# A compact solar occultation instrument for the UV/Visible spectral range: instrument design and performance testing

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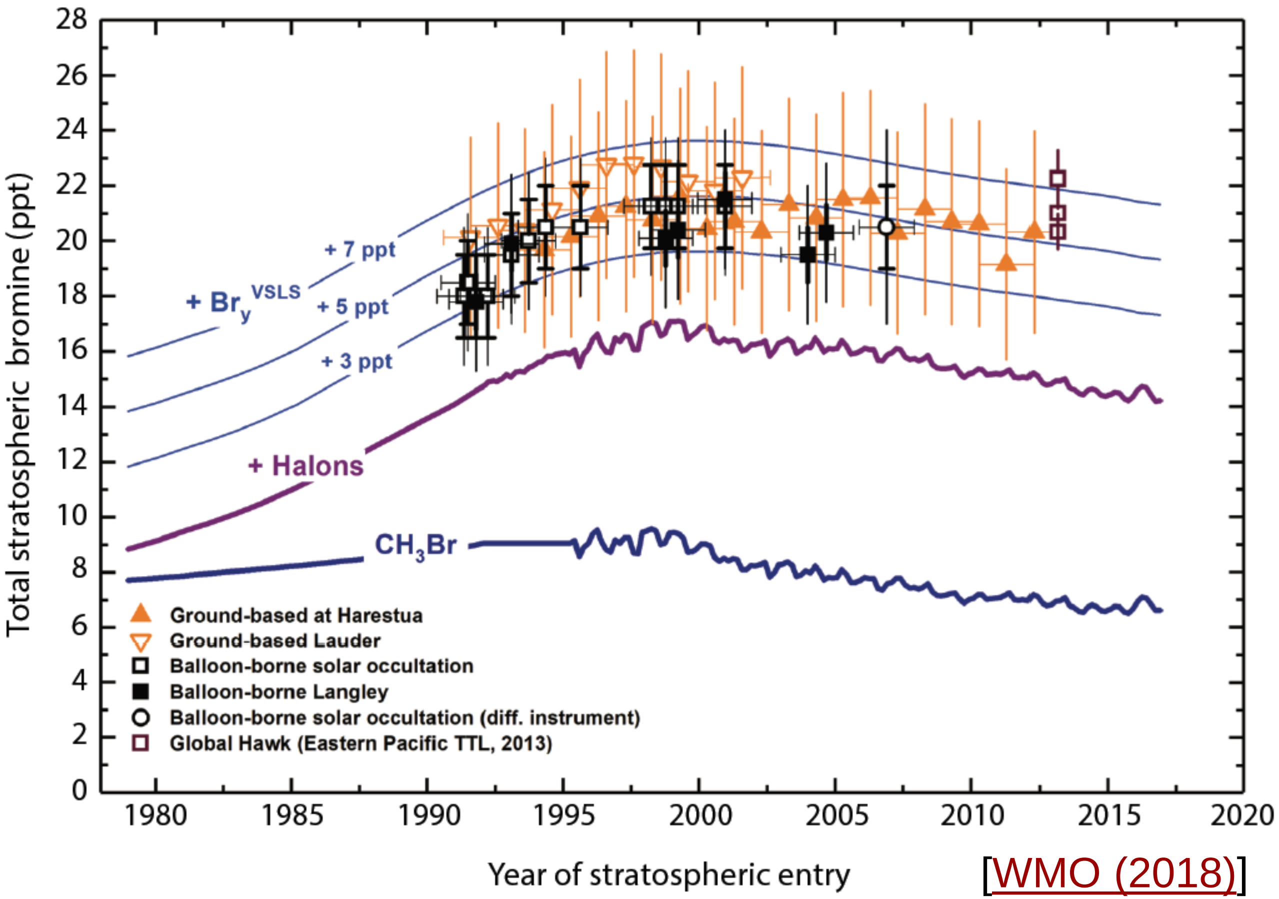
# Motivation

