Society of Physics Students Regional Meeting

Feb 20th, 10:00 AM - 11:00 AM

Poster Session: Predicted Net Flux Versus Pressure Profiles During a Probe Descent into Uranus's Atmosphere

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Presenter Information

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Predicted Net Flux Versus Pressure Profiles During a Probe Descent into Uranus's Atmosphere

Meredith Wieber

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Why the Ice Giants?

Recommended by the Planetary Science Decadal Survey

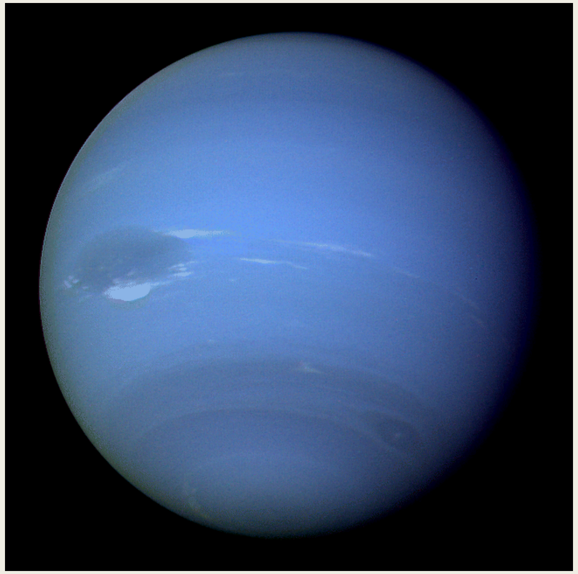
NASA research teams are competing for funding to develop

