CSUG: AMICal Sat Mar 2020

Université Grenoble Alpes · Grenoble INP · Air Liquide · Teledyne e2v Everywhereyoulook · Lynred by Sofradir & Ulis · Nicomatic · Gorgy Timing La marque du temps · NPC System Neyric Satellite Tracking Solutions · EDF · Fondation Université Grenoble Alpes · Liberté · Égalité · Fraternité République Française Ambassade de France en Russie · cnrs

- CSUG – Open up the space of possibilities

From payload to uses

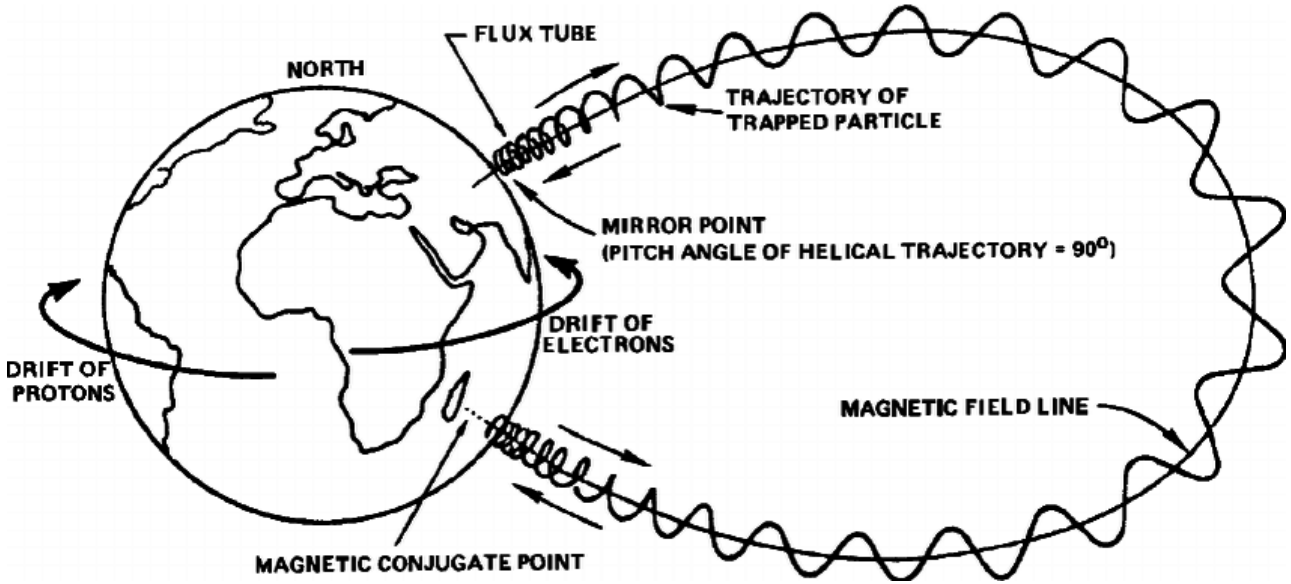
Thierry Sequies (PM) & Mathieu Barthelemy (Director)

- Thierry Sequies
  - Program director of CSUG
  - Mechanical engineer
  - Responsible for operations at CSUG

- Mathieu Barthelemy
  - Director of CSUG
  - Professor at UGA, specialised in space weather and space instrumentation

