esa

FFG
Austrian
Research Promotion Agency

→ SUMMER SCHOOL ALPBACH 2017

The Dusty Universe

18 – 27 July 2017 | Alpbach/Tyrol – Austria

Details and further information: **www.summerschoolalpbach.at**

INTERNATIONAL SPACE SCIENCE INSTITUTE

AUSTROSPACE

Austrian Research Promotion Agency, FFG | Sensengasse 1 | 1090 Vienna, Austria | Phone +43 (0)5 7755-0 | www.ffg.at

CONTENTS

1. The Workshop and Student Project Teams: Introduction

Dust in the Universe is the topic of the Summer School Alpbach 2017. Understanding dust, its role for and diagnostics on cosmic evolution has tremendously benefited from space missions covering the electromagnetic spectrum from X-rays to mm wavelengths, and will do so in the future.

Students will be informed about past achievements and current issues, and will be invited to propose ideas to further explore the dusty Universe.

Dust particles pervade the Universe, from the Solar System to remote galaxies. Although dust represents only a small fraction of the total mass, it's role in our perception and the evolution of the Universe is significant. Dust particles strongly affect the signals we receive throughout the electromagnetic spectrum, being strong absorbers and re-emitters of radiation. They also are an important agent in cosmic evolution, as a main coolant of the interstellar medium for star formation, and as the seeds around which planets eventually form. Understanding dust, its role for and diagnostics on cosmic evolution has tremendously benefited from space missions covering the electromagnetic spectrum from X-rays to mm wavelengths, and will do so in the future.

Observing dust particles is best done in infrared light, like for example ESA's Infrared Space Observatory (ISO) and Herschel missions, NASA's Spitzer mission, which have discovered new and important features of dust in interstellar space and beyond. The topic is rich for future observational possibilities.

More than 50% of the time spent in Alpbach will be dedicated to the workshops. During these workshops, each of the four teams of about 15 students will define, study and design a scientific satellite mission using imaginative concepts. And on the last day, each team will present a short mission study to an expert review panel and all other teams, tutors and lecturers.

The teams will be supported by tutors who are experts in the scientific aspects of the summer school topic and in space mission design. Each team has two tutors, one covering the scientific aspects and one covering the engineering aspects. In addition roving tutors will provide advice on scientific, engineering and programmatic aspects to all teams. The Head Tutor will coordinate the support provided during the Workshops.

The aim of the workshop is to develop four different mission concepts — one by each team, to a point where a space agency could, in principle, take the concept over and start the mission assessment phase.

The teams select a mission concept within the topic of the Summer School based on the information provided in the lectures and their own knowledge of the topic. They then define the scientific objectives of their proposed space mission and provide a preliminary end-to-end mission concept including launcher, spacecraft, scientific instruments as well as mission and science operations that will meet their stated mission objectives.

By the end of the workshop, the teams will have considered not only the scientific instrumentation, which can meet the chosen scientific requirements, but also the mission design (launch, transfer and orbit), the spacecraft design with all required subsystems, the ground segment, development schedule, risk and rough-order-of-magnitude mission cost.

Lectures will cover science aspects, space mission design and other technical background, necessary to perform the tasks in the workshop. Many of the lecturers will be present throughout the duration of the Summer School and will also assist the teams for the definition of the missions. Lectures will provide an overview on dust in the Universe, its composition and structure and associated scientific challenges, justifications why and how to observe dust remotely.

The aim of the lectures is to present the current knowledge and gaps in our understanding to enable the students to select and formulate objectives for new space missions.

The offered lectures will cover existing and planned space missions, space mission design, and the principles of instrumentation for the required observations including in-situ measurements of dust. The lectures will provide the students with the scientific and technical background needed for defining and elaborating innovative space missions observing dust in the Universe.

Four student teams will be setup to define the scientific objectives of a space mission and a preliminary end-to-end mission design including the spacecraft, scientific instruments, mission and science operations that will meet the stated objectives.

The dedicated lectures as well as plentiful of scientific and background material and the support and advice of tutors and lecturers will assist the students to carry out successfully their challenging task of designing their space missions.

Students will come to understand how the general constraints of operations in space, launcher capability and, as a driving constraint, the availability of the required technologies will impact on the achievement of these goals. Students will learn how to form an international team to tackle the many issues connected with space mission design, and how to achieve the goals by working together as a team under pressure. These requirements are exactly those that arise in all space missions, and so the workshop is a good preparation for a career in space.

In order to monitor the progress of the project, three reviews have been introduced in the programme of the Workshops. Each team will undergo an Objectives and Requirements Review, a Preliminary Design Review and a Final Design Review. These reviews are separately to each team; lecturers and tutors will attend and contribute advice, although the teams themselves will need, in the first place, to learn from the reviews and improve on eventual shortcomings.

Each team will prepare and give a one-hour presentation on their completed mission concept and submit a written report. A jury of experts will evaluate the mission concepts according to the scientific case, the technical feasibility, the innovative nature and competitiveness, and quality of presentation. The jury will evaluate the proposed concepts in each of these four categories and will give feedback to the teams. Your work will be published on the web following the Summer School.

