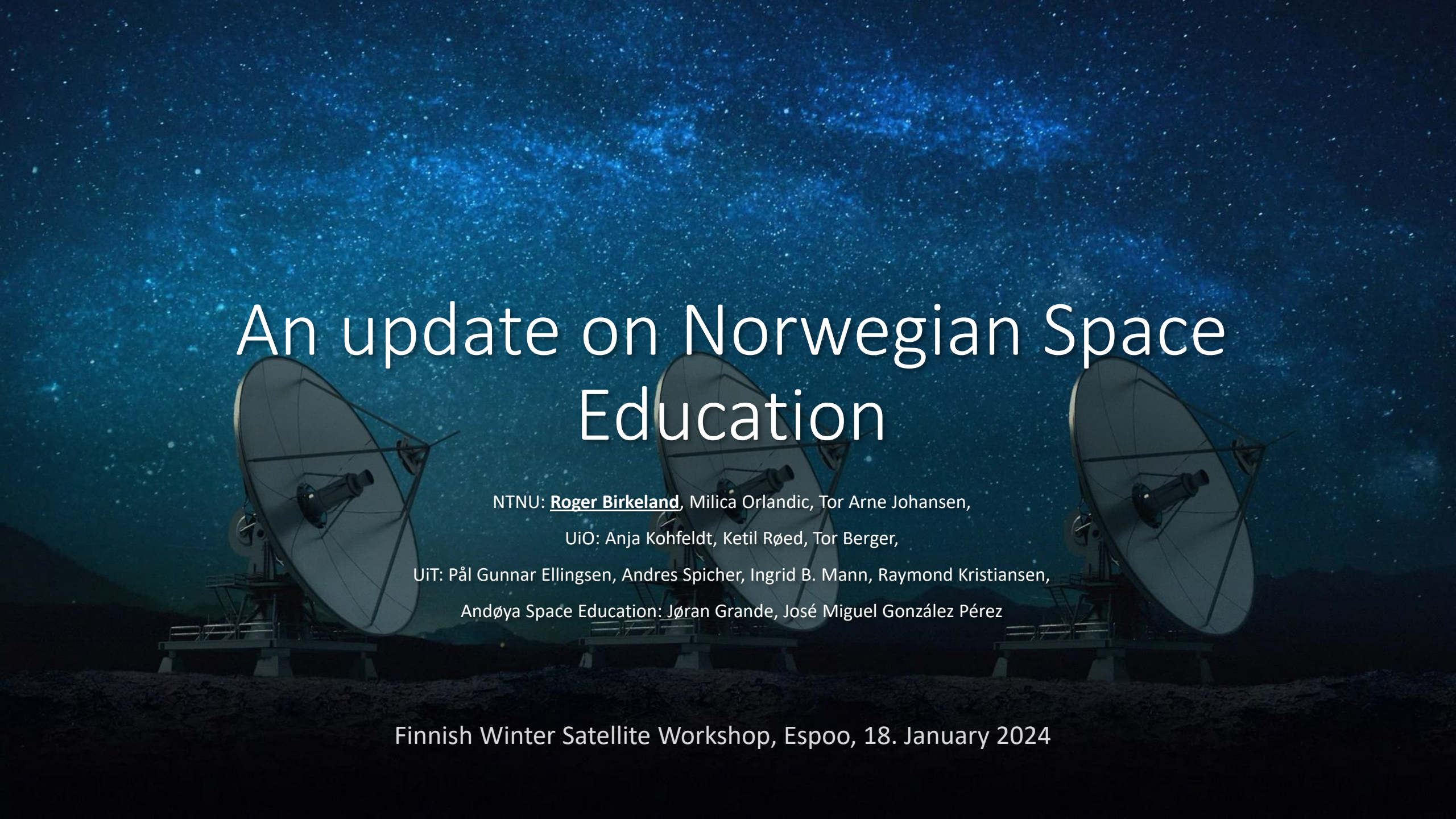


An update on Norwegian Space Education

NTNU: **Roger Birkeland**, Milica Orlandic, Tor Arne Johansen,

UiO: Anja Kohfeldt, Ketil Røed, Tor Berger,

UiT: Pål Gunnar Ellingsen, Andres Spicher, Ingrid B. Mann, Raymond Kristiansen,

Andøya Space Education: Jøran Grande, José Miguel González Pérez

Finnish Winter Satellite Workshop, Espoo, 18. January 2024

Abstract

Norway was one of the first countries to carry out educational CubeSat activities with the nCube project that was active from around 2001 to the launch in 2006. This was followed by a 10-year Norwegian student satellite program including several satellite projects like CubeStar, HinCube and NUTS. After that, several universities have established space/satellite education programs, satellite activities and space based research projects that aim to de-velop instruments and/or satellites in-house. Most of the educational efforts within space technology has been part of other study programs, with some specialized courses in between. This with an exception to the aerospace engineering study at UiT/Narvik. From the fall semester of 2023, UiO has established a new 2-year program for a master in space systems, along with the already existing specialization track of space physics and technology in the physics master's program. NTNU has established specialization tracks for engineering studies within electronics and cybernetics. In parallel, Andøya Space Education is gearing up their support towards the higher education in Norway, with the projects Space Education 2.0 and Norwegian Space Academy. The goal for these projects is to provide a platform for practical experience to students, support educational activities, as well as to identify activities and funding schemes that can promote collaboration across educational institutions and make use of Andøya as an on-site complementary laboratory for students. In addition, there are active student organizations that is pursuing satellites and rockets at several of the universities. In this talk we will present the current efforts and our common visions for the future of the Norwegian space education and research activities, with an emphasis on small satellites and how Andøya can be a joint sandbox to try out new hands-on, complementary and collaborative activities for the higher education