AMICal Sat Scientific objectives

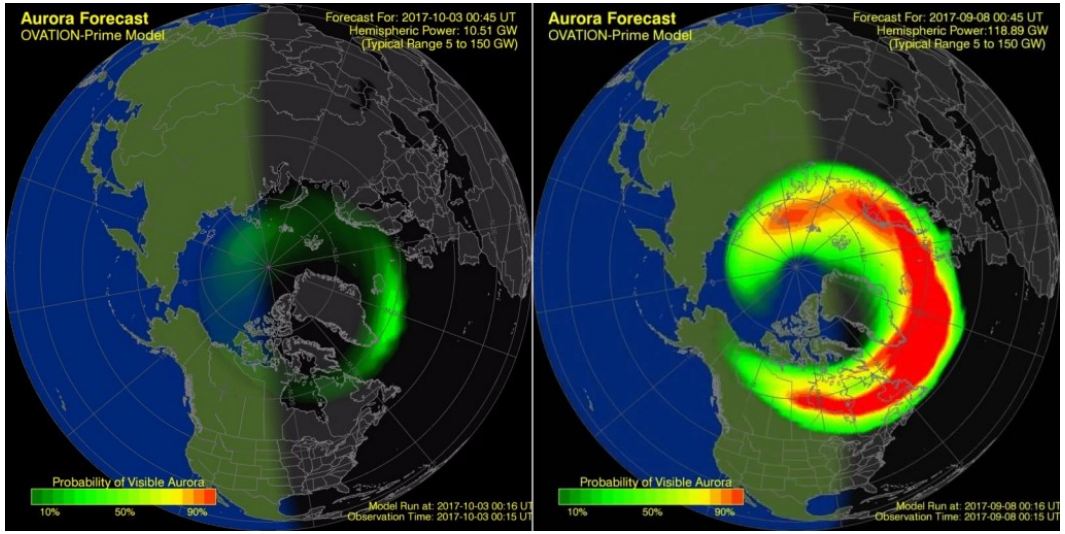
- Main questions:
  - Interface between upper atmosphere and magnetosphere
  - Particle fluxes at the top of the atmosphere
    - Energy of individual particles, total flux, distribution shape
  - Depoisition into the atmosphere
    - Altitude of the emissions as a tracer…
      - Between 90 and 300 km