Measurement of stratospheric total bromine and iodine inventories

- Monitoring is necessary due to effective stratospheric ozone depletion by halogen oxides
- Bromine makes up over one third of ozone loss [WMO, 2018]
- Observe trend in total bromine concentration

Compact solar occultation instrument for UV/visible range

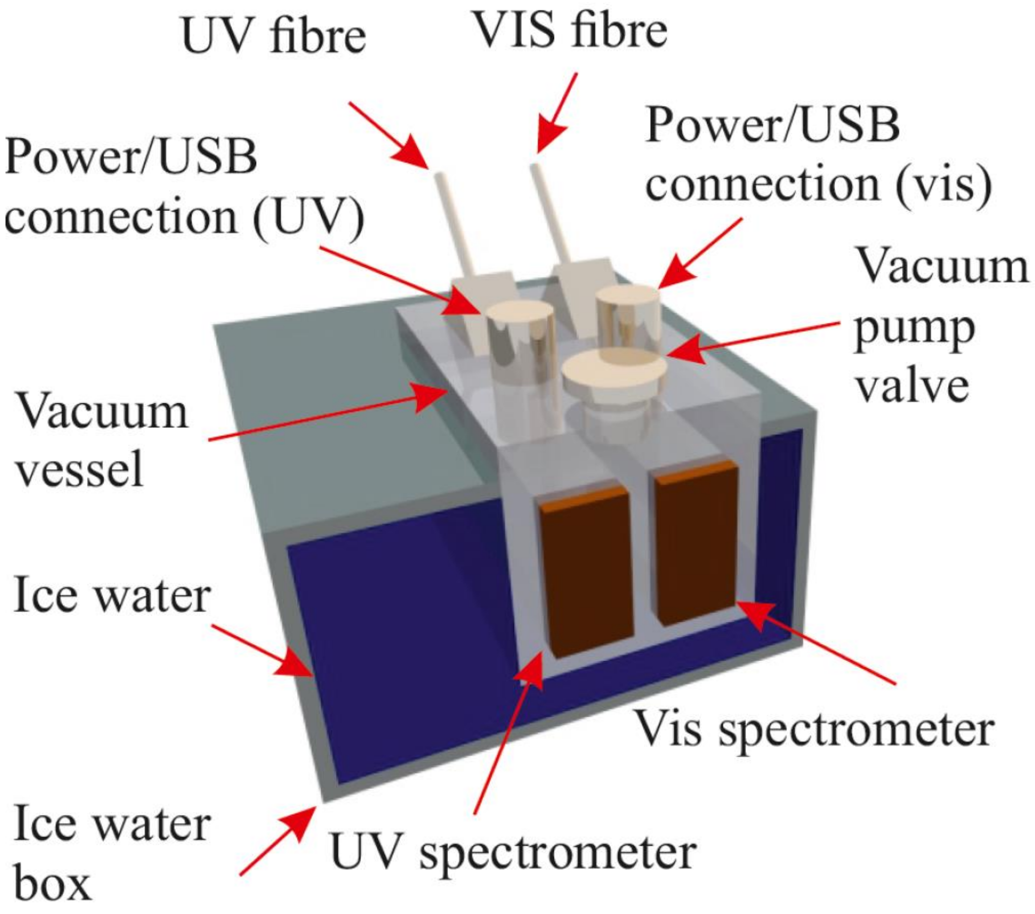
- Designed for deployment on stratospheric balloons
- Lightweight (< 40 kg), low power consumption (< 100 W), withstand stratospheric conditions




[WMO (2018)]

# Spectrometers

- Two grating spectrometers (Ocean Optics QE Pro Series)
- Resolution 0.5 nm
- UV wavelength range: 305 to 385 nm
  → measure stratospheric BrO
- Visible wavelength range: 415 to 515 nm
  → measure stratospheric IO
- In evacuated box to ensure a constant refractive index and avoid condensation onto actively cooled detectors
- Temperature stablized by water-ice bath (deviations < 0.5°C for >12h in lab conditions)
- Retrieval via DOAS method



