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TATA INSTITUTE OF FUNDAMENTAL RESEARCH

ICTS Fluid Dynamics Seminar

Title : The Role of Earth's Mantle Convection in Planetary Habitability

Speaker : Jyotirmoy Paul (University of Oslo, Norway)

Date : Thursday, 25 September 2025

Time : 11:30 AM (IST)

Abstract : Earth's unique habitability is influenced by four key features: liquid surface water, an oxygenated atmosphere, plate tectonics, and a geomagnetic field. These are sustained by the convecting silicate layer comprising the lithosphere and mantle which serves as the dynamic link between the climate-ocean system and the planetary dynamo at the core. The lithosphere (mantle's top thermal boundary layer) has cooled and thickened over time, forming early continents, called cratons. While the oceanic lithosphere is recycled by plate-tectonics within ~200 million years, cratons have survived for over 3000 million years - How? To address this, I use global mantle convection models to explore how cratons resist recycling and how this stability influences early climate evolution and habitability.

The geomagnetic field might have also influenced Earth's habitability. Since mantle convection is slower than in the outer core, lateral heat flux variations in the lower mantle impose a quasi-stationary boundary condition at the core-mantle boundary (CMB), affecting core convection. Recent studies suggest that enhanced antisymmetric harmonics in the CMB heat flux promote geomagnetic reversals, whereas symmetric harmonics tend to stabilize the dipolar magnetic field. I am currently testing the temporal evolution of lower mantle heat flow in controlling geomagnetic reversals.

Venue : Emmy Noether Seminar Room

Zoom Link: <https://icts-res-in.zoom.us/j/95145572447?pwd=XfhL5bK8zCN9ku9NPrX1wrLfU56Wuf.1>

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