

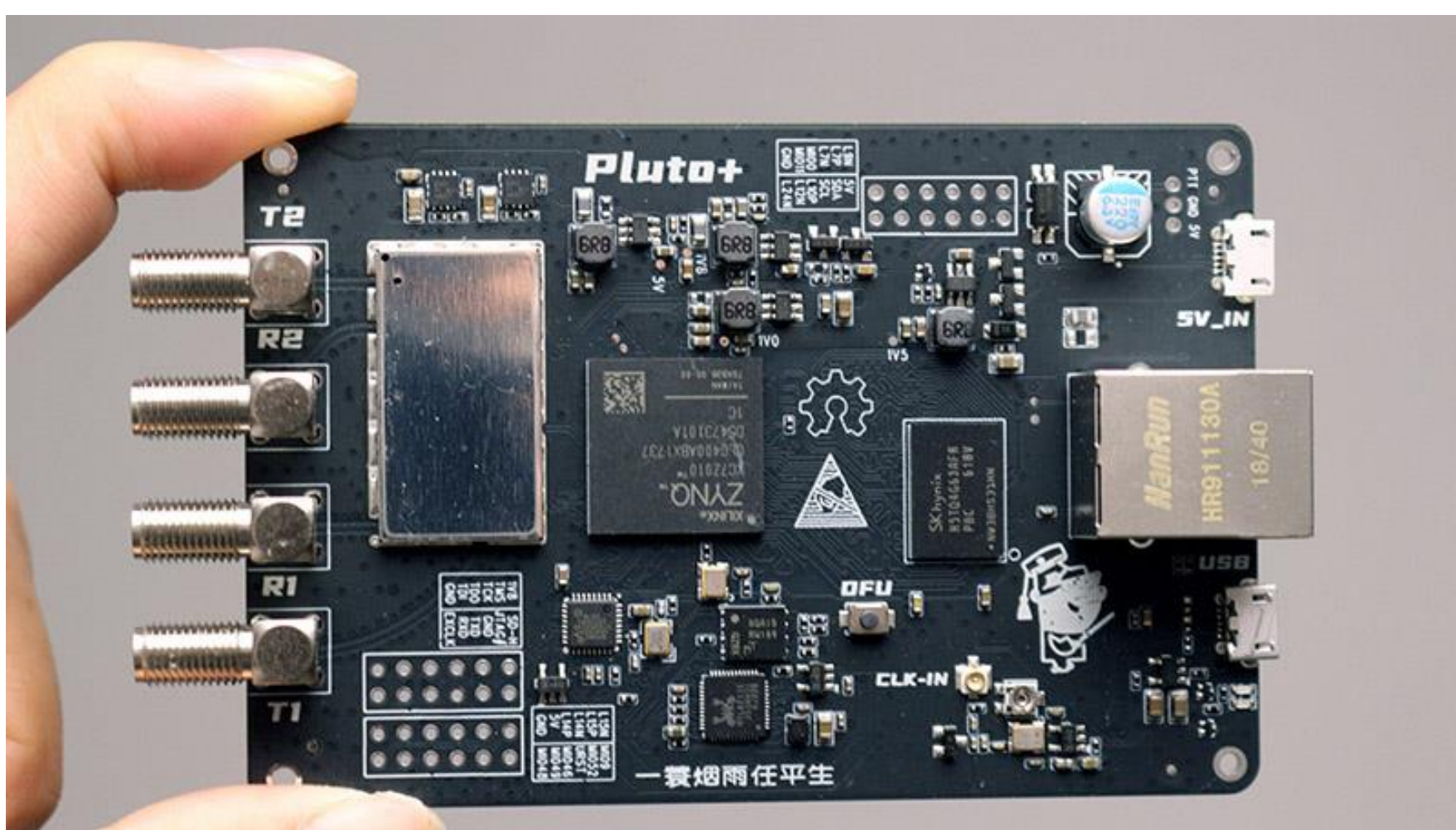
Analyzing Signals From Space

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Credit: Jeff Helderman, NRAO/AUI/NSF

Participate in the installation and calibration of the new radio telescope of the Physik-Institut. Receive and analyze artificial and natural signal sources from within and beyond our solar system.