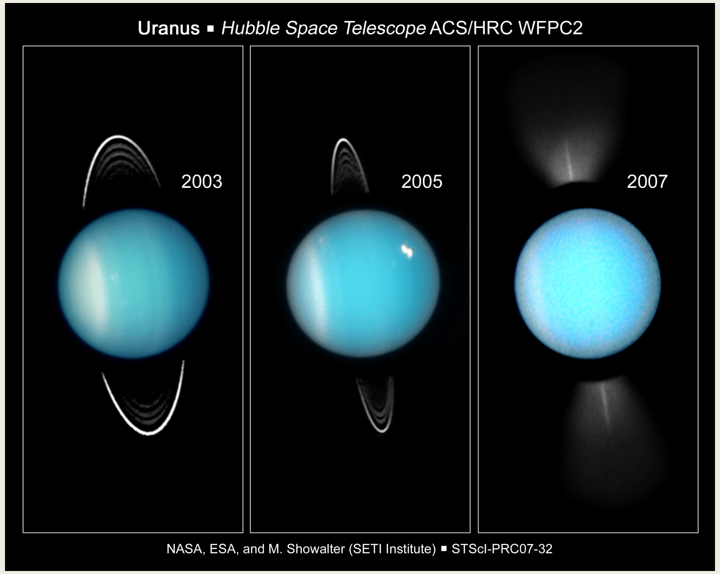
Only visited once each by Voyager Two

- *Uranus 1986*
- *Neptune 1989*

Distant Earth Observations

They're part of the most populous class of exoplanets currently discovered



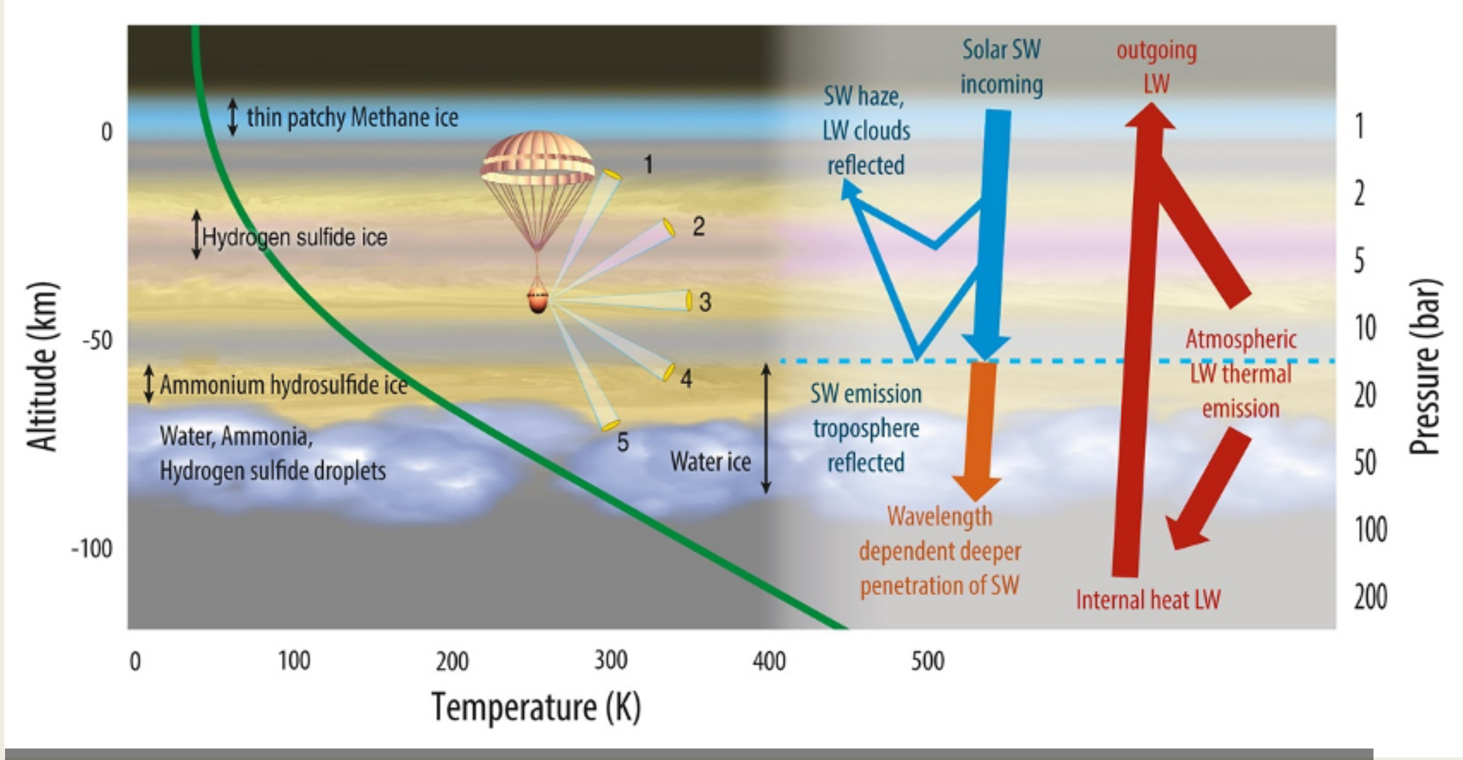


Radiative Transfer and the IG-NFR

IG-NFR = Ice Giants Net Flux Radiometer

Original specs:

- *5° FOV on Winston Cones*
- *5 viewing angles*
- *1s integration at each viewing angle*
- *7 spectral channels to observe*