WFAI-ATISE-AMICal Scientific objectives

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

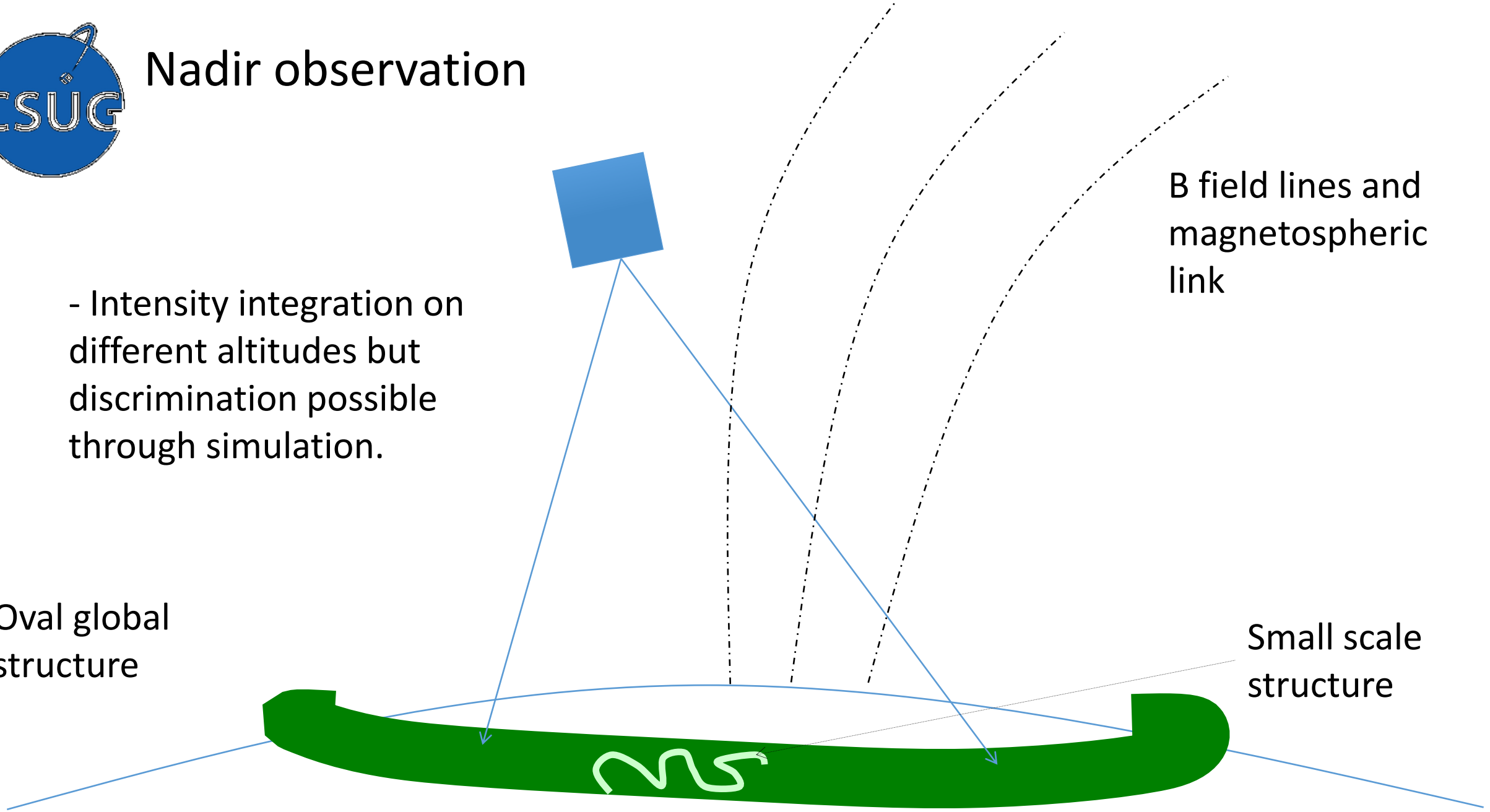


- Goal of observations: Global reconstruction of particle precipitations