Software-Defined Radio

Project

Advances in low noise radio frequency amplifiers allow small antennas to receive very weak signals from distant sources. In 2025, the Physik-Institut plans to set up a small radio telescope of 1.8m diameter, which will allow students to receive and analyze radio signals ranging from low earth orbit to distant pulsars. The antenna will be controlled fully remotely and can observe radio sources in the range between 1-10 GHz. It is therefore not limited to data-taking during the night or clear sky conditions.

Skills

- thermodynamics, nuclear physics, astrophysics
- movement of targets in gravitational fields
- working with radio frequencies
- analyzing signal demodulation and decoding with GnuRadio
- ultra-precision frequency measurements
- trajectory analysis with GMAT

Possible Topics

Natural sources

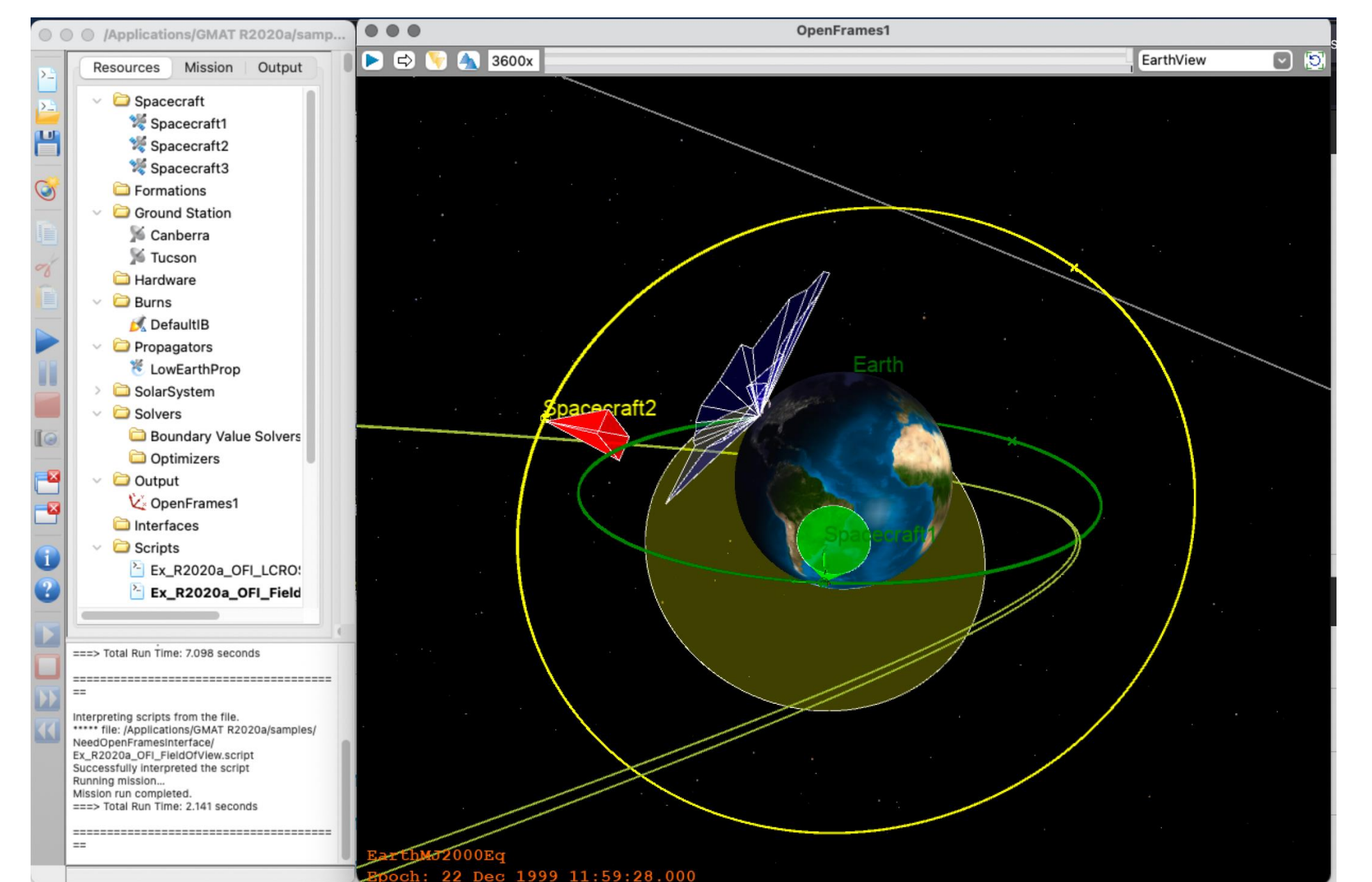
- black body radiation from Moon and Sun
- mapping the milky way: neutral hydrogen emission
- pulsar detection