Outline

- Motivation
- History
- Status and Plans
- Goals

Motivation

- Need for space-related education
- Activities across Norway
- Desire for more collaboration
- How to utilize Andøya as a «lab»

Space in Norway – education, research, industry

- A few big space companies
- A growing number of «new-space» companies
- More application research in addition to basic sciences
  - Cosmology, atmosphere physics, planetary science
  - More: Space as an enabler for EO, exploration and in-situ
  - The different universities have different focus areas

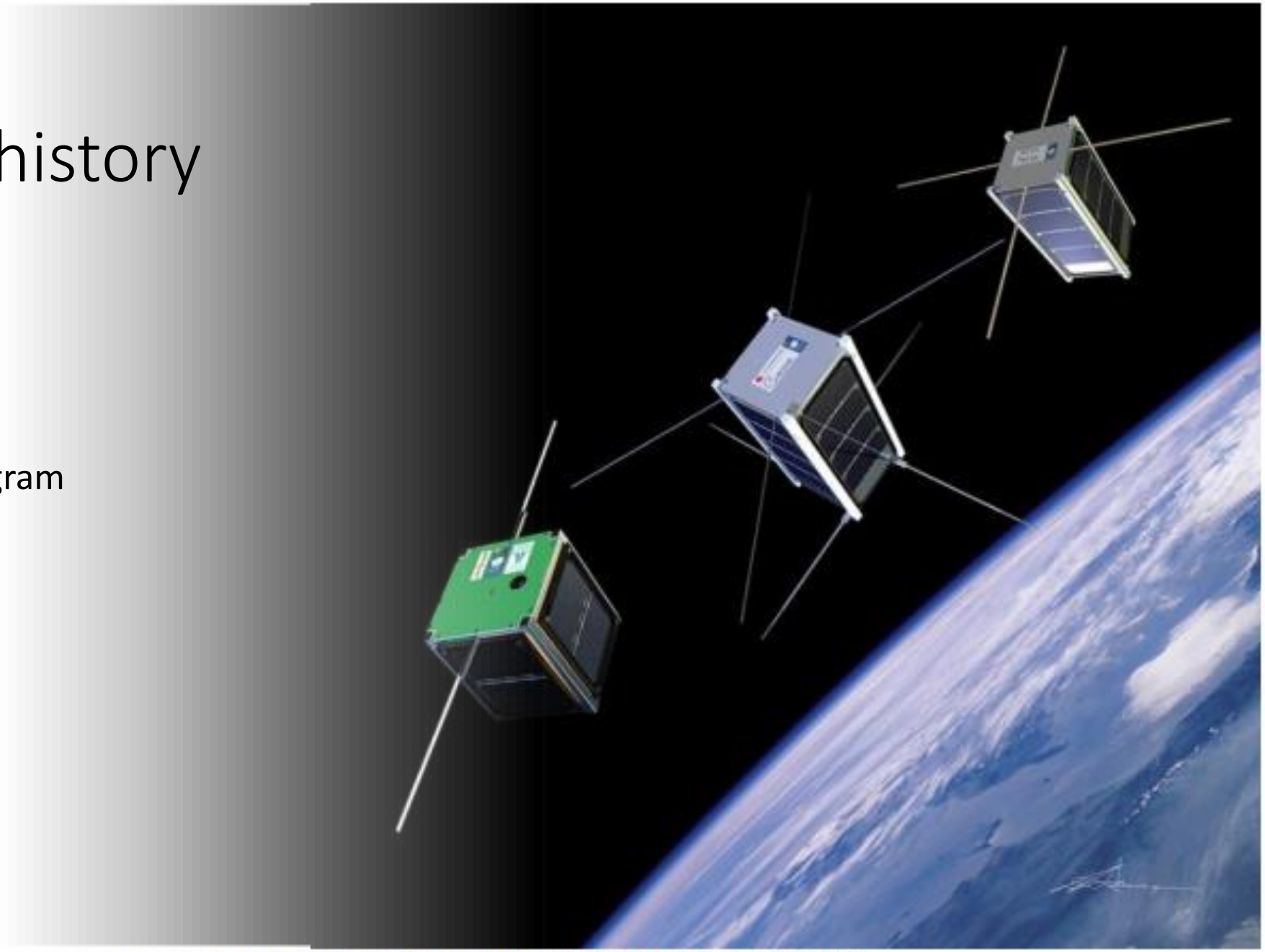
Joint satellite history

Historical activities

- nCube (2001 – 2006)
- The student satellite program (2007 – 2013)

