Can the thermospheric green line at 557nm be considered as a non-polarised standard ?

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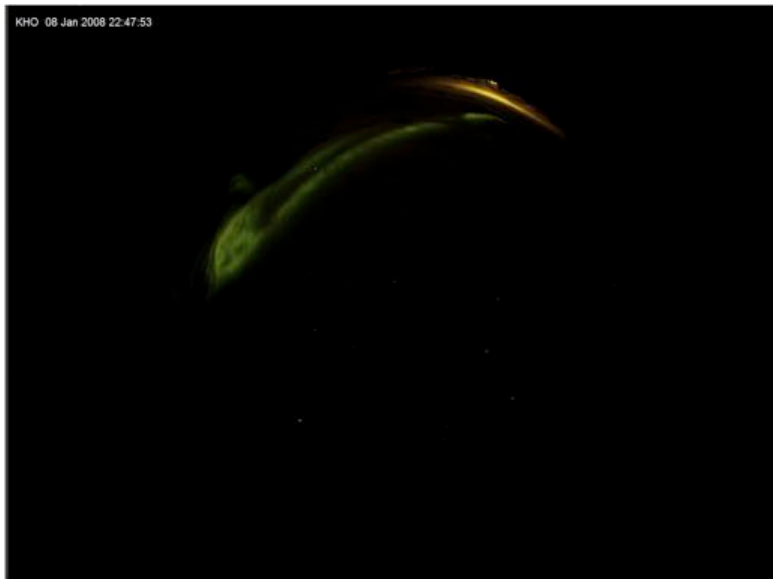
Problematic

- Zero polarisation calibration target.
  - Extended sources
  - Line polarisation

  - Airglow lines are visible everywhere.
    - Equatorial and auroral regions
      - Main lines: O I 557 nm and 630 nm.
        - Red line line can be polarized (Lilensten et al. 2013 and Bommier et al. 2011).
        - Green line correspond to the O^1S-O^1D transition.
        - Non LTE process of emission. Excitation mostly by particle impact.
          - Forbidden transition. $\Delta J=2$ ie quadrupolar transition.
          - Upper state ^1S ie $J=0$ and thus no possible polarisation.