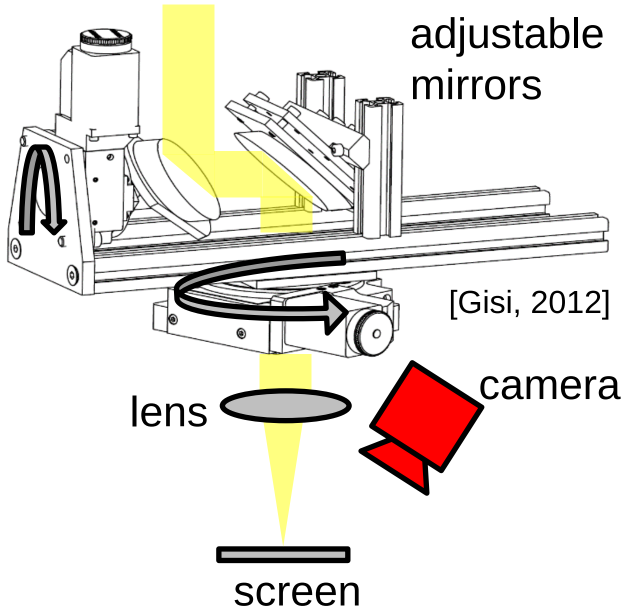

[Kazarski (2019)]

# Two Step Active Solar Tracker

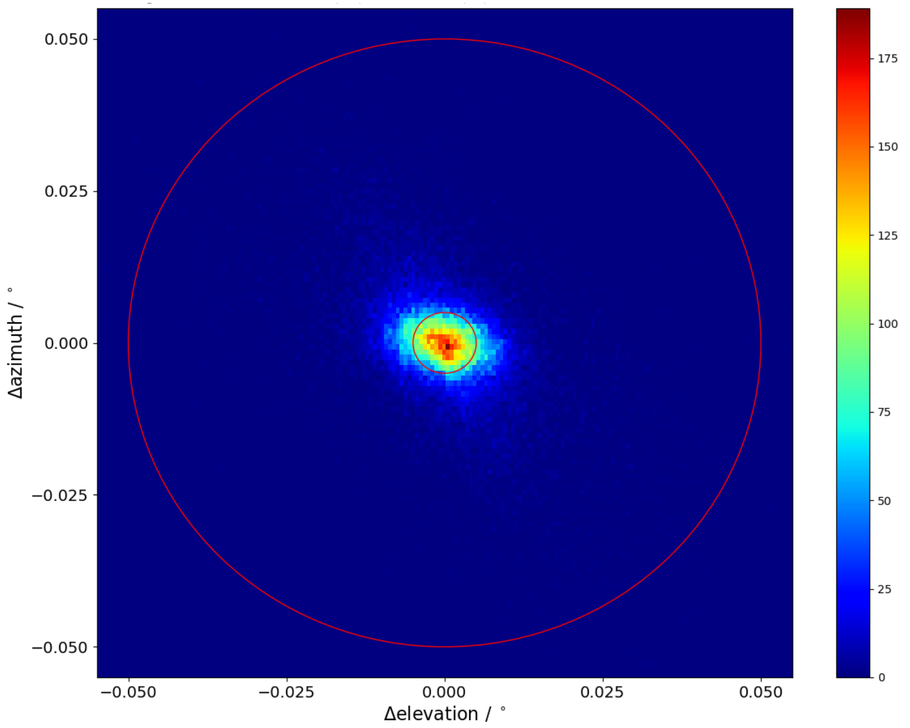
## Step 1: Coarse tracking

- Camera with fish-eye lens (FoV 185°) finds coarse sun position (±3°) in sky
- Fine tracking takes over as soon as the solar disk is within its FoV (9° x 8°)

## Step 2: Fine tracking




- Fine tracking uses Alt-Az mounted mirror assembly.
- The sun’s disk is then projected on a screen and centered on a target.  The mirror positions are updated with 100 Hz using the camera image.