  - p^+ and e^-
  - Mean energy, total flux, distribution shape

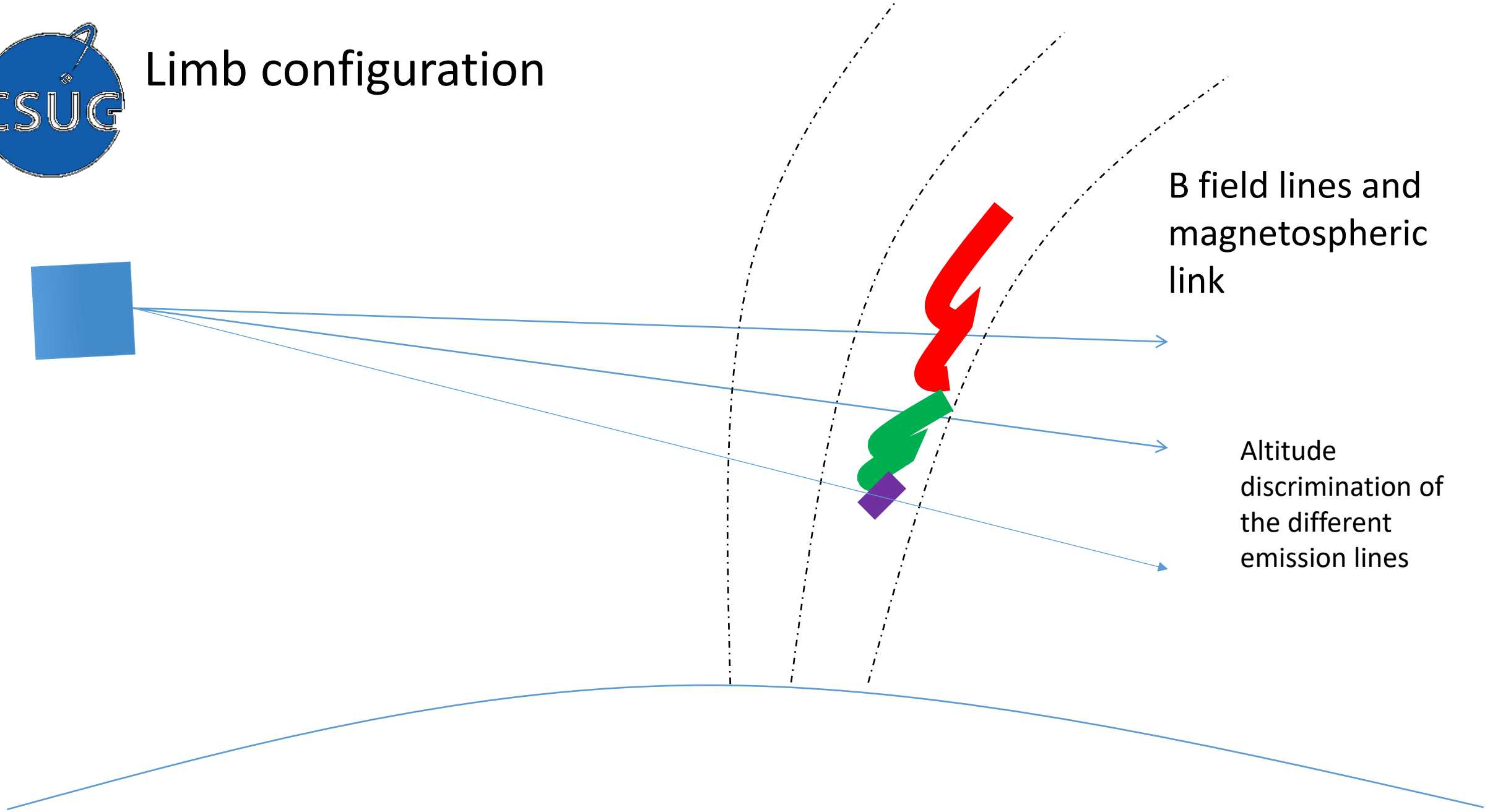
- **No other way to get global large scale particle precipitation monitoring (quasi continuous)**