AuroraSpace
Boosting Space Business

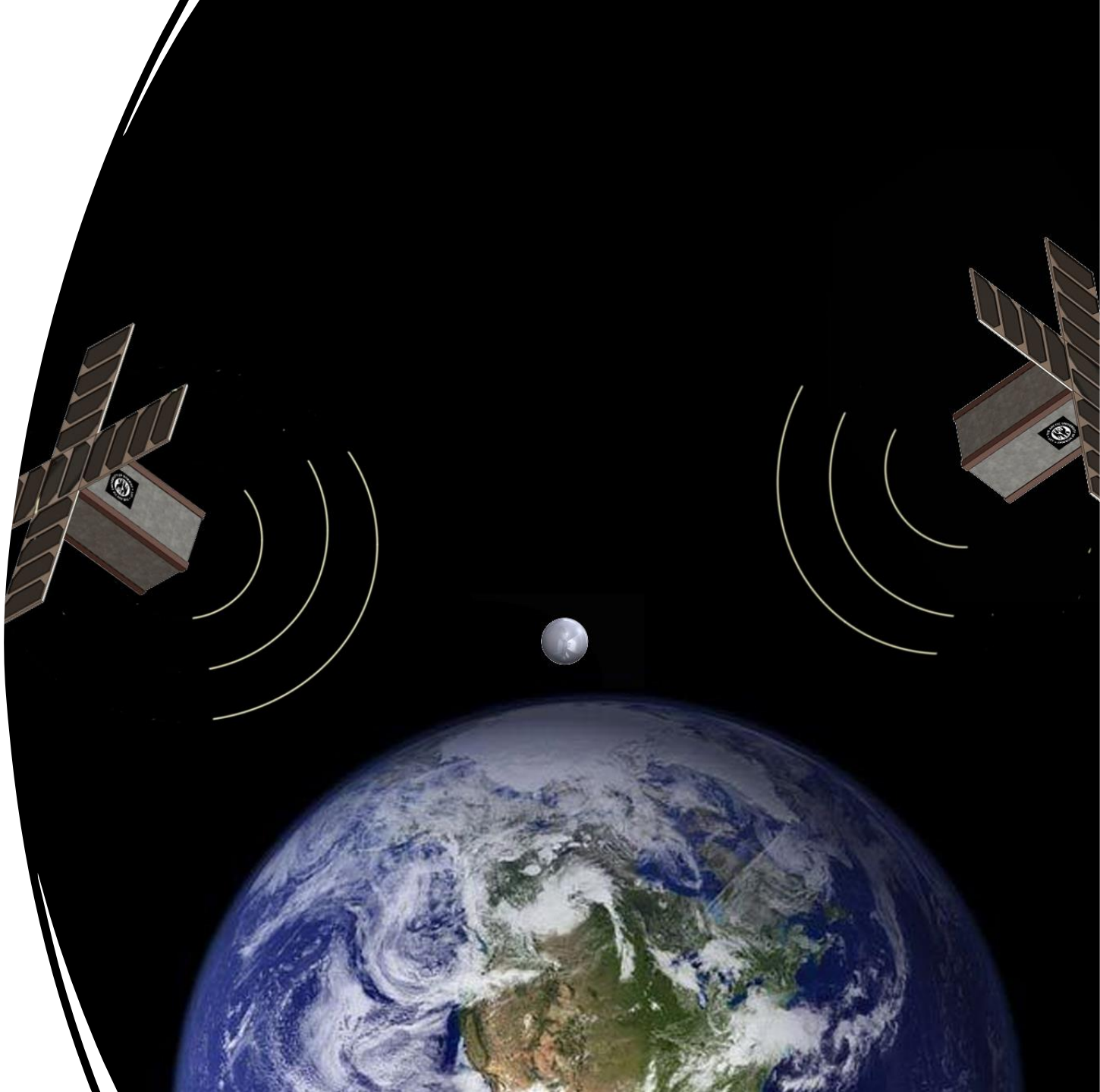
https://auroraspace.eu/

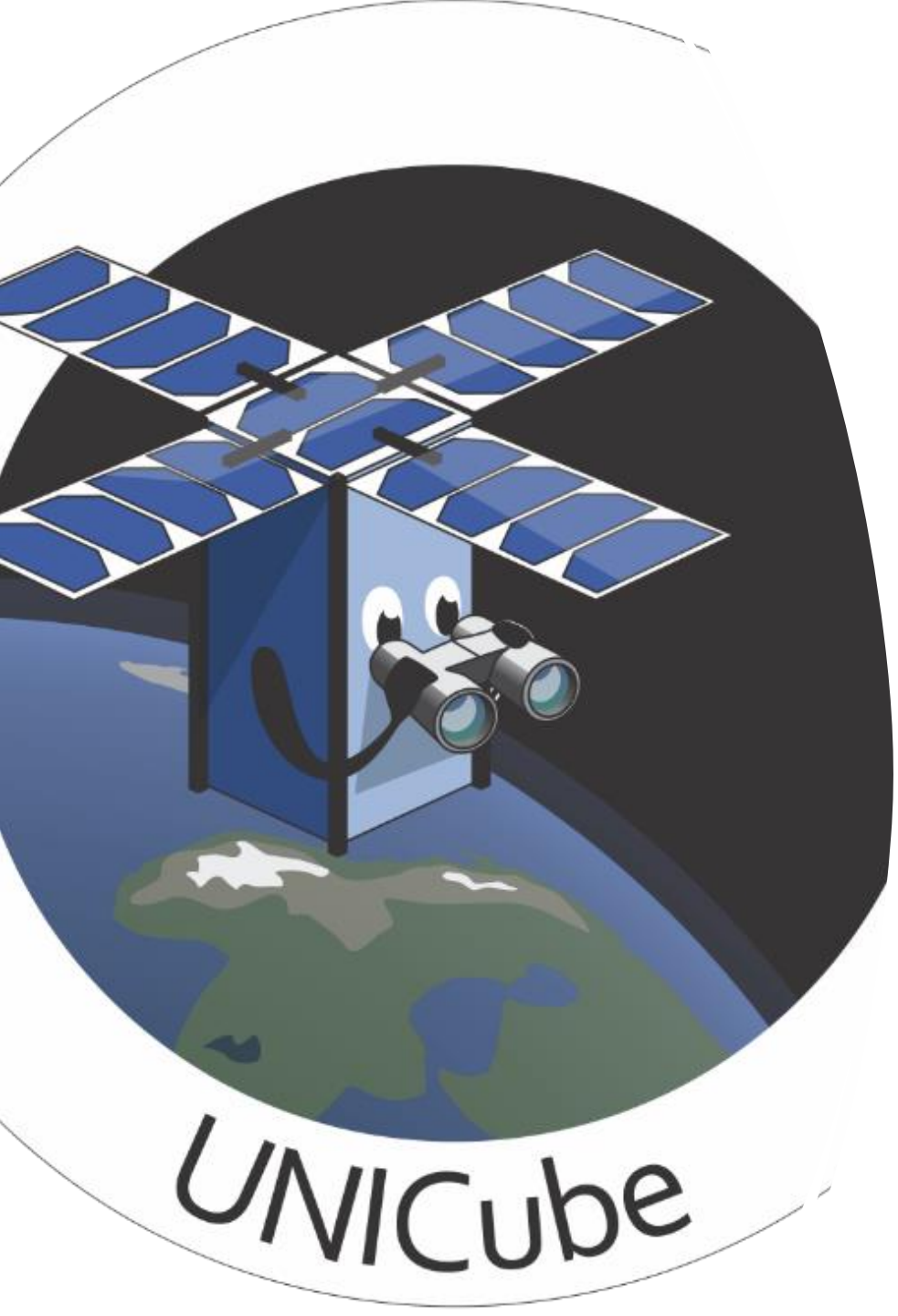


Illustrasjon av studentsatellittene HiNCube, CubeSTAR og NUTS

UIT, campus Narvik History

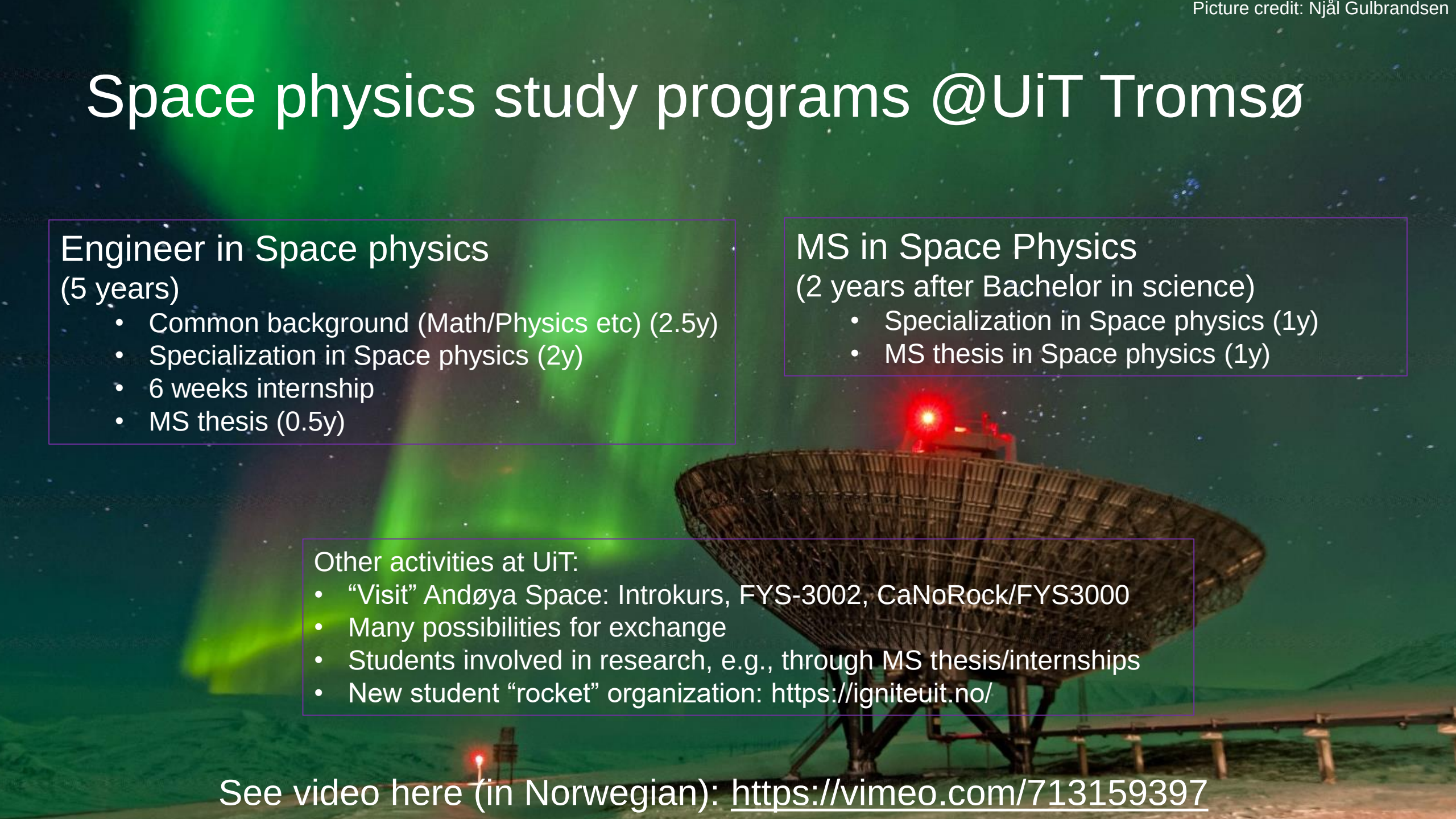
- Technical education on BSc and MSc level since 1996
- Focus on satellite and aerospace engineering
- Participation on several sounding rockets, G-CHASER and REXUS / BEXUS (RAPTEX)
- Collaboration with Andøya in different forms over several years





