UNIVERSITÀ DI TRENTO

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PhD SST Space Science and Technology

DIPARTIMENTO DI

FISICA

The evolution and scientific impact of the National Doctorate in Space Science and Technology

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Summary

- ***Part 1.*** Past and present of the DN-SST.

- ***Part 2.*** The presence of the DN-SST in the space science community.

Part 1: Past and present of the DN-SST

A short overview

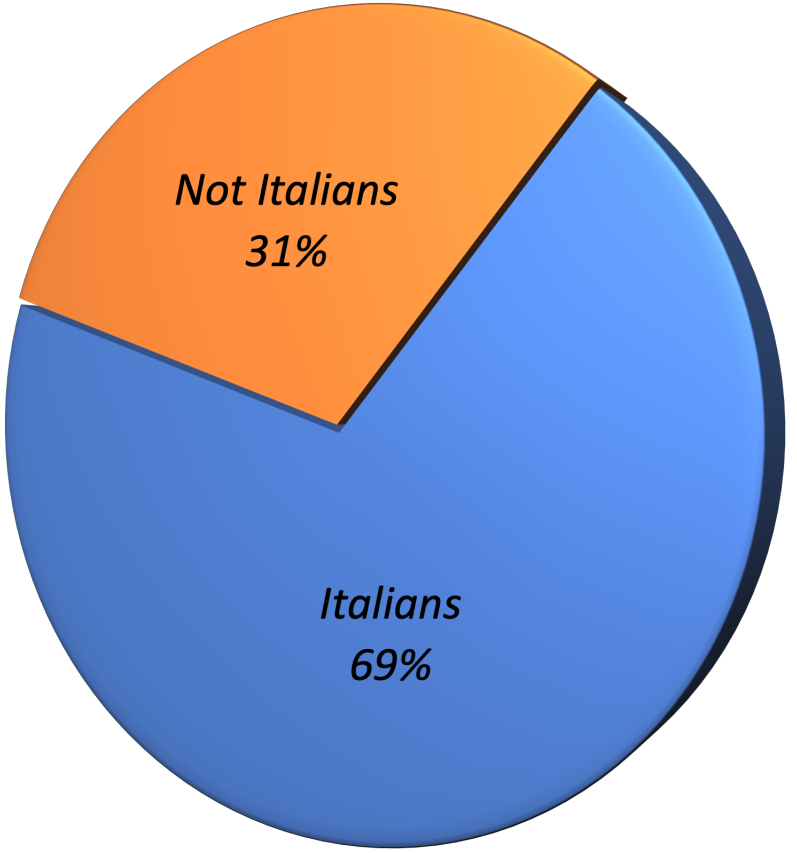
Part 1. Past and Present: our numbers.

- ***XXXVIII cycle:*** 33 students, 10 not Italians.

- ***XXXIX cycle:*** 42 students, 13 not Italians.

- ***Total:*** 75 students, 23 not Italians.

For the ***XL cycle***: 35 confirmed scholarships, some other from ASI in pending.



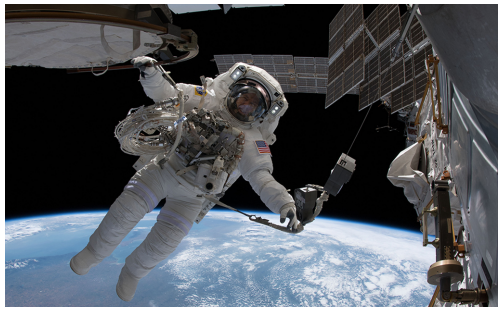
Part 1. Past and Present: how it started…

- Last year, we from the XXXVIII cycle ***started out a little blind***, expecially due to:

1. ***Not clear guidelines*** from the Italian ***ministry*** of University and Research;
2. ***Bureaucracy*** in general;
3. ***Bad communication*** between the operational sites and the University of Trento.

- Among the ***problems we experienced*** last year there are:

1. ***Recognition*** as PhD student of the operational sites;
2. ***Housing*** issues;
3. Access to ***facilities*** (canteen, library, etc.).



Part 1. Past and Present: …and how it is going on

Most of the cited problems were solved during last year.

