Platinum Jubilee

Physical Research Laboratory

MetMeSS-2022

2nd Symposium On

"Meteoroids, Meteors and Meteorites: Messengers from Space"

Plenary Talk

Date	Time	Speaker	Title of talk
24th Nov. 2022	11:00-12:00	Marc Chaussidon	When and how did the first planets form and differentiate in our solar system?
25th Nov. 2022	14:15-15:15	Yurimoto Hisayoshi	Geochemical analysis of Hayabusa2 returned samples

When and how did the first planets form and differentiate in our solar system?

Marc Chaussidon (Institut de physique du globe de Paris)

A major discovery in recent years has been the ability to precisely date the age of metal-silicate differentiation in the parent bodies of iron meteorites and to show that some of them formed within the first million years of the solar system. Recent models of planetary formation in the accretion disc around the young Sun suggest that in fact a multitude of small differentiated planets may have formed as early as this. Very few traces remain of this first generation of planetesimals, which are the first step in the formation of terrestrial planets. Until now, no meteorite has been found that could give direct information about the mantle or crust of these early planets. The age of crystallisation of the newly found Erg Chech 002 meteorite (a lava of andesitic composition) implies that its parent body was accreted at the same time as the oldest iron meteorites. The composition of Erg Chech 002 provides insight into the internal structure of these early planets and their accretion and differentiation history.

Geochemical analysis of Hayabusa2 returned samples

Yurimoto, Hisayoshi

Hokkaido University (HokuDai)
Sapporo 001-0021, JAPAN

Hayabusa2 spacecraft delivered samples collected from asteroid Ryugu to Earth on 2020 December 6. Geochemical analysis revealed that the samples were similar to Ivuna-type carbonaceous (CI) chondrite. In this talk, I will present how analyze the samples and what difference appear between Ryugu, CI and other chondrites.

Platinum Jubilee

Physical Research Laboratory

MetMeSS-2022

2nd Symposium On

"Meteoroids, Meteors and Meteorites: Messengers from Space"

Invited Talk

Date	Time	Speaker	Title of talk
24th Nov. 2022	14.00-14.30	NG Rudraswami	Extraterrestrial dust reaching the Earth surface
24th Nov. 2022	15:20-15.50	J.S. Ray	Understanding Early Silicate Earth Differentiation.
24th Nov. 2022	17:45-18.15	A.D. Shukla	Indian meteorites collection: Fall Characteristics and contribution to Planetary Research
25th Nov. 2022	09:30-10:00	K Kishore Kumar	A Decade of Meteor Radar Observations of the Low Latitude Mesosphere Lower Thermosphere Dynamics.
25th Nov. 2022	10:00-10:30	Umesh Kadhane	A molecular physics prospective of high energy radiation processing of organic matter in our solar system
25th Nov. 2022	11.45-12:15	Sujoy K. Ghosh	Formation of High-Pressure Phases in Shocked Chondrite.
25th Nov. 2022	16:20-16:50	Alik S Majumdar	Serpentinization of iron-rich olivine and its potential for abiotic methane synthesis in planetary bodies
25th Nov. 2022	17:30 - 18:00	Kuljeet K. Marhas	Overview of Science Highlight of PLAS Group

Extraterrestrial dust reaching the Earth surface

Rudraswami N G
National Institute of Oceanography, Dona Paula - 403 004, Goa, INDIA
Email: rudra@nio.org

The Earth has been constantly bombarded by high velocity extra-terrestrial dust particles largely contributed by asteroid and cometary bodies. The extra-terrestrial dust that are in size range from few ten of µm to few mm provide glimpses of the diverse properties of parent bodies that has been accreted after the formation of the proto-Sun. The Earth accretes ~110 tonnes of dust material everyday out of which a large portion (>90%) get ablated during entry and a small fraction (<10%) survive reaching the Earth's surface (called micrometeorites). These micrometeorites provide us with an exceptional opportunity to unravel diverse properties of solar system bodies in the laboratory with the potential to understand the formation of particles in early solar nebula, type of diverse object, oxygen isotope properties, chemical composition, etc. Our understanding of micrometeorites particles are derived mostly from their chemical and isotopic properties with certain constraint which has to be related to the known precursors. The amount of of chemical alteration and oxygen isotopic exchange by these small-sized particles during Earth's atmospheric entry is multifaceted to straighten out as it depends on temperature, entry velocity, zenith angle, apart from most crucial parameter, namely, initial chemical and isotopic composition of the precursor material. A large number of micrometeorites have shown chemical, isotopic and trace element composition that can be linked primarily to primitive chondrites such as CI and CM. However, there are many that differ considerably in textural and mineralogical composition which is not found in meteorite studies indicate diverse type of precursors in the asteroidal belt that is still not in our collection. The abstract and the talk will focus on discussion about micrometeorites, its collection technique, chemical and isotopic properties of these enigmatic particles and its comparison to meteorites that provides significant insights and enhances our understanding of the solar system objects.

