostic Labs of ICMR, 10 labs under National Centre for Disease Control (NCDC) and the NIV (National Institute of Virology) are active.

## CARE TO PROTECT OURSELF

Genetic material of the virus encased in a layer of lipid (a fat) envelope, pin shaped soap molecules with a hydrophilic (water loving) head and oleophilic tail (oil loving) are useful. The oleophilic tail, with high affinity for and competes with the lipids in the virus envelope. Chemical bond holding the virus is not very strong. The long oleophilic tail gets inserted into the envelope, breaks the lipid envelope with a crow bar effect. Tail also changes the shape, denatures, the mushroom shaped

spike protein structure which helps the virus to bind to human cell and enter into the cell. Tail also competes with the bond with RNA Lipid envelope, dissolves the virus into its components and is removed by water on washing with water. Sanitizers with alcohol base, like soap, dissolves the lipid envelope, inactivate the virus.

Denatures the mushroom shaped protein structure (helping the virus to bind to human cell and entering the cell). Sanitizers with 60% alcohol effective. But Unlike soap lather, does not come in contact with all parts of the hand. Also sufficient amount of sanitizers needed to get rid of the virus. Further, sanitizers do not remove the dead viruses from hand. Although, quickly reduces the number of microbes but does not reduce all type of germs. Sanitizers are also not effective, if hands are visibly dirty or greasy.

Sanitizers approved by WHO (World Health Organization) (virus reduction factor > 3.8.)

Two formulations

- (I) Ethanol – 80% (v/v)  
glycerol – 1.45% (v/v) (glycerine)  
Hydrogen peroxide – 0.125% (v/v)
- (II) Isopropanol – 75% (v/v)  
Glycerol (glycerine) – 1.45% (v/v)  
Hydrogen peroxide – 0.125% (v/v)



Exposure for 30 seconds found SARS CoV-2 inactive as tested in laboratory cultures.

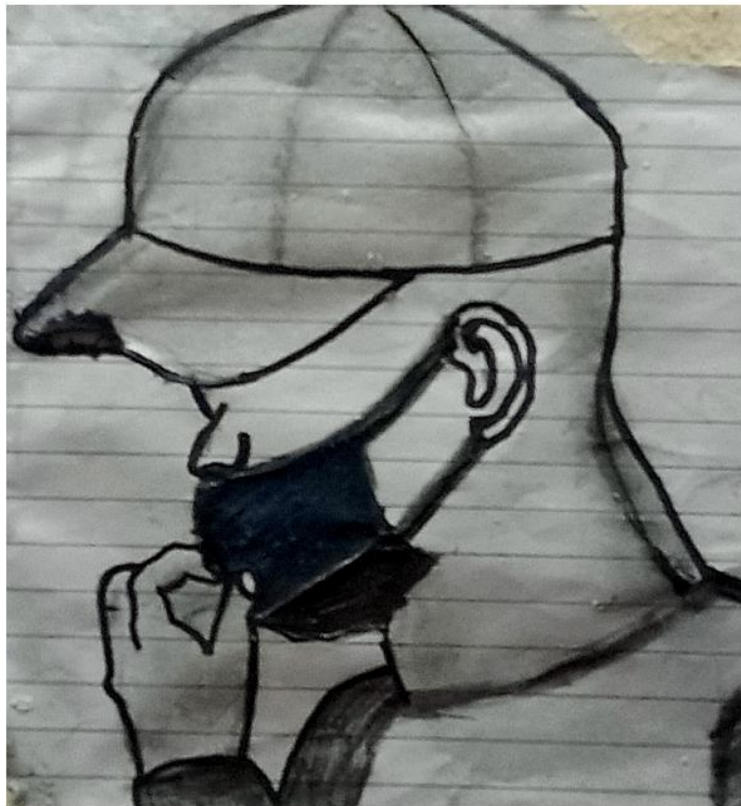
Alcohol-based products disintegrate the protective lipids. Quaternary ammonium disinfectants, commonly used in health-care and food-service industries, attack protein and lipid structures, thwarting the pathogen's typical mode of infection. Bleach and other potent oxidizers swiftly break down a virus's essential components. 70% Alcohol can be used to wipe down surfaces where the use of bleach is not suitable, e.g. metal. Chloroxylenol (4.5-5.5%) / Benzalkonium Chloride or any other disinfectants found to be effective against corona virus may be used as per manufacturer's instructions. Disinfectants are used alone or in combinations (e.g., hydrogen peroxide and peracetic acid) in the health-care setting. These include alcohols, chlorine and chlorine compounds, formaldehyde, glutaraldehyde, ortho-phthalaldehyde, hydrogen peroxide, iodophors, peracetic acid, phenolics, and quaternary ammonium compounds. Commercial formulations based on these chemicals are considered unique products and must be registered with EPA (Environment Protection Agency) or cleared by FDA (Food And Drug authority. In most instances, a given product is designed for a specific purpose and is to be used in a certain manner. Users should read labels carefully and select product for the intended use and apply efficiently. Alcohol based sanitizers do not eliminate all types of germs.



Soap and water are more effective than hand sanitizers at removing certain kind of germs like cryptosporidium, norovirus and clostridium difficile.

## USING A MASK

Medical masks help prevent the spread of corona virus infection. If worn properly, they are effective in preventing transmission through droplets from coughing and sneezing from people infected. Surgical mask helps block larger potential droplets, splashes, sprays or splatter that may contain germs (viruses and bacteria), keeping it from reaching mouth and nose, reduces exposure of saliva and respiratory secretions to others. Loose fit masks do not provide complete protection and should not be shared or reused at all. N 95 respirator provide close facial fit and are designed to form a seal around nose and mouth. They are commonly used in health care settings but they too must be used only once and must be disposed after single use. They provide very efficient filtration of air - born particles.

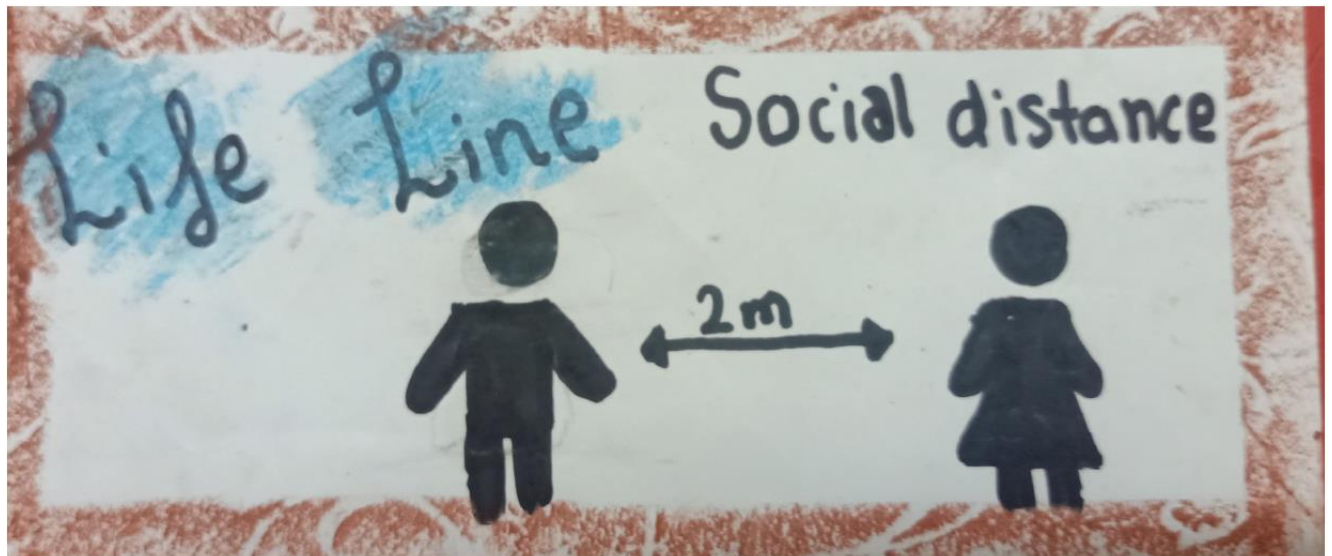


( Ojasvi Sharma, Anushakti Nagar, Mumbai)

## SOCIAL DISTANCING

A distance of at least 1 meter (3 ft) must be maintained from any one coughing or sneezing to avoid the spray of small liquid droplets from their nose or mouth containing COVID-19 virus –as per guidelines issued by WHO (or preferably 1.5 m). Hands can pick up viruses on coming in contact with many surfaces. Touching eyes, nose or mouth by hands must be avoided.

Respiratory hygiene should be maintained. Mouth and nose should be covered with bent elbow or tissue while coughing or sneezing. Used tissue should be immediately disposed.



( Ojasvi Sharma, Anushakti Nagar, Mumbai)

## CLOSING OF SCHOOLS

Children generally pass along viruses quickly as don't wash their hand or practice much personal hygiene. To avoid spread of the virus schools are closed. The virus travel by road, air and sea. They travel by aero-plane now a days along with the infected passengers with SARS CoV-2.

Incoming passengers on airport undergo thermal scanning. Thermal scanners are effective in detecting people who have developed a fever due to infection with new corona virus.

However infected people cannot be detected if not having fever as it may take 2 to 10 days to become sick and develop a fever.



( Ojasvi Sharma, Anushakti Nagar Mumbai)

## TREATMENT AND PREVENTION

No current evidence is available from randomized controlled trials to recommend any specific treatment for suspected or confirmed COVID-19 patient. In the search for an effective treatment, old method of fighting similar infectious diseases recently surfaced.

## BASED ON CONCEPT OF PASSIVE IMMUNITY

Antibodies developed in a person already cured may be used for treating others. Plasma in the blood contains antibodies. Antibodies fight foreign pathogens. Some blood cells act as memory cell and store information. When they come in contact with same kind of pathogen; Identify, defeat it quickly by producing the same antibodies.

## PLASMA

Plasma is Pale yellowish liquid part of the blood. It holds the blood cells in suspension in whole blood, carries protein, minerals, nutrients and hormones to different part of the body. It makes up about 55% of the bodies total blood volume. Plasma is made up of 90% water and contains proteins such as albumin, gamma globulin, anti-haemophilic factor and mineral, salts, sugars, fats, hormones and vitamins. Major function of plasma is to maintain normal blood pressure, supply proteins to different parts of the body for blood clotting and immunity, carry electrolytes such as sodium and potassium to our muscles and maintain a proper pH balance in the body. Collected plasma should be transfused in

the patient's body within eight hours or should be immediately frozen. Although, storing plasma is not recommended as storing plasma makes the antibodies present in it less effective.

Eligibility criteria for a plasma donor

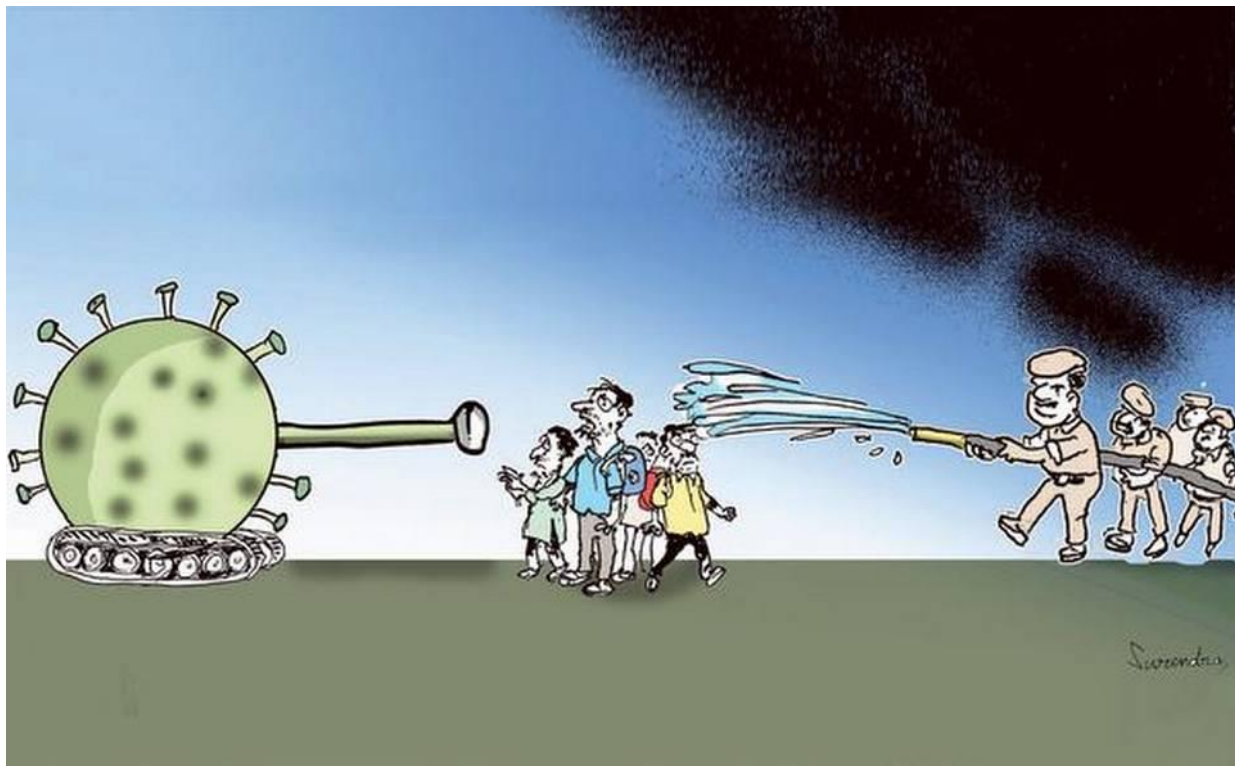
- Age between 18 – 60 years.
- Weight > 50 kg.
- Should not be suffering from any transmissible or chronic disease.
- Pulse rate normal between 50 – 100 without irregularities.
- Haemoglobin level minimum 12.5 g/dL.
- BP and body temperature normal.
- Should not have got piercing or tattoo in the past 6 months.

## DEVELOPMENT IN TREATMENT

Drugs acting on the corresponding targets in similar viruses were assessed for their effect on SARS-CoV-2 infection. Identification of specific targets is important for identifying drugs. Finding inhibitors for the Novel Corona virus's main protease; examining cryo EM structure, sample of spike protein or proteins DNA code were explored. Fusing SARS antibody from Liama with a fragment of human antibody yielded a hybrid which neutralized the virus responsible for COVID-19. Data suggest that such hybrid could be useful in combating corona virus epidemic. Antibodies are much smaller than human antibodies, called nano bodies, scientist tried to use them into therapeutic. 3CLpro & PLpro two viral proteases responsible for cleavage of viral peptides into functional units for the virus replication and packaging within the host cell.

Drugs targeting these protease in other virus such as HIV drugs lopinavir and ritonavir explored. RdRp- the RNA dependant RNA polymerase, responsible for viral RNA synthesis should be blocked. Proposed drug candidate or existing drugs such as remdesivir should be explored for the effective treatment of SARS CoV-2. The interaction of viral S protein with its receptor ACE2 on host cells and subsequent viral endocytosis into the cells also is examined feasibility of a viable drug target. Broad spectrum antiviral drug, arbidol acts as an inhibitor of virus – host cell fusion, prevents viral entry into the host cell against influenza virus. Comostat mesylate, inhibitor of TMPRSS-2 (transmembrane, serine 2- protease an enzyme) to block SARS-CoV-2 entry to human cells acts as a potential drug. During a viral infection, the most prominent cytokines IFNs (interferons) produced have ability to interfere with viral replication. Interferons and interferon fusion protein have been utilized as therapeutic agents for treatment of viral infection being used for past 20 years have been explored for SARS-CoV-2. The ability to chemically synthesize modified and analogues of micro

RNAs as well as siRNA (small interfering RNAs) capable of altering disease related gene expression or inhibiting pathogen gene expression has created the host of new therapeutic option. Anti viral vaccines falling into one of the following types Inactive or live - attenuated viruses, virus like particles VLP, viral vectors(with the care that gene effects only requisite type of cells and not the healthy cells as well as cancer cells or in wrong location in the DNA and cause harmful mutation to the DNA) protein based, DNA based and mRNA based vaccines. 363 patents related to vaccine development to prevent viral SARS-CoV-2 have been submitted. More than 500 patents, using four biologic classes- Therapeutic antibodies, cytokines, RNA therapies, vaccines have been submitted. Finalizing a drug or vaccine, a series of clinical trials are needed, first on animals and then on successively larger groups of peoples, to be sure that it is 100% safe for everyone. To get regulatory approval and subsequent commercialization may take one to two years on optimistic side.