2. The Workshops: Organisation, support and practical advice

The four student teams, red, blue, green, and orange, will prepare its own structure and organisation. The election of spokespersons is essential, as they will be asked to report briefly on the team's progress on a daily basis. In most cases a small planning group of two or three people may also prove useful to determine and allocate tasks to the team. It is important that each member of the team contributes to the work according to his or her ability and enthusiasm, knowledge, training and experience. It is equally important that all team members should be kept informed of activities, undertaken by specific team members or small subgroups.

The student teams will be supported by **team tutors** who will be dedicated to the team and provide expert advice on the project. **Roving tutors**, who will not be attached to a particular team, will provide help and advice to the student teams on general aspects of mission design. A **Head Tutor** will coordinate the support provided to the students during the workshops.

Many of the lecturers will remain in Alpbach for the duration of the school and all will be available to help students with advice on relevant aspects of their mission. In addition, any tutor or lecturer is available to help any team, in his or her area of expertise.

Access to the internet will be possible during the summer school, either through fixed laptops allocated to each team, or through personal laptops using wireless access. Supporting material (books, reports, internet address lists, dedicated server with supporting material) will be centrally available for the use by the students.

Joint evening dinners will be organised at the Fichtensaal of the Hotel Böglerhof for the entire Summer School team including lecturers, tutors, students and accompanying persons to provide a convivial atmosphere for informal discussions.

The workshop is a unique opportunity for the Alpbach students to explore new objectives and mission concepts in a realistic context and with the support of professional space scientists and space engineers. Teams are therefore encouraged to be as innovative and visionary as possible; of course they have to be able to justify the scientific objectives and requirements, and they also have to show their understanding of questions related to the technical and programmatic feasibility of the chosen mission. To achieve the expected standard of mission design, the teams collectively, and the students individually should make full use of the resources of the Alpbach Summer School, lecturers, and tutors and, in a demonstration of cooperative teamwork, equal share of each other's' experiences and knowledge.

Since the time available for the projects is limited, students should:

- Elect the team spokesman or spokeswoman and establish the team organisation, latest on day 2 (Wednesday, July 19).
- Establish the project essentials (scientific objective, target object, mission scope), as soon as possible, latest on day 4 to prepare the Objectives and Requirements Review (scheduled for Friday July 21)
- Plan the work sensibly, identifying which decisions need to be taken early and the various tasks to be done and distributed within the team
- Identify as early as possible the main questions and problem areas related to the selected mission concept and start gathering information, solutions from the tutors, lecturers, the internet and books.

- Iterate frequently within the whole team, so that completion of tasks can be monitored, progress and status reviewed, unproductive paths abandoned and that every team member can contribute effectively to the overall goals.
- Prepare for the Preliminary and Final Design Reviews (Monday and Tuesday, 24 and 25 of July, respectively) and use these as milestones in the scheduling of all the tasks
- Collaborate within the team; let (and make sure) that each team member contributes; once decisions are taken get behind the chosen course of action, even if it was not your choice
- Use all the resources of the Summer School; ask tutors and lecturers for advice and help — it is what they are there for
- Remember that the report and presentation take time to prepare, start early on the organisation of this part of the activity, preferably at the start of the second week of the Summer School.

Role of students, tasks and goals

- **Plan the work sensibly**, identifying **decisions to be taken** and **tasks to be done**
- Identify as early as possible **main questions and problem areas** related to the selected mission concept and start gathering information, solutions from the tutors, lecturers, and the internet
- **Use all the resources** of the Summer School; ask tutors and lecturers for advice and help — it is what they are there for
- **Come to all lectures and listen carefully** – ask questions, ask for advice
- **Iterate frequently within the whole team**, so that completion of tasks can be monitored, progress and status reviewed, unproductive paths abandoned
- **Collaborate within the team**: let each member contribute; once decisions are taken get behind the chosen course of action, even if it was not your personal choice
- Remember that the **report and presentation take time to prepare**, start early on the organisation of this part of the activity, preferably at the start of the second week of the Summer School

3. Evaluation guidelines

The team projects will be evaluated by the Jury according to the following criteria:

A. The science case for the mission

- The overall importance of the mission objectives in the scientific topic of the Summer School
- Statement of scientific requirements to meet the stated objectives
- How much the expected results from the proposed mission advance the field

B. The technical case for the mission

- The suitability of the proposed payload to meet the mission objective(s) (matching of payload and instruments to the science requirements)
- The technical feasibility of the proposed payload, including accommodation and other spacecraft resource requirements such as mass, power and telemetry
- Presentation of the Technical Readiness Level(s) of the mission components and the identification of enabling technologies
- The technical feasibility of the whole mission concept, including launch and orbit requirements and launcher constraints
- The feasibility of the operational concept and its matching to the mission objectives

C. The competitiveness of the mission

- How well the mission competes with, or complements other missions (approved or planned) and with ground based observations (where relevant) in the scientific topic of the Summer School
- The value for money of the mission; the quality and breadth of the contribution compared with the expected cost category of the mission
- The identification of descoping options and their impacts on the scientific capability of the mission

D. The Quality of

- The presentation of the Team
- The final written report
- The answers of the students to questions of the Jury