CSUG: AMICal Sat
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- CSUG – Open up the space of possibilities

From payload to uses
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  • Mechanical engineer
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  • Director of CSUG
  • Professor at UGA, specialised in space weather and space instrumentation
AMICal Sat Scientific objectives

• Main questions:
  • Interface between upper atmosphere and magnetosphere

• Particle fluxes at the top of the atmosphere
  • Energy of individual particles, total flux, distribution shape

• Deposition into the atmosphere
  • Altitude of the emissions as a tracer...
    • Between 90 and 300 km
Auroras are a tracer of:

- Particle precipitation from plasma sheet and boundary region (Suprathermal particles, eV and KeV ranges)
  - 2nd most important in term of energy
  - Need for overall coverage
- Observables:
  - Auroral oval location
  - Overall shape and small scale structures
  - Intensities in different lines and bands
- Goal of observations: Global reconstruction of particle precipitations
  - \( p^+ \) and \( e^- \)
  - Mean energy, total flux, distribution shape
- No other way to get global large scale particle precipitation monitoring (quasi continuous)
Nadir observation

- Intensity integration on different altitudes but discrimination possible through simulation.

Oval global structure

B field lines and magnetospheric link

Small scale structure
Limb configuration

B field lines and magnetospheric link

Altitude discrimination of the different emission lines
Interpretation methods: the trans code

- Through the Transolo code

  Fitted parameters
  - $E_{\text{tot}}$
  - $E_{\text{moy}}$ for the distribution
  - If possible: $\Delta E$

  Considering the possibilities of several distributions (Need for enough information ie enough emission lines)
Vertical integration of line intensities vs mean energy of the particles

Allow to reconstruct mean energy of the particle distribution quite well for particle with energies lower than 2 keV

More difficult for 2 keV-30 keV particles

Existence of multiple solution if considering both mean energy and total energy

N2+: 391 nm
N2+ 427 nm
N2 1P
Green: 557 nm
Red: 630 nm
AMICal Sat: a 2U cubesat for SW on a short time schedule

- ATISE Imager tests
  - NADIR (Auroral Mapping)
  - LIMB Images (Vertical Profile)
    - Sensitivity: 500R
    - Exp time: 1s
- Orbit
  SSO, Local times: ~11h
  Altitude: 510km

AMICal Sat Launch: Launch schedule.
March 24th, 2020 @ 1:50 UT
Vega, Kourou.

Lifespan: 1 year (extensible to 3 years)
AMICal Sat Payload – Imager

• Commercial detector (ONYX Teledyne E2V)
  • Large pixels: 10µm
  • Sparse RGB matrix: high sensitivity

- **Objective:** Designed at IPAG. \( f = 23\text{mm}, f/1.4 \)
- **Wide FoV** = 42° (Diag)

  - **Auroral shape**
  - **Small scale structure**
  - **Deposition reconstruction in RGB**
Imager

- Wide field of view
  - 42°
- Sparse RGB

The potential FoV of the 6 spectral LoS is added
Images taken from Skibotn (Norway)  
March 3rd.  
Geomagnetic conditions: Kp=3
Image processing

Debayered BW image

Recolored image
Link between aurora and radio communications

• Aurora: Light emissions in the ionosphere (100-300 km)
  • Trace of suprathermal electrons transport.

• Means increase of Ionosphere electron density.
  • Shift in ionosphere cut off frequency

• Other space weather effects
  • For satellites, SEU, surface charging, TID
  • For power grids: GIC
  • For communications: Solar radio burst and ionosphere cutoff.

We will give you access on demand to the results of the AMICal Sat experiment:
Images and code output.
Please contact mathieu.barthelemy@univ-grenoble-alpes.fr
AMICal Sat Radiofeatures

• A Franco-Russian satellite
  • Operated by MSU (Moscow State University) through NILAKT
  • Call sign: ....

• Downlink: UHF
  • Available to the community

• Data downlink: S band
  • Possible to downlink the data with registration...
  • For more information contact Julien Nicolas (ADRI 38) and/or Mathieu Barthelemy and/or Thierry Sequies

For more information see www.csug.fr and the presentation of Julien Nicolas.
Take a Space ride with us!