Nadir observation

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



Limb configuration

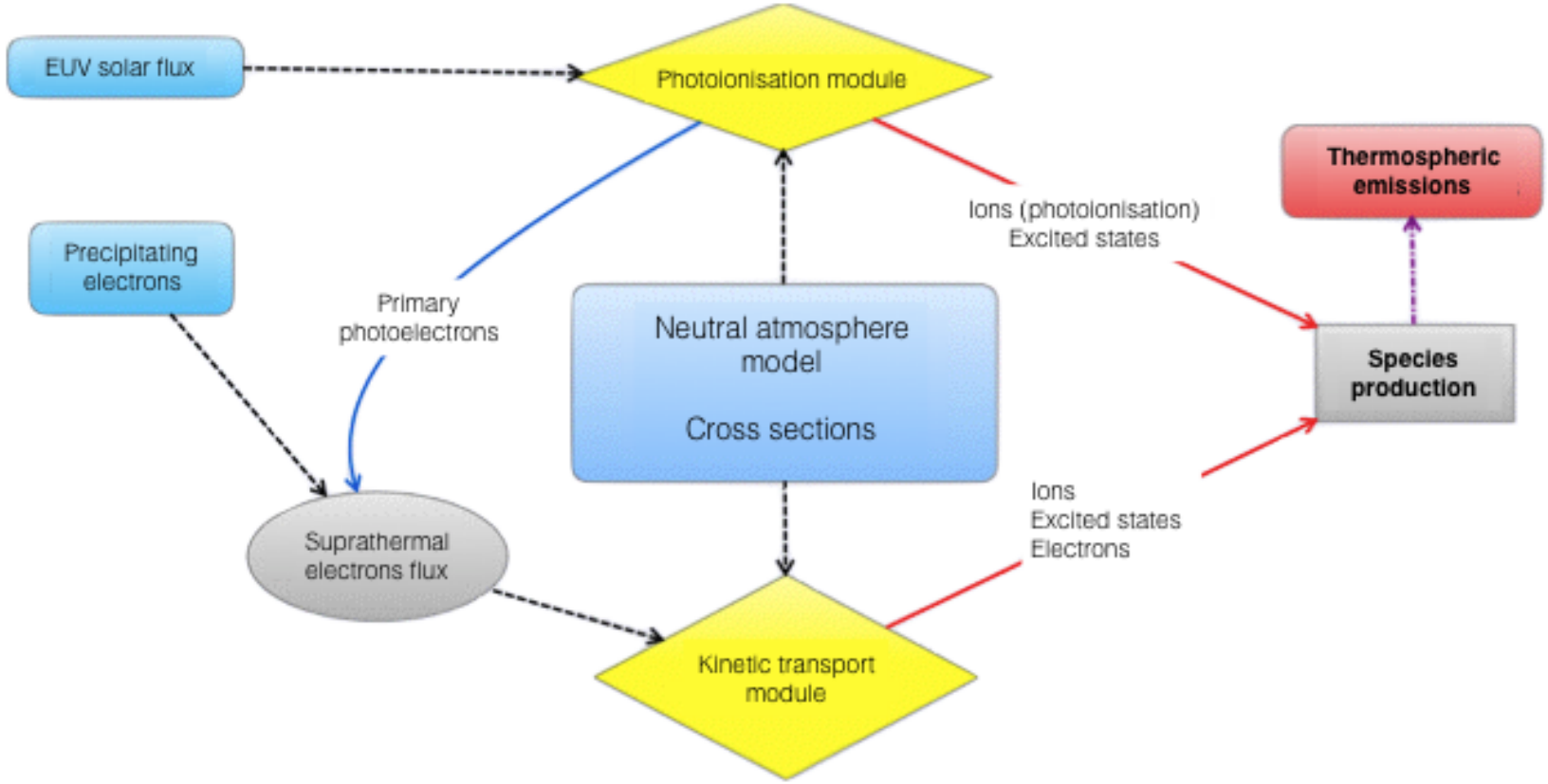


B field lines and magnetospheric link

Altitude discrimination of the different emission lines

Interpretation methods: the trans code

- Through the Transolo code



Fitted parameters

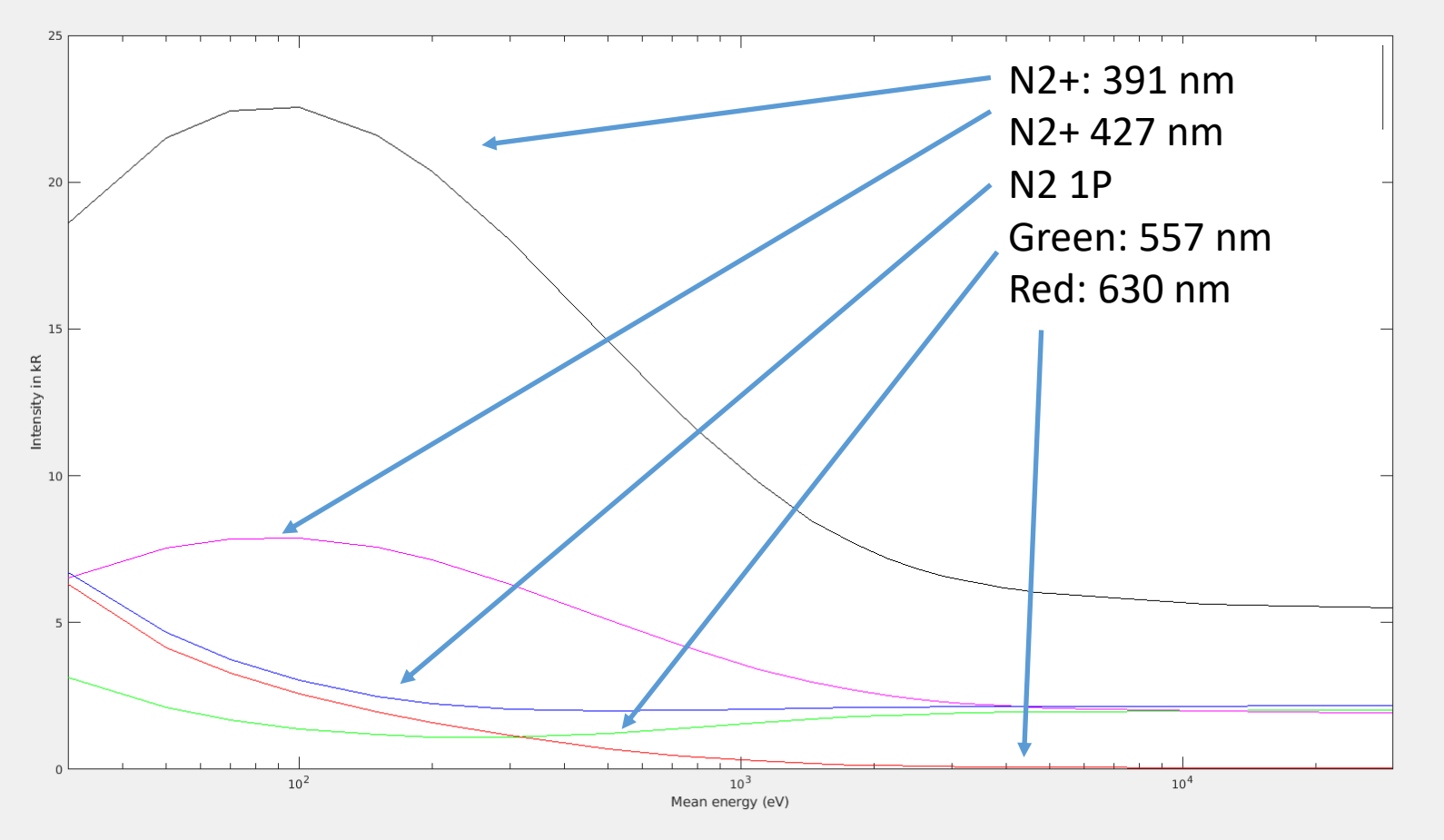
E tot

E moy for the distribution

If possible: ΔE

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

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**

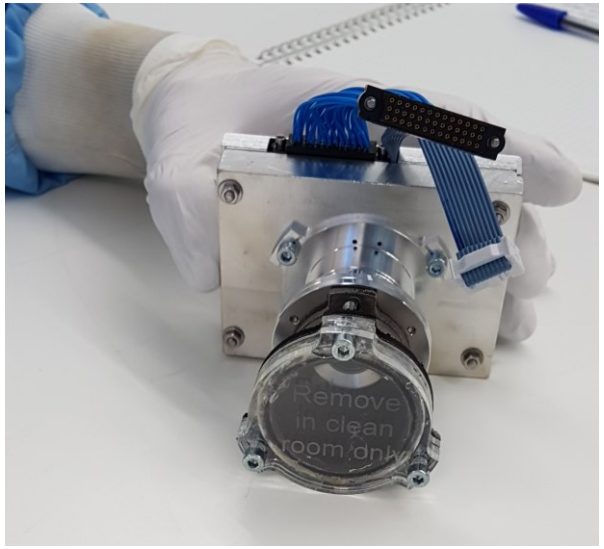