Artificial sources

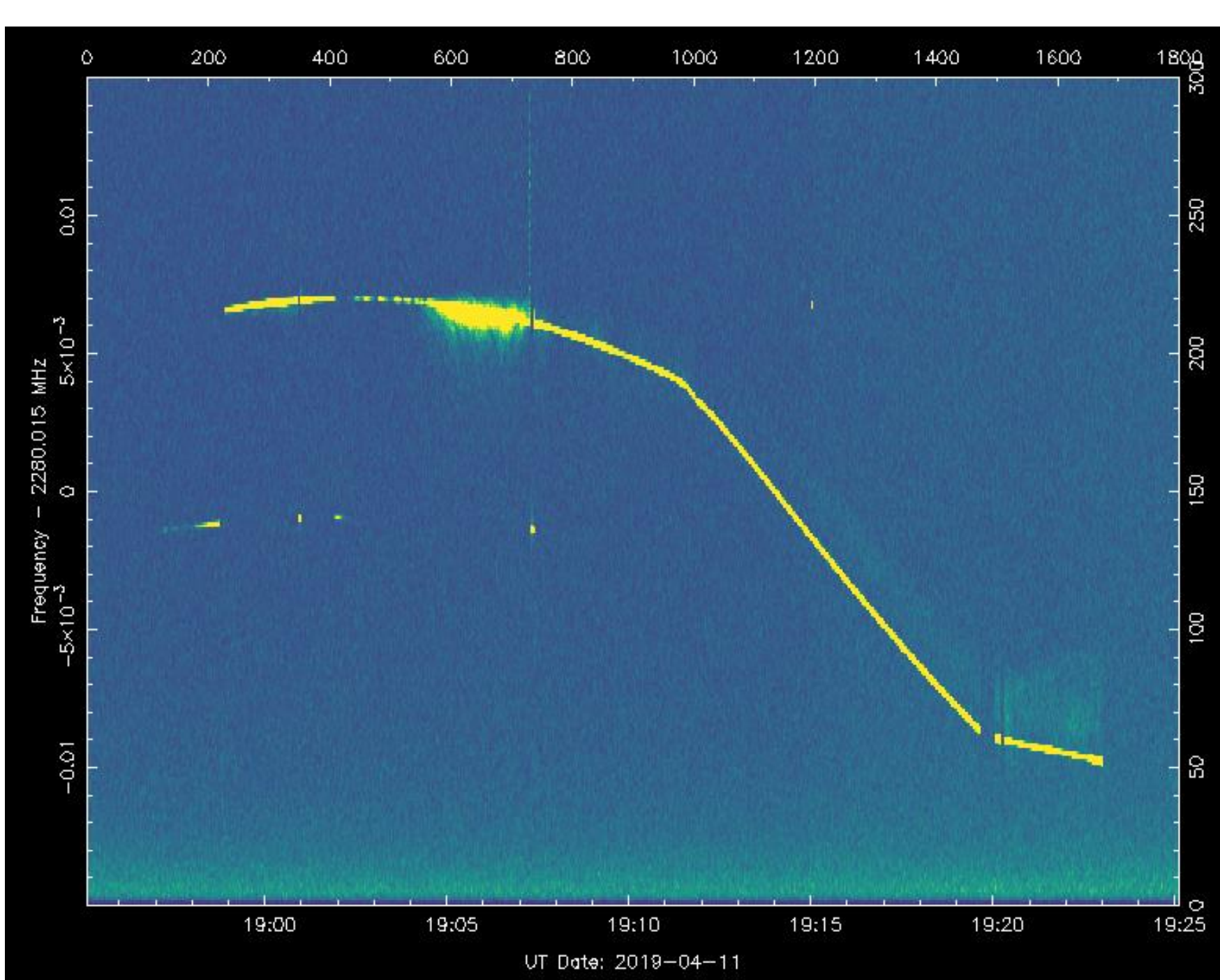
- spacecraft orbit determination via Doppler analysis (both earth orbit and interplanetary)
- image reception and analysis from earth observation satellites

