Call for Proposals

Announcement of priority areas

Online portal for details and submissions: **https://stars.iisc.ac.in**

Scheme for Transformational and Advanced Research in Sciences (STARS)
Ministry of Education
Indian Institute of Science, Bangalore

Projects are sought on applications for any branch of PURE or applied Physical Science, with special emphasis on problems of societal relevance. Given the scope of the program, we expect the projects to be ambitious, collaborative, and transformative. The quality of science should be of international standard and should involve substantial theoretical/experimental components.

Priority Areas

- Quantum Technologies: Quantum Information Sciences, Quantum Computing, Quantum Communication and Quantum Sensing
- Photonics and Quantum Photonics
- Designing Self Assembled Functional Materials / Robotics with Control and Adaptation, Reprogrammable Group / Collective Agent Dynamics, Soft Engineering, Reprogrammable Soft Materials
- Physics of living systems
- Advanced Hard Materials (smart / high strength / Energy storage and harvesting)
- Topological matter, novel superconductors
- Efficient power sources, Smart Grids
- Sensors physics, data storage, data encryption
- Planetary physics

Proposals that involve probing fundamental aspects of chemical science, synthetic, computational and physical as well as analytical, that would lead to translational output, particularly on immediate relevance to the societal needs are welcome. The areas mentioned below are notional and are not restrictive. However, the projects are expected to lead to demonstrable outcome in terms of applications.

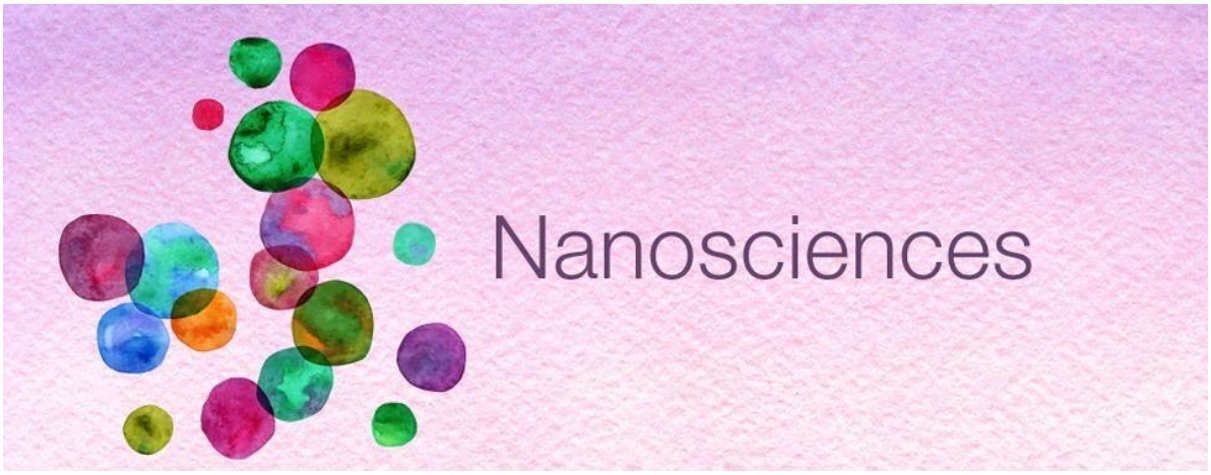
Major Goal: Ability to design and manipulate matter using principles of chemistry. The following are only indicative of the thrust areas:

- Understanding Electron / Ion Coupled Transport in various systems.
- Catalysis – Development of novel catalysts for dinitrogen and C=O bond activation.
- Production of Hydrogen from Sea water/Water using Photocatalytic, Electrocatalytic, Electrolysers and Reformers.
- Development of Photochemical and Electrochemical or radiation assisted processes for bulk production of chemicals like ammonia, MEG, ethylene, propylene etc replacing energy intensive thermal processes.
- New approaches for heterogeneous catalysis, e.g., using porous organic polymers (POPs); zeolites
- Novel aspects of asymmetric synthesis / catalysts / enzymatic reactions / soft Matter / chemical biology / Sustainable chemistry and waste utilization, e.g., plastics and polymers.
- Capture, Utilization and Storage of Small Molecules such as CO_2, Reversible Hydrogen Storage and conversion to useful products/ Scavenging of pollutants (from environments, water, air, etc.) by new mechanisms.
- New functional molecules and functional materials, including supramolecular systems.
- Sensors and application in the fields of health, environment, and safety and their translation to products/devices.
- Products for air and water purification, disease diagnosis and therapy.
- Photochemistry and electrochemistry of nanostructured organic/ plasmonic/semiconductor materials