SSO, Local times: ~11h

Altitude : 510km

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

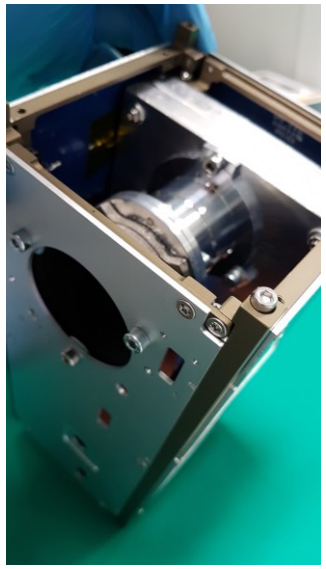
Lifespan: 1 year (extensible to 3 years)

AMICal Sat Payload– Imager

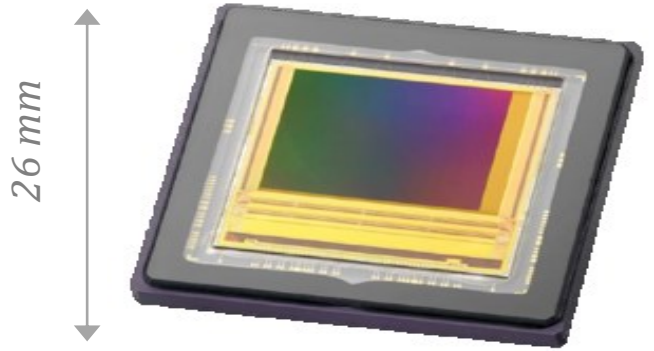


- **Commercial detector (ONYX Teledyne E2V)**
  - **Large pixels : 10µm**
  - **Sparse RGB matrix: high sensitivity**

- **<u>Objective: Designed at IPAG. f =23mm, f/1.4</u>**
- **<u>Wide FoV= 42° (Diag)</u>**



- **<u>Auroral shape</u>**
- **<u>Small scale structure</u>**
- **<u>Deposition reconstruction in RGB</u>**