# Indian Mars Orbiter Mission

Dr. K.N. Ninan

Webinar held on Aug 14,2020



*Former Deputy Director of Vikram Sarabhai Space Centre & Emeritus Professor of Indian Institute of Space science & Technology.*

Born in 1946, Dr. Nina obtained his B.Sc. and M.Sc. in chemistry with first rank for both. He acquired Ph.D. from the University of Kerala. He started his career at VSSC in 1968 as a Propellant Engineer trainee and retired as “Outstanding Scientist”, after a tenure of 40 years. He established a state-of-art Analytical & Spectroscopy Division at VSSC , was appointed first Divisional Head in 1980.He contributed greatly to the application of analytical sciences for the advancement of India’s space program. The pioneering research work and the technical leadership provided by him as Group Director & Dy. Director VSSC, led to the development of rocket propellants, polymers and several chemical systems for ISRO. Spearheaded several expert teams, like Design Review Team for Solid Propulsion Systems and Steering Committee for Indigenization of Space Materials. 28 students carried Ph.D. under his guidance. He has published 198 papers in international journals and 28 patents, including one US, European patent, in the areas of propellants, polymers &thermal analysis. He was Emeritus Professor of IIST for 5 years. He had played significant role in setting up IIST and gave guidance to students for making the first student sounding rocket in India. An Honorary Fellow of High Energy Materials Society of India, Fellow of Kerala Academy of Sciences and a Member of International Academy of Astronautics. Awards received by him include: Life Time Achievement Award of Indian Society of Analytical Scientists in 2019 and Performance Excellence Award of ISRO, received from *President of India in* 2009.

## Why an Unparalleled Achievement ?

A Unique Scientific Achievement (5 Nov. 2013 – 24 Sept)

Overall success rate of Mars Missions : < 50%, because of the technological challenges

Mission type	Success rate	Total attempts	Success
Flyby	45%	11	5
Orbiter	43%	23	10
Lander	53%	15	8
Rover	66%	6	4
<b>Total</b>	49%	55	27

## History of First attempts to Mars

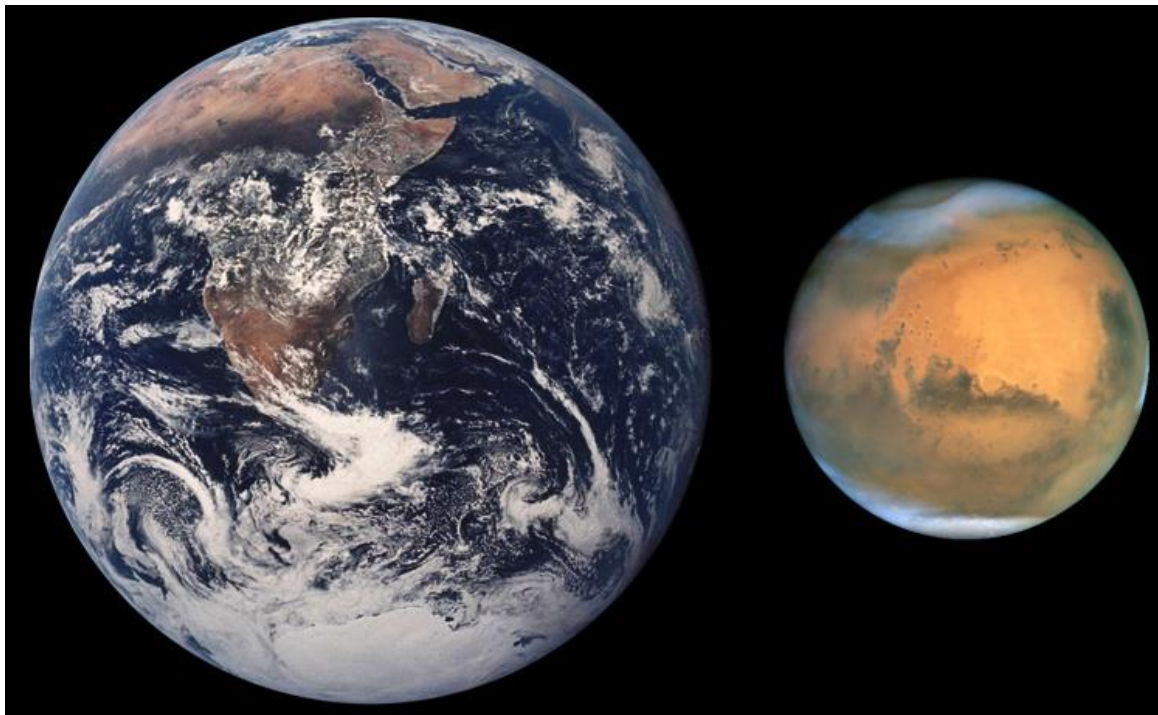
Country	Launch Date	Mission	Result	Remarks
USSR	10 Oct 1960	Flyby	Failure	Success in 10th Attempt, May 1971
USA	05 Nov 1964	Flyby	Failure	Success in 2nd Attempt, Nov. 1964
Japan	03 July 1998	Orbiter	Failure	
ESA	02 June 2003	Lander	Failure	Orbiter Success
China	08 Nov 2011	Orbiter	Failure	
India	05 Nov 2013	Orbiter	SUCCESS	

India is **ONLY** country in the world to succeed in the very **FIRST attempt** &  
The **ONLY Asian country** to reach Martian Orbit



मेरा भारत देश महान,  
प्रक्षेपित किया मंगलयान ,  
प्रथम प्रयास में सफल अभियान ,  
स्थापित किया विश्व कीर्तिमान,  
जय जवान, जय किसान, जय विज्ञान ।

(डॉ. प्रदीप कुमार)



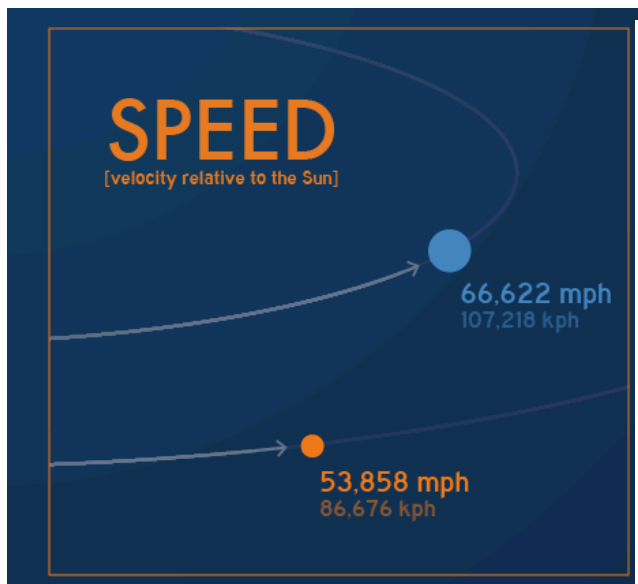
Satellite Images of Earth & Mars



Why the Martian Explorations?  
Global Interest in Mars from ancient times  
Romans : Name of god of war & “Chovva dosham”

## Challenge for travel to Mars

The enormous distance, differential speed and the energy needed for travel



### Salient Features about mars

Gravity : 1/3 of that on earth

Diameter ~ 1/2 of earth

Mass ~ 10% of earth

One year = 687 Earth days

One day = 24 hr. 40 min

Av. Temp = - 63°C

Atm. Pressure = 0.06 Atm.

96% carbon dioxide

## WATER on MARS



Mars is dry; no liquid on its surface

21 million Km<sup>3</sup> of ice + solid carbon dioxide at the polar region

Hypothesis: 3 Billion years ago, mars had liquid water on the surface and microbial life

## **More conclusive evidence of life: Methane (CH<sub>4</sub>) gas in Mars**

90% of methane on Earth is produced by microbes

- Methane can indicate the presence of microbial life on Mars
- Some missions of NASA & ESA show ppb ranges of methane in Martian atmosphere; No concordant results so far
- Is methane present in Mars: an evidence of life on Mars?

## **Current Global Interest in Mars**

- 1 To confirm the presence of methane (life) on Mars
- 2.To establish the location, amount and nature on water present in Mars
- 3.Exploration for rare minerals
- 4.Mars as a future Habitat or Intermediate Station to Distant Planets (Long term)

## **India's Maiden Mars Mission**

**Main Objective:** To lay the foundations for an Interplanetary Mission and develop the technologies required for it

**Scientific Objective:** Exploration of Mars surface features and Martian atmosphere using indigenous scientific instruments.

## **The Major Elements of the Mars Mission:**

- 1)Choice of a suitable Launch Vehicle ( from the available ones)
- 2)Design and realization of a Mars Orbiter (New)
- 3)Design of the Trajectory to Mars (New)
- 4)Deep space communication & navigation (Partly new)



## ISRO's Launch vehicles

### SLV-3 & ASLV :

Experimental LV of 1980s (PL Capability:50 to 100 kg in LEO)

### PSLV:

Highly reliable & cost effective Operational launch vehicle

Record 41 successful launches & 237 foreign satellites of 28 countries

Versatile (for both SSPO ~ 1.8 t & GTO ~ 1.4 t missions)

### GSLV:

2.5t to GTO; 1st Launch in 2001; 8 flights - 3 unsuccessful (at time of choice)

### GSLV Mk III:

India's most powerful rocket to date. Mass = 640t; PL capacity 4 t in GTO & 10 t in LEO; First flight on 5 June 2017; Not available at the time of choice.

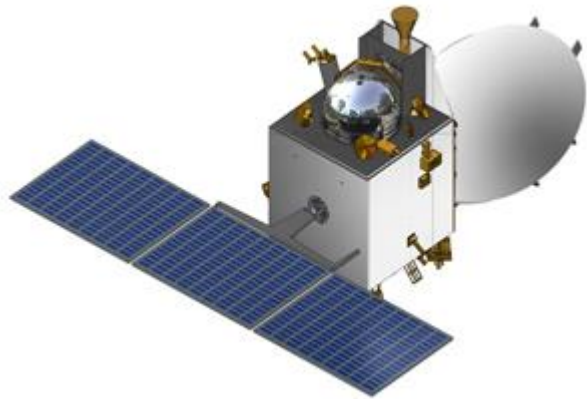


Then, How it started

How it is going, Now

## DESIGN & REALIZATION OF MARS ORBITER, Mangalyaan (By URSC, Bangalore)

Spacecraft with autonomous features (Enormous distance to Mars up to 24 min. for 2-way communication)



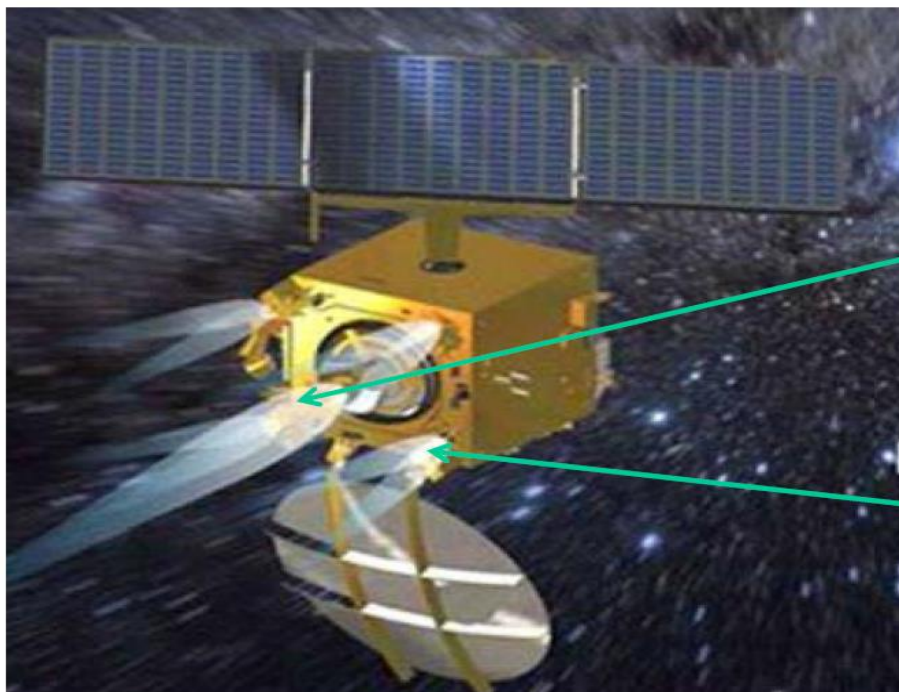
**Mass Budget**

**Total Mass = 1340 kg**

**Propellant mass = 850 Kg**

**Two Liquid Engines in Mangalyaan** (by LPSC)

For orbit raising, attitude control and other maneuvers.





**440 N LAM (Liquid Apogee Motor) as the main engine**



**8 nos. of 22 N AOCS (Attitude & Orbit Control System) Thrusters**

### **Propellant for Mangalyaan (by PCM Entity, VSSC)**

**Oxidizer: MON-3 = 3% NO + 97% N<sub>2</sub>O<sub>4</sub>**

**Fuel: MMH (Mono methyl Hydrazine)**

N<sub>2</sub>O<sub>4</sub> prepared by catalytic oxidation of ammonia; produced in Industry

NO: prepared by reaction of sodium nitrite with nitric acid

NO & MON 3 produced in-house

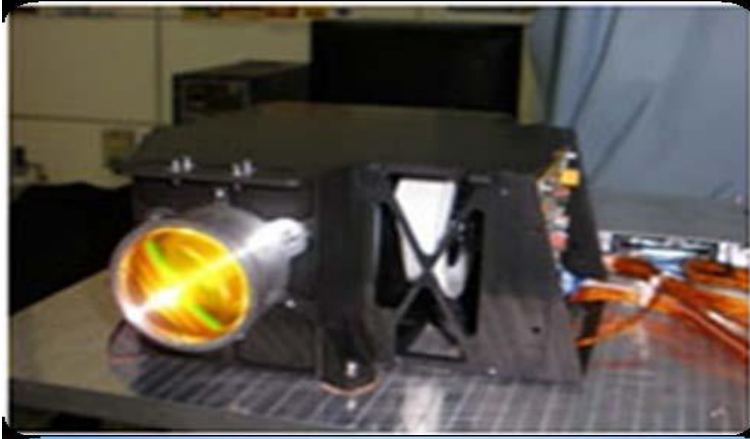
MMH prepared by reaction of excess methylamine with chloramine in presence of alkali. Technology transferred to industry for production

**FIVE Measuring Instruments on Board Mangalyaan**

**To measure Mars surface morphology & Martian atmosphere**

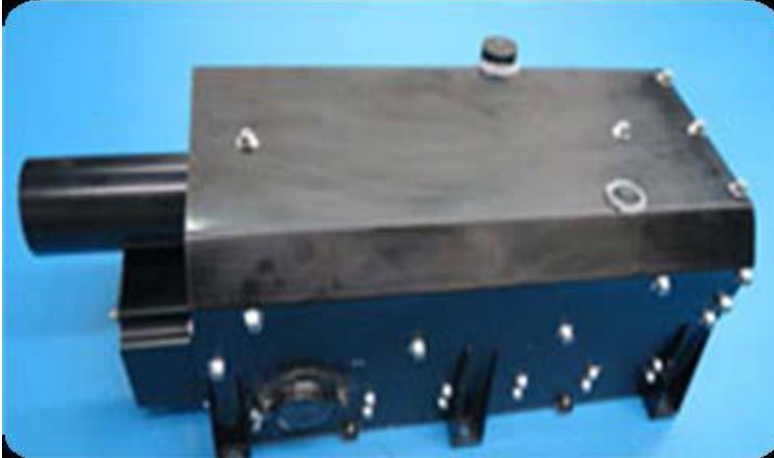
**All indigenously developed; Total mass = 14 kg**





### **Methane Sensor:**

(Short wave IR Radiometer;  
Measuring range: ppb)  
(by SAC, Ahmadabad)



### **Lyman Alpha Photometer (LAP)**

Measures  $H_2/D_2$  ratio in upper atmosphere; to study how water was lost from Mars (by LEOS, Bangalore)



### **Mars Exospheric Neutral Composition Analyser (MENCA) :**

Quadrupole mass spectrometer, for measuring relative abundance of neutral constituents in upper atmosphere (by SPL, VSSC, Trivandrum)

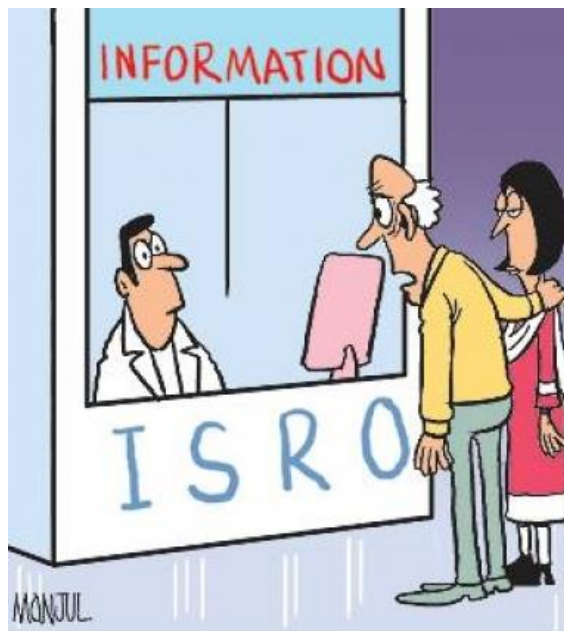


**Thermal Infrared Imaging Spectrometer (TIS):**

Surface composition & mineralogy of Mars  
(by SAC, Ahmadabad)



**Mars Colour Camera**  
(by SAC, Ahmadabad)

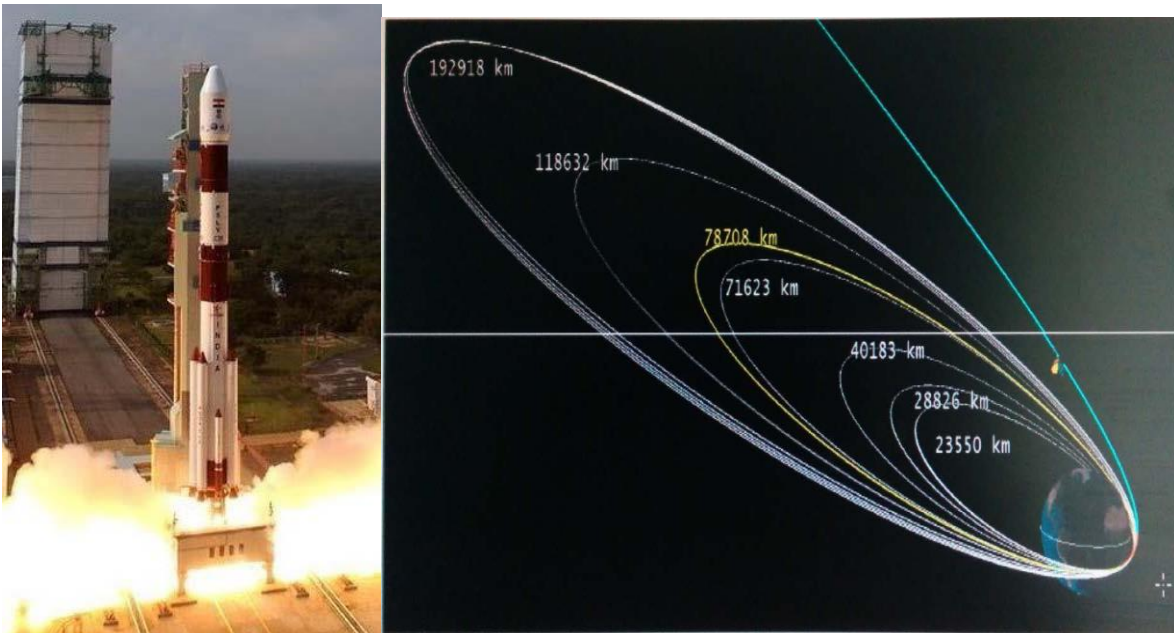


Any good news for my daughter from your Mangalyaan?  
You see, she is a *manglik*.