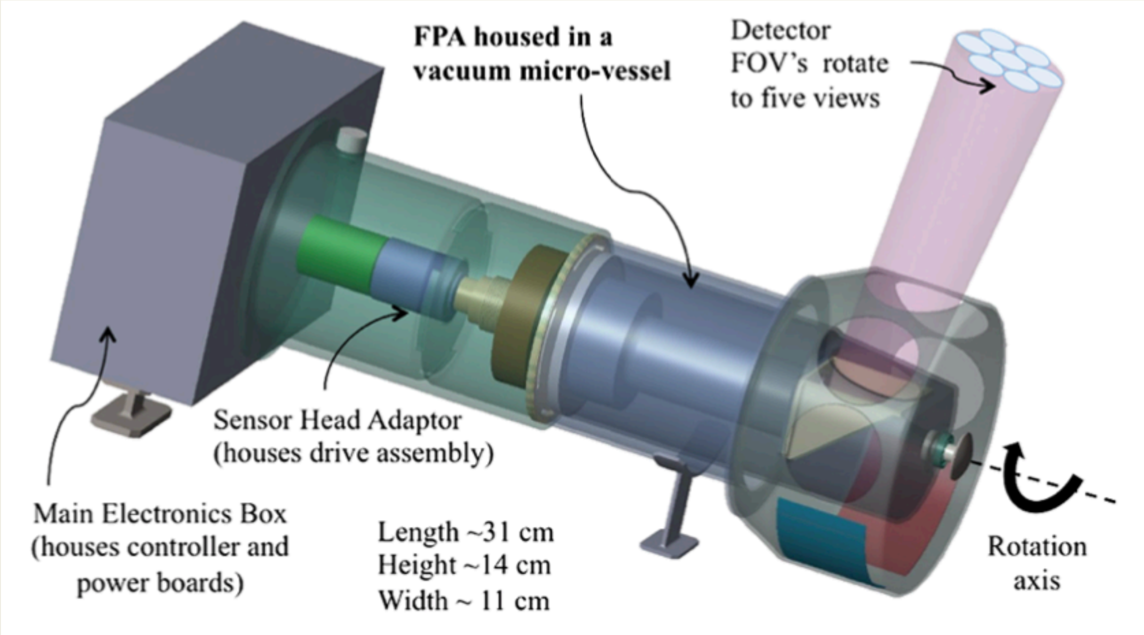


An animation of the IG-NFR descending through an Ice Giant Atmosphere. Five viewing angles are shown, along with predicted cloud layers and radiation paths. [2]

Goal of my project

Examining Responsivity of the Net Flux Radiometer for the Ice Giants (IG-NFR) with the goal to find the best spectral channels to observe in an Ice Giant Atmosphere

- Three filter bandwidths previously defined for broad areas of interest
- Four channels to be determined