1) Bureaucracy issues have been fixed out in a clear way thanks to a ***directive of the ministry about the National Doctoral Programs*** (it came, finally!);

But…

2) We can proudly say that we solved some problems because ***we talked, we asked, and we required our rights***!

Of course we did with the help of:
The ***PhD coordinator*** (Prof. R. Battiston), the ***secretaries*** (Gaia and Francesco), the whole ***PhD committee*** (Collegio dei Docenti).

Golden Rule:
Talk, talk, and talk!

(With your colleagues, supervisors, the PhD coordinator, and so on…)

Part 2: The presence of the DN-SST in the space science community.

A not exhaustive overview

Part 2. The DN-SST presence: our curricula.

- 7 ***curricula*** and 27 ***scientific areas***.

- Curriculum 1: Observation of the Universe
- Curriculum 2: Earth and the Sun-Earth system
- Curriculum 3: Planetary Sciences
- Curriculum 4: Astrobiology, Life Sciences and Space Medicine
- Curriculum 5: Space sensing and instrumentation
- Curriculum 6: Engineering and satellite platform technologies
- Curriculum 7: Economics, law and space diplomacy

Scientific Areas

BIO/09 - Physiology
BIO/10 - Biochemistry
FIS/01 - Experimental Physics
FIS/02 - Theoretical Physics, Mathematical Models And Methods
FIS/03 - Physics Of Matter
FIS/04 - Nuclear And Subnuclear Physics
FIS/05 - Astronomy And Astrophysics
FIS/06 - Physics Of The Earth And Of The Circumterrestrial Medium
GEO/04 - Physical Geography And Geomorphology
GEO/06 - Mineralogy
GEO/10 - Solid Earth Geophysics
ING-INF/01 - Electronics
ING-INF/02 - Electromagnetic Fields
ING-INF/03 - Telecommunications
ING-INF/05 - Information Processing Systems
ING-IND/01 - Naval Architecture
ING-IND/12 - Mechanical And Thermal Measurements
ING-IND/13 - Applied Mechanics
ING-IND/22 - Materials Science And Technology
ING-IND/24 - Fundamentals Of Chemical Engineering
ICAR/08 - Structural Mechanics
IUS/01 - Private Law
MAT/05 - Mathematical Analysis
MAT/07 - Mathematical Physics
M-PSI/01 - General Psychology
M-PSI/02 - Psychobiology And Physiological Psychology
SPS/06 - History Of International Relations

Part 2. The DN-SST presence: our scientific impact.

What is the ***scientific impact*** of the DN-SST in the space science community?

Part 2. The DN-SST presence: a collective presentation.

To answer the latter question, I decided to make this presentation with the ***help of my colleagues.***

Then, ***I asked for help*** in our telegrams groups and I got many responses.

Here I will try to give you an ***incomplete*** overview of the ***main experiments and collaborations*** we all are involved for each curriculum, based on what my colleagues told me.

Part 2. The DN-SST presence: Curriculum 1.

The ***LiteBIRD*** experiment:
The ***Lite*** satellite for the studies of ***B***-mode polarization and ***I***nflation from cosmic background ***R***adiation ***D***etection is an in development JAXA satellite whose main goal is to measure or constrain ***large-scale primordial gravitational waves*** and B-modes in the CMB, and thereby constrain theories of ***inflation*** in the early universe.

There are many DN-SST's people involved in this experiment:
- Florie Carralot from SISSA, which is involved in the calibration of several systematic effects;
- Eugenia di Giorgi from Uni Pisa, which studies systematic effects on the satellite detectors;
- I'm (indirectly) performing a theoretical study on inflation which can forecast parameters with LiteBIRD.