## The Journey of Mangalyaan to Mars: In 3 Steps

1. Leaving the Sphere of Influence (SoI) of Earth & getting injected into an orbit towards Mars using PSLV and spacecraft propulsion (Similar to Chandrayaan mission)
2. Cruising to Mars with minimum energy (propellant) utilization (No Experience)
3. Entry to the required Mars Orbit (Experience of Lunar orbit insertion, but under different conditions)



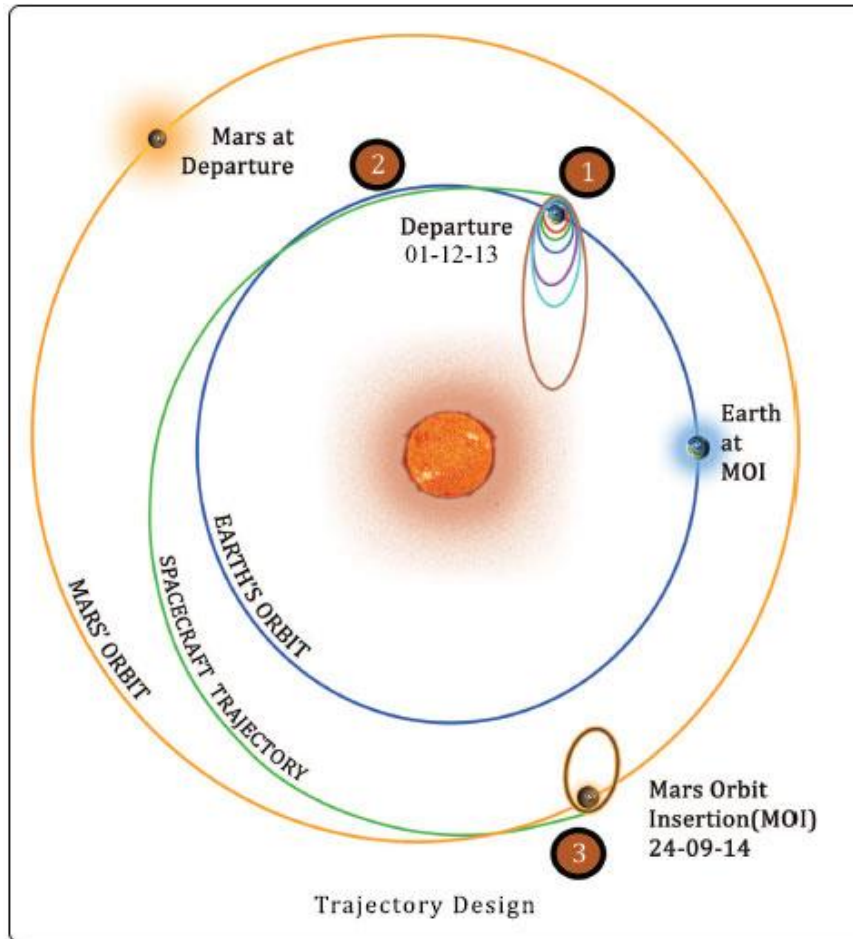
### Leaving the Sphere of Influence of Earth

On Nov. 5, 2013, Mangalyaan was launched by PSLV into 250 x 23500 km elliptical orbit around Earth (using ~ 2,60,000 kg of LV propellants)

Six orbit raising maneuvers & injection towards Mars: by the spacecraft propulsion [using 447 kg (53%) of s/c propellant]

# The Trajectory of Mangalyaan to Mars

(Based on thousands of simulations & exact calculations)



On Nov 30 (1), the velocity of s/c was increased tangentially (Hohmann Transfer), to take it into as elliptical orbit around the sun (2) (thereafter, no energy is needed to travel around sun).

Travel from (2) to (3), the meeting point of Mars = 667 million km, in 300 days

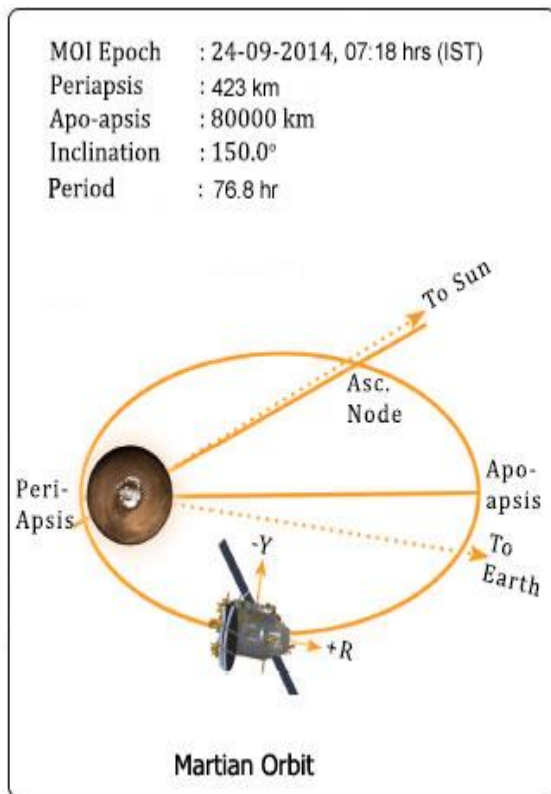
The calculations & the performance of the propulsion system were so precise that only 2 minor orbit correction (with 0.8 kg propellant utilization) were required in the 300 days.

On 24 Sept. 2014, the s/c was slowed down for Mars' gravity to capture it into a pre-determined Martian orbit.

# Entry to Mars Orbit

## Major Events on Sept 24, 2014

### Predicted Orbit



**06:56:32 hrs:** S/C was turned by 180 deg to reduce velocity by 'reverse firing'

**07:17:32 to 7:41:46:** The thrusters were fired for 24 min 14 s, using 248 kg propellant (communication black out for ~ 10 min.)

**Velocity reduced to 1.099 km/s** (within 0.1% of the target  
Near perfect performance of the propulsion system)

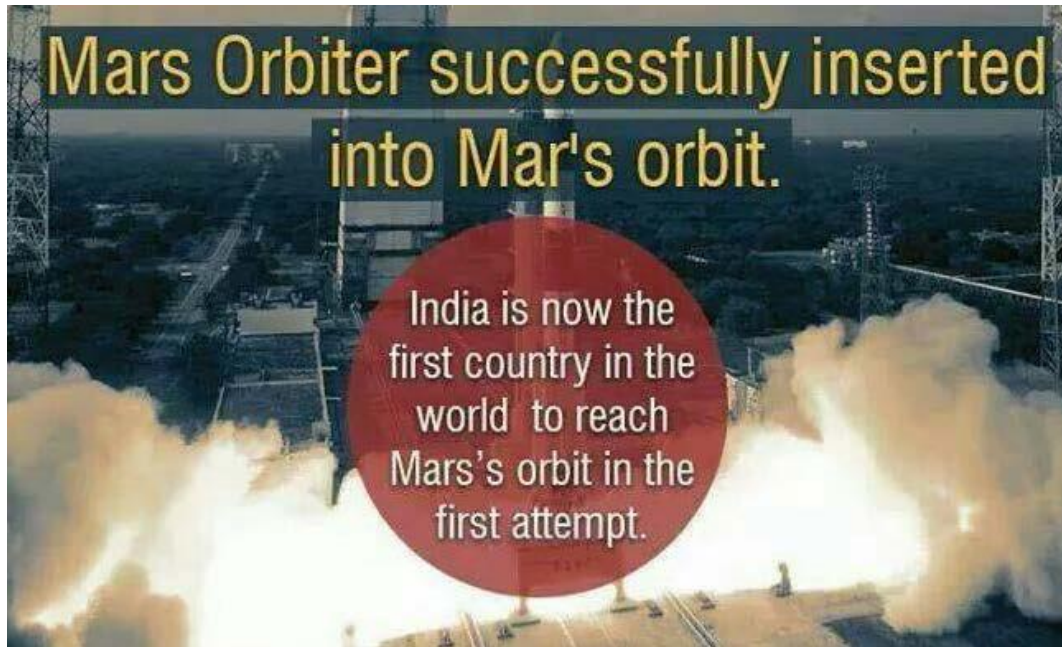
**Spacecraft turned back to normal position**

**08:00:00: confirmation of the orbit from Canberra**

Realized Orbit: 421.7 x 76,993.6 km. **Very close to predicted orbit (PERFECT Mission)**

50 kg propellant for > 1 yr. life





**The only country in Asia to reach Mars Orbit**  
**Realized in record time of 15 months**

**Joined the elite group of 3 space fairing nations of USA, Russia & Europe**



**The First picture of Mars Surface taken by Color Camera of Mangalyaan**



## The most cost effective Mars Mission

The total cost of the mission was approximately Rs. **450 Crore**, making it the least-expensive Mars mission to date.

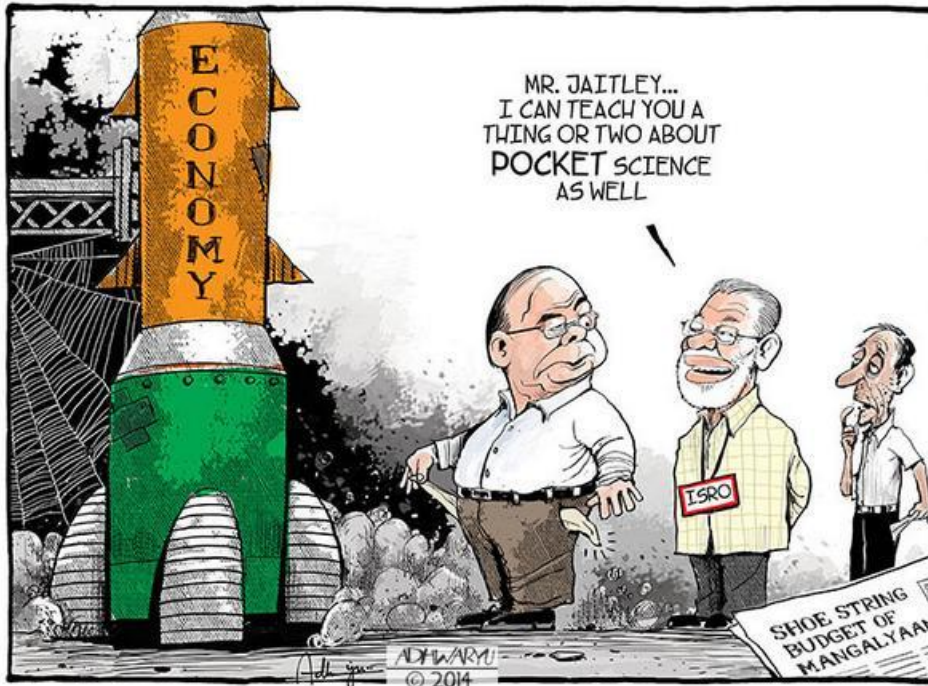


Image of Mars' moon (PHOBOS) capture by Mangalyaan on 1 July 2020

## **Emerging Trends in the Application of Nuclear Medicine for the Diagnosis and Therapy of Cancer**

Dr. M.R.A. Pillai

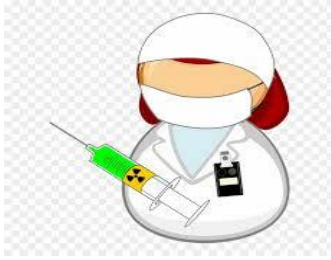
( Ph.D; D.Sc.)

ISAS Webinar, Held on 22<sup>nd</sup> Aug, 2020



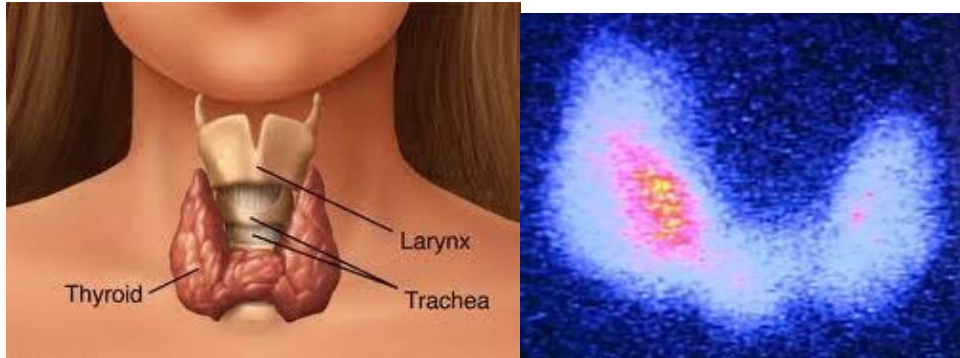
Retired as Head Radiopharmaceuticals Division, Bhabha Atomic Research Centre in 2013. He worked at the International Atomic Energy Agency (IAEA), Austria as Technical Officer during 2003-2010. Presently working as Group Director at the Molecular Group of Companies, Kerala, India since 2014. Molecular group has set up the only Medical Cyclotron operational in Kerala and supplying radiopharmaceuticals for PET-CT imaging. The group also operates two nuclear medicine departments in Kerala. Dr. Pillai joined Bhabha Atomic Research Centre Training School in 1975 after completing his graduation in chemistry from the Fatima Mata National College, Kollam, Kerala. Dr. Pillai did his M.Sc and Ph.D. from the University of Bombay in 1986. He worked at the University of Missouri-Columbia (UMC), USA as a Post-Doctoral Research Associate (1987-89), Visiting Assistant Professor (1992) and Visiting Professor (1994). He received six awards including the Distinguished Service award during his seven-year tenure at the IAEA. He is a recipient of the Life Time Achievement Award from the Association of Nuclear Medicine Physicians (ANMPI), India for his contributions in nuclear medicine. Dr. Pillai obtained Doctor of Science (D.Sc.) degree from the Institute of Nuclear Chemistry and Technology (INCT), Poland in 2011. Dr. Pillai was a research guide for M.Sc and Ph.D in University of Mumbai and Homi Bhabha National Institute (HBNI). Dr. Pillai published more than 200 papers and has two US patents to his credit. He wrote three books and edited 14 books published by the IAEA. He has over 4500 citations in Google Scholar, an 'H'index of 37 and i10 index of 106. His Academia Website has 45000 views and is followed by 1295scientists. Dr. Pillai visited 55 countries during his professional life.