UIT Narvik – Current and Future

- Student satellite program – UNICube.
  Mission: In-orbit detection of space debris
  https://uit.no/project/cubesat
- Research project – QBDebris.
  Mission: In-orbit space debris detection and attitude control
  https://uit.no/project/qbdebris
- Long-term goals:
  - Sustainable Space Operations - Centre for research-based innovation
  - Partake in Space Education 2.0 at Andøya Space
  - Space innovation cluster



Space physics study programs @UiT Tromsø

Engineer in Space physics
(5 years)

- Common background (Math/Physics etc) (2.5y)
- Specialization in Space physics (2y)
- 6 weeks internship
- MS thesis (0.5y)

MS in Space Physics
(2 years after Bachelor in science)

- Specialization in Space physics (1y)
- MS thesis in Space physics (1y)

Other activities at UiT:

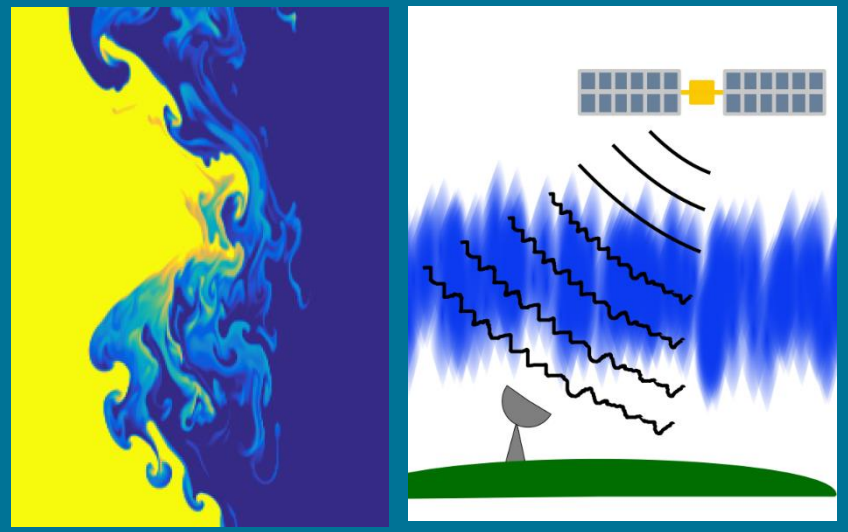
- “Visit” Andøya Space: Introkurs, FYS-3002, CaNoRock/FYS3000
- Many possibilities for exchange
- Students involved in research, e.g., through MS thesis/internships
- New student “rocket” organization: https://igniteuit.no/

See video here (in Norwegian): https://vimeo.com/713159397

UiT: What we study

- Auroral ionosphere
- Radar signal processing: applications in Space debris, meteors, planetary radar and ionospheric science
- Cosmic dust, and dusty plasma in the mesosphere
- Gas giant magnetospheres & auroral images studies
- Ionospheric turbulence
- Ionospheric modification
- Long-term trends in the ionosphere
- Machine learning
- Laboratory plasmas etc.

