

Radio amateurs in service for NASA

For the last 17 years DLØSHF in Kiel has been a voluntary 'employee' of NASA. Day after day we track the sun-observing spacecraft STEREO-A (earlier also STEREO-B) and deliver the data via the German Research Network DFN to NASA.

Sun-observing spacecraft play an important rôle for the protection of humans and satellites in space. Predictions of solar eruptions allow to protect both humans and technical facilities in time. Even on the Earth surface strong solar eruptions can cause considerable effects, such as the break down of overland high voltage networks.

How came radio amateurs to be involved in this long-term projekt?

At that time, NASA had asked scientifically active and commercial ground stations for any free capacities. Apart from AMSAT DL (with its 20m dish), DLØSHF nonetheless applied with our 9m dish (Fig. 1).



Fig. 1: The 9m dish was used for tests on 8.4 GHz

Initially, one felt from NASA's side some scepticism about involving a private operator, but somehow someone at NASA had the pluck and two days later the first data came from Kiel! Obviously, the astonishment was great. Via contacts with the University of Kiel we learned that already for many years on-measuring instruments had been developed by the Applied Physics Institute, which had flown on many NASA satellites. Half a year after the start of the data transmissions there was a

meeting at the University on the subject of „STEREO“, attended by numerous scientists and engineers from NASA. DLØSHF also was invited. We learned many new things and could establish many connections. For one afternoon, the meeting took place on the grounds of DLØSHF (Fig. 2) at Kiel-Rönne, which houses six dishes between 4m and 9m diameter.



Fig. 2: Overview of the grounds of DLØSHF at the present time: In the background the 9m Sdish for 1.3 GHz, at left the 7.2m dish for 8.4 GHz, at the centre a 7.2m dish for 10 GHz and a 6m dish for 2.4 GHz.

Astonishment and the recognition could clearly be felt, which motivated us enormously for further steps. Many of us were strongly interested to solve problems with simple means. Over the length of the project there have been numerous visits by people from NASA.

After the STEREO spacecraft on their way around the Sun moved at ever greater distances from the Earth (about 300 million km), which made their signals weaker, the receiving system at DLØSHF came close to its limits. Aided by James Miller G3RUH we changed the decoding from FM-slope to LSB and also constructed a hardware decoder. A few years later it again became difficult to receive the signals. An improved modulation method - developed by Mario Lorenz DL5MLO – was installed by NASA in the spacecraft. This allowed DLØSHF to participate up to the mission's maximum distance from Earth.

Since as an amateur one cannot keep a close eye on the entire installation every day over 17 years, we had to learn how to make many procedure fully automatic and operationally safe. Here are some of the issues:

--- further development of the 8 GHz receiving system by an improved feedhorn design, with support from Paul Wade W1GHZ

--- improvement of the long-term frequency stability to 0.1 Hz, firstly by a rubidium source, later by reference to GPS.

--- improvement of the tracking accuracy by a pointing correction program by Joachim Köppen DF3GJ to 0.01° over the entire year.

--- automation and remote control of all actions and procedures by Martin Sürfke DM4MD.

Dealing with all the problems and challenges, often by external help, as well as new interesting human contacts have been for us both motivation and reward. In addition, this created opportunities for companies and government agencies to donate discarded materials.

About 2 years ago, NASA asked us, whether we had interest to participate in the new IMAP-mission ('Interstellar Mapping and Acceleration Probe'). This new IMAP spacecraft would be positioned in the Lagrangian point L1 between the Earth and the Sun, at a distance of about 1.5 million km. The expected data rate of 2Kb/s is well four times as high as for STEREO-A/B. Since we look back over 16 years of experience of receiving STEREO, and 8 years with ACE on 2.2 GHz with a 6m dish, the higher rate wetted our interest. Based on link budget calculations with IMAP's horn antenna and 10 W transmission power and DLØSHF's 7.2 m dish (Fig. 3), NASA decided that a cryogenic LNA (Fig. 4) with a substantially lower noise figure would be needed for use.



Fig 3: The 7.2m dish for 8.4 GHz

Since this cannot be realised with amateur means, NASA agreed to finance the LNA and lease it to us (via the University of Kiel). The cryogenic LNA has to work without servicing, i.e. without requiring a regular refill with liquid gas. The choice of the hardware was left for us, which resulted in a visit to the company Callisto, which is located in the vicinity of Toulouse.

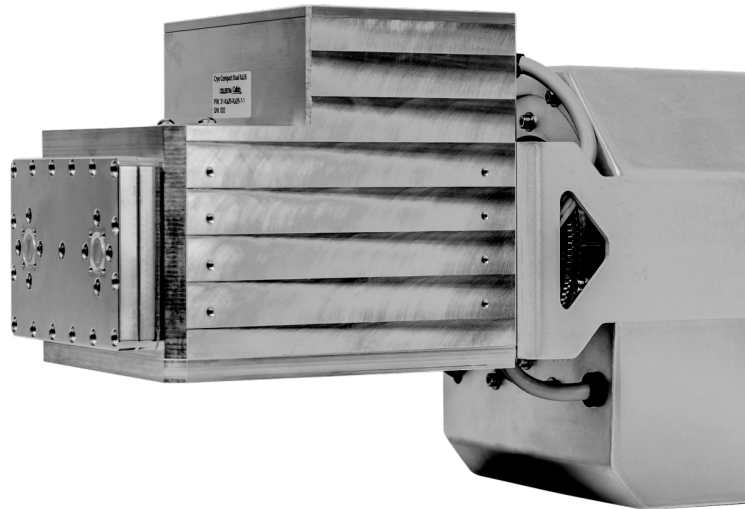


Fig. 4: The Compact Cryo-LNA (with kind permission by the Callisto company)

The LNA has been ordered and will be received by me after a briefing in Toulouse in spring 2026, and will immediately be integrated in the station. Until that time, it is quite possible that reception will suffer from short perturbations during poor weather. DLØSHF is glad that our amateur service finds recognition.