## What is nuclear medicine



Nuclear medicine is a faculty of medicine which uses radioactive preparation as a medicine  
Radioactivity is administered to the patient  
Nuclear medicine is used for imaging  
Nuclear medicine is used for therapy

## Thyroid Scan Using Iodine-131



## Treatment of Thyroid Cancer

- Surgical removal of cancer identified by nuclear imaging
- A large dose of iodine-131 is given to the patient
- The patients are given hormone supplement
- They can live a normal life without further complication

**Iodine therapy is practiced since 1946**

## How is Nuclear Medicine Done?

- A radioactive material is administered to the patient in tracer dose
- An imaging is done to detect the disease
- A radioactive material is administered in large dose
- The radiation kills the cancer cells by interacting with the cellular DNA
- How to accomplish this?
- We need the radioactive material which is called radiopharmaceutical

## What is a Radiopharmaceutical

- A medical preparation containing a radioisotope and safe for human administration
- It must be useful
  - Diagnosis or
  - Therapy

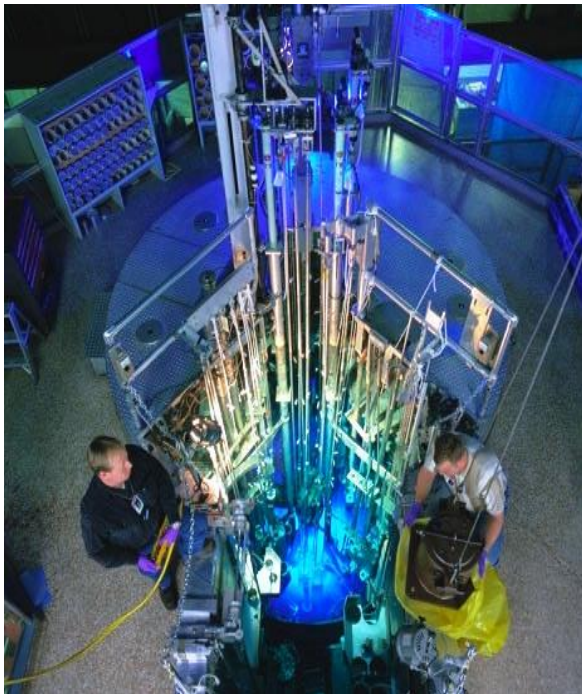


## Different type of radioisotopes

Neutron deficient radionuclides	Neutron excess radionuclides
They decay often by emission of $\beta^+$ particles	They decay by emission of $\beta^-$ particles and $\gamma$ rays
Used for PET-CT imaging	They also decay by emission of $\alpha$ particles

### How to make a radioisotope?

- Neutron Excess Radioisotopes :Nuclear Reactor
- Neutron Deficient Radioisotopes: In an accelerator



### Important Medical Isotopes

#### Prepared in Nuclear Reactor

**Molybdenum-99**

**Technetium-99m**

**Iodine-131**

**Samarium-153**

**Lutetium-177**

**Thulium-170**

**Phosphorus-32**

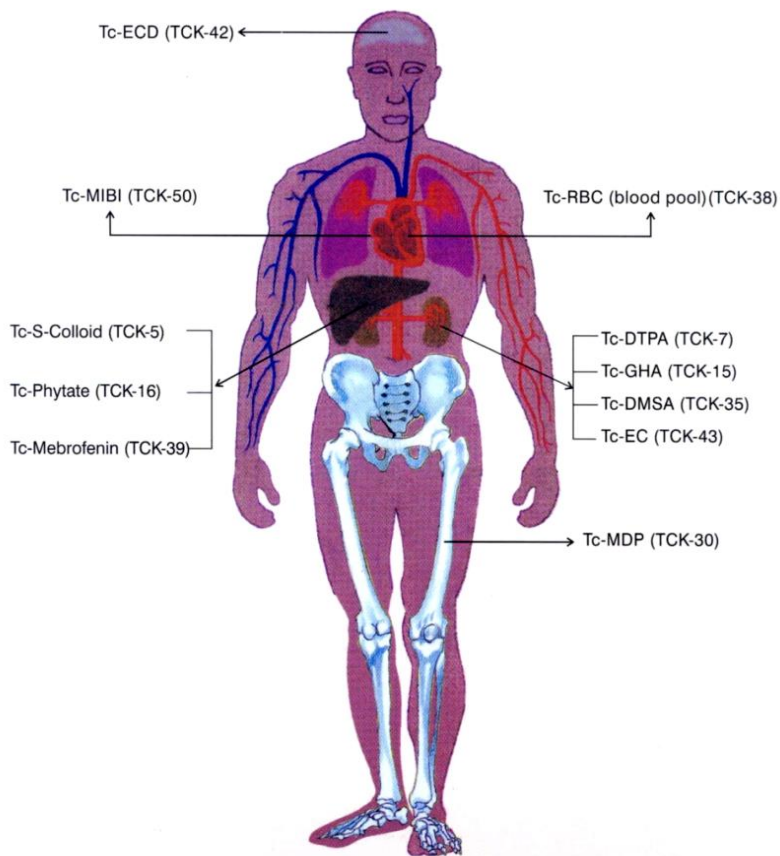
**Cobalt-60**

**Iridium-192**



## APSARA Reactor

First Research Reactor in Asia Commissioned on 4<sup>th</sup> August, 1956



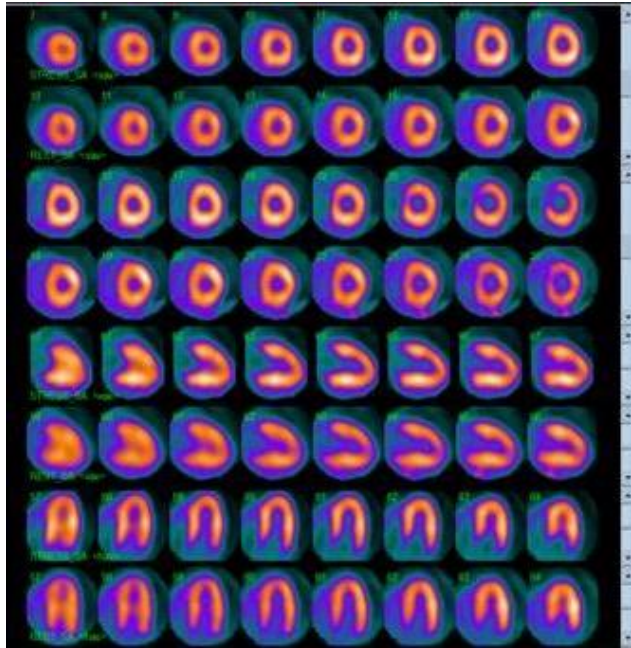
## Technetium-<sup>99m</sup>Tc

- Half life 6 hours
- Available from  $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$  generator
- Pure gamma emitter
- Used for about 50 million studies

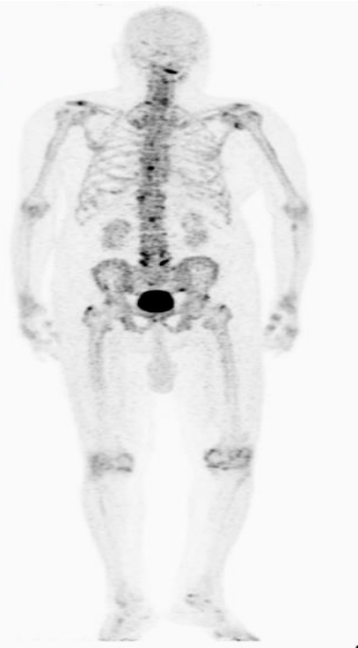
A Nuclear Scan will help in early diagnosis Coronary Artery Disease (CAD) and

## Bone Scanning to find bone metastasis

About 15 million diagnostic studies are done in the US alone for the early diagnosis of Coronary Artery Diseases. Mandatory for insurance coverage in the US before any invasive studies are done. A radiopharmaceutical MIBI or tetrofosmin is injected to the patient

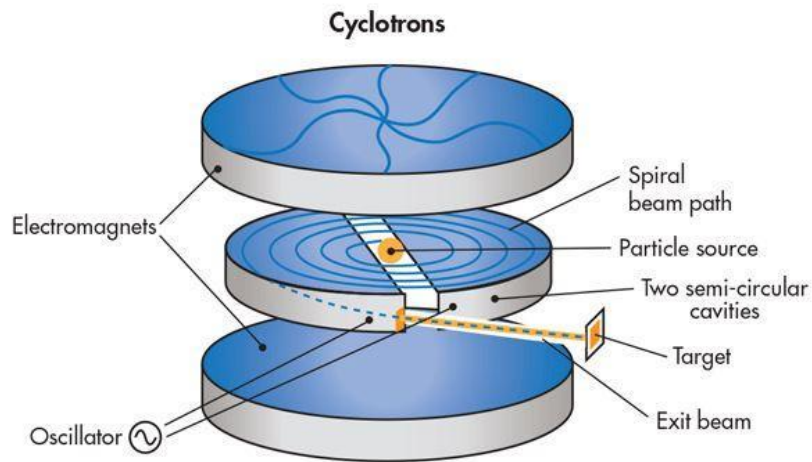


Cardiac SPECT with  $^{99m}\text{Tc}$ -MIBI



Bone Scan using  $^{99m}\text{Tc}$ -MDP

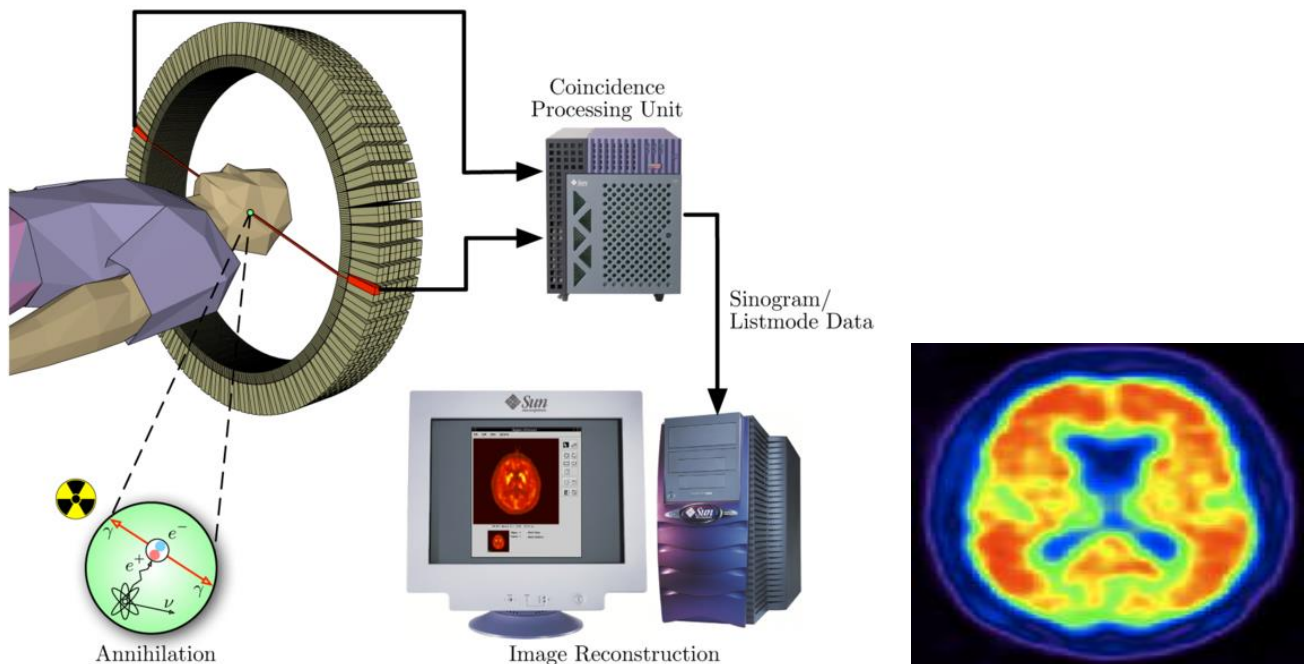
## Principle of Cyclotron Two Ds in between two Electromagnets



(Image courtesy of Symmetry Magazine)

## Positron Emission Tomography (PET)

One of the imaging modality we here very often these days is PET. A cancer patient is told to go for a PET imaging before starting therapy; and after as follow up of treatment. In PET we use a radioactive medicine labeled with a positron emitting radionuclide. Positron is a negative electron after it loses its energy it annihilates into two gamma photons moving in opposite directions. These gamma rays can be detected by coincidence technique and the information is used to map the tracer concentration in the body. Glucose is the fuel of our brain. If we use a Flourine-18 glucose we get an image like this.

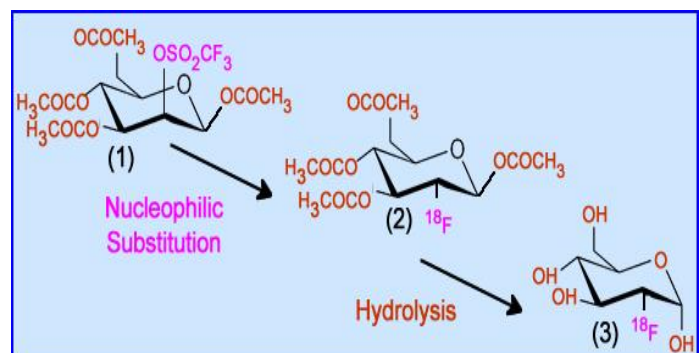


### Molecule of the Millennium:

#### [ $^{18}\text{F}$ ]Fluorodeoxy Glucose FDG

- Half life of  $^{18}\text{F}$  is just 108 minutes
- Difficult to transport
- 1000 mCi in 6 hours will be  $\sim 100$  mCi
- The patients need to travel to PET Centres
  - Cost of travel of self and accompanying persons
  - Stay at different cities
  - Inconvenience to already sick patient
  - Cost of investigation

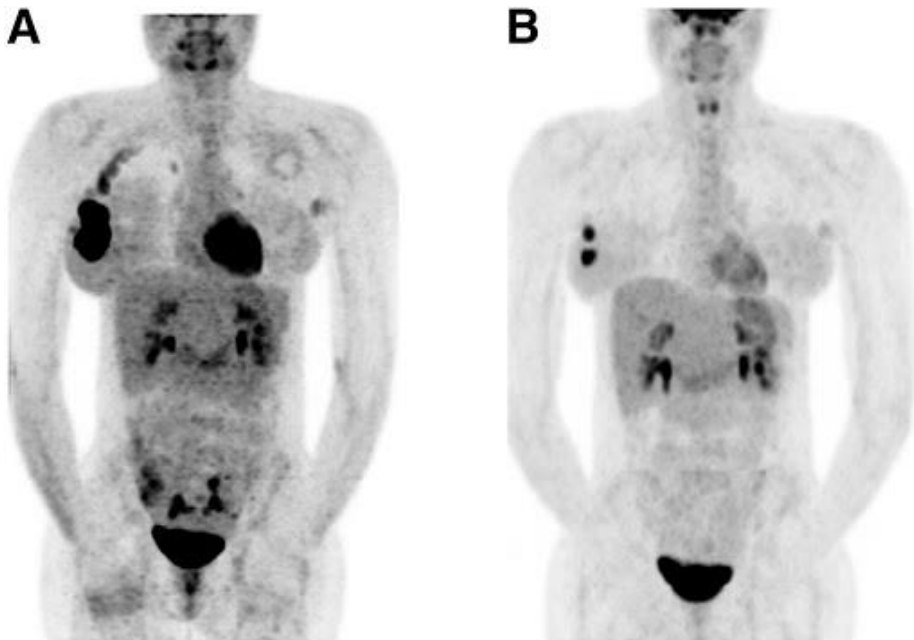
### Preparation of Fluorine-18, $^{18}\text{O}(p,n)^{18}\text{F}$



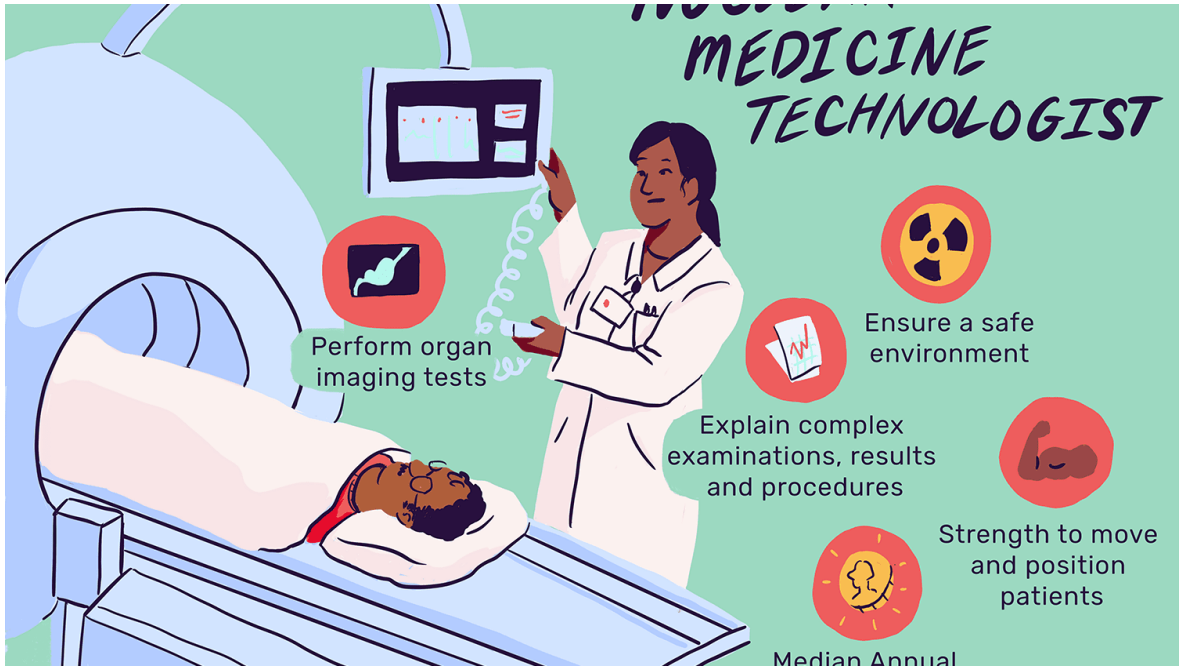




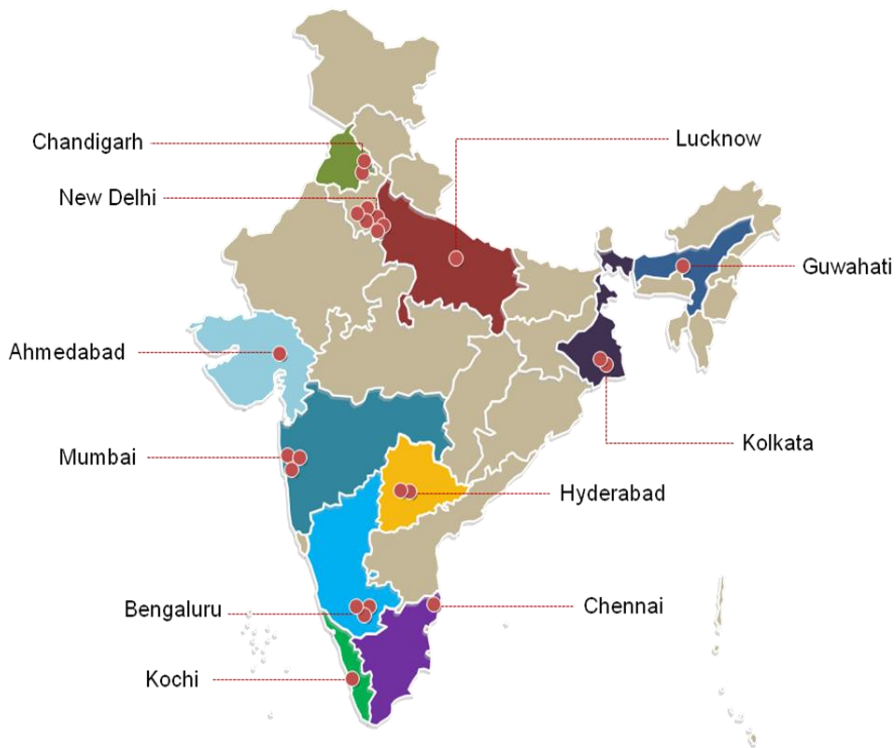
PET-CT Imaging



Breast Cancer Patient Before and After Treatment



## MEDICAL CYCLOTRON FACILITIES IN INDIA (2019)





## Molecular Cyclotron Project Cochin, Kerala India



### Siemens Eclipse HP Cyclotron

11 MeV Proton Machine, 2x60 mA beam Current



## Venkatesh Bapuji Ketkar

Eminent Indian Scientist

Dr. Pradeep Kumar,  
Senior Scientist  
Bhabha Atomic Research Centre, Mumbai  
Vice President & Chief Editor, ISAS