Ionospheric turbulence and Space weather

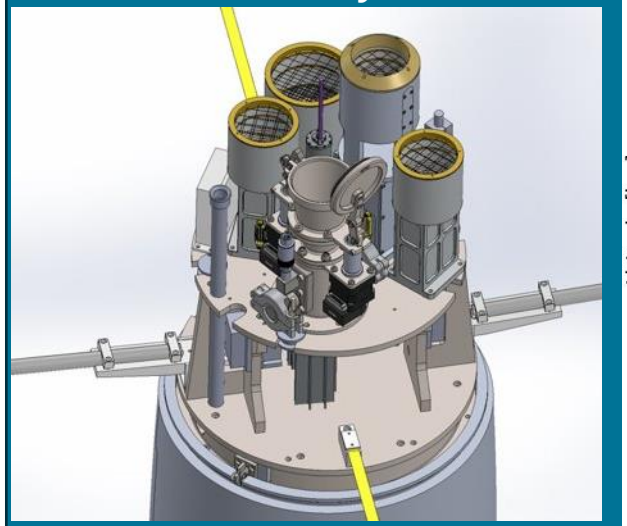


After Spicher et al. (2022), JGR, DOI:10.1029/2019JA027734

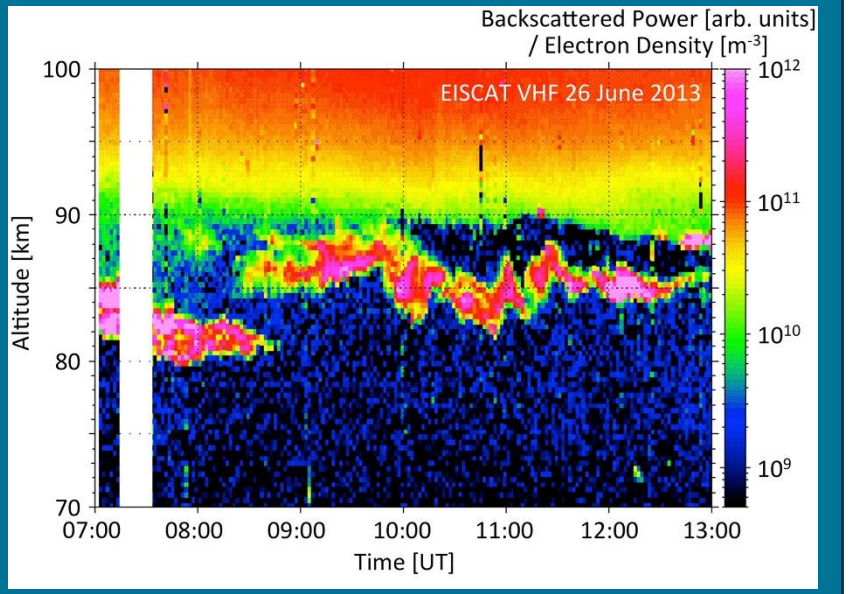
RCN CASCADE project 326039

Dusty plasma in the mesosphere

MaxiDusty 2

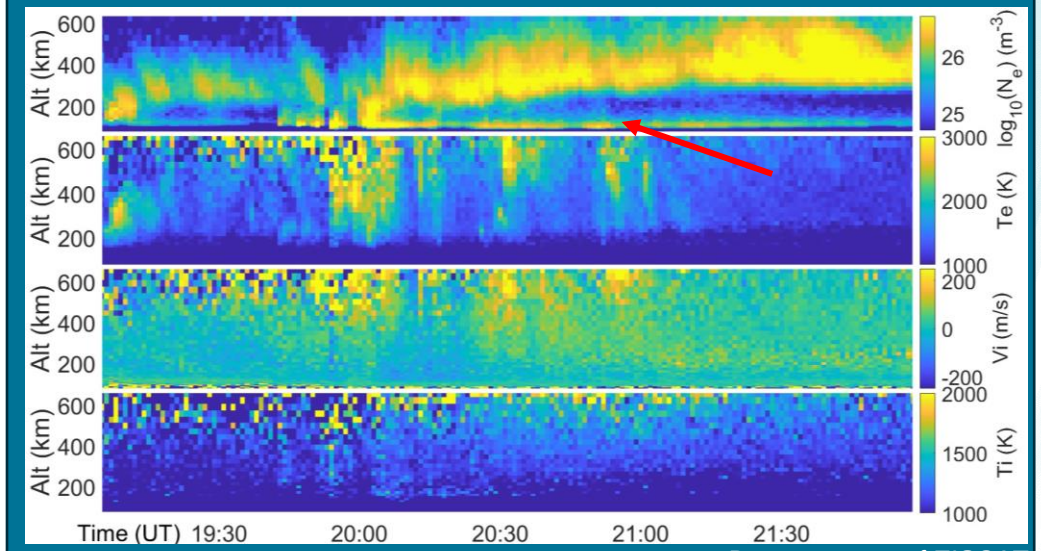


Credit: UiT



After Mann et al. 2016, JGR, doi:10.1002/2016JA023080.

Aurora in radar (EISCAT VHF) data



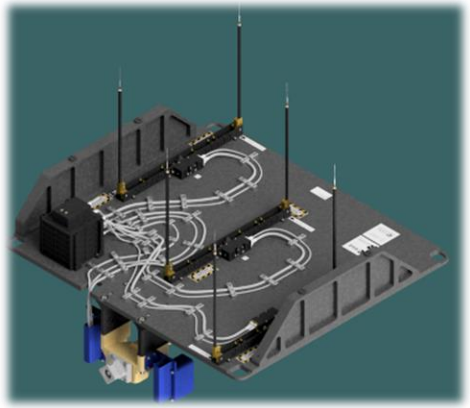
Data: property of EISCAT

UiO – multidisiplinary space related activities

- Long space related education and research activities at many departments*[link]
  - Institute of Theoretical Astrophysics, Department of Physics,
    Department of Technology Systems, Department of Geosciences,
    Oslo University Hosptial, Scandinavian Institute of Maritime Law.

