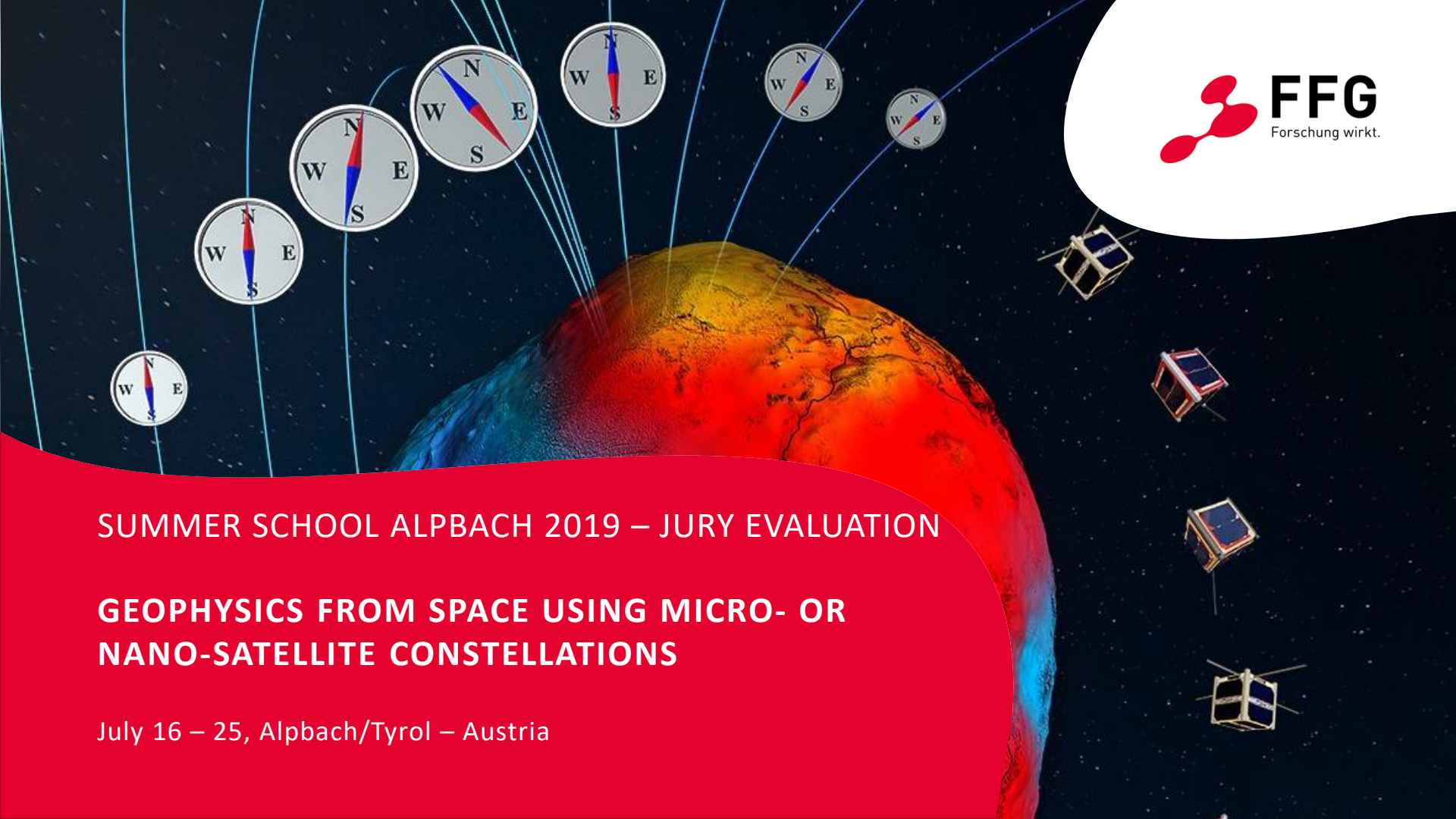

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SUMMER SCHOOL ALPBACH 2019 – JURY EVALUATION

GEOPHYSICS FROM SPACE USING MICRO- OR NANO-SATELLITE CONSTELLATIONS

July 16 – 25, Alpbach/Tyrol – Austria

The team of students 2019

FOUR TEAMS – THREE MAGNETIC FIELD MISSIONS – ONE GRAVITY FIELD MISSION

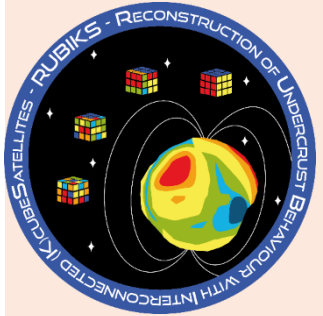
THE MISSIONS OF THE STUDENTS

GRAVL (GRAvity Observations by Vertical Laser Ranging): a mission to study mass redistribution in the upper mantle before, during, and after earthquakes by measuring the vertical component of the gravity vector of low-orbiting satellites from a high orbit laser ranging platform.

MAGMA-C: MAGMA-C is a proposed eight-satellite constellation in a Low-Earth Orbit (LEO) to measure Earth's magnetic field in order to study the induced magnetic field in the mantle. The primary objective of the MAGMA-C mission is to provide an unprecedented 3D conductivity profile of the Earth's mantle, derived from its induced field.