Indian meteorites collection: Fall Characteristics and contribution to Planetary Research

Anil D Shukla
Physical Research Laboratory, Ahmedabad

India has unique history of the fall of meteorites as well as the collection history. The earliest recorded by Varahamihira in his compilation 'Brihatsamhita (5/6 century AD)' where he dedicated many shlokas with various types (shapes) of meteors and meteorites in the context of astrological implications. The physical evidence exists since 1621AD record of the Jalandhar iron meteorite which was used to make sword and dagger for the emperor Jahangir. During the talk, I am going to review the Indian meteorites collections and its fall pattern as well as some significant contributions which have enhanced the knowledge of the planetary science community.

A Decade of Meteor Radar Observations of the Low Latitude Mesosphere Lower Thermosphere Dynamics

Karanam Kishore Kumar

Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram-695022, India

Meteor radars have been making significant contributions in divulging the structure and dynamics of mesosphere lower thermosphere (MLT) by providing continuous measurements of zonal and meridional winds in the 80-100 km altitude. The wind measurements by meteor radar at Thumba (8.5°N and 77°E), which was installed in the year 2004, have been providing new insights into the MLT dynamics. The radar observations were extensively employed to investigate the role of atmospheric waves in vertically coupling the lower and middle atmosphere. The role of gravity waves in driving the long-period oscillations in the MLT region is quantified using meteor radar observations over Thumba. The planetary wave and diurnal tide interactions were also established in the MLT region employing bi-spectral approach on hourly zonal and meridional wind measurements. The meteor radar observations were also employed to investigate the signatures of sudden stratosphere warming in the low latitude MLT region. These results emphatically brought out the high and low latitude coupling mechanisms in the middle atmosphere. It has been shown that by modifying the background winds, the SSW events influence the propagation of planetary waves as well as semidiurnal tides in the middle atmosphere. Apart from this, the meteor radar measurements are used for bringing out the climatology of quasi2-dya and quasi16-day planter waves in the MLT region. Further, the meteor decay time is employed in estimating the temperature profiles in the MLT region. Recently, an outstanding question on the mesospheric quasi biennial oscillations is addressed using long-term observations from meteor radar. Simultaneous observations from equatorial and low latitude meteor radar measurements were used to extract the horizontal wavenumber of planetary waves in the MLT region. The present talk focuses on highlights of meteor radar observations and the need for the network of meteor radar measurements over the Indian region to have comprehensive understanding of low latitude MLT dynamics.

A molecular physics prospective of high energy radiation processing of organic matter in our solar system

Umesh R. Kadhane*
Indian Institute of Space Science and Technology, Thiruvananthapuram-695547, Kerala
*umeshk@iist.ac.in

Occurrence of organic molecules, particularly polycyclic aromatic molecules (PAH), in various members of our solar system has generated strong interest among researchers in the last two decades. This is mainly driven by five very successful missions namely Cassini-Huygens, Dawn, Rosetta, New Horizons and Stardust mission. World over, discoveries of a myriad of new organic molecules and associated dynamic models inspace are being reported from solar system members including Jupiter, dwarf planets Pluto and Ceres, moons like Titan, Triton, Europa, Enceladus, comets and asteroids, etc. Though many biologically important molecules including amino acids are already detected in situ. As it turns out, large organics seem to be more prevalent in our solar system then we expected. The abundance is not just incremental but it is overwhelming.

In our solar system, the abundance of primary molecular inventory like N_2, O_2, CH_4, H_2O, H_2, etc. is obviously decided by the formative processes of our solar system. Energetic radiation from the sun helps to process this raw material in dense environments around planets, moons or comets into complex and sometimes biologically useful substances. The time is ripe to invest in multi-dimensional laboratory investigations focused on understanding this evolution. And to use the ever-growing capabilities of Indian space programs to plan a much focused space mission which will enrich the human understanding of the origin of life in our solar system. At the same time a mission of this magnitude will rejuvenate interest in laboratory based molecular physics research. I would be presenting a short overview of molecular interactions with high energy radiation from the laboratory setup to deep space. And how such an exquisite endeavor demands an equally special space mission.

Formation of High-Pressure Phases in Shocked Chondrite

Sujoy Ghosh

Department of Geology and Geophysics, Indian Institute of Technology Kharagpur

Shocked chondrites contain different high-pressure minerals, such as olivine, pyroxene, feldspar, quartz and their polymorphs. Such high–pressure phases were formed by a planetesimal collisions in the early solar system and the impact events on the surfaces of Mars and Moon. These high-pressure minerals are formed in and around the shock melt veins and melt pockets in chondrites. In this presentation, I will give a brought overview of transformation mechanism of high-pressure phases in shocked chondrites.