

Strategy 2030: Astrophysics for Excellence

**Institute of Theoretical Astrophysics
University of Oslo**

Adopted by the Institute Board 21st of September 2022

The Institute of Theoretical Astrophysics

The study of the universe that we are part of has caught the imagination of humanity since the first civilisations emerged. Besides medical sciences, astronomy is the scientific subject that catches the greatest interest in the public and in media. Astronomy research and education at the University of Oslo started at the dawn of the University's history, when Christopher Hansteen in 1814 took up his lectureship (professorship from 1816) in applied mathematics and astronomy. In 1833, he opened Oslo University Observatory as the first permanent building of the University of Oslo. In 1934, Svein Rosseland moved astronomy and astrophysics to the Blindern campus, where, based on a generous grant from the Rockefeller Foundation, the Institute of Theoretical Astrophysics was founded. The Oslo Analyzer, the world's largest mechanical computer, was in use from 1938 in the basement of the Institute's building, from 1994 appropriately named the Svein Rosseland building.

In 2011, the Institute had 44 employees. At the start of this decade, in 2021, the Institute of Theoretical Astrophysics has 81 employees (full time equivalents, including 30 doctoral students), so the growth, mostly funded by external funding, especially from the Research Council of Norway, the European Union and the European Space Agency, has been substantial. The Institute also has 24 master's students on the programmes "Astronomy" and "Computational Sciences/Astrophysics" and contributes courses that are part of the bachelor programme "Physics and Astronomy".

At the start of the decade, the Institute has two sections, one for Solar and Stellar Physics and one for Cosmology and Extragalactic Astrophysics. In the period 2017 – 2027, the Solar and Stellar Physics section is the Research Council of Norway's Centre of Excellence "*Rosseland Centre for Solar Physics – RoCS*". Counter to the Institute's historic name, both sections are heavily involved in both observational and theoretical research. Observational data are obtained from international space missions and ground observatories, while the theoretical studies are primarily based on huge numerical simulations. Analysis of the observational data as well as the numerical simulations require extensive IT infrastructures locally, nationally and internationally. The Institute is Norway's largest single user of the national HPC infrastructures.

Over the last decade, the Institute has been leading in introducing new methods of teaching based on extensive use of computational projects in all courses. The Institute of Theoretical Astrophysics is Norway's only university department with research and education over broad fields of astronomy and astrophysics.

Context

The Institute of Theoretical Astrophysics (ITA) is a department of the Faculty of Mathematics and Natural Sciences of the University of Oslo. The strategy adopted by ITA follows up the Faculty's "Knowledge development in a changing world – Science and technology towards 2030".

Especially important for ITA are the following statements in the Faculty's strategy:

- The cornerstone of the Faculty's activities comprises basic long-term research on mathematical and natural sciences and technology.
- The Faculty aims to be one of Europe's leading centres for research, education and innovation by being a contender in the top echelons of research-intensive universities in Europe.
- The Faculty shall develop academic groups that will feature among international leaders in their respective fields.
- The Faculty's education of researchers shall be improved.
- The Faculty shall participate in the development of important research infrastructures, both nationally and internationally.
- The education programmes at the Faculty shall maintain a high international standard at all levels and be closely connected to research.
- The Faculty shall provide support for the general presentation of research in society and active participation in social debate.
- The Faculty shall be involved in all significant aspects associated with the development of excellent working and study environments. This also means placing increased focus on recruitment processes, equality and diversity, leadership, organisational development and the development of digital expertise for all employees and students.
- The Faculty of Mathematics and Natural Sciences shall continue to develop its activities in respect of the basic development of knowledge in the various academic disciplines. Four thematic initiatives across units and in cooperation with partners shall receive special attention. Two of these, *Earth and Space Sciences* and *Digitalisation and Computational Science*, are highly relevant for the Institute of Theoretical Astrophysics.

The lead lies in research

Goal: The Institute of Theoretical Astrophysics will:

- *Maintain and further develop the Institute as an international leader in research in solar and stellar physics, cosmology and extragalactic astrophysics.*
- *Welcome new ideas and research opportunities through a bottom-up approach.*
- *Attract and retain internationally leading researchers.*
- *Secure access to excellent local and international research infrastructures.*

The following actions will be implemented to reach these goals:

- The Institute will continue concentrating on solar physics, cosmology and extragalactic astrophysics, but will remain open for research in other areas.
- Quality in research and teaching will be given the highest priority in hiring processes for permanent academic staff.
- Future funding of the solar physics group after the end of RoCS as a Centre of Excellence (CoE) will be sought, possibly as a new CoE proposal.
- The Cosmology and Extragalactic Astrophysics section should submit a CoE proposal before 2030.
- The Institute will encourage and support the writing of proposals for externally funded projects.
- The Institute will support its participation in the Swedish 1m Solar Telescope and the Nordic Optical Telescope through the decade.
- The Institute will strongly support the construction of a new European Solar Telescope and membership in it by the Institute.
- The Institute will evaluate possibilities for participation in larger ground based optical/IR and radio astronomical observatories, with AtLAST and ESO as main possibilities.
- The Institute will give major priority to exploit possibilities given by future missions in ESA's Space Science Programme, including "missions of opportunity", e.g., LiteBIRD and MUSE.
- The Institute's Project Related IT Services (PRITS) group will have a major role in supporting participation in new space missions of major scientific interest for the Institute. All academic employees are made aware of this group and its capabilities.
- The Institute will search for possibilities of funding for developing its IT infrastructure ("Centre for Analysis of Astrophysical Data") in the future.
- The Institute will lobby for development of, and easy access to, national and European High Performance Computing infrastructures.