ORPHEUS: innovative series of small satellite constellations that provide insights into the geodynamo within the Earth`s outer core. Continuing on the dataset produced by SARM it will provide additional measurements of the ionospheric current density.

RUBIKS (Reconstruction of Undercrust Behaviour with Interconnected (K)cube Satellites): a nanosatellite mission dedicated to analysing the mantle. With 8 CubeSats (6U) on two Cartwheel-helix orbits, it is proposed to take magnetic and gravity measurements of the Earth's interior, in order to gain information on the electrical conductivity and density of the mantle, especially the lower mantle.



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The Alpbach Jury: R. Bonnet, H. Maree, KH Glassmeier, H. Sünkel, F. Ongaro, S. Ulamec

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Alpbach Awards 2019:

- Best Science Case to Team Orange (Orpheus)
- Best Technical Case to Team Green (GRAVL)
- Most Innovative Mission to Team Red (RUBIKS)
- Best Crisis Management to Team Blue (MAGMA-C)
- Best presentation to Team Orange (Orpheus)

BEST CRISIS MANAGEMENT
MAGMA-C: TEAM BLUE

BEST TECHNICAL MISSION: GRAVL – TEAM GREEN

BEST SCIENCE CASE & BEST PRESENTATION: ORPHEUS – TEAM ORANGE

MOST INNOVATIVE MISSION: RUBIKS - TEAM RED

ORPHEUS MISSION, PRESENTED BY THE ORANGE TEAM, RECEIVING THE SCIENCE AWARD

- Next to the oceans the core is the most fluid part of our planet. The enormous heat generated by the gravito-thermal processes creating the inner core causes the outer core iron-alloy convection out of which the dynamo process generates the terrestrial magnetic field. This magnetic field testifies that we inhabit a living planet.
- Many important aspects are not yet understood on how core processes work, how Orpheus, the boss of the underworld operates.
- The proposed mission represents a most advanced new concept to unravel Orpheus secrets. Combining long-term measurements, lasting for more than two solar cycles, with a new curlometer configuration, allowing estimating ionospheric current flows, significantly improve to characterize the structure and dynamics of the core magnetic field.
- The ORPHEUS mission proposal has the scientific potential to further our understanding of planet Earth.

ORPHEUS MISSION, PRESENTED BY THE ORANGE TEAM, RECEIVING THE AWARD FOR BEST PRESENTATION

- Having regard:

- (1) to the ‘story-telling’ style of the presentation
- (2) to the clarity of presented information (both visually and orally)
- (3) to the persuasiveness and smoothness of the flow
- (4) to the engagement, as from the start, of the presenters
- (5) to the responsiveness and spontaneity to the jury’s questions

GRAVL MISSION, PRESENTED BY THE GREEN TEAM, RECEIVING THE AWARD FOR THE BEST TECHNICAL MISSION

- Among the four excellent technical concepts, the team Green one, GRAV-L, stands out for the originality of the solution, with a mix of very advanced technology, laser ranging, on a GEO satellite and an almost passive LEO component. This was arguably the most architecturally complex system.
- The team managed to convincingly show that they had addressed all aspects in the presentation and subsequent answers.

MAGMA-C MISSION, PRESENTED BY THE BLUE TEAM, RECEIVING THE AWARD FOR THE BEST CRISIS MANAGEMENT

- Crisis management is an important element not only for space missions.
- One team had to overcome a significant crisis due to a very late, but important feedback of a science tutor.
- Consequently the team had to focus on reworking the science case formulation with a negative impact on the available time and work force for the engineering elements of the mission.
- The team succeeded with a sustained effort (at very late / early hours) to conclude also the engineering part.
- Consequently the Jury decided to award an additional award for Crisis Management.

RUBIKS-MISSION, PRESENTED BY THE RED TEAM, RECEIVING THE AWARD FOR THE MOST INNOVATIVE MISSION

- RUBIKS as a very small-size mission of type CubeSat. Given the very low costs, it can be considered as a particularly good investment for the investigation of heterogeneities in the Earth´s mantle which are due to composition, mineralogy, water content and temperature, for the investigation of mantle plumes and their temporal flow and the possible link between magnetic and gravity anomalies in the lower mantle.
- It complements the scientific goal of both the past CHAMP, GRACE and GOCE missions and the on-going SWARM mission by additionally using electromagnetic sounding with much deeper penetration depth. A de-scoping option is not feasible due to the planned minimum number of satellites in orbit.

POST ALPBACH 2019 MISSION: GRAVL

- For Post Alpbach, the mission chosen is GRAVL, which is most challenging in its technical implementation, consisting of three different designs of Flight Elements.
- It requires a constellation of 11 satellites and relies on state of the art ranging technology and a sophisticated operational concept.
- The mission design, which has been outlined very well during the 10 days in Alpbach would benefit very much by a more detailed analysis, considering various options and trades to optimize the scientific output as well as cost efficiency.
- The study in the concurrent facility could merge the expertise required in the fields of satellite system design (both for GEO as well as passive in LEO), laser ranging technology, high quality attitude sensors, mission design and data evaluation.

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