Onyx, 2Mpx, e2v

Imager

- Wide field of view
  - 42°
- Sparse RGB

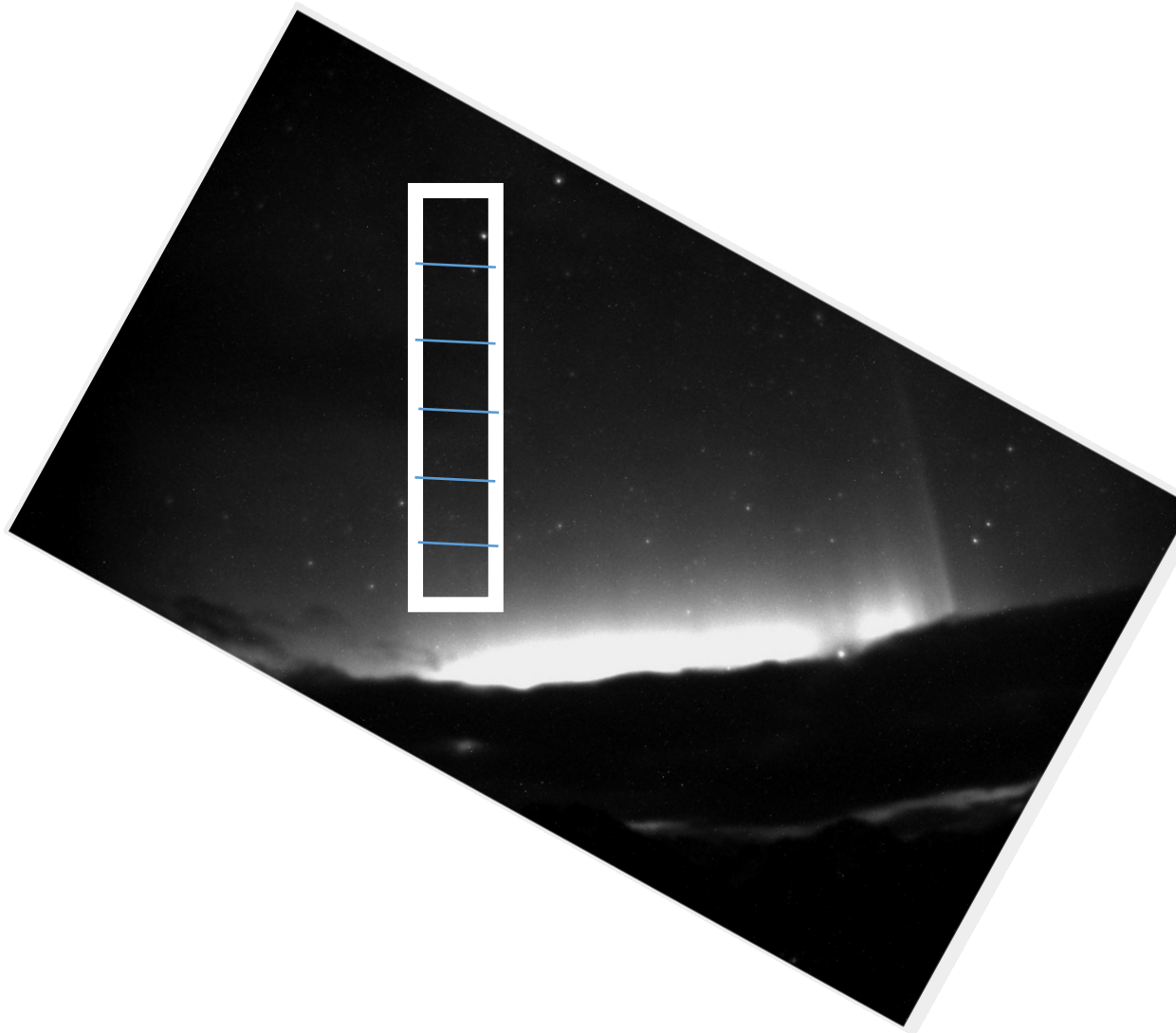
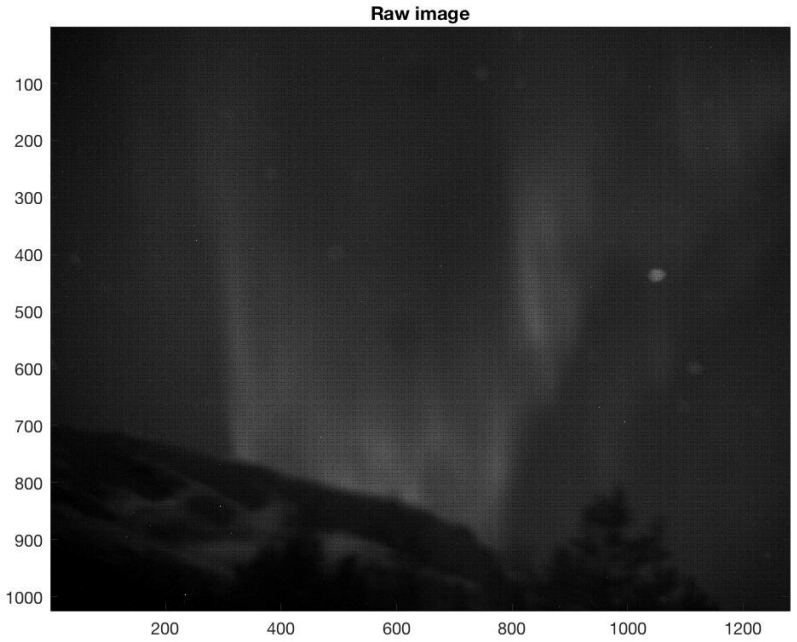