With numerous contributions from Master's and PhD projects

- Long standing collaboration with Andøy Space and Andøya Space Education
  - Scientific sounding rockets (UiO ICI-series***, Grand Challenge Initiatives) and student rockets ESPIRIT 2006, G-Chaser 2019, GHOST 2025/26, and CaNoRock** since 2010.
  - Space Systems Project – mission development and launch of CANsat systems on balloons
  - Collaboration in development of courses and workshop, such as AIT workshop at Andøya
- Dedicated options on Master's level (two years)
  - Space Systems
  - Space physics and space technology (programme option within MSc in Physics)
  - Astronomy
- Relevant programmes at Bachelor's level
  - Physics and astronomy
  - Electronics, Informatics and technology



*Main focus on Department of Physics and Department of Technology Systems for this presentation
**CaNoRock: Canadian-Norwegian student sounding rocket progbramme
*** ICI: Investigation of Cusp Irregularities

UiO – Space Systems

2-year Master program, offered by Department for Technology Systems (ITS) [link]

- Contact: anja.kohfeldt@its.uio.no
- New program, started Aug 2023

You will learn about:

- Space technology and different space segments
- System engineering and development processed of satellites and payloads
- Space environment and simulation on Earth
- Relevant standards and regulations
- Practical experience in design and development of payload and satellite systems (incl. Trip to Andøya)

Examples of research opportunities at ITS:

- Planetary exploration: Neutron and gamma-ray instrumentation for abundance mapping
- Interplanetary operation and science: RIMFAX ground penetrating radar on Mars
- Satellite communication, ground station setup and operation
- Hyperspectral camera design and characterization
- Educational 6U CubeSat: CENSSAT-1

UiO ITS maker space.

Students during hands-on experience with Kitsat student CubeSats, Sep 2023 @ UiO

RIMFAX at Work on NASA's Perseverance Rover, credits: NASA/JPL-Caltech/FFI

-Recto
ducation
Innovation
Organization and Infrastructure
Staff

HMI and control rooms

Material science

Atmospheric research

Satellites and sensor systems

University Library
Communication Division
Recor Manage t Divi
IT Division
Governance and Management Systems
vision

Vice-Rector NTNU in Gjøvik
Faculty of Human-ities (HF)
Faculty of Architecture and Design (AD)
Faculty of Information Technology and Electrical Engineering (IE)
Faculty of Engineering (IV)
Faculty of Medicine and (MH)
Faculty of Sciences (NV)
Social a Educatio Science (SU)

7 departments
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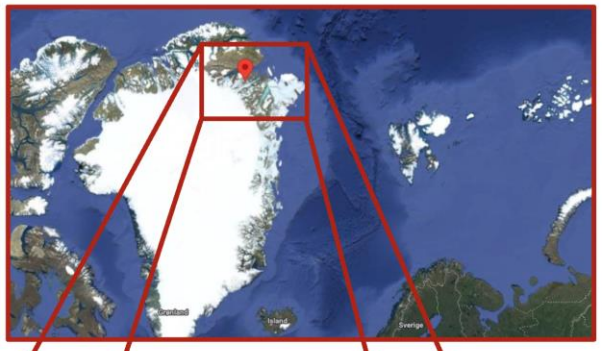
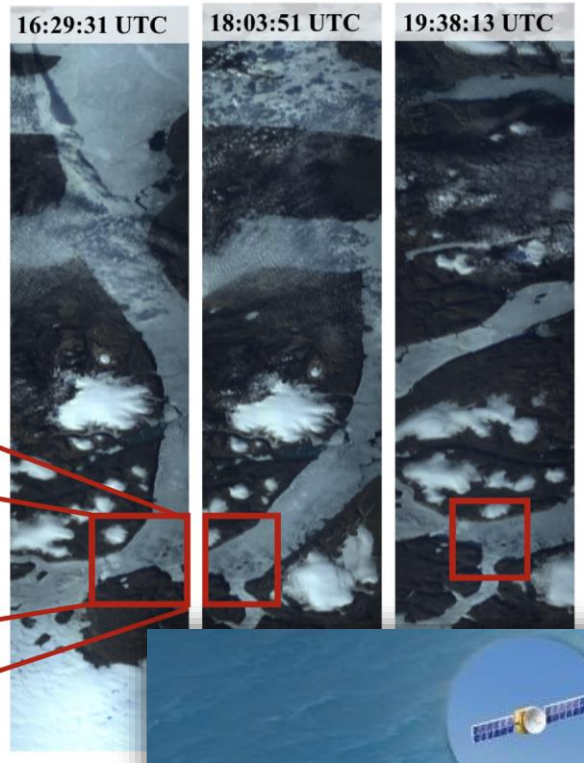
55 DEPARTMENTS