Participation

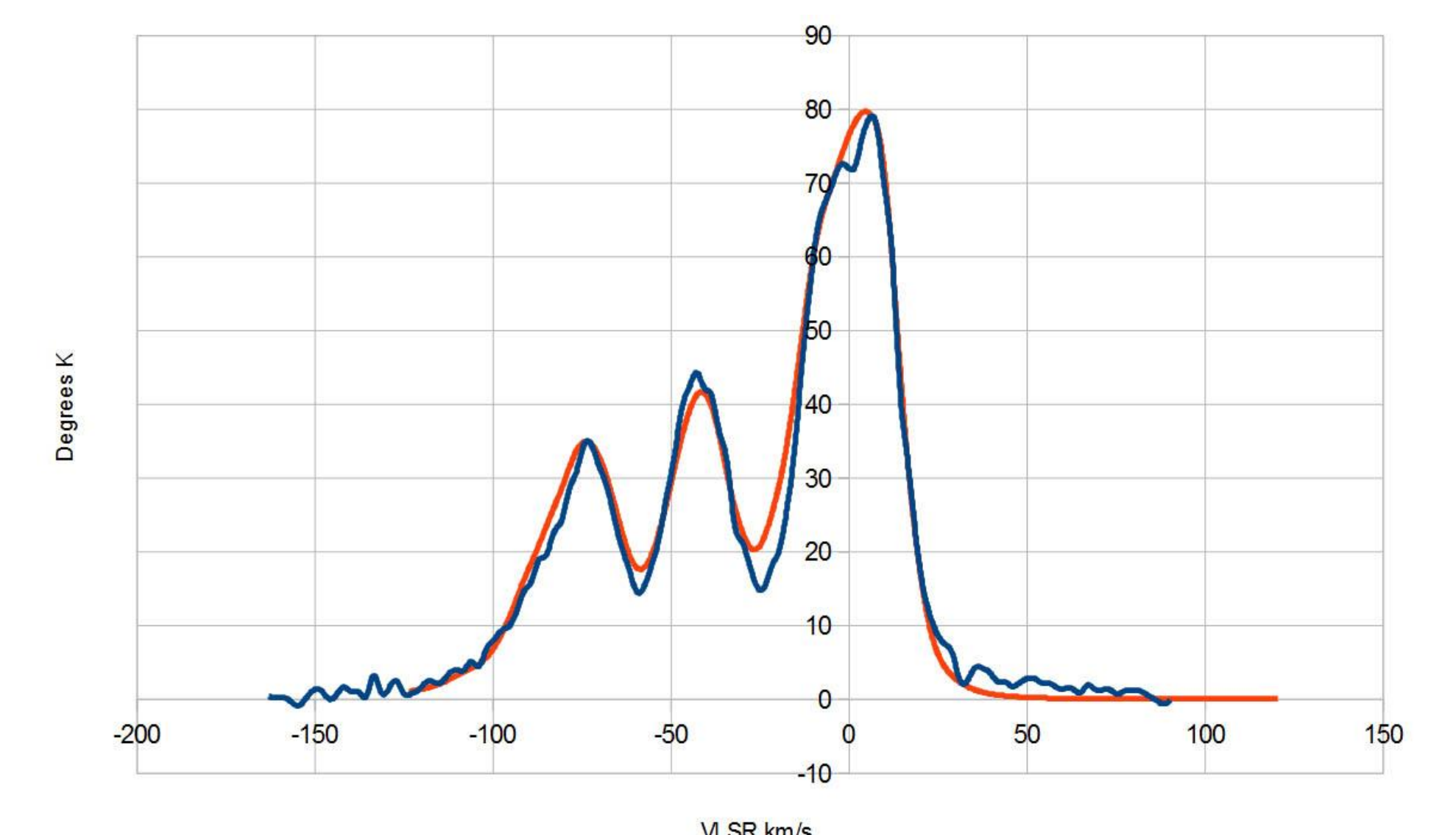
In the scope of an internship or a bachelor thesis, you can participate in the construction of the system, the initial calibration or data acquisition and analysis. It is also planned to integrate the system into the practical courses, which requires a new set of documentation and problems which future students can work on.



Fit observed Doppler data with GMAT to obtain spacecraft state vectors



Doppler curve of the Israeli Moonlander "Beresheet" during landing, as measured with the Dwingeloo (NL) Radio Telescope



Example of H-I mapping, brightness vs. radial velocity. Credit: Brian Coleman G4NNS

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