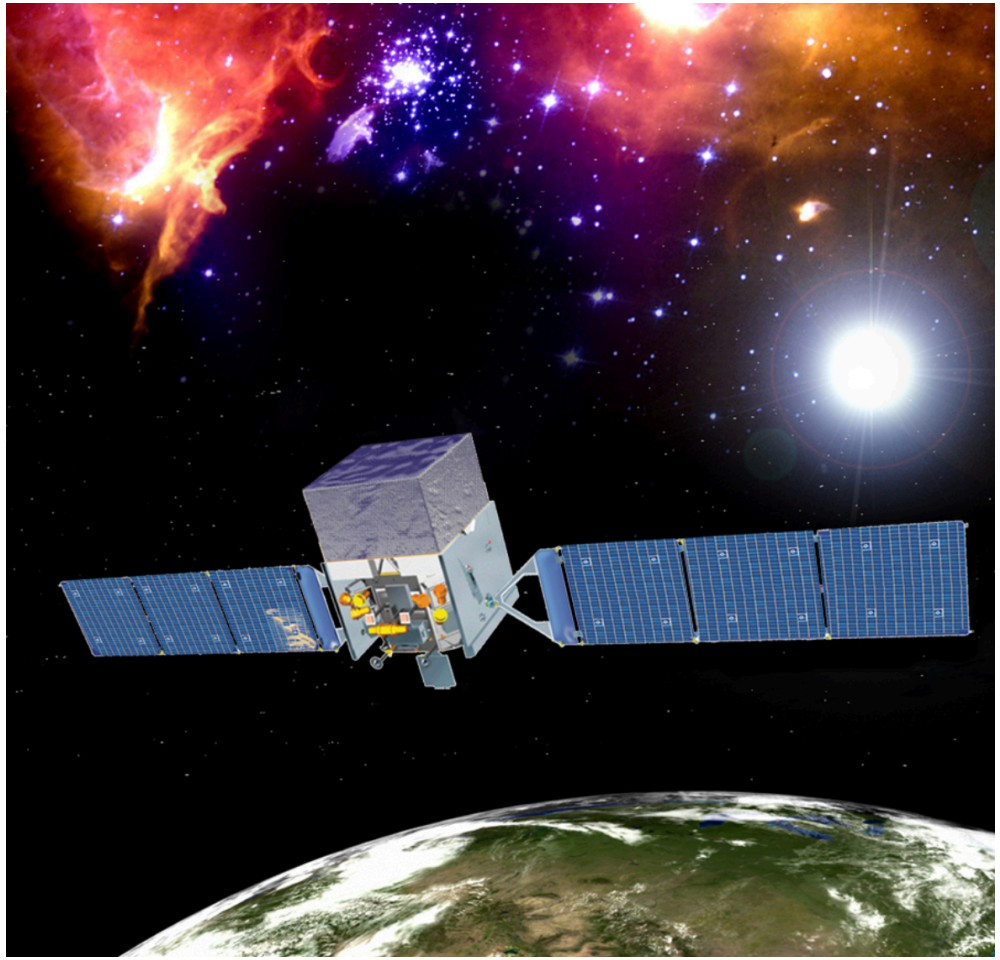
Part 2. The DN-SST presence: Curriculum 1.

The NASA ***Fermi Gamma-ray Space Telescope*** collaboration:

It's a space telescope for revelations of gamma rays with energy range between 8keV and 300GeV, it consists of two instruments:

1) ***Large Area Telescope*** (LAT) sensitive to 20MeV gamma radiation to 300GeV.

2) ***Gamma-ray Burst Monitor*** (GBM) sensitive to gamma radiation from 8keV to 40MeV.



Part 2. The DN-SST presence: Curriculum 1.

The ***Cherenkov Telescope Array Observatory (CTAO):***
It will be the largest ground-based observatory ever built for the observation of very-high-energy (VHE) ***gamma rays***.
It will be actually constructed in two sites:
1) In Paranal, Chile, to study gamma rays from the southern sky;
2) In La Palma, Canary Islands, to observe gamma rays from the northern sky.

The observatory will cover a vast energy range, from 20 GeV to 300 TeV, i.e. it completes a high-energy band that the Fermi space telescope cannot cover.

Chiara Bartolini at Uni Bari is currently working on both the collaborations: she performing a ***multi-wavelength study of the blazar emissions*** (jets of active galactic nuclei direct toward us) and then she needs to cover both the Fermi + CTA energy ranges.