Question: is it useable for polarisation calibration

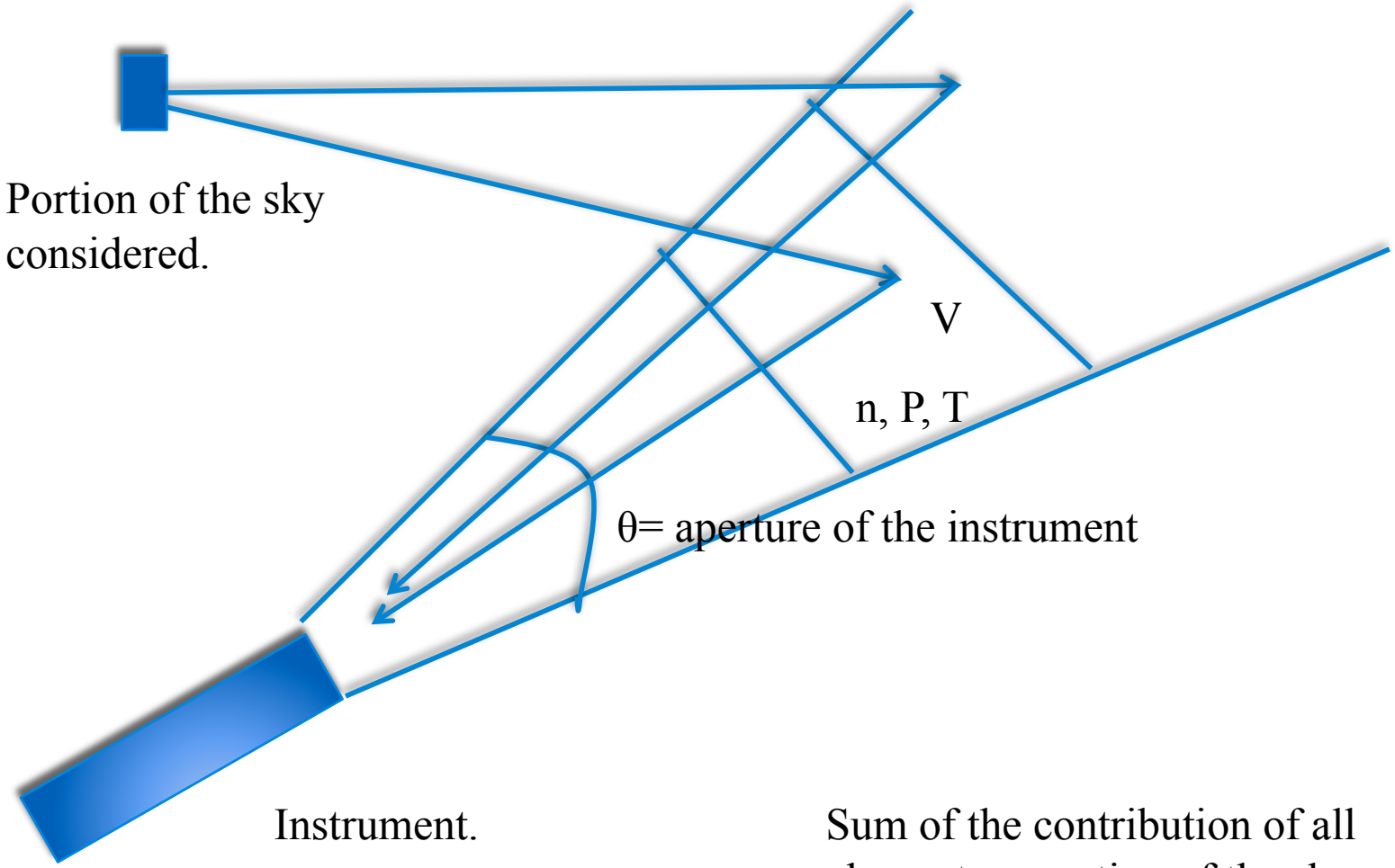
- Is the line intense enough?
- Full sky source: can diffusion in the lower atmosphere cause some fake polarisation?



Spurious polarisation: calculation principles

- Single Rayleigh Scattering
- Use of the volumic scaterring coefficient from Bucholtz (1995). Variation with temperature and pressure considered.
- Calculation of the volume seen by the instrument considering the field of view. Discretisation of this volume.
  - Considered altitude z<15km
- From all sky camera, map of the sky green line intensity (UCL all sky at KHO)
- Discretisation of the sky with elementary solid angle smaller than the field of vie
- Calculation of the scattered intensity in the direction of instrument for each elementary volume in the field of view
- Comparison with the direct intensity

Scheme of the calculation principles.

