Solar fibre-optic coupling to portable low-resolution FTSs EM27 and IRcube

David Griffith, Nicholas Jones, Nicholas Deutscher
University of Wollongong
contact: griffith@uow.edu.au

Summary and Introduction

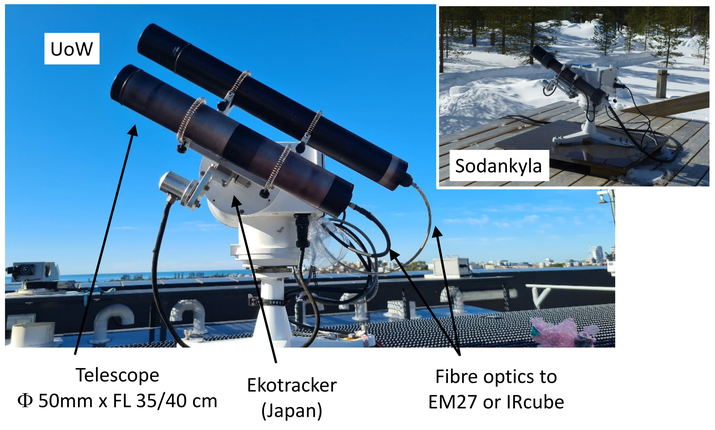
- We present an alternative solar tracker setup to the conventional alt-azimuth 2-mirror tracker such as the Bruker / EM27SUN camtracker
  - The sun is imaged into an optical fibre (FO) by a simple glass lens telescope mounted on a commercially-available Aeronet-style tracker
  - The FO brings the solar radiation into the lab
  - The divergent FO exit beam is collimated into the FTS for spectrum measurement
  - EM27 spectra using the telescope-FO and Camtracker are compared

- This setup allows the FTS to be operated indoors, avoiding harsh environments
- We have successfully used the telescope-FO tracker system for several years in the FRM4GHG project with a Bruker IRcube FTS
- Here we combine the telescope-FO input with an EM27 FTS and compare to EM27SUN with camtracker

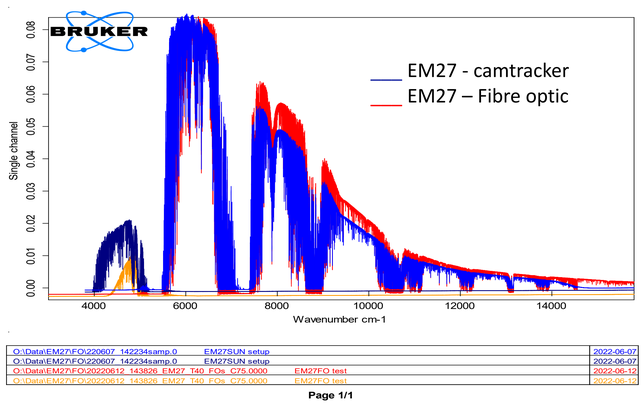
Details

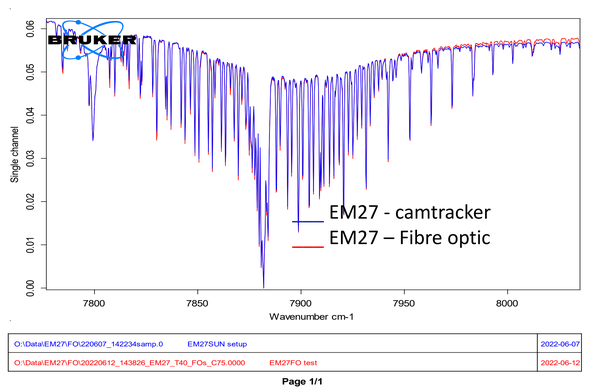
- Ekotracker: autonomous, active tracking <0.1°, self-parks at night. Robust, reliable, weatherproof
- Telescope: BK7 glass lens, Φ 50mm x FL 35 or 40 cm
- Glass fibre optics Φ500 or 800 μm, 20 m long, divergent exit beam ~ F/3
- IRcube 0.5 cm^{1} resolution, single sided igm
- EM27 0.5 cm^{-1} resolution, double sided igm

On the roof



Comparative spectra





Pros

- Tracker is autonomous, robust, reliable and weatherproof
- FTS is housed indoors in protected environment
  - Weatherproofing not required
- Continuous 24/7 measurements
- Comparable signal levels and SNR

Cons

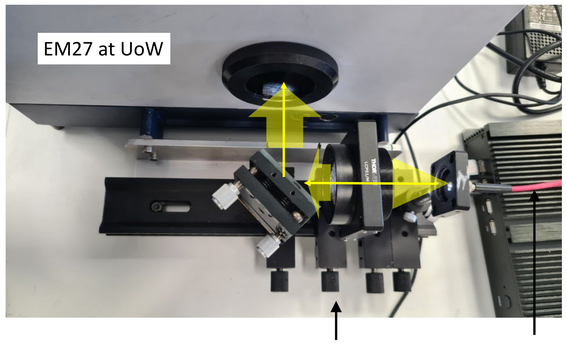
- Possible fibre spectral structures and variability
  - Continuum shape, fringing
- Fibre/glass cutoff below 4500 cm^{-1}
  - CO, N_2O bands not accessible

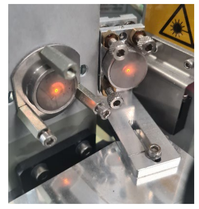
Conclusions

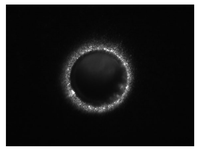
- Spectra via the telescope-FO and the Camtracker are so far very comparable
- Encourages further investigation to assess accuracy and variability

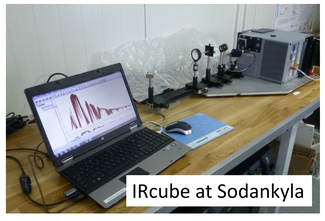
In the lab

FO input replaces camtracker




Detector view


Camtracker view



Next steps …

- Optimise fibre optic for robustness and reproducibility
- Check for fibre spectral effects
  - spectral structures, fringing
  - Dependence on fibre bending and movement
  - Not apparent so far
- Routine data collection and analysis (GGG, PROFFAST)
- Comparisons with co-located TCCON
  - New HR125 at UoW
- Comparisons with co-located COCCON

Acknowledgements

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