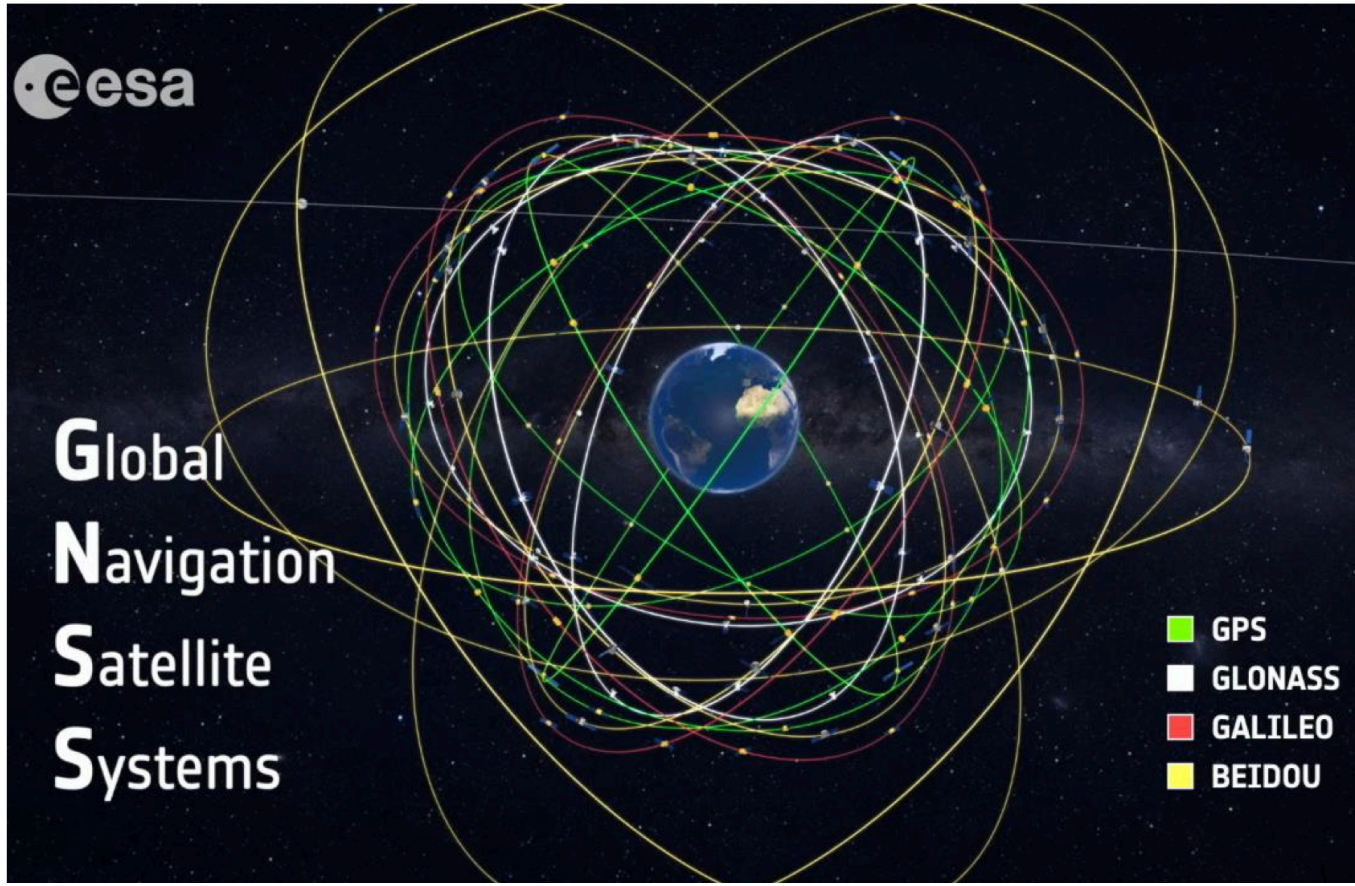
Part 2. The DN-SST presence: Curriculum 1.

Part 2. The DN-SST presence: Curriculum 2.