Single spectra / Difference spectra

Full / Just CH4 / Just H2O / Just H2S / Just NH3 / No H2O / No H2S / No NH3

Full / Just CH4 / Just H2O / Just H2S / Just NH3 / No H2O / No H2S / No NH3

90˚ / 48˚ / 10˚ Solar Elevation Angle

±80˚ / ±45˚ / ±10˚ - NFR Viewing Angles

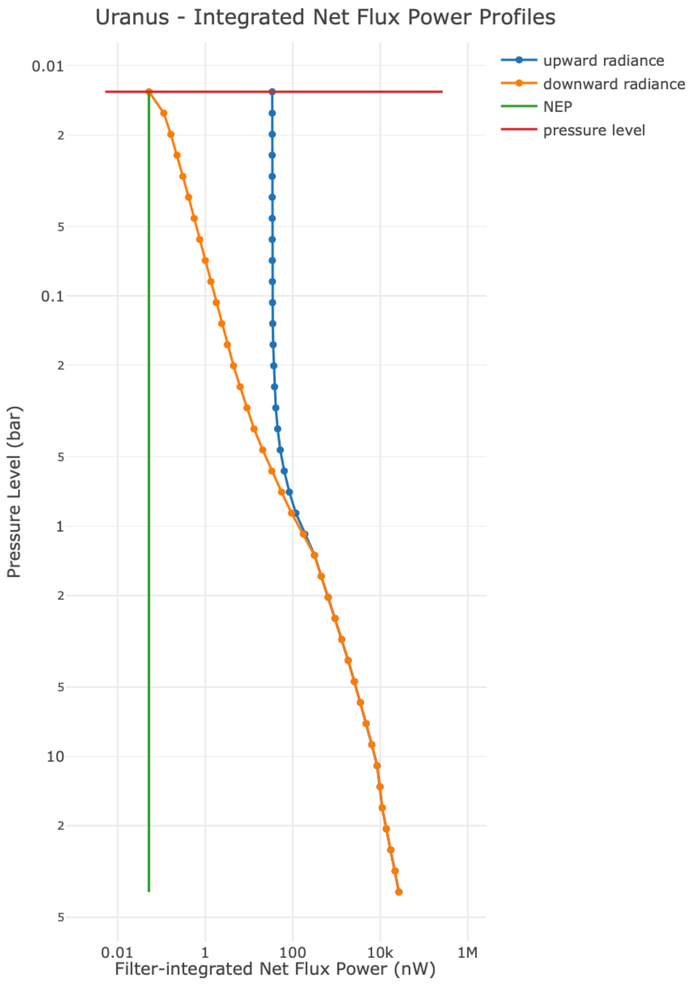