Dr. Pradeep Kumar is senior scientist at Bhabha Atomic Research Centre Mumbai. He is heading chemical quality control section in Nuclear Fuels Group at BARC. He graduated from snow covered hill state, Himachal Pradesh, Shimla in 1988. Acquired his Master in Science ( Chemistry) from Taj City Agra, Dayalbagh University in 1990. On successful completion of BARC training school, He joined nuclear fuel fabrication group of BARC. Where he contributed significantly by carrying out chemical analysis of indigenous nuclear fuel (mixed oxide) being developed for Tarapur Atomic Powers Station. He developed non-destructive assay techniques and successfully applied during fuel fabrication. He has carried out pioneer work in the field of supercritical fluid extraction. He is expert in instruments like inductively coupled plasma optical emission spectrometer (ICP-OES), Inductively coupled plasma mass spectrometer (ICP-MS), wave length dispersive X-Ray fluorescence spectrometer (WD-XRF), gamma spectrometry, neutron counting etc. He obtained Ph.D. from Mumbai University. Dr. Pradeep Kumar did Post Doctorate from Orleans University, France (2009-11). He is recognised guide for Ph.D. and Asst. Professor at Homi Bhabha National Institute, Mumbai. He is Vice president and chief editor of ISAS. He has translated one IANCAS news bulletin, Nuclear Reactor into Hindi. He is recipient of four group achievement awards at BARC. He is life member of IANCAS, ISMAS, ASSET, INS. He is reviewer for many papers for journals such as Radiochimica Acta, Journal of Hazardous Materials, Desalination. He has around 90 publications in reputed international journal and seminars.

A common myth among people in India specially among youngsters persists is that science has developed mainly in Europe and America. One day my son, Ojasvi Sharma asked me, "Papa, Science has developed only in Europe and America not in India". I was taken by surprise by this incident. We are forgetting our glorious ancient contribution towards science. This incident inspired me to peep into our remarkable ancient Indian science. World's first planned city was Indus valley Civilization which spreaded across a region about half the size of Europe. Ancient India was pioneer in developing the technology of producing rust-free iron as evident from Iron Pillar of Delhi which remains almost rust free even today. Shipbuilding was one of India's major export industries till the british dismantled it and formally banned it. Medieval Arab sailors purchased boats from India. India was the first country in world to master zinc distillation. Zinc being low boiling point ( $907^{\circ}\text{C}$ ) substance, tends to vaporize on ore smelting. Pure zinc could be produced its copper ore only after a sophisticated 'downward' distillation technique in which the vapor was captured and condensed in a lower container.

Ancient India has immense contribution in the field of science specially mathematics, astronomy and astrology. Many renowned scholars have taken birth on Indian soil. Some scholars predicted events much before Europe actually verified with the help of sophisticated instruments. It is very much exciting to know that existence of an Indian scholar who predicted existence of Pluto many years before its actual discovery. The prediction was without any sophisticated instruments, no telescope, no super computer. We really feel proud of knowing about this Indian Talent which has not been acclaimed as deserves. Let us have look into the life of this person and his contribution towards science specially astronomy. This article is devoted to Venkatesh Bapuji Ketkar. This unsung star from the field of Indian Astronomy, the legendary 'Jyotirvid', dedicated his life for the research and purification of Indian almanac system (*Pancānga*) of timekeeping. It is a lesser known fact that he predicted the existence of 'Pluto' in 1911; even before its discovery in 1930. He fought with Lokmanya Bal Gangadhar Tilak. He authored a number of books on astronomy, *Pancānga* and literature and also published many research papers in European science journals. It is matter of great sorrow in spite of his remarkable contribution to the field of science, not much has been written about him except for a couple of biographies.

Venkatesh Bapuji Ketkar was born on January 18, 1854 in Nargund. The name "Nargund" comes from "Nari Gundu", which means "Hillock of Foxes" in Kannada. The town is marked by such a hillock right in the centre of town. He lost his father at very early age of 16. So he has to face financial crisis's. Coping with the adverse financial condition, Venkatesh Ketkar passed the

matriculation examination in 1874 and secured third place. For this achievement, he was felicitated with the 'Bai Manik Bairamji Jijibhoy Award'. But the deteriorating financial condition made it impossible for him to continue his education. He had to skip further education and accept a job as a school teacher at the age of 21. After Accepting the teaching profession, he continued his service for 25 years at school in Bagalkot. Venkatesh Ketkar worked in various other schools till he retired in 1911. In 1881, he got married to Ramabai. They had thirteen children in total. He fulfilled the educational needs of his children and inculcated values in them.

Ketkar ji got inspiration from total solar eclipse in 1868 at Kolhapur. During the eclipse, it went dark and some stars began twinkling in the sky. By this event he became curious about space and astronomy. He himself started learning. He acquired knowledge about mathematics available at University of Mumbai and University of Madras. He sought guidance from Simon Newcomb the famous American mathematician and astronomer. He acquired knowledge in the fields of spherical geometry, algebraic geometry, trigonometry, statistics and other complex mathematics and Newton's 'Principia Mathematica'. At the age of thirty-one he wrote a separate treatise on astronomy. He made the necessary corrections in the existing knowledge based on texts like Suryasiddha Grahalaghav'. He published his new almanac, called 'The Ketaki *Pancānga*'. With the advancement in mathematics in ancient astronomy, planetary mathematics in real sense started developing. Ketkar has shared some of his views on the history of Indian astronomy. According to Ketkar, the Chaldeans should be given the credit of being the first to observe planetary motion. In ancient Assyria, there was an intelligent tribe called the Chaldea. So was the influence of their intelligence on the royal court, that the name of this country's name was changed to Chaldea.



*Venkatesh Ketkar ( With Wife Ramabai)*

Ketkar fought with Bal Gangadhar Lomnaye Tilak, the renowned Indian freedom fighter.

Why he fought with such eminent personality? Actually Ketkar was very calm and serious, he was very straightforward and fair witted. It was not usual fight as between two persons. This was fight of opinion on astronomy. Tilak had also made significant contributions to astronomical research. According to him "The almanac is a mirror of the sky, it should depict scenarios as seen in the sky and vice versa". He wrote about the *Pancānga* in daily newspaper 'Kesari' frequently. Lokmanya Tilak encouraged astronomical scholars all over the country and Venkatesh Ketkar was at the forefront. Greatness of ketkar can be felt from fact that Tilk asked Ketkar to write book on almanac. Almanac includes three factors, astronomy, muhurtashastra and dharmashastra. But there were differences of opinion about these three factors. Due to this, different types of almanacs were formed. Tilak and Ketkar, both sacrificed their lives for the purification or betterment of the almanac."

Why difference arose between them. Ancient astronomers have designed the system of zodiacs and constellations to indicate the positions of the sun, moon and different planets on the celestial sphere. Two systems to mark the start of the zodiac and constellations are in practice. These are named 'Sayan' and 'Nirayan' systems.

The system used to calculate the position of zodiacs and constellations from a moving point in the sky is called the 'Sayan' system and system from a fixed point in the sky is called the 'Nirayana' system. "There were Many disputes about the consideration of the position of the fixed point. Many almanac conventions were organised. This resulted in two major parties viz. the 'Revathi paksha' and the 'Citrā paksha'. Lokmanya Tilak belonged to Revathi paksha, which considered the star named Zeta Piscium (Jayanti) as the fixed starting point. Venkatesh Ketkar supported the *Citrā* paksha, which considered the fixed point 180° away from the star 'Spica' in *Citrā* constellation. Both parties were adamant on their opinion, leading to many disputes between Tilak and Ketkar. Today, Indian government endorsed *Ayanamśa*, Lahiri *Pancānga* of north India and Date *Pancānga* as per *Citrā* Paksha. Ketkar named his *Pancānga* adapted from *Citrā* paksha as 'Ketaki *Pancānga*'.`





### Ketki Pancānga Nirnay

After working for many years through sleepless nights, on February 18, 1930, a young American astronomer, Clyde Tombaugh discovered the ninth planet, Pluto." However, Before Tombaugh, Venkatesh Ketkar had written a scholarly article in the scientific research journal of Société astronomique de France 'in 1911, stating that there should be two planets revolving outside the orbit of Neptune. He also predicted the figures depicting the position of the orbit of the ninth planet, which were again closer to those discovered afterwards. He also suggested names for these two planets. The Ninth Planet was named as 'Brahma' and the Tenth as 'Vishnu' by him. The period of revolution of Brahma was 242 years as predicted by him. After the discovery of Pluto, scientists have estimated the period of revolution of Pluto as 247.7 years. He had also predicted the distance of the ninth planet from the sun, which was 38.95 Astronomical Units, which matched with the distance of 39.5 AU, found out afterwards.

**TABLE 1**  
*Ketkar's orbital elements of trans-Neptunian planets*

Elements	1st planet (Brahmā)	2nd planet (Viṣṇu)
Mean longitude on July 23, 1911	109°-51'-57"	289°-51'-52"
Mean longitude on January 1, 1911	109°-2'-26"	289°-25'-42"
Mean distance (A.U.)	38.95	59.573
Daily mean motion	14".6364	7".7378
Period (years)	242.28	458.27

Sadly, Ketkar could not get the appropriate recognition and fame for this discovery. The calculations of this discovery are available today with his descendants. Renowned



scientist Dr. Jayant Naralika has mentioned the important contribution of Ketkar from time to time in his speeches and writings. Ketkar research papers include, 'importance of the year 432', 'How should the 'varshmaan' be calculated from 'Suryasiddhanta?'' 'The time of creation of the text 'Taittiriya Brahmana', 'The theory of precession of earth's axis in 4600 BC', 'The times of Mahakavi Kalidas' , 'Kannada words inDnyaneshwari'. A few of his other important research papers were 'Bhagavad Gita', 'Kalnirnay', 'Chronology of aryan', 'Estimation of Shivaji Maharaj's Birth date', '*Āryabhata* and Kuttaka Mathematics'.

After reading his research work, one his friend suggested Ketkar to apply university of Mumbai for the Springer scholarship. University of Mumbai did not consider him worthy of the scholarship nor did they appreciate his qualities. As many educational and research institutes in India including University of Mumbai were under the control of British government, many Indian scientists like Ketkar might have been neglected. Due to this reason, Pandit Madan Mohan Malviya along with the like minded people, founded Central Hindu College (Banaras Hindu University) in 1916 inviting the researchers and educationists of nationalist ideology. In 1918, Pandit Madan Mohan Malviya, Vice Chancellor of Banaras Hindu University, met Ketkar in the city of Pune. This was followed by the correspondence revealing Ketkar's intelligence and his work which resulted in offering the letter of appointment as the professor of astronomy in Banaras Hindu University. But due to his mother's sad demise, Ketkar could not accept the post."



# NUCLEAR POWER FOR CLEAN, GREEN AND SUSTAINABLE ENERGY SECURITY

B. VIJAYAKUMAR  
 OFFICER INCHARGE  
 ENVIRONMENTAL SURVEY LABORATORY  
 KUDANKULAM NUCLEAR POWER PROJECT

Webinar held on Sep 20, 2020

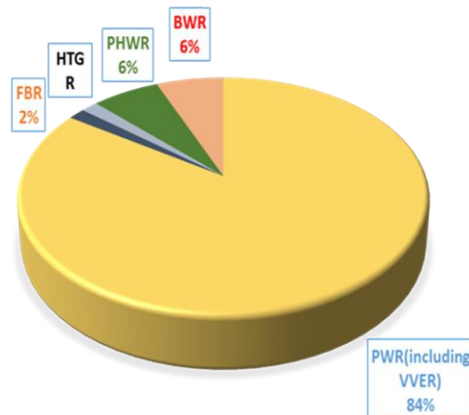
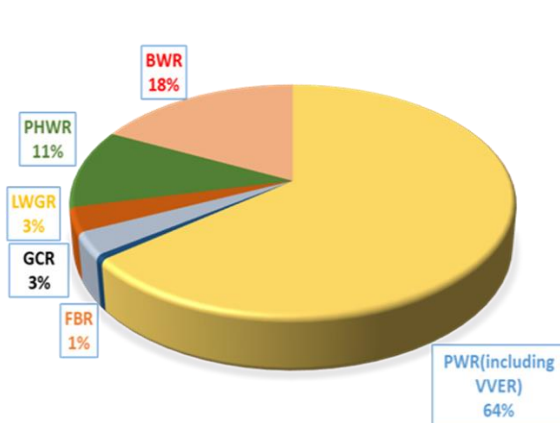


## 60 Years of N-Energy

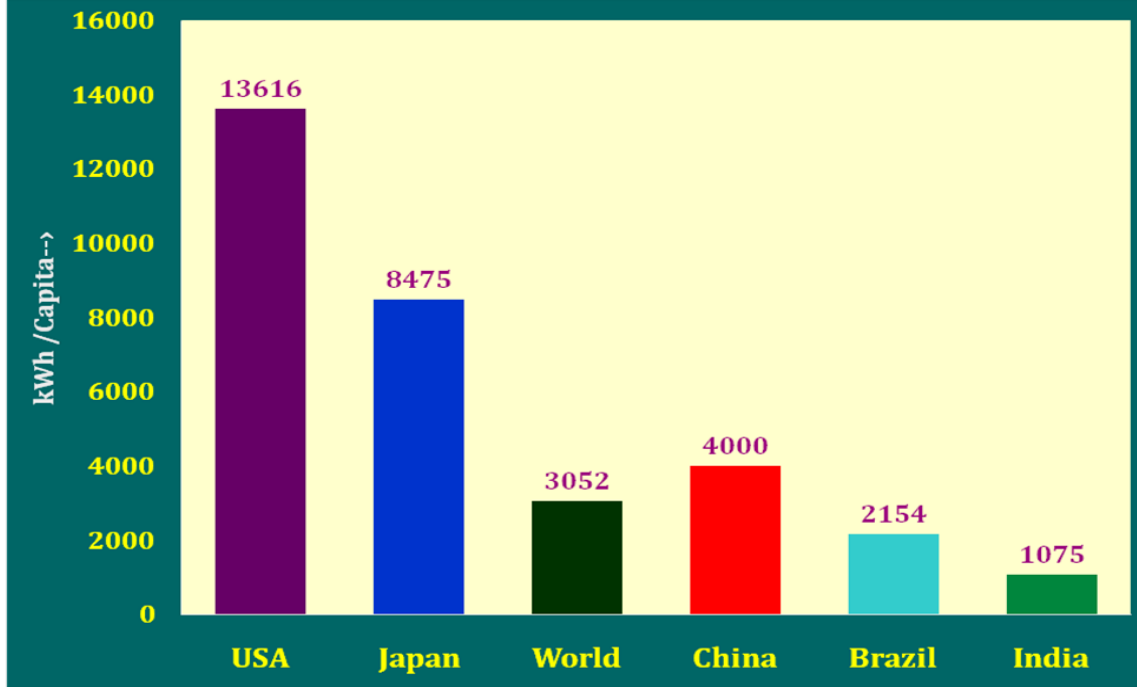
The energy produced by breaking down the atom is a very poor kind of thing. Anyone who expects a source of power from the transformations of these atoms is talking moonshine.” Lord Ernest Rutherford, 1933. It is not too much to expect that our children will enjoy in their homes [nuclear generated] electrical energy too cheap to meter.” Lewis Strauss, Chairman, US Atomic Energy Commission, 1954. In 2016, 62 years after electricity was first produced by nuclear power and delivered to grid, we know the truth lies somewhere between the extremes.