The international satellite system ***Global Navigation Satellite System (GNSS):***

It is the set of the different satellite constellation in geostationary orbit around the Earth, which are:

- GPS (U.S.A.)
- GLONASS (Russia)
- GALILEO (European Union)
- BEIDOU (China)
- QZSS (Japan)



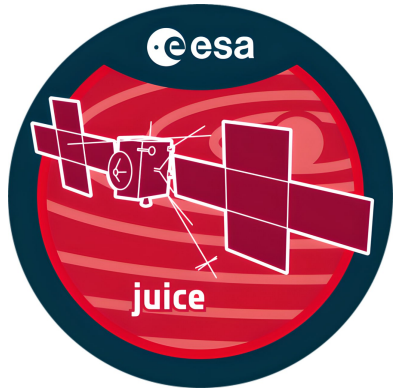
Federico Ferrara at INGV Catania section is working on the ***GNSS data*** to ionospheric detection of mount ***Etna volcanic eruptions***.

Part 2. The DN-SST presence: Curriculum 3.

ESA mission ***Jupiter Icy Moons Explorer (JUICE):***
This mission is devoted to the observation of ***Jupiter's Galilean moons*** (Io, Europa, Ganimede and Callisto). It was launched in April 2023 and it's expected to reach Jupiter's orbit in 2031, starting its scientific mission in 2034. It carries 11 instruments, the main are:

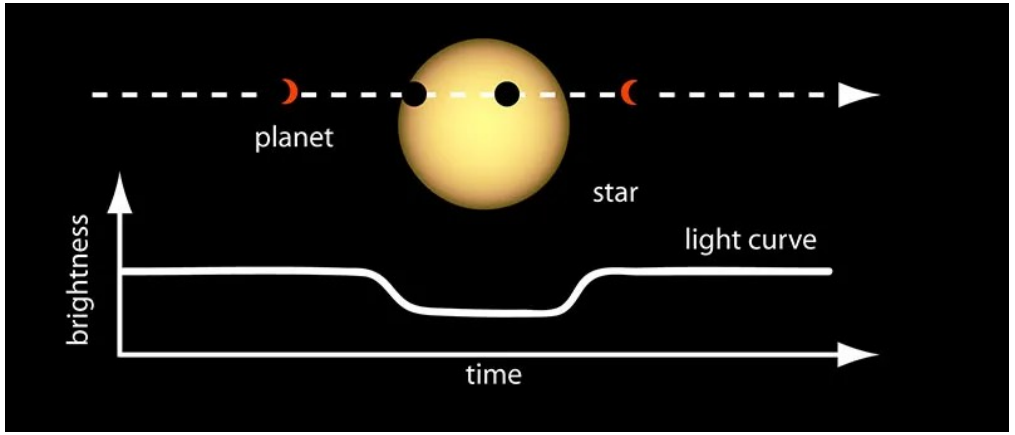
- JANUS = high-resolution camera
- MAJIS = spectrometer
- RIME = radar
- 3GM = radioscience antenna

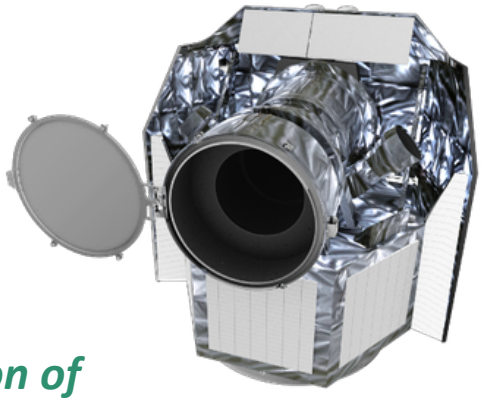
Edoardo Santero Mormile at Uni Pescara is working on the ***3GM*** instrument, whose goal is to infer the internal structure of Ganymede from its gravitational field.



Part 2. The DN-SST presence: Curriculum 3.

ESA mission ***CHaracterising ExOPlanets satellite (CHEOPS):***
It is an ESA S-class mission, launched in 2019, which focuses on ultra-high-precision photometric measurements of ***bright stars to study exoplanets***.





Pietro Leonardi from University of Padua is currently working on ***characterization of multi-planet systems***.