Culture for learning

Goal: The Institute of Theoretical Astrophysics will:

- *Attract and train the best national and international students.*
- *Provide education in astronomy and astrophysics of international high quality, including the introduction of research-based methods for teaching and assessment in all courses.*
- *Integrate digital competences in all courses.*
- *Qualify our candidates for work in academia, industry and the public sector.*
- *Make contact between teacher and student central in our educational philosophy.*

The following actions will be implemented to reach these goals:

- The Institute will participate actively in the programme boards of the bachelor programme “Physics and Astronomy” and the master’s programme “Computational Science”.
- The Institute will actively develop its master’s programme “Astronomy”, and frequently review its composition.
- The Institute will ensure that all study programmes in which the Institute is actively involved encompass a natural transition between courses at different levels.
- The use of computational projects as a major part of all our courses on both bachelor and master’s level will be continued and developed further.
- The Institute will investigate whether the popular course AST1010 “Astronomy – a Cosmic Journey”, meant for non-astronomy majors, also can be used as a continuing education course for schoolteachers.
- The Institute will investigate methods for giving hands-on (or “hybrid” through remote use) experience on observatories for bachelor and master’s courses, e.g., by cooperation with the Nordic Optical Telescope and/or the Onsala Space Observatory.
- The Institute will ensure that the master’s and Ph.D. students for their thesis projects get access to observatories and observational data of high quality, and to excellent tools for data analysis and numerical modelling.
- The Institute will motivate and enable their lecturers to actively stay up-to-date on research-based methods for teaching and assessment.

Knowledge in use

Goal: The Institute of Theoretical Astrophysics will:

- *Nurture society's interest in astronomy and astrophysics.*
- *Provide Norwegian society with excellent researchers and developers in data science and computational science through their training and research in astrophysics.*
- *Collaborate with Norwegian industry and other university departments in developing instrumentation for astrophysics space missions.*
- *Support emergent research within astronomy and astrophysics at other Norwegian universities and colleges.*

The following actions will be implemented to reach those goals:

- The Institute will continue its instrumental role in publishing the Almanac of Norway.
- The academic staff will engage in outreach.
- The Institute will integrate science communication and public outreach as a part of the scientific training of Ph.D. students and Postdoctoral Research Fellows.
- With the goal of increasing diversity and gender equality in science, the Institute will maintain the existing communication platforms highlighting the role of women in science, such as the "Women in Astrophysics" blog.
- With the goal of reaching out to the youngest ones and promoting astronomy in schools, the Institute will take a leading role in the Norwegian participation in the International Olympiad on Astronomy and Astrophysics.
- In cooperation with the International Astronomical Union's Office for Astronomy Outreach (OAO), the Institute will take a leading role in building a Norwegian astronomy outreach network and in implementing national outreach projects.
- The Institute will seek to establish a network of alumni (especially previous Ph.D. students and postdocs) working in industry and applied research institutions to inform both students and employers about the excellent transferable skills obtained through astrophysics education and research.
- The Institute will keep contact with Norwegian space industry and other relevant university departments (especially the Department of Technology Systems) to explore possibilities for Norwegian instrument participation in astrophysics space missions and ground observatories.
- The Institute will support participation in national (e.g., Norwegian Physical Society) and Nordic meetings for networking and for stimulating the emergence of other Norwegian astrophysics research groups.

Focusing on people

Goal: The Institute of Theoretical Astrophysics will:

- *Emphasize openness, transparency and democracy as core values.*
- *Provide a good and safe work and study environment for all.*
- *Provide excellent support for research, teaching and outreach.*
- *Have an active policy for recruitment of excellent employees and for developing their skills and careers.*
- *Actively improve gender balance and diversity in all employee groups, academic, administrative and technical, as well as among the students.*

The following actions will be implemented to reach these goals:

- The Institute's work and study environment development is continued, led by the HSE committee and the HSE responsible in the administrative staff.
- "Mingle meetings" will be held for the whole institute several times per semester, providing cross-section interaction and providing information on science, management and HSE.
- The Friday colloquia will be continued as the Institute's most important scientific meeting place, but their format will be evaluated.
- International employees will be encouraged to learn Norwegian.
- The Institute will review its organisational structure.
- The agenda of the Institute board meetings will be communicated to all employees and students before the meetings.
- The Institute maintains an effective and flexible administration. The Institute will strive to develop the qualifications of the administrative staff to meet future requirements.
- The Institute will evaluate how it can improve administrative support for large research projects.
- The Institute maintains a well-qualified IT staff to maintain and upgrade the local IT infrastructure and to make its use easy for all employees and students.
- The Institute will evaluate possibilities for getting more office space.
- The Institute will seek to have good procedures for "onboarding" and "offboarding" of employees.
- The Institute will continue its policy for gender balance and diversity in the hiring process for permanent academic staff, and will strive to improve gender balance and diversity for technical and administrative staff, as well as for postdocs and Ph.D. students.
- All employees will be encouraged to get training on "implicit bias".