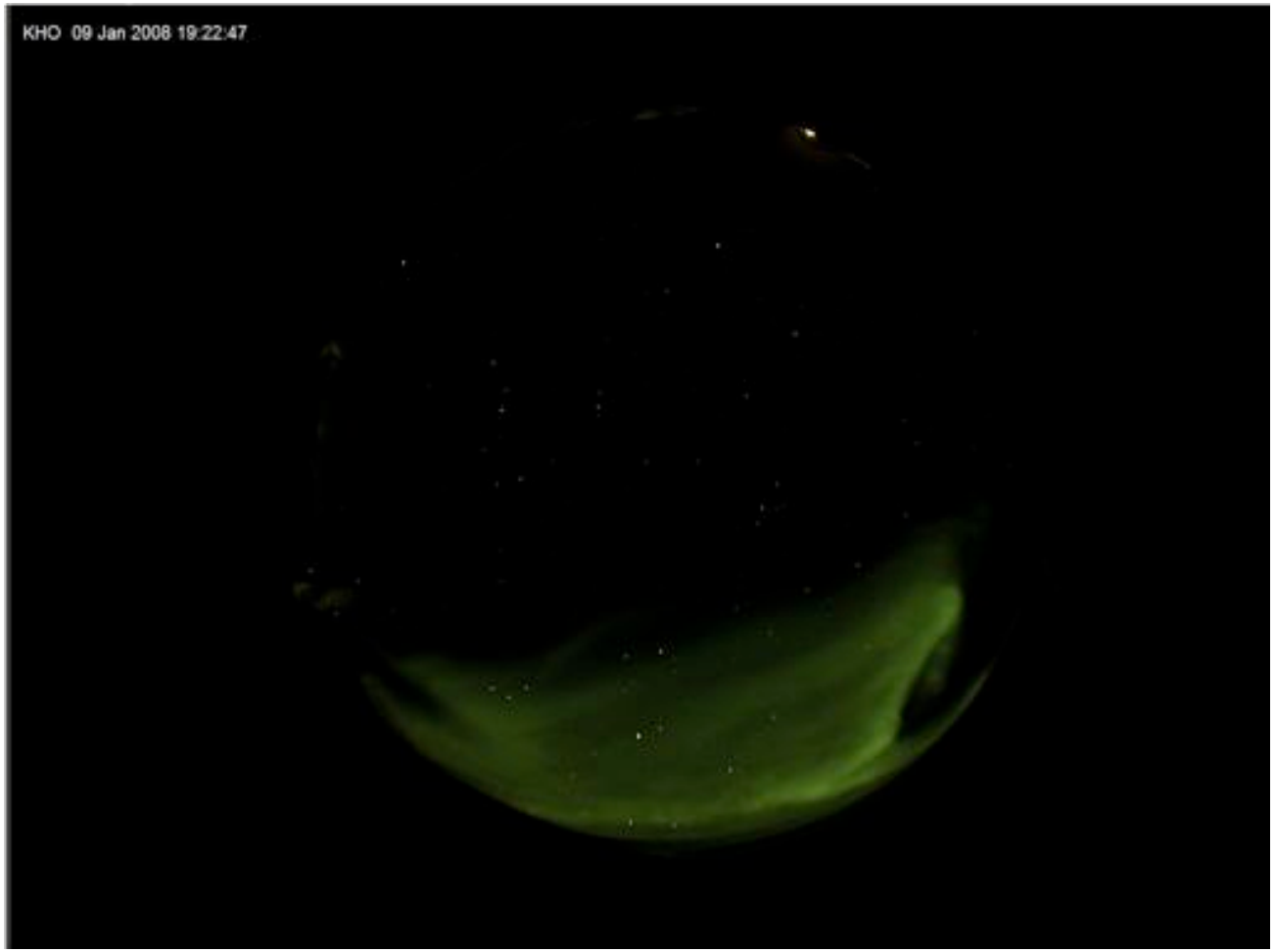


Forseen intensities and variabilities

- Equatorial regions
  - Full sky almost uniform airglow
    - Rayleigh diffusion
    - But
    - Symmetry leads small resulting polarisation measured.
    - At low elevation (30°):
- Measured DoLP: ~1e-4-1e-5
- Faint intensity ~1R ie 3e-7 erg.cm^{-2}s^{-1}sr^{-1}

- Auroral regions
  - Strongly structured emission
  - Simulation shows for single Rayleigh diffusion and low elevation (30°) a possible polarisation of :
  - Diffused green line around 2% of the direct intensity
  - DoLP~ 5% for this diffused part
- Measured DoLP: ~1e-3
- Important intensity (~3e-4 erg.cm^{-2}.s^{-1}.sr^{-1} ie ~1kR)

Example of a full sky image (Longyearbyen Svalbard)



UCL all sky camera. KHO, Longyearbyen, Norway

Variations of the line

- With the position on Earth
  - Auroral or equatorial region
- With time
  - Dependance with solar activity
  - Geometry of the airglow or auroral emissions

For a more accurate modelisation

- Multiple scaterring
  - Probably not to important since single scattering is faint.
- Aerosols, ice, etc
  - Need for mie diffusion simulations
  - Need to know the quantities
- Can be a strong source of variation if the effect are important

Conclusions: work in progress

- Green line probably interesting as non polarized standard.
- Diffusion in the atmosphere leads to a fake polarisation up to 10^{-3}
- Need for test on telescopes
- Need for more accurate simulations