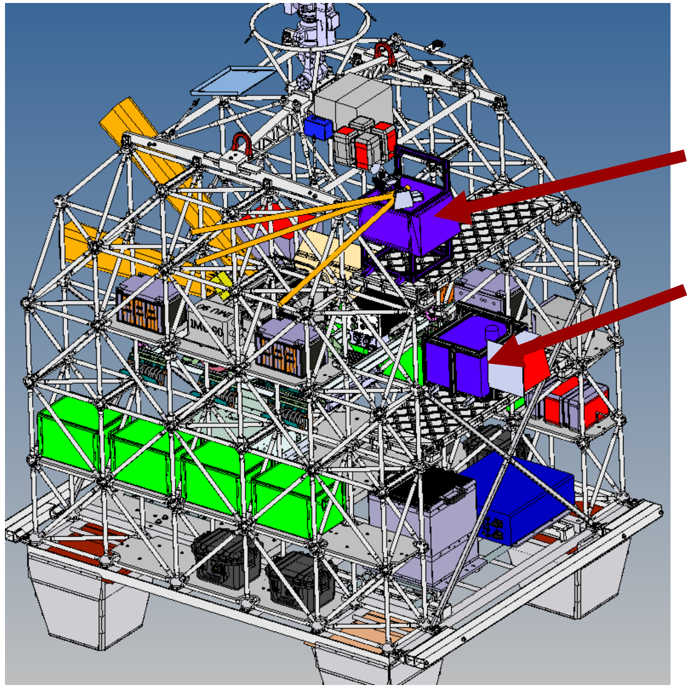



Tracker perfomance on 19.03.2021 during campaign onboard MV Mirai (MR21-01).
98.3% of the deviations are < 0.05°, and 38.3% < 0.005°.
More details can be found here:
https://doi.org/10.5194/egusphere-egu21-4030

https://www.iup.uni-heidelberg.de/en/research/ghg

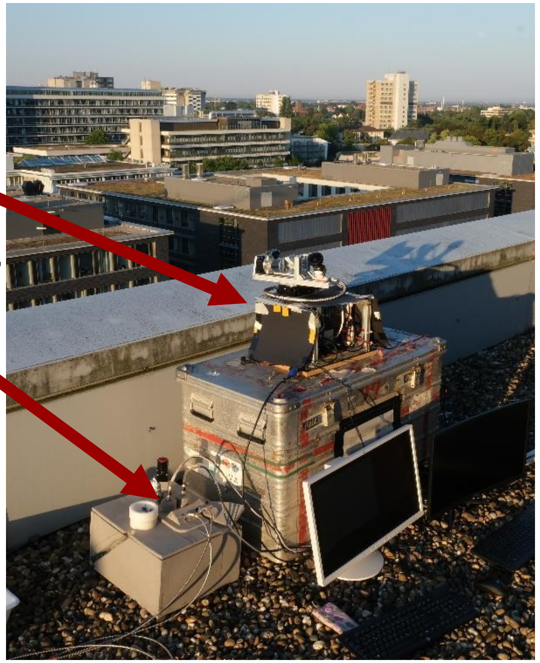
# Outlook

TotalBrO Campaign August 2021 in Kiruna, Sweden using HEMERA infrastrucure.
Further deployment on Balloon planned in 2022.



Solar Tracker

Spectrometer



CAD Model of TotalBrO on Gondola
[provided by CNES and KIT]

Test measurements on institutes rooftop.

Further material on Solar Tracker Setup:

- Instrument description:
  https://doi.org/10.5194/amt-4-47-2011
  https://doi.org/10.5194/egusphere-egu2020-9596

- Deployment on vessel:
  https://doi.org/10.5194/egusphere-egu21-4030
  https://doi.org/10.5194/essd-13-199-2021
  https://doi.org/10.5194/egusphere-egu2020-7345

Further material on Spectrometer Setup:

https://doi.org/10.11588/heidok.00027655

https://www.iup.uni-heidelberg.de/en/research/ghg