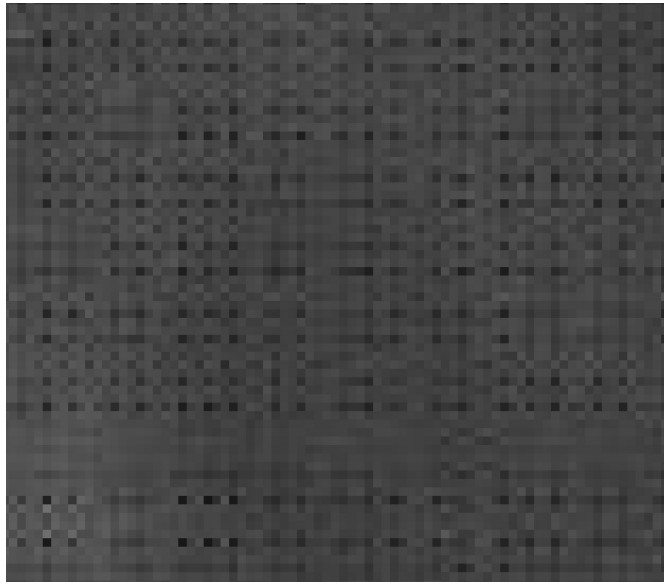
Image taken with the E2V ONYX detector. Svalbard Nov 2017.
The potential FoV of the 6 spectral LoS is added

Image processing

Raw image



Zoom on raw image

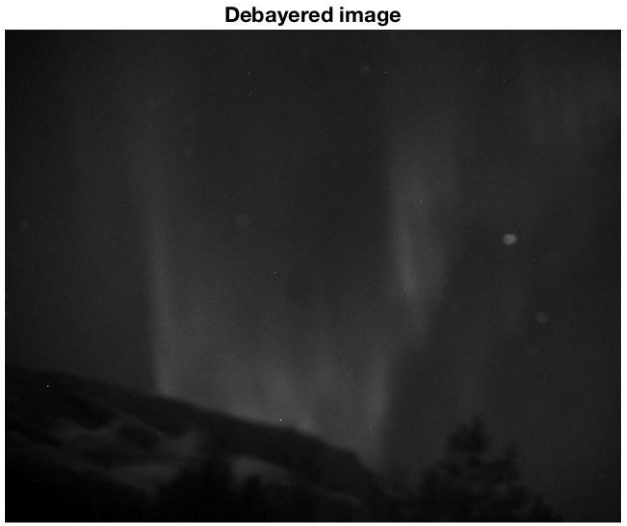


You can notice the lower sensitivity of the colored pixels

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 !

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