IMAP was successfully launched on August 23rd, 2025 and is now on its journey to its destination. It is planned to start with regular operations at the beginning of February 2026. DLØSHF received the first signals on the second day after launch, and passed the decoded data on to NASA. For this purpose, Mario Lorenz DL5MLO developed a new concept. The receiver is a ADALM-PLUTO SDR with a preceding mixer from 8.4 GHz to 1.2 GHz. The decoder also needed to be newly developed. The software (Fig. 5) also provides the tracking data for the dish. The entire system runs on a mini-PC under Linux.

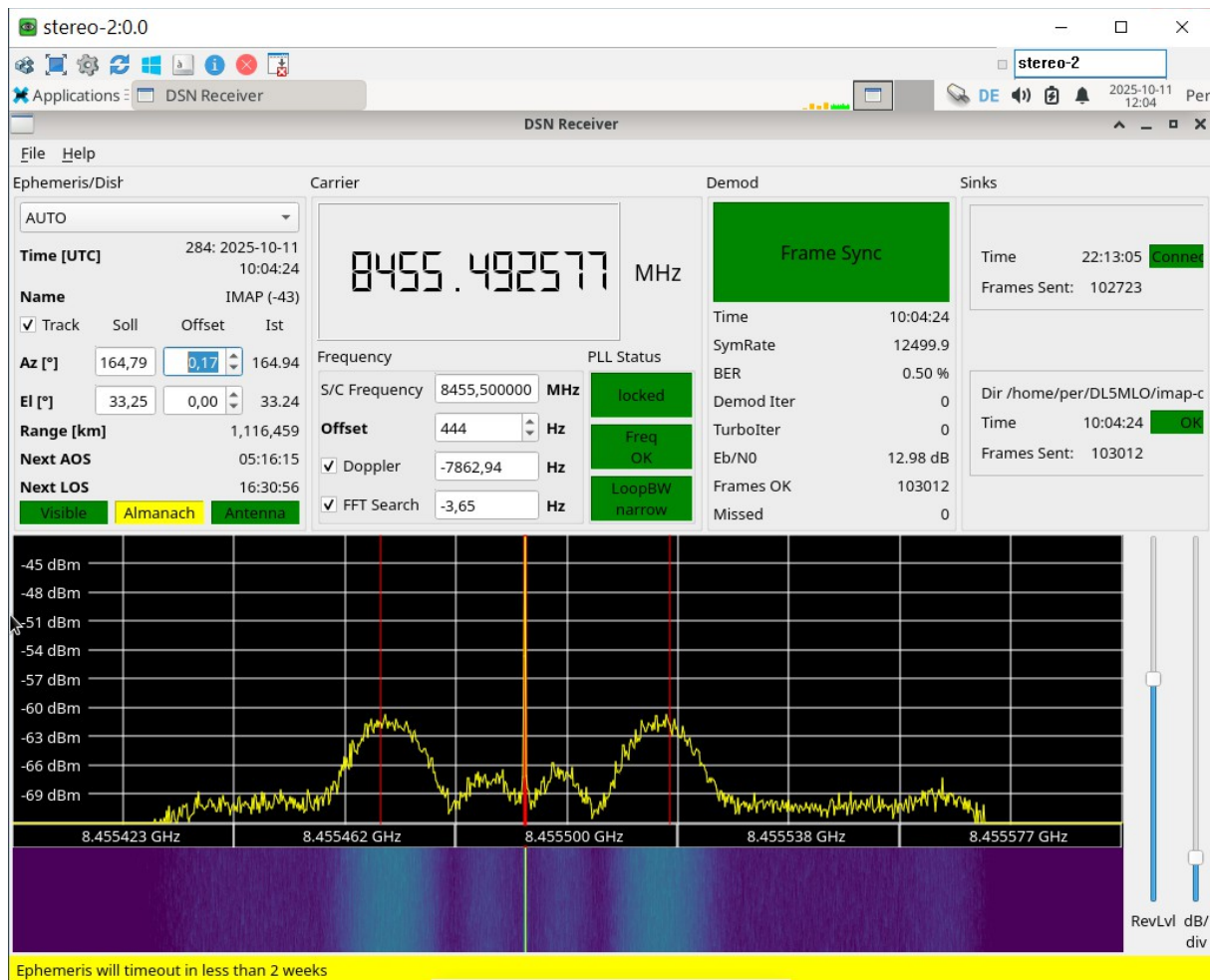


Fig. 5: Screenshot of the software by DL5MLO for reception, decoding, tracking, and data-routing for the data from IMAP

For me as organizer, procurer, and supervisor of the hardware these projects showed very clearly that the working together and combining the efforts of different individual interests can furnish great results.

DLØSHF is glad about everyone who likes to join in these activities and bring in his knowledge to solve problems, above all via remote and online operations, of course.

Kiel Oct. 8th, 2025 Per Dudek DK7LJ