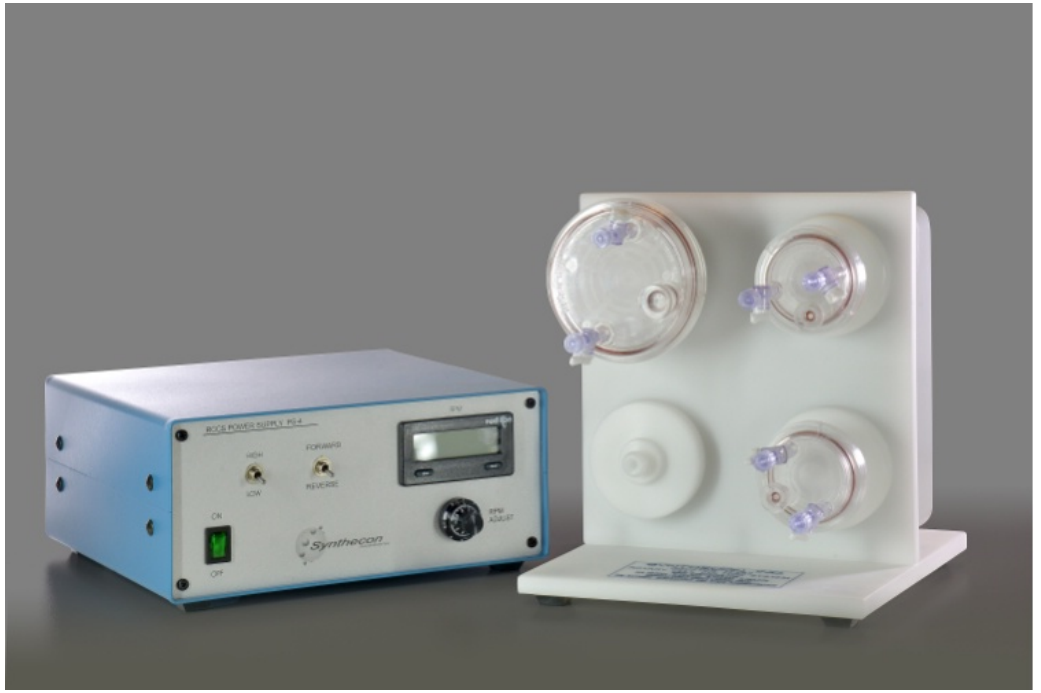
Part 2. The DN-SST presence: Curriculum 4.

NASA instrument ***Rotary Cell Culture System (RCCS):***
It is a ***clinostat*** 2D used to reproduce a ***microgravitational environment***.

Based on the imposed RPM, RCCS can reach values of microgravity of $10^{-4}g$ (same value on the ISS).

Noemi de Dominicis from Uni L'Aquila is working with this instrument to ***test the effects of microgravity on human intestine cells***.

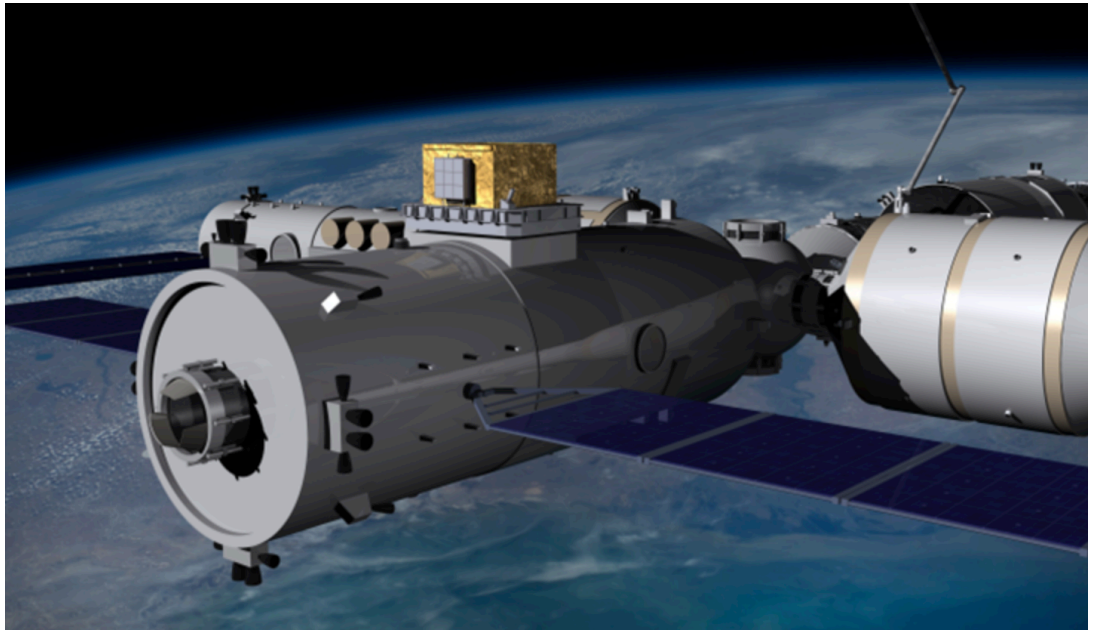
On another side, Thomas Cretien from Uni Trento is studying the ***effect of microgravity on brain and on bones for long-term spaceflight***. This projects is developed at the Uni Plovdiv in Bulgaria as well.