**Reactors in Operation : 442  
 ( 392 GWe)**

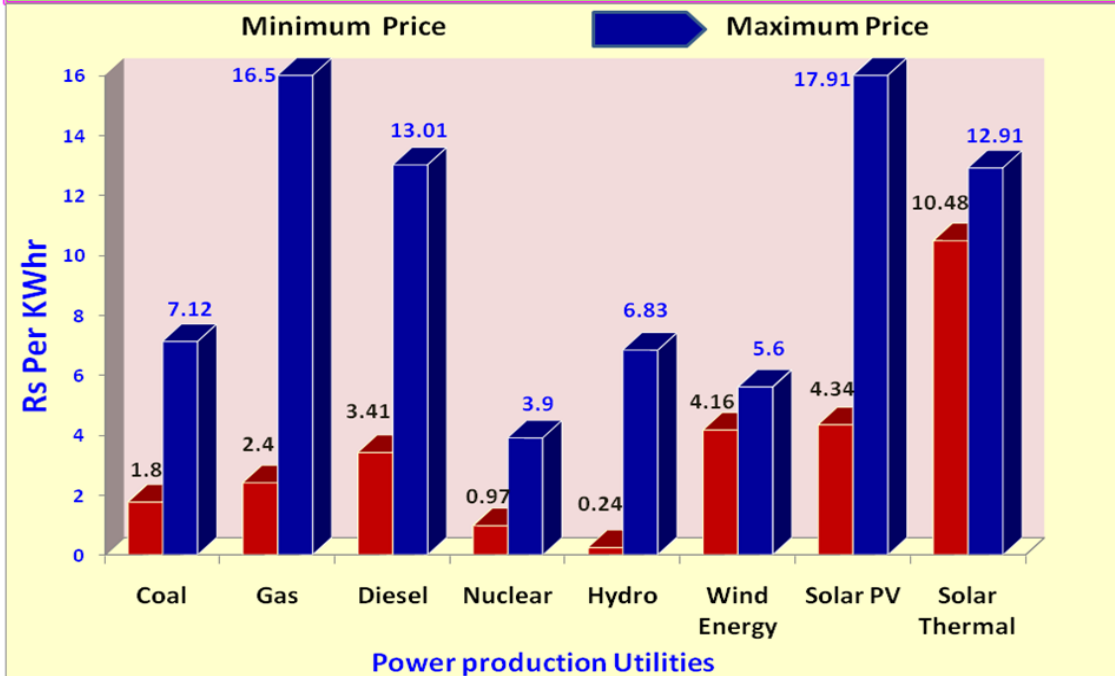
**Reactors Under Construction : 53  
 ( 56 GWe)**



## World and India Energy Scenario



## Nuclear energy tops cost competitiveness (as on Dec 2016)



## Climate Change

Climate system of the Earth atmosphere is changing. Global mean surface temperatures rising  
Change in rainfall. Oceans are warming. Sea levels are rising. Features of extreme weather and  
climate events are changing. 50-85 % reduction in GHGs required by 2050.

## Global Energy Challenge

Energy central to development. Alleviate poverty. Improving human welfare. Raising  
living standards. Energy precondition for investments. Improve healthcare. Develop  
human capital Gender equity and Social equity. 2.6 billion people rely on traditional  
biomass as their primary source of energy. 1.3 billion people do not have access to  
electricity.

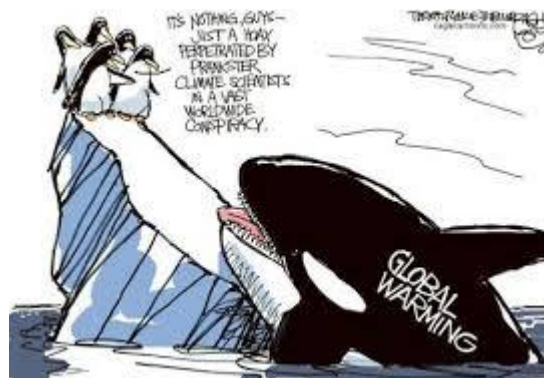
## Global Warming

The emission of CO<sub>2</sub> and other green house gases cause global warming.

CO<sub>2</sub> gas is produced while burning coal, wood, diesel, oil etc.

One unit of electricity generated using

Coal – 1 kg CO<sub>2</sub> :Oil – ¾ kg CO<sub>2</sub> :Gas – ½ kg CO<sub>2</sub> :Nuclear - Nil.





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**“Nuclear power is the only low-carbon technology that is available today that has the potential to be deployed on a wide scale and in large capacities to help meet the global climate–energy challenge.”**

— Mikhail Chudakov, IAEA  
Deputy Director General and  
Head of the Department of  
Nuclear Energy

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**“Nuclear science, including nuclear power, can play a significant role in both climate change mitigation and adaptation.”**

— Yukiya Amano,  
Director General, IAEA

## Nuclear = clean air

No global warming; No acid rain; No urban smog; No oxides of Sulphur, Nitrogen; Very less land requirement.

Can be built close to where electricity is required, unlike hydro, hence no long transmission lines

Less transmission losses

## Advantages of Nuclear Power

### The Greenhouse effect (Global warming)

G.H effect is the progressive gradual warming of the earth's atmosphere. It is caused due to increase in the absorption of solar energy due to buildup of CO<sub>2</sub> in atmosphere. CO<sub>2</sub> is produced when fossil fuels are burned.

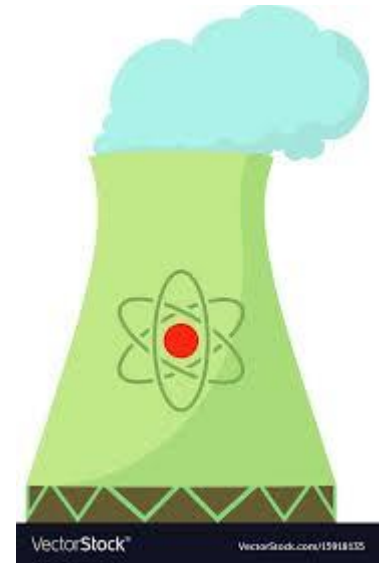
The main causes of the green house effect are the greenhouse gases, namely CO<sub>2</sub>, water vapour methane, nitrous oxide, and the CFCs (organic compound containing carbon, chloride & fluoride).

Nuclear power plants don't burn anything, so they don't produce any combustion products. Emission-free nuclear plants help protect our air quality. Nuclear energy is critical to meeting our environmental and energy goals.



## Factors favouring N-power

Help mitigate climate change  
N-Pow (1.88 Gt CO<sub>2</sub> eq) having largest potential to combat climate change at lowest cost  
Could account for 15 % GHG reduction by 2050  
Increases in fossil fuel prices  
Reliability of supply sources  
Ample Uranium resources all over the world  
Uranium fuel cost, a small fraction of N-Electricity  
Prevent local and regional air pollution  
Lowest external costs – in terms of damage to human health and environment



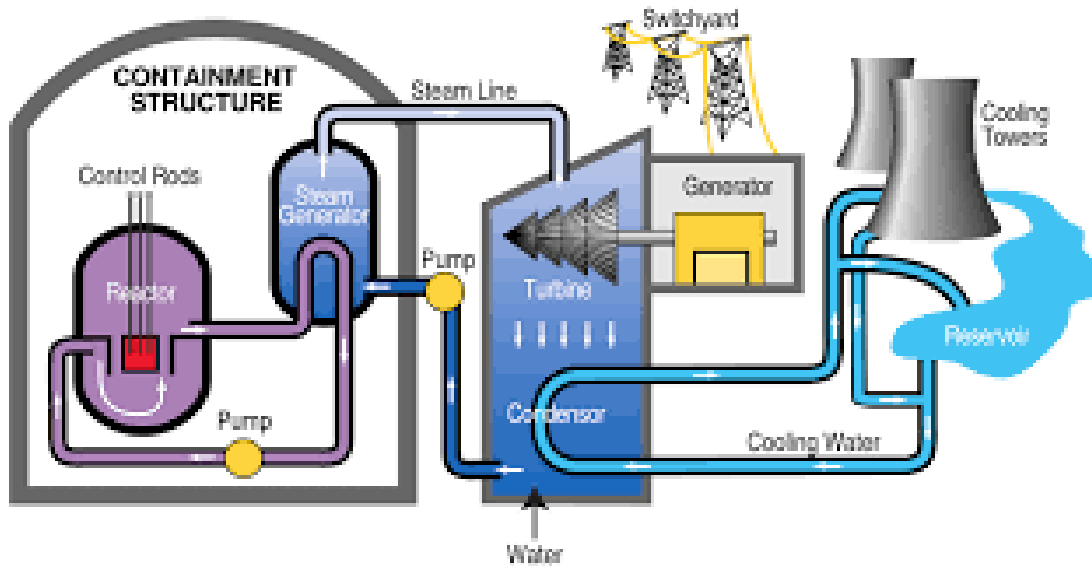
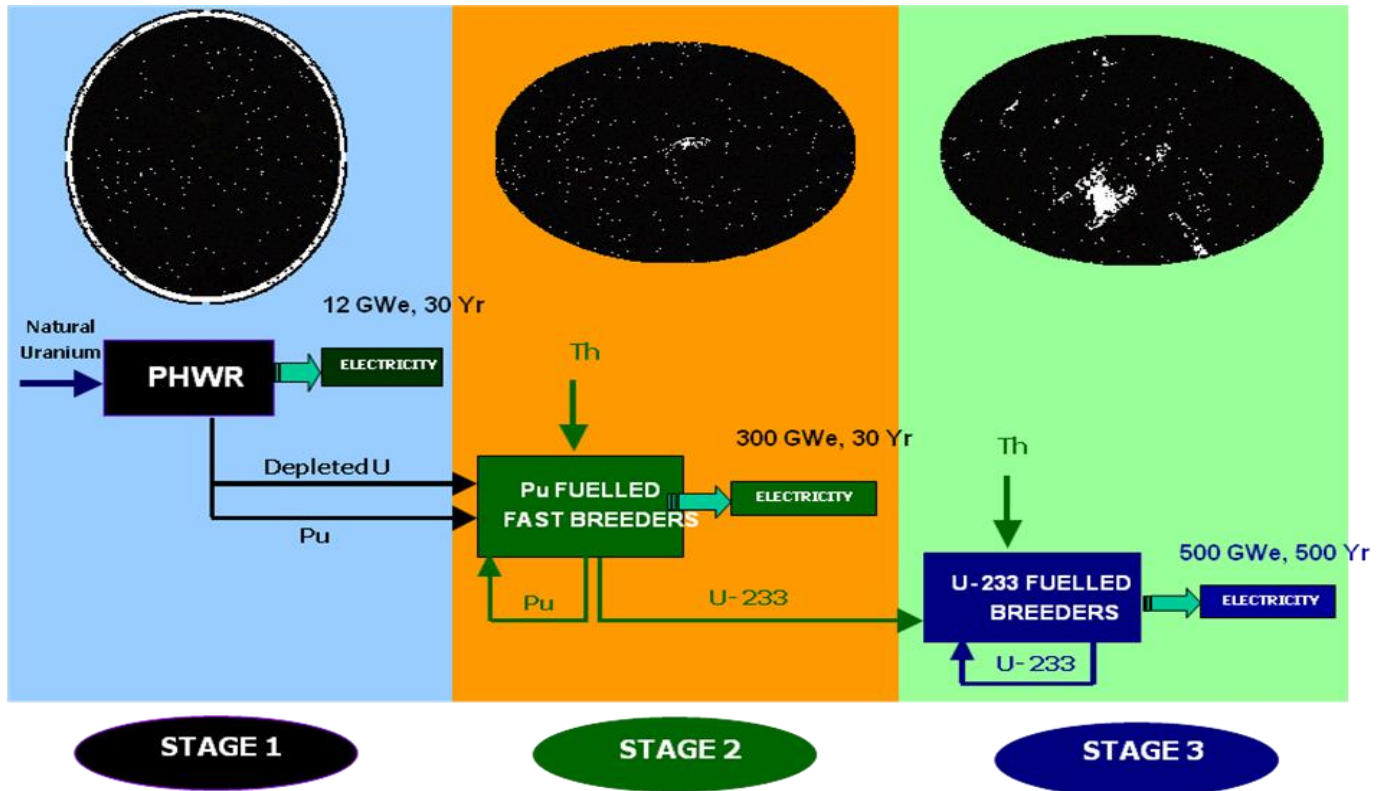
## NUCLEAR POWER AND ITS CONTRIBUTIONS

Nuclear Power : A Sustainable Source of Energy. Provide National Pride.  
Improve Living Standards: Contributes to National Economic Development.  
Spin-offs From Nuclear Power Technology. Create Job Opportunities.  
Supports Local Communities Located Nearby the Plant to Become Most Developed Villages  
Contribute to the Environment Protection.





## Three Stage Nuclear Power Programme

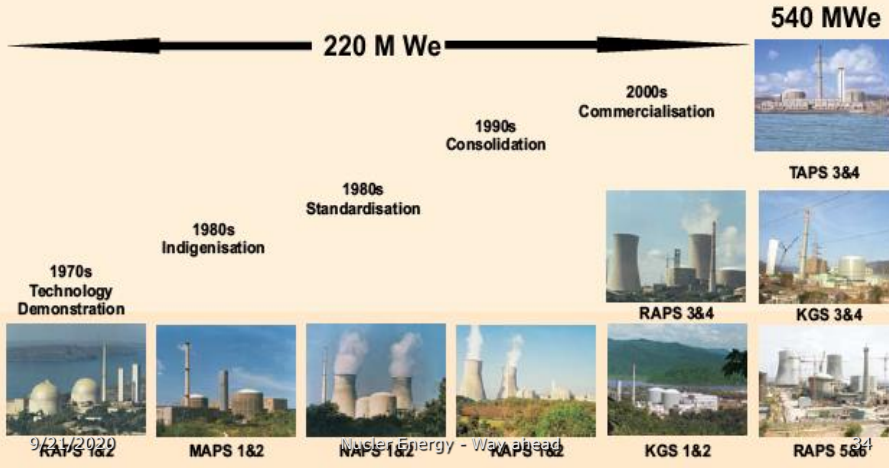


# PHWR Programme

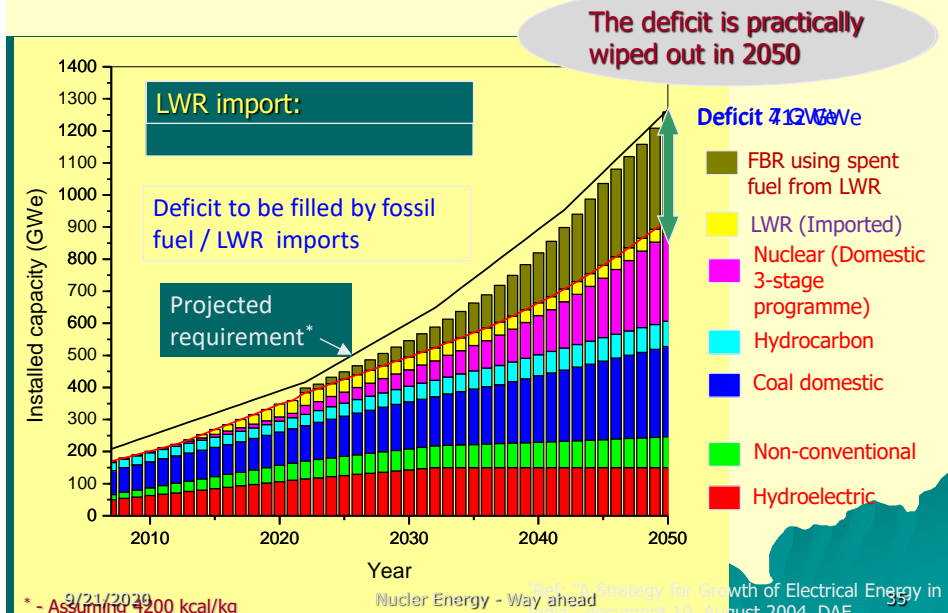
The units set up after Tarapur 1&2 were of Pressurised Heavy Water Reactor (PHWR) type. These units constitute the first stage of India's nuclear power programme. The units have evolved since 1970s, when Rajasthan units were set up, both technologically as also in unit size.