Interdisciplinary and collaborative projects are sought in the following thrust areas:

1. Human health
   Sub areas: metabolic disorders, genetic disorders, infectious diseases, non-communicable, ecosystem health
2. Plant health and nutrition:
   Sub areas: nutrition, value addition, stress resistance, plant diseases, agroecology
3. Systems and synthetic biology
   Sub areas: microbial factories, synthetic circuits, computational tools, ecological networks

The projects could address specific problems in any of these areas or subdisciplines within these areas through either an integrated approach or through approaches tackling a specific aspect of the problem. Potential approaches include those involving either genetics, biochemistry, genomics, metabolimics, chemico-biological, biophysical or structural; ecological or environmental, evolutionary and theoretical modelling; engineering and systems level. Projects with a strong interdisciplinary and collaborative approach with complementarity between collaborative groups and projects with a more systems or integrated approach would be given preference.



The research proposals in the domain of Nanoscience will be encouraged along the lines of application areas that are both cutting-edge globally, and relevant nationally – from the perspectives of Security, Healthcare, Agriculture, Pedagogy, Environment and Energy ('SHAPE'). The broad project objectives should concentrate on a set of clear, measurable, and visible deliverables, based on the proof of concept already established by the PI. The proposal should focus on the research that can be translated into visible and commercially viable deliverables by indicating the current and projected Technology Readiness Level (TRL).

Priority Areas

- Nanoscience and technology for emerging electronics, Novel quantum and emergent sensors, Nano photonics, and Heterogenous nano systems/devices.
- Nanoscience and technology for Security, Healthcare, Energy and Environment, and Agriculture/Food
- Nano-ceutical fabrics /coatings for PPE and bioelectronic devices to combat infectious diseases
- Quantum devices and technology

Interdisciplinary and collaborative projects are sought in the following thrust areas:

- Use of techniques from differential equations (ordinary or partial), random processes, etc. to model phenomena in meteorology, oceanography, environmental sciences, geophysics, etc. with accompanying analysis and/or numerical or simulation techniques.
- Epidemiological models, both differential equation based and probabilistic, and allied inference and prediction problems
- Modeling and prediction of economic factors using advanced mathematical models and data science techniques
- Application of statistical methodologies to medicine, weather prediction, disaster prediction (e.g., earthquakes), environment, and so on.
- Application of algebra, algebraic geometry, number theory, etc. to problems relevant to national security such as coding theory and cryptography.
- Application of statistical methodologies and optimization in logistics applied to areas such as defence, disaster management, etc.
- Development of provably effective algorithms for analysis of large data sets of social relevance such as in problems of resource allocation.
- Application of dynamical systems and control theory to robotics, aerospace engineering, etc.
- Applications to medicine (medical image analysis, tomography, dosage optimization)
- Modelling and analysis for meteorology, oceanography etc., (monsoon modelling, disaster prediction)

This list is suggestive and not exhaustive. The projects are encouraged to be translational, in the sense that the research should demonstrably lead to concrete results in the domain for which the application is intended and not merely be an ‘in principle’ or ‘proof of concept’ result. At the same time, it should not be a routine application of existing techniques.

Projects are to focus on the interacting earth system processes and their feedback mechanisms that are critical to the sustainability of our planet through (a) exploration and sustainable exploitation of natural resources; (b) quantifying impacts of anthropogenic forcing on climate change and its environmental, social and economic impacts; (c) risk assessment from natural hazards like earthquakes, tsunamis, cyclones, landslides, avalanches, floods etc.and (d) development of models of interactions between lithosphere-atmosphere-hydrosphere-cryosphere and biosphere.

Priority Areas

- Watershed management – water management (including contaminants and pollutants) – watershed to basin.
- Climate change through time, impact of global warming on heat stress, sequential CO_2 sequestration, sustainability
- Accounting for the Himalayan glaciers and their vulnerability
- Protection of coastal zones- mapping the limits of coastal inundation from sea surges (cyclones and tsunamis) considering sea level changes in the past and projections to future based on climate change models, surface water-aquifer interactions, submarine groundwater discharge, pollution, and salt water intrusion into coastal aquifers in response to sea level dynamics.
- Earthquake, landslide and tsunami hazards-mapping the vulnerability zones, impact assessment, preparedness.
- Use and application of AI/ML techniques in Earth Sciences
- Interactions among surface processes, climate and tectonics with focus on human sustainability
- Develop a unifying theoretical framework of Critical Zone evolution that integrates physical, chemical and biological processes.
- Lithospheric processes
- Exploration and sustainable exploitation of natural resources