Part 2. The DN-SST presence: Curriculum 5.

The ***High Energy cosmic Radiation Detection facility (HERD)***:
It consists of detectors that will be installed onboard the future ***China's Space Station (CSS)*** around 2027.
The primary scientific objectives of HERD are:
1) ***Indirect dark matter search*** with unprecedented sensitivity;
2) ***Precise cosmic ray spectrum*** and composition measurements;
3) ***Gamma-ray monitoring*** and full sky survey.

Currently Essna Ghose from Uni Salento in Lecce, is working on ***design, simulation and test*** of a not-imaging space detector.

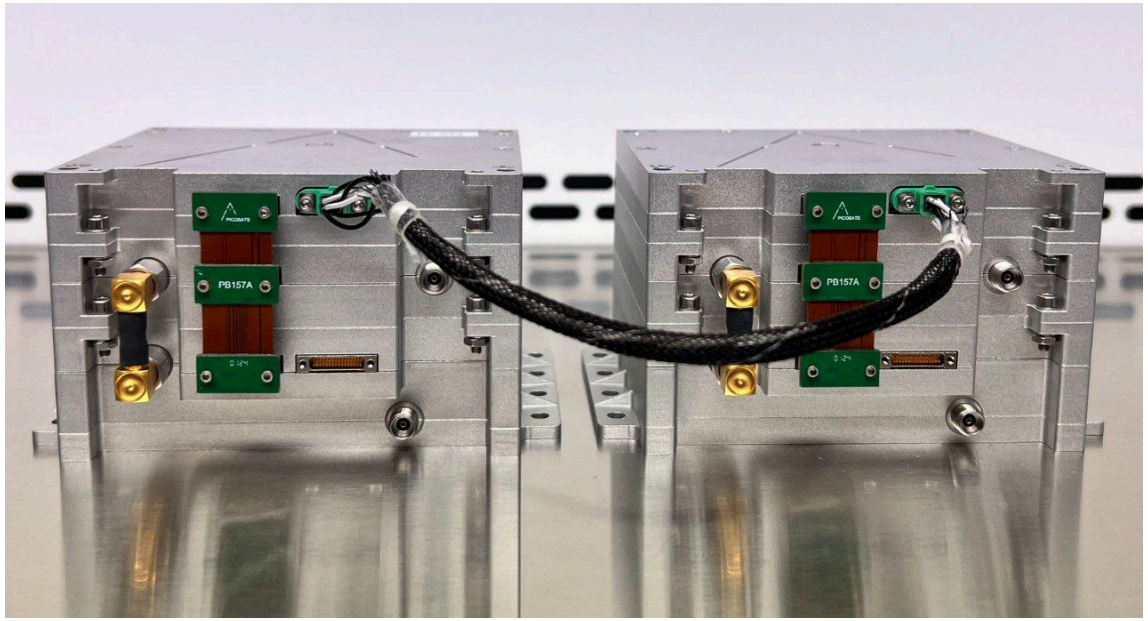


Part 2. The DN-SST presence: Curriculum 6.