700 MWe & above

**FUTURE PROJECTS**



# Strategies for long-term energy security



## RADIATION – A FACT OF LIFE

We are exposed to radiation from Sun and outer space

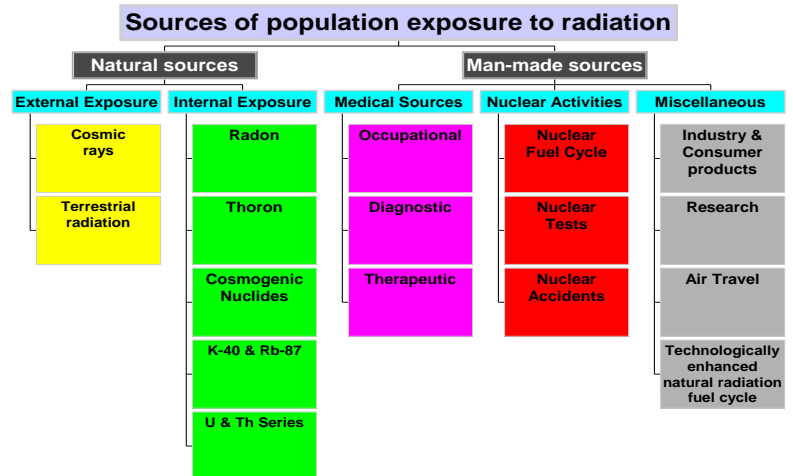
Radioactive materials present in the earth

House we live in

Buildings where we work

Food we eat &

Air we breath



### Concerns about N-Power

Radiation risk

Nuclear Safety

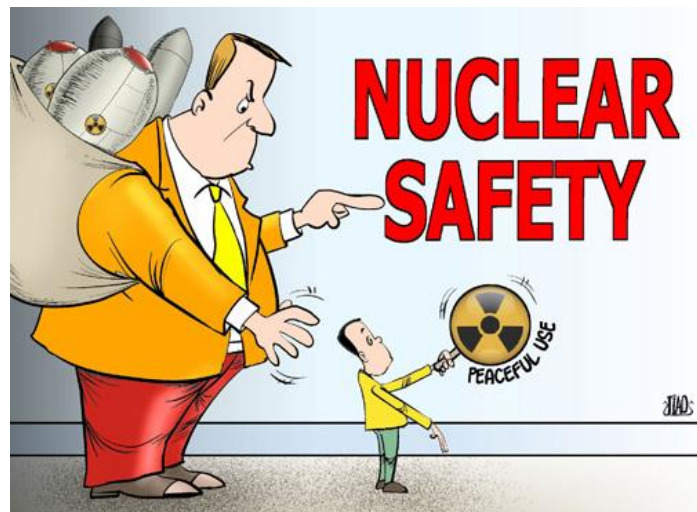
Environmental Safety

Ecological Safety

Waste Management and disposal

Proliferation concerns

Public Acceptance



Even our own bodies contain naturally occurring radioactive elements

Radiation is inescapable.

Background Radiation Contributes 2.4 mSv/year per Person.

a) Cosmic - 0.4 mSv

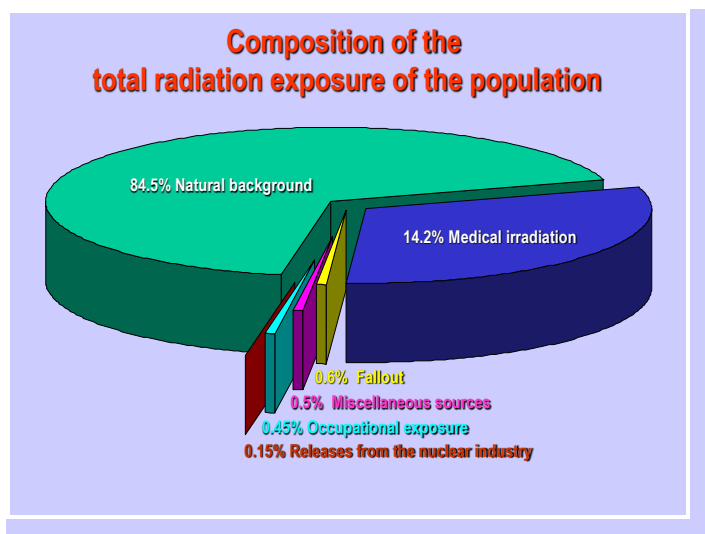
b) Radon – 1.2 mSv

c) Terrestrial - 0.5 mSv

d) Food - 0.3 mSv

Man Made Sources of Radiation Contribute an Average of 0.6 mSv/year

a) 5,000 Km travel by air b) Medical - 0.5 mSv c) Power Plants and Fallout < 0.05 mSv

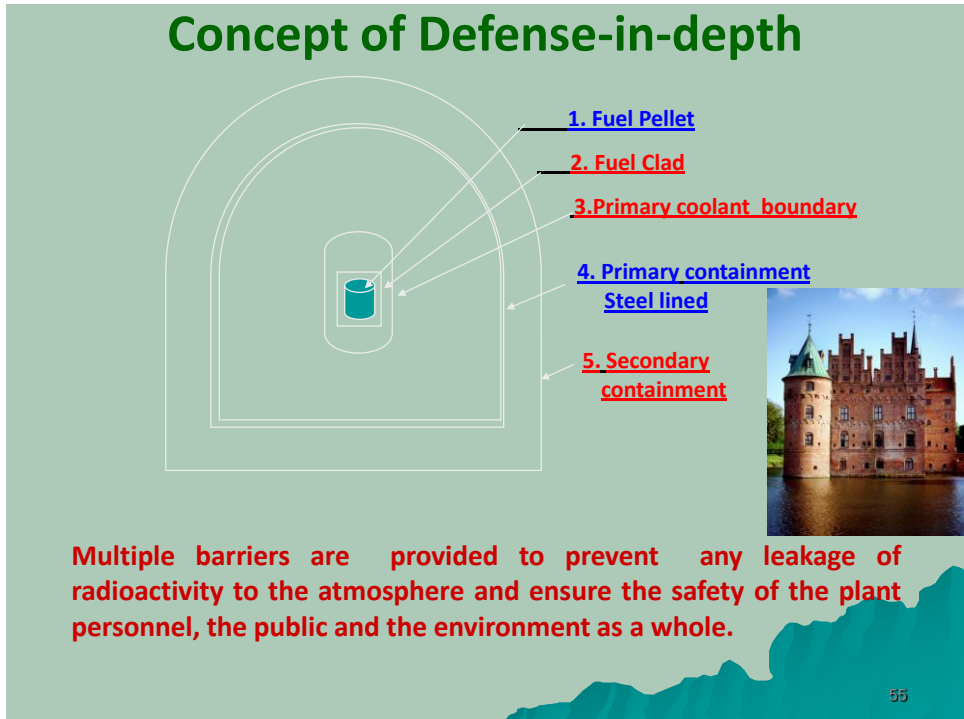
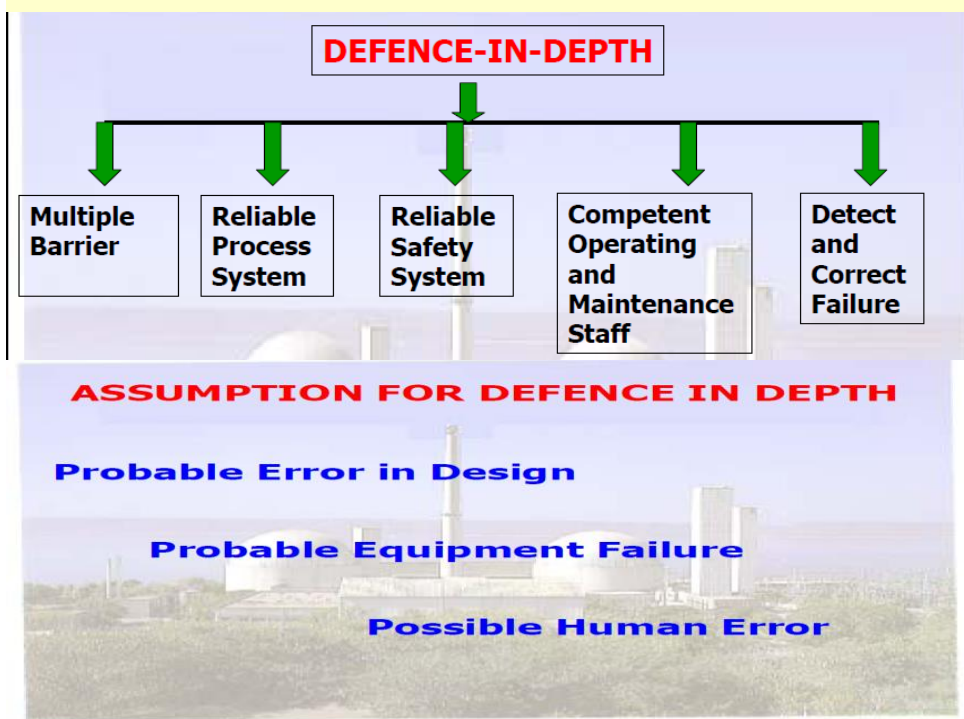


## RADIOACTIVITY AROUND US

AMBIENT AIR	10-100 Bq / m <sup>3</sup>
FRESH WATER	~ 1 Bq / l
SEA WATER	15 Bq / l
MILK	10 Bq / l
FRUITS / VEGETABLES	100-150 Bq / Kg
HUMAN BODY	~ 120 Bq / Kg
CEREALS	~50 Bq / Kg
TOP SOIL	~500 Bq / Kg
WOOD	~1 Bq / Kg
BRICK	50-100 Bq / Kg

## Natural Background Radiation in Various Cities

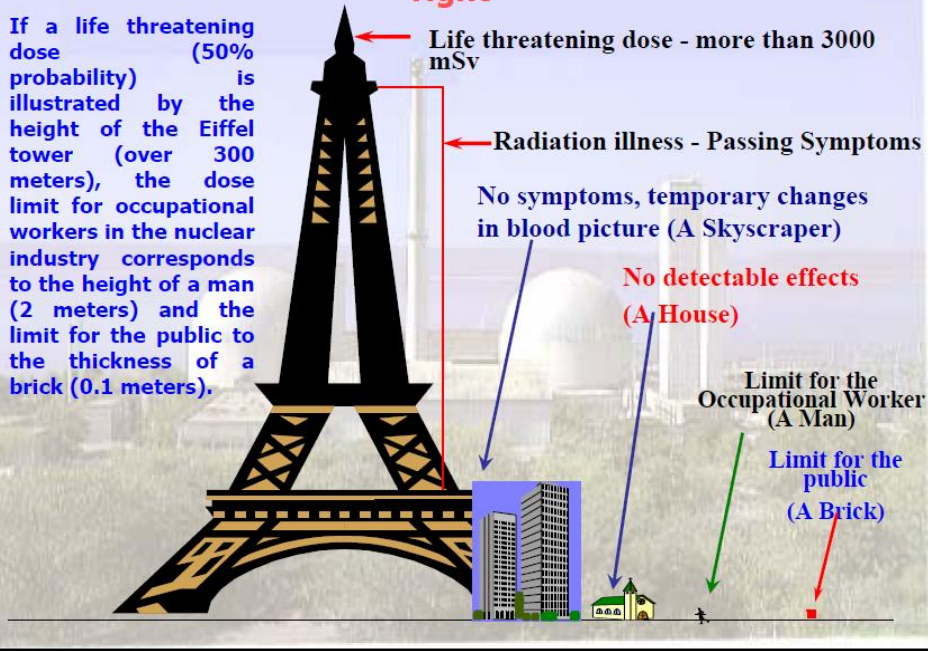
CITY	mGy.y <sup>-1</sup> *		
	COSMIC	TERRESTIAL	TOTAL
MUMBAI	280	204	484
KOLKATA	280	530	810
DELHI	310	390	700
CHENNAI	280	510	790
BANGALORE	440	385	825





## Exposure to Radiation Dose – Getting the Perspective right

If a life threatening dose (50% probability) is illustrated by the height of the Eiffel tower (over 300 meters), the dose limit for occupational workers in the nuclear industry corresponds to the height of a man (2 meters) and the limit for the public to the thickness of a brick (0.1 meters).



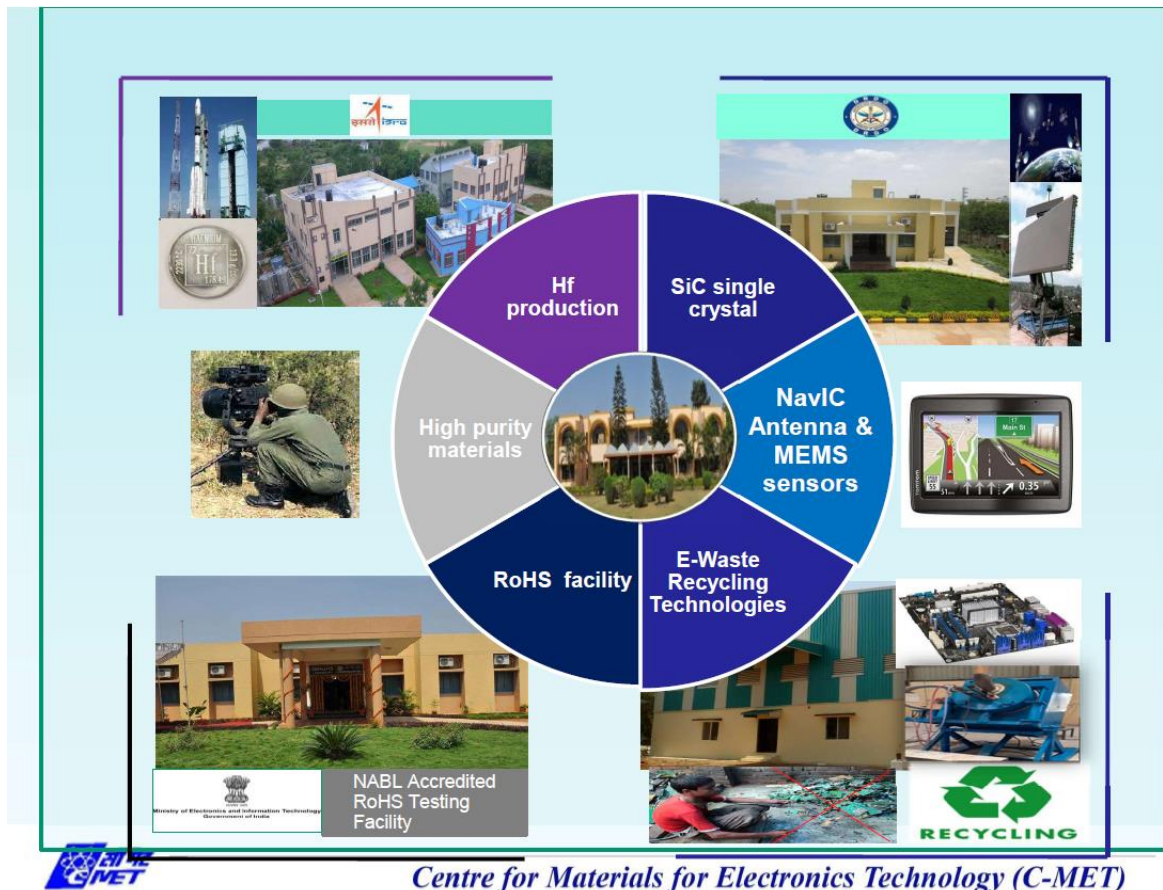


# Sustainable E-waste recycling in India: Challenges and Opportunities

R. Ratheesh

Director, C-MET, HYDERABAD

Webinar held on 8th August, 2020



## What is E-Waste?

Waste **E**lectrical **E**lectronic **E**quipment (**WEEE**) is known as **E**-waste



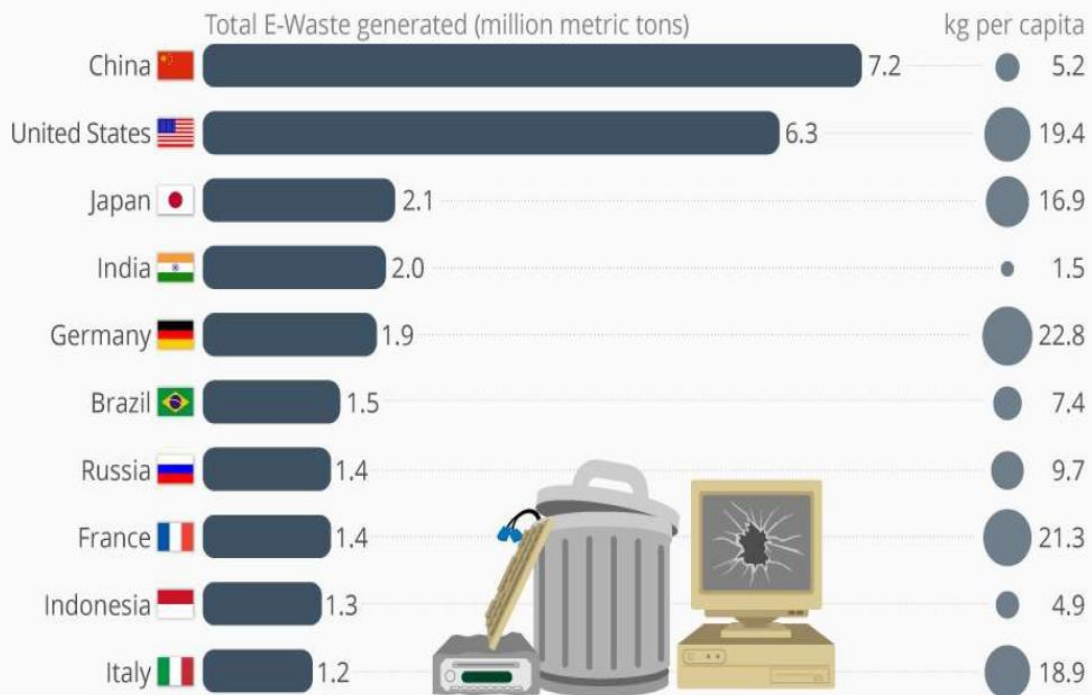
**E-waste is not waste: It is wealth: metals, Non metals can be recovered**