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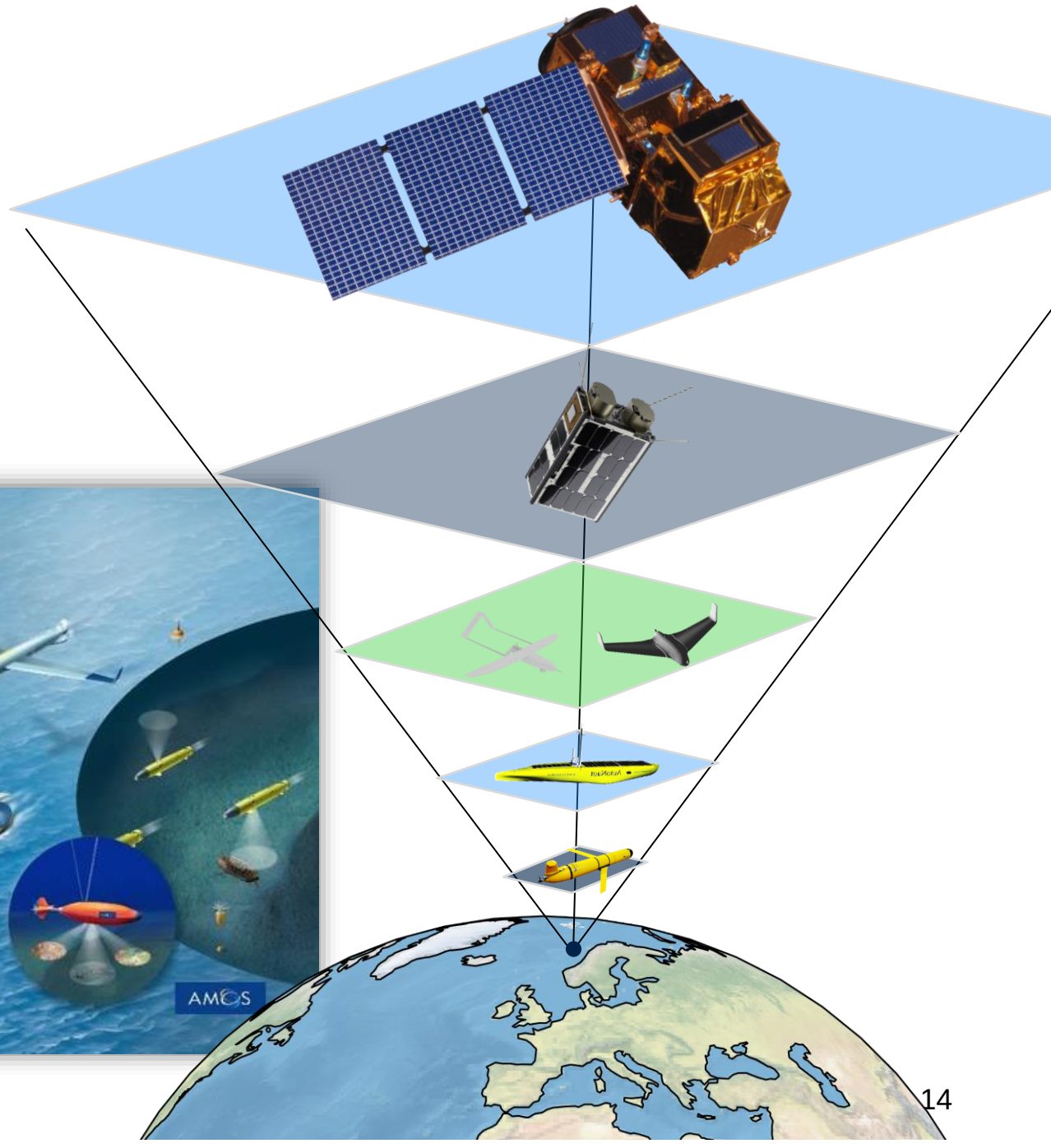

Andøya Space Education

In collaboration with academia, industry and other partners, establish «Norwegian Space Academy» that aims to build:

- A platform for **collaboration**
- **Complementary Space-related** educational and training **activities**
- **Network** of experts
- Unique **infrastructures**
- Contribute to **recruitment** for the space sector

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Norwegian Space Academy

A part of Andøya Space Education

New offers in collaboration with academia and the space industry:

- Assembly Integration and Testing – AIT training activities
- Collaboration with UiO master program in Space Systems
- Collaboration with Nord University master program - Entrepreneurship and business development
- NIFRO Award – yearly award for the best Space-related Master thesis
- Collaboration with KDA and EIDEL – Satellite Mission Design for Ocean Utilization - Summer project 2024-2026
- Workshop Space Education 2.0 – Recruitment to the Space Industry and Academia

Norwegian Space Academy

A part of Andøya Space Education

New offers in collaboration with academia and the space industry:

- Supporting Access to Space for Norwegian Universities
- Collaboration with UNIS, Svalbard – Online module: Space Mission Design 2024
- Collaboration with Canada and Norway (UiO) – CaNoRock student rocket 2024
- Collaboration with ESA and NoSa - Fly a Rocket! 2024
- Collaboration with NASA sounding rocket GHOST mission 2024/2025

Summary

- There are space education and research at several universities and the activity is increasing
  - Mostly complementary research areas: Space physics; space debris; sensors and exploration; remote sensing technology including applications
- We aim for more joint activities, including student mobility. This includes involving the growing group of student organizations
- How to utilize Andøya as a lab
- How to build networks and collaborations across the northern region