±80˚ / ±45˚ / ±10˚ - NFR Viewing Angles

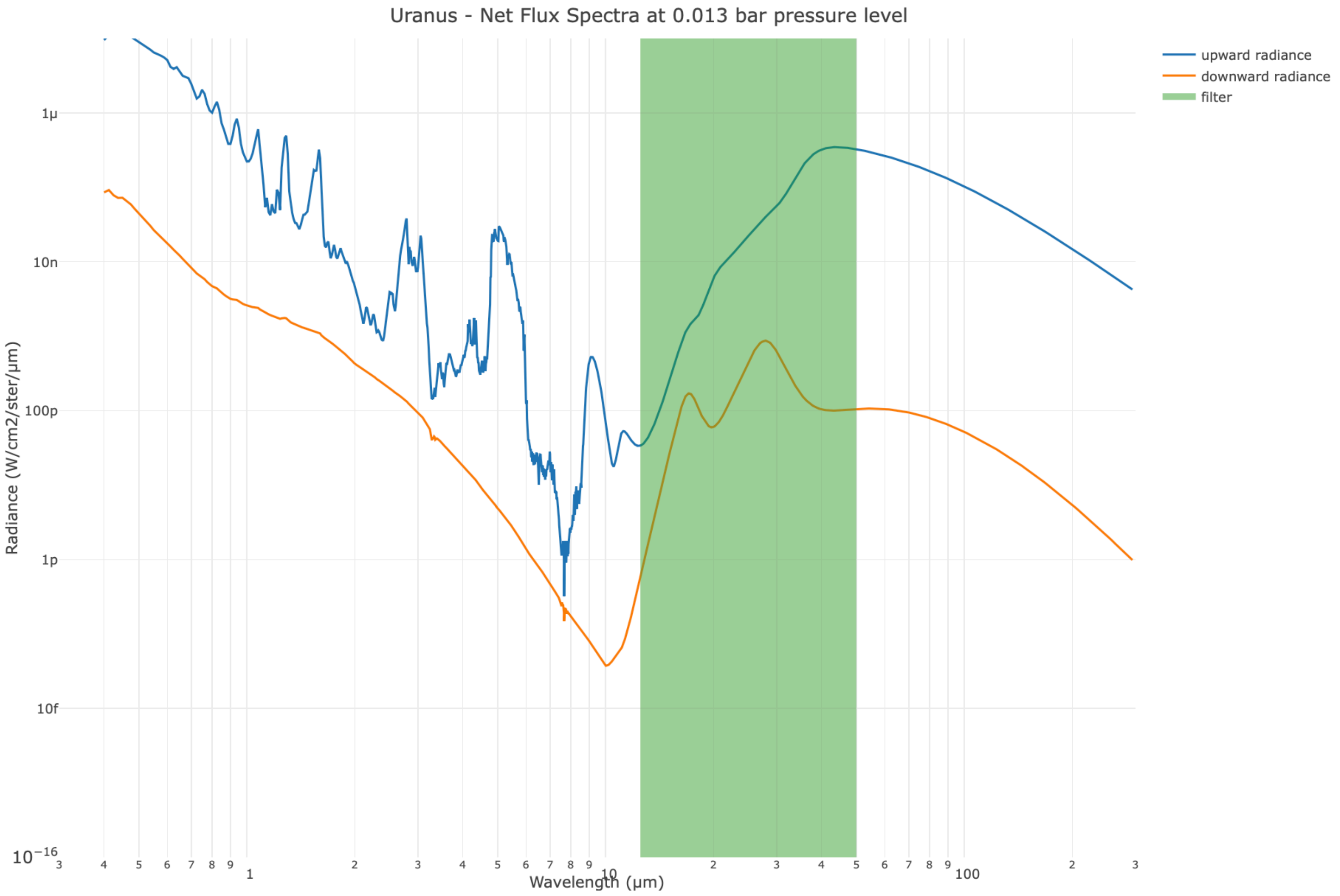
no cloud / cloud

Uranus / Neptune

NEP (nW)	NFR-FOV (˚)	Filter Left (µm)	Filter Right (µm)
0.052	10	12.5	50

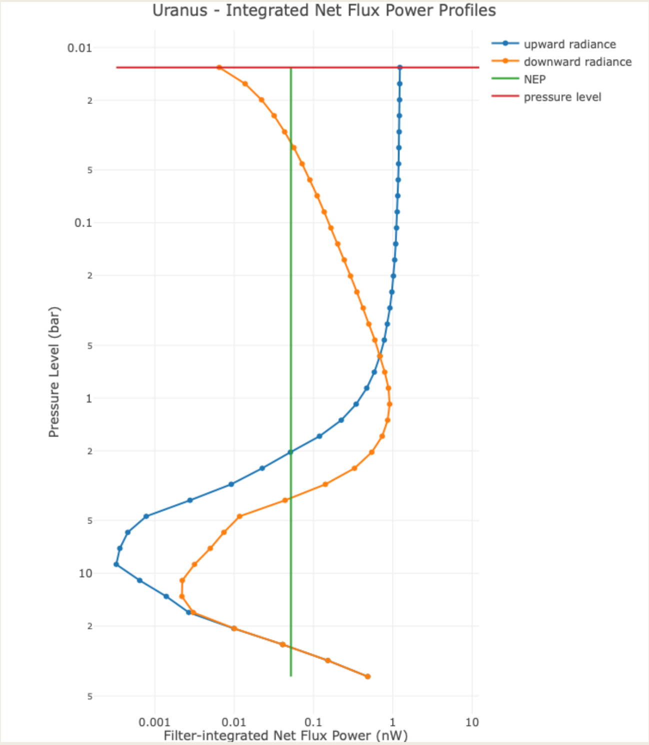
EXPORT NF-PROFILE



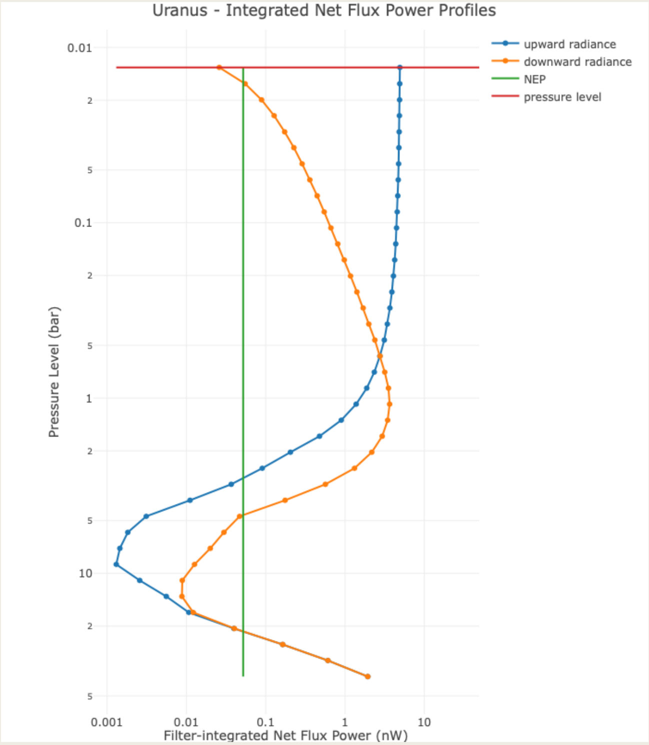


Field of View (FOV)