*Centre for Materials for Electronics Technology (C-MET)*

## These Countries Generate the Most Electronic Waste

Top 10 countries by the amount of e-waste generated in 2016\*

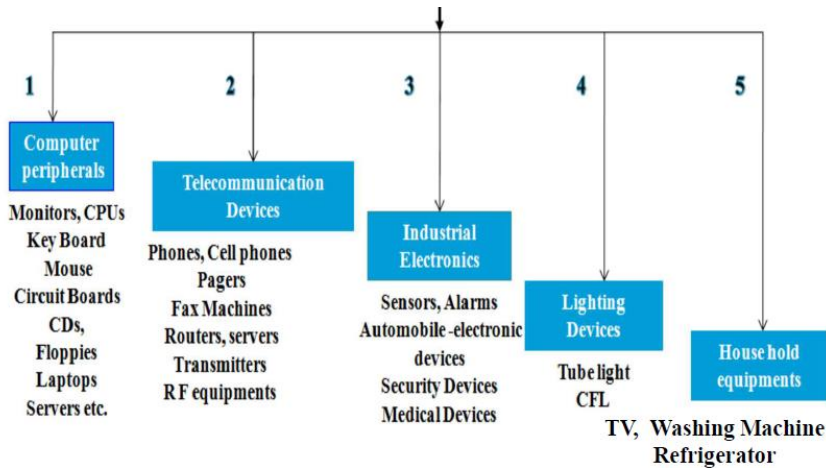


*Centre for Materials for Electronics Technology (C-MET)*

# GLOBAL E-WASTE GENERATED IN 2019: 53.8 MT

(7.3 Kg/capita)

## Classification of E-Waste

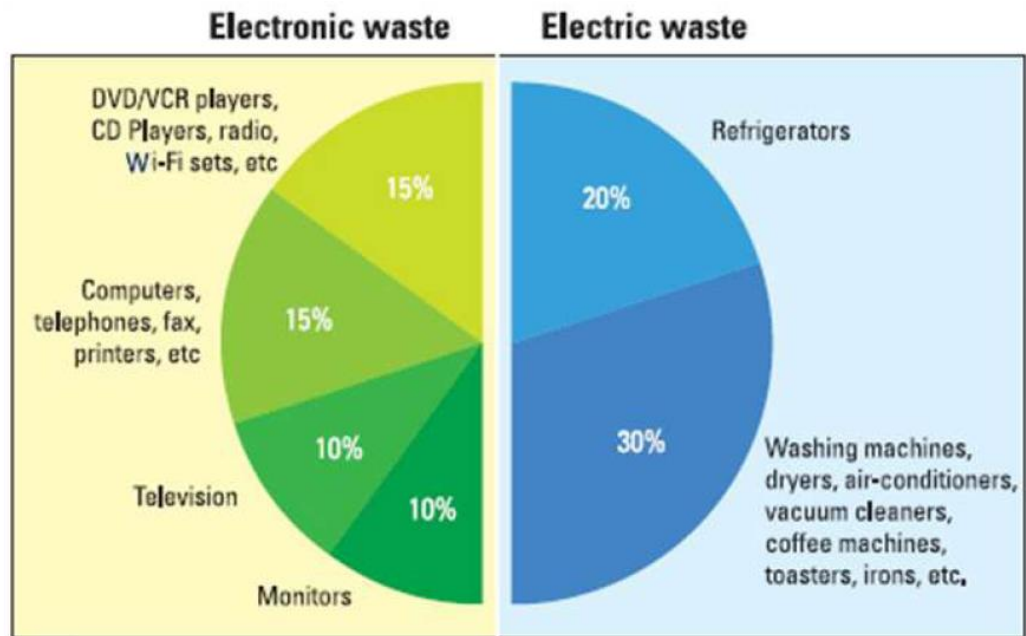


### New Class: Confidential E-waste

\* Source: Global e-waste Monitor, ITU

Centre for Materials for Electronics Technology (C-MET)

## Percentage of waste from components

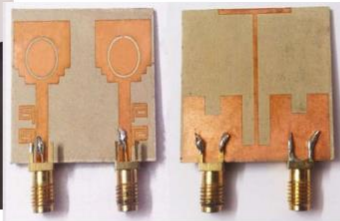




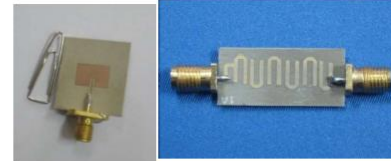
## MICROWAVE PRINTED CIRCUIT BOARDS DEVELOPMENT AT C-MET



Indigenously developed microwave Substrates



UWB MIMO Antenna



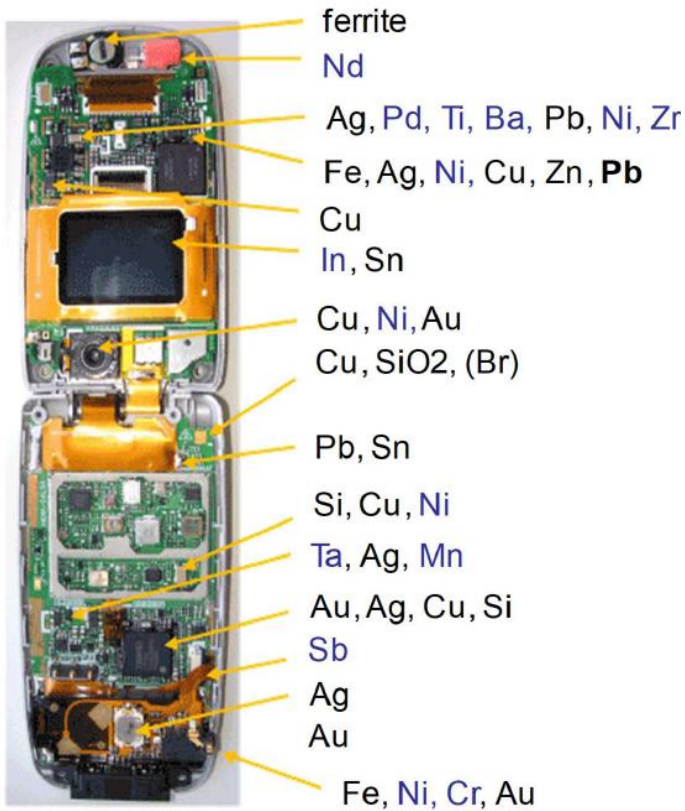
5GHz MICROSTRIP PATCH ANTENNA

Band pass filter

- › US patent No. US9455064 B2, September 27, 2016
- › US Patent No. US 9505902 B2, November 29, 2016

Supported by BRNS, DAE

## Valuable Materials that could be recovered from screen



Source: <http://www.coden.jp/rare-metal/use.html>

## Average Metal Contents in PCBs



Metal /ton of PCBs	%	kg
Copper	25	250
Silver	0.05	0.5
Gold	0.01	0.1
Aluminum	5	50



Al



Cu



Ag



Au

### E-Waste Toxins and Affected Body

#### Parts

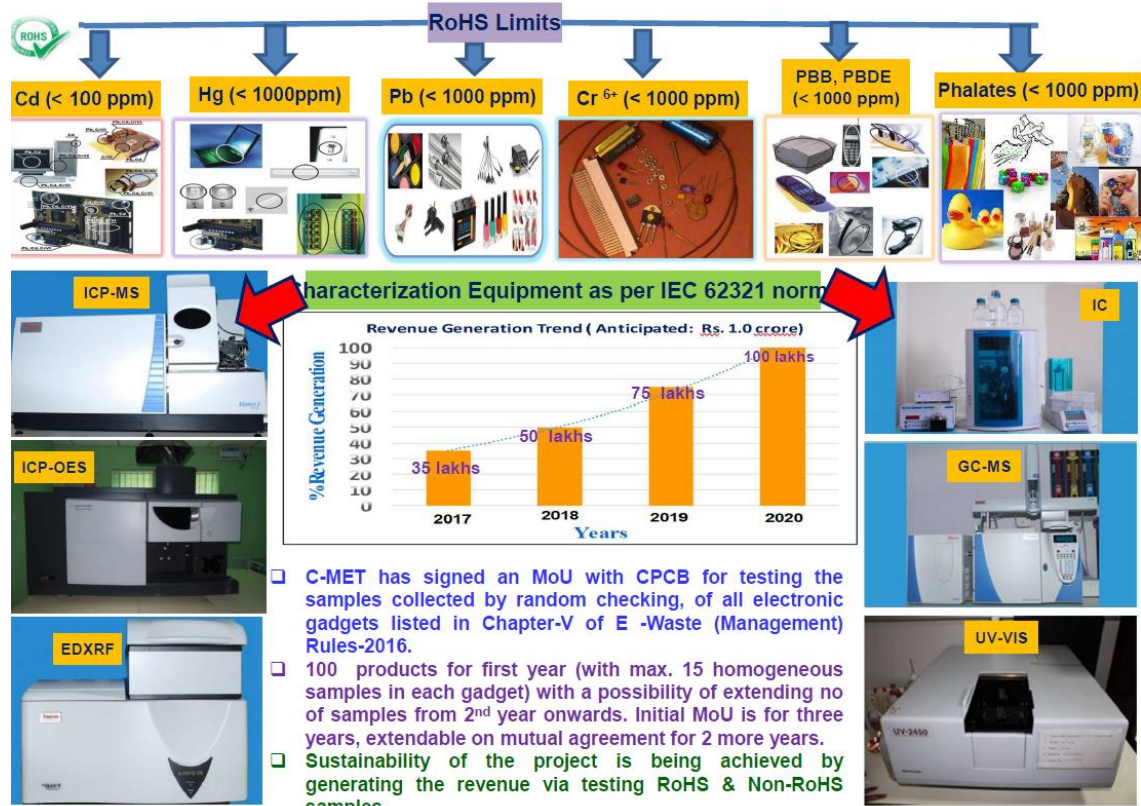
Components	Constituents	Affected Body parts
Printed circuit boards	Lead and cadmium	Nervous system, kidney, liver
Motherboards	Berillium	Lungs, skin
Cathode ray tubes(CRTs)	Lead oxide, barium and cadmium	Heart ,liver, muscles
Switches and flat-screen monitors	Mercury	Brain, skin
Computer batteries	Cadmium	Kidney, liver
Cable insulation/coating	Polyvinyl chloride(PVC)	Immune system
Plastic housing	Bromine	Endocrine

#### Discard Rate of Electronics Items

ITEM	Discard /replace rate
Mobile telephone	1 to 3 years
PC	Every 2 years
Camera	3 to 5 years
Television	10-15 years
Refrigerator	10-15 years
Washing machine	10-15 years
IT accessories	Very fast



## World Class Govt. Funded NABL Accredited RoHS Testing Facility



## Recycling Techniques

### Hydrometallurgical methods:

Recycling of metallic fraction

Metal contents are leached into strong acids and alkalies

Electrorefining of desired metal

Leachants can be aquaregia nitric acid, sulphuric acid and cyanide solution

### Mechanical recycling:

Physical recycling method

PCBs pulverised to fine powder

magnetic separation, electrostatic separation, air classification are used for separation

### Recovery of resin by organic solvent

DMSO dissolves the brominated resins and separated metal, fibres

DMSO is recovered by evaporation

### Pyrometallurgical methods

Pyrolysis, followed by hydrometallurgy

Pyrolysis followed by smelting, electrorefining etc.



## Smelting Operation

Rotary tilting furnace is used for smelting



**TBRF**



**FFRTF**





1000 Kg/day PCB processing facility at Industry collaborator site



Photographs of Major Process Facilities at C-MET



FFRTF firing position



FFRTF tilting position



TBRF erected with fume hood



Copper Electrowinning system



Gas cleaning system:  
secondary burner



Heat exchanger,  
quencher and scrubber

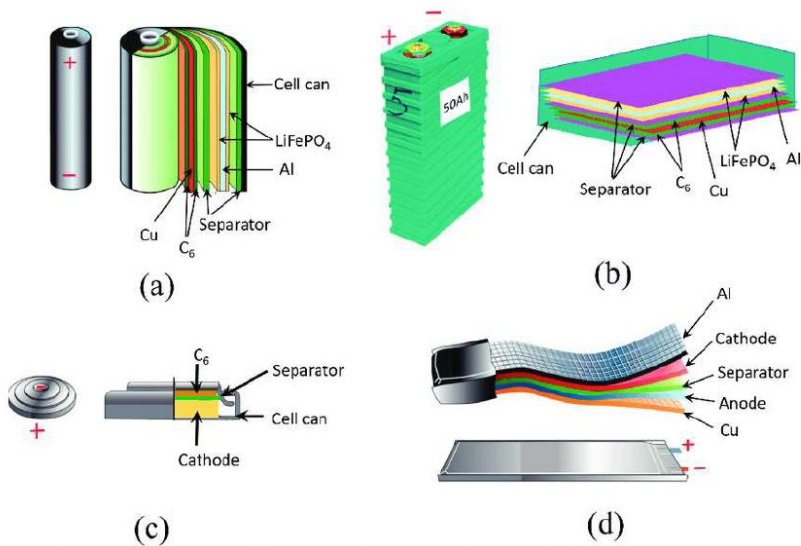
**Technical services extended to dismantlers, recyclers and informal sector for recovery of metals from spent printed circuit boards**



**First batch of technical service deliverables  
Handing over of copper, gold and silver to M/s Deshwal Waste Management Pvt. Ltd.**

**Dismantling of Li-Ion Battery**

Separation of cathode and anode materials;



**Different shapes of lithium ion batteries with detail internal assembly as  
a) Cylindrical b) prismatic c) Coin d) Thin and Flat**



# Materials composition in lithium ion batteries

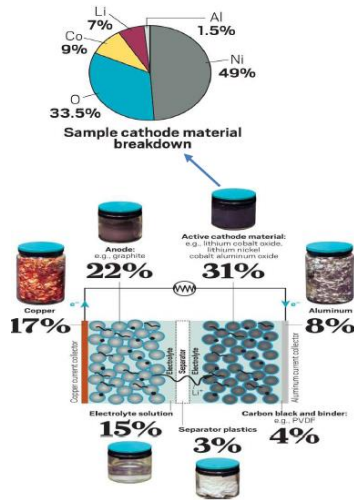


Table: Elemental composition of active cathode material

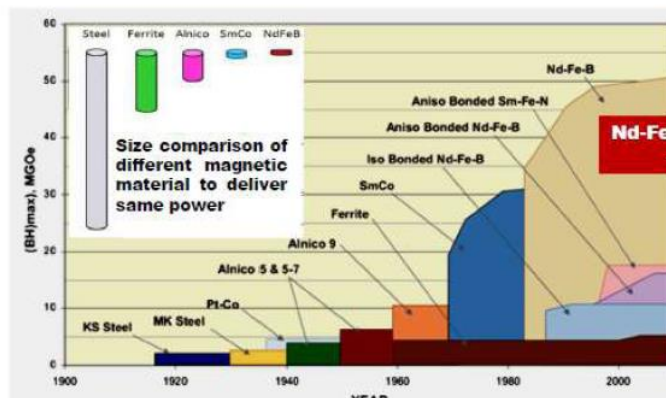
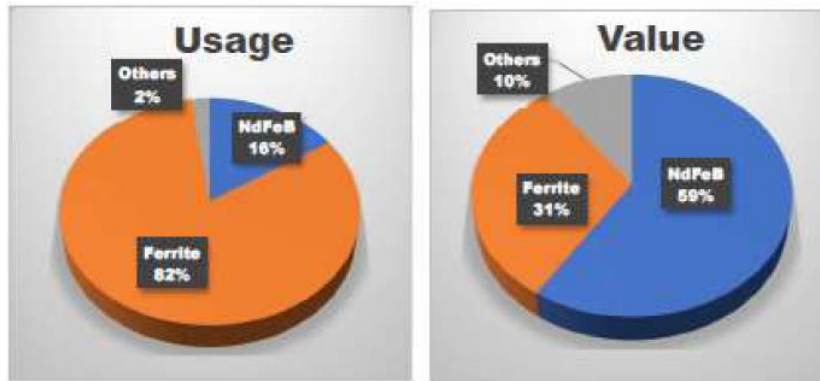
	NMC (111)	NMC (622)	NMC (811)	LCO	NCA	LMO	LFP
Active Cathode Material	34.1%	31.8%	31.1%	35.3%	30.4%	40.1%	32.2%
Elemental composition of active cathode material							
Li	7.86%	7.82%	7.79%	7.09%	7.22%	3.84%	4.40%
Co	20.21%	12.07%	6.02%	60.21%	9.20%	...	...
Ni	20.13%	36.07%	47.93%	...	48.87%	...	...
Mn	18.84%	11.26%	5.61%	...	...	60.77%	...
Al	...	...	...	...	1.40%	...	...
Fe	...	...	...	...	...	...	35.40%
P	...	...	...	...	...	...	19.63%



## Recycling of Spent Permanent Magnets



### Market share of Permanent magnets



Electric vehicles impossible without Nd-Fe-B magnets





**Recycle and Save Earth**