Joint collaboration ESA + ***Picosats srl***:
Picosats is an University of Trieste spin-off which designs ***telecommunication systems for satellites***. The latter works expecially in S and X bands (under 12GHz), but also in K and Ka bands (up to 32GHz).
Picosats is collaborating with ESA to install 5G in some satellites.

Francesco Adamo in Trieste (Universy + Picosats) is currently working on the ***development of the 5G antenna***.

PICOSATS
SPACE TECHNOLOGIES SOLUTIONS

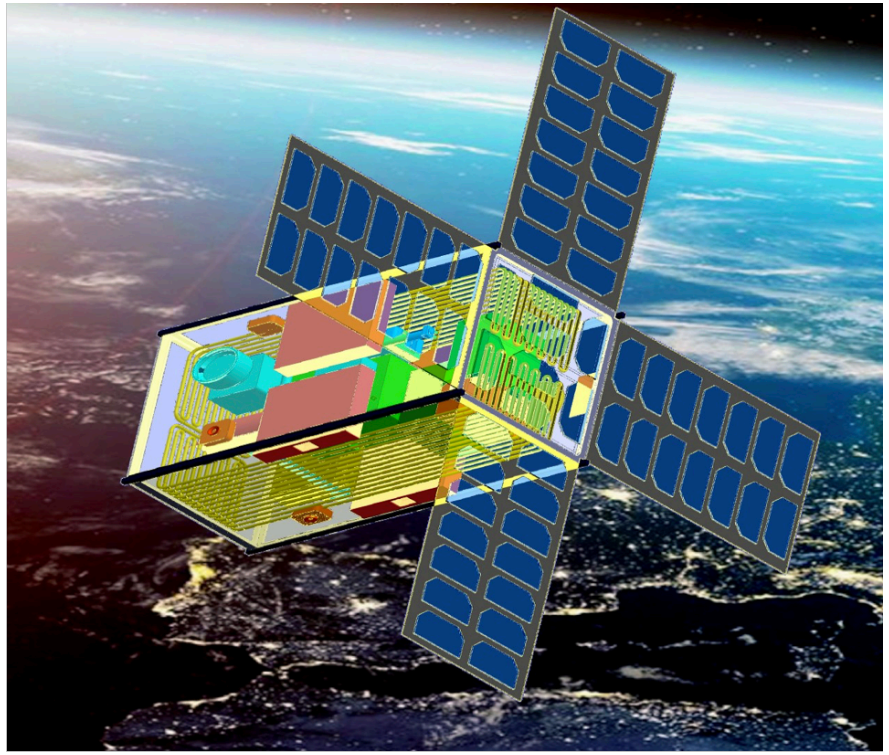


Part 2. The DN-SST presence: Curriculum 6.

ASI mission ***EXtended Cubesat for Innovative Technology Experiments (EXCITE):***
The primary objective of the EXCITE mission is to validate several innovative technologies for small and cubic satellites in orbit.

Matteo Gemignani from Uni Pisa is currently the ***system engineer*** of the mission.

Agenzia Spaziale Italiana



Acknowledgment

I have developed this presentation with the help of the following colleagues (in alphabetical order):

1. Francesco Adamo (University of Trieste)
2. Chiara Bartolini (University of Bari - Aldo Moro)
3. Florie Carralot (SISSA)
4. Thomas Cretien (University of Trento)
5. Noemi De Dominicis (University of L'Aquila)
6. Federico Ferrara (INGV Catania)
7. Eugenia Di Giorgi (Universiy of Pisa)
8. Matteo Gemignani (University of Pisa)
9. Essna Ghose (University of Salerno in Lecce)
10. Margaux Introna (University of Turin)
11. Pietro Leonardi (University of Padua)
12. Edoardo Santero Mormile (University of Pescara - G. D'annunzio)
13. Iqra Saddique (Gran Sasso Science Institute)

Please consider ***this talk as made by everyone*** in the list, I'm just speaking on behalf of them.