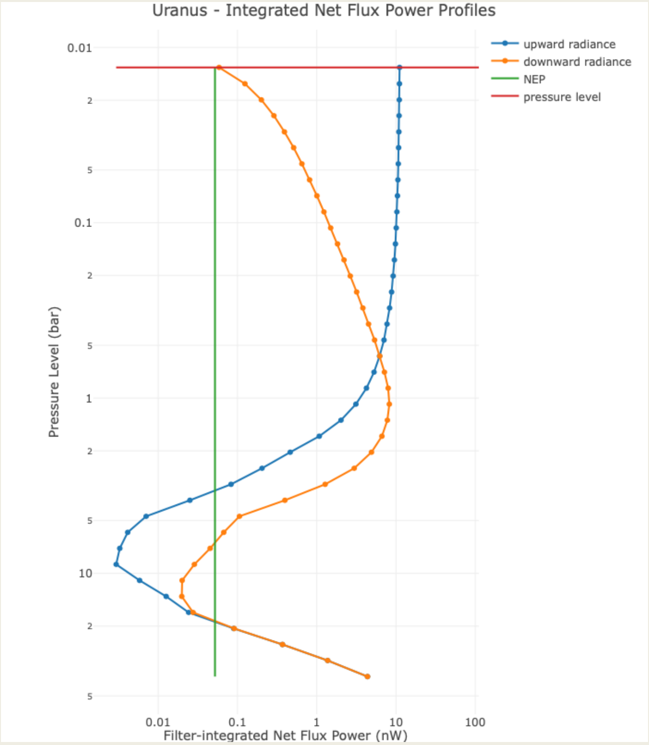
FOV 5°



FOV 10°



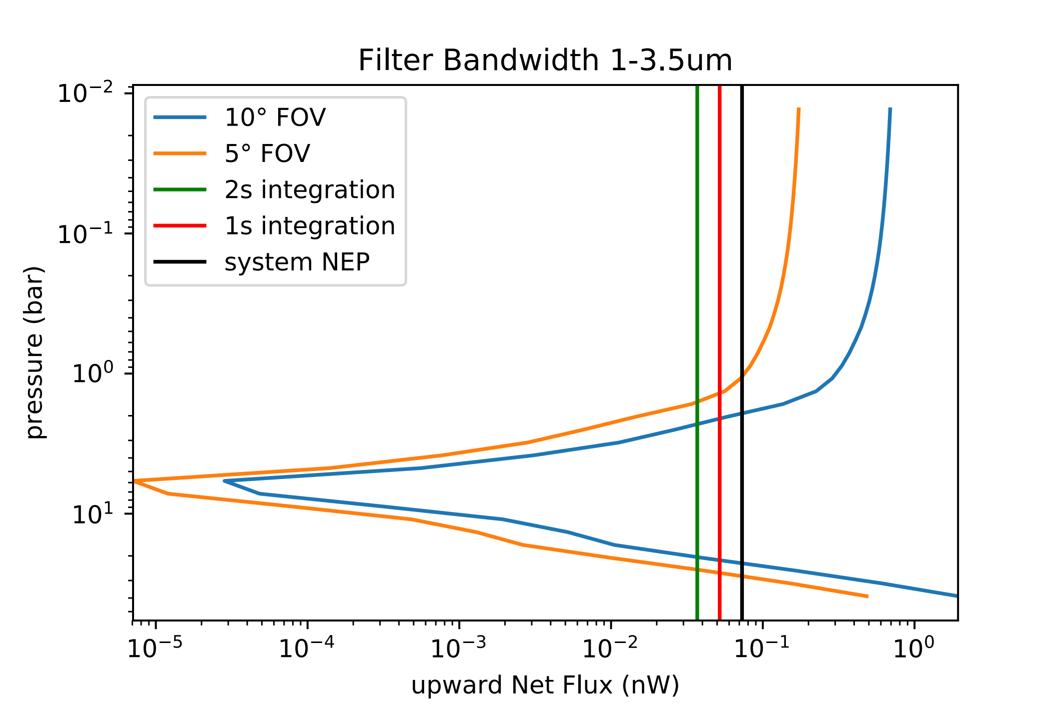
FOV 15°

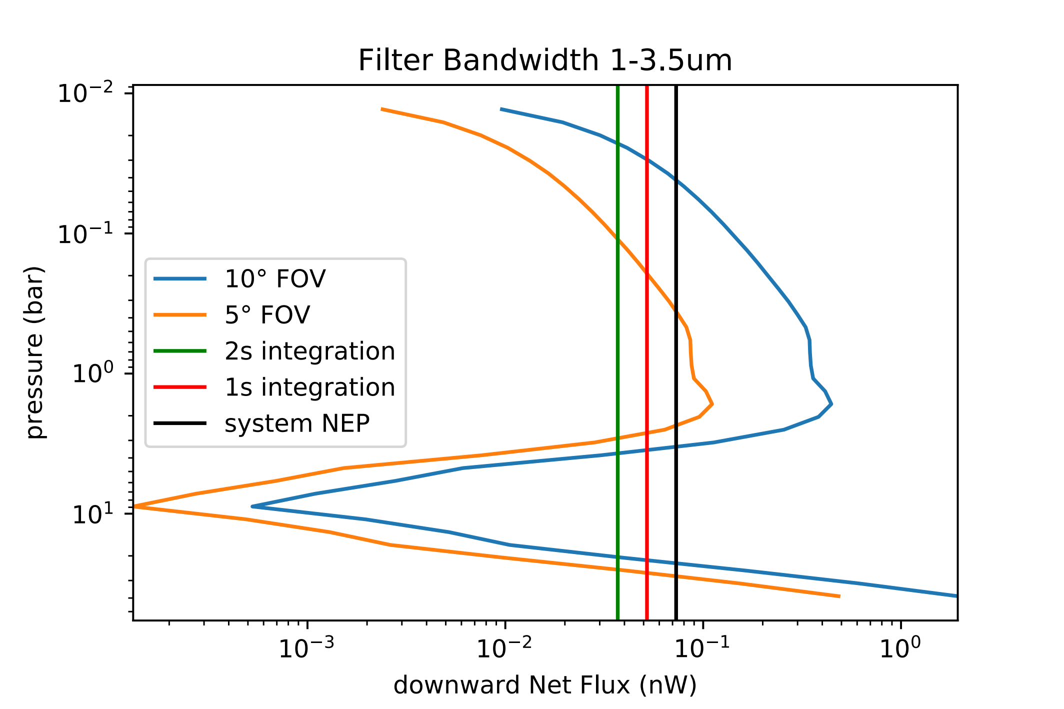


Bandwidth: 0.6-3.5um, 1s integration (NEP 52pW)

Improvement based on changes

Result of investigations done throughout the project. These plots show improvement in the thinnest (hardest to distinguish) channel, 1-.3.5um.





Additional Contributions to the Project

- Firmware on the NFR FPGA
  - *error checking script*
  - *A counter to determine the time that passes between events*
  - *https://www.researchgate.net/publication/340882630_Radiation-hard_parallel_readout_circuit_for_low-frequency_voltage_signal_measurements*
- Noise calibration test and fiber optic cable tests in the lab

Conclusions and Future Plans

- These findings are being used in a proposal to continue to receive funding for the development of the IG-NFR
- Repeat for Neptune

References

- [1] Sromovsky, L. A., Collard, A. D., Fry, P. M., Orton, G.S., Lemmon, M. T., Tomasko, M. G., Freedman, R. S. 1998. Galileo probe measurements of thermal and solar radiation fluxes in the Jovian atmosphere. *Journal of Geophysical Research* **103**, 22929-22977.
- [2] Aslam, S, Achterberg, R.K., Calcutt, S.B, Cottini, V., Gorius, N.J., Hewagama, T., Irwin, P.G., Nixon, C.A., Quilligan, G., Roos-Serote, M., Simon, A.A, Tran, D., Villanueva, G. (2020). Advanced Net Flux Radiometer for the Ice Giants. Space Science Reviews. 216
- [3] Irwin, P. & Teanby, N.A. & Kok, Remco & Fletcher, Leigh & Howett, C.J.A. & Tsang, Constantine & Wilson, Colin & Calcutt, Simon & Nixon, Conor & Parrish, P.D.. (2008). The NEMESIS planetary atmosphere radiative transfer and retrieval tool. Journal of Quantitative Spectroscopy & Radiative Transfer. 109. 1136-1150. 10.1016/j.jqsrt.2007.11.006.
- [4] G.L. Villanueva, M.D. Smith, S. Protopapa, S. Faggi, A.M. Mandell, Planetary Spectrum Generator: An accurate online radiative transfer suite for atmospheres, comets, small bodies and exoplanets, Journal of Quantitative Spectroscopy and Radiative Transfer, Volume 217, 2018, Pages 86-104, ISSN 0022-4073, https://doi.org/10.1016/j.jqsrt.2018.05.023.