The IVS Technical Development Center at the Onsala Space Observatory

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Abstract

We give a short overview of the activities at the Onsala Space Observatory related to the function as an IVS Technology Development Center. We concentrate on the ongoing work with the development of a new S/X-band feed system for the 20-m telescope and the design and construction of a new microwave radiometer.

1. Staff at Onsala Associated with the IVS Technology Development Center

The staff at Onsala associated with the IVS Technology Development Center is: Rune Byström (engineer), Gunnar Elgered (scientist), Lubomir Gradinarsky (Ph.D. student), Rüdiger Haas (scientist), Jan M. Johansson (scientist), Karl-Åke Johansson (engineer), Lars Pettersson (engineer), Hans-Georg Scherneck (scientist) and Borys Stoew (Ph.D. student).

2. Technical development at Onsala

2.1. New S/X feed system

The development of a new S- and X-band feed is ongoing. It consists of two feed reflectors used for both S- and the X-band. A more detailed description of the feed has been reported earlier [1], [2]. Two dual-band corrugated horns have been manufactured. The first version turned out to have a frequency band which was not centered correctly. A second, rescaled version was measured and showed a good antenna diagram for both bands. The coaxial waveguide transformer (COWAT) is the component which makes it possible to have access to the X-band ports (Right Hand Circular Polarization and Left Hand Circular Polarization) that are inside the coaxial S-band waveguide, before transforming the S-band coaxial waveguide into the S-band septum polarizer in circular waveguide (see Figure 2). Also the prototype COWAT was found to have the center frequency slightly off the desired value and it is now being redesigned. Simulations show that a reduction in length of some parts of the COWAT will lower the center frequency. The amount of reduction has not yet been decided. An X-band polarizer of septum type has been built (see Figure 4) and measurements show that it works though more measurements are needed before it can be decided if it fully meets the specifications. The S-band polarizer will be a scaled version of the X-band polarizer and has not yet been manufactured.

Figure 1: The dual-frequency corrugated horn.

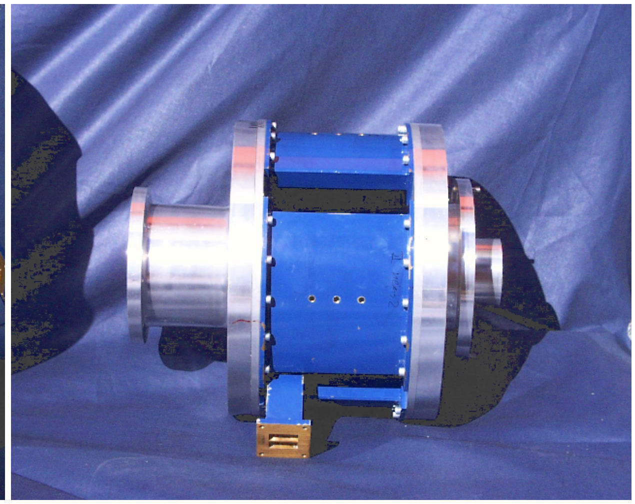

Figure 2: The coaxial waveguide transformer (COWAT). Note the X-band waveguide with output ports for both right and left circular polarizations.

Figure 3: The feed horn and the COWAT mounted together.

Figure 4: View into the COWAT showing the X-band septum polarizer sitting inside. The polarizer uses a stepped metal septum to separate the two modes into two rectangular waveguides for right hand and left hand circular polarization.

2.2. A Micro Rain Radar

In the fall of 1997 a small radar was obtained for characterization of rain events at the Onsala Space Observatory. It is a Frequency Modulated-Continuous Wave (FM-CW) radar and is always measuring in the zenith direction. A picture of the radar is shown together with a block diagram in Figures 5 and 6. The radar measures the velocity spectra of the falling drops. From these data the rain rate and the liquid water density can be inferred. During the first year the radar was operating to a height of 1200 m with a range resolution of 200 m. The data so far used is the rain rate at the height of 200 m. This information is used to develop an independent method to firstly have an archive of rain events at the Onsala site, and secondly to assess the quality of microwave radiometer data used for propagation delay studies. A preliminary investigation concerning the use of rain radar data for automatic editing of microwave radiometer data was recently presented. It was found that the earlier used threshold value of 0.7 mm liquid water content is reasonable when trying to eliminate microwave radiometer data acquired during rain [3].

Figure 5: The zenith looking Micro Rain Radar (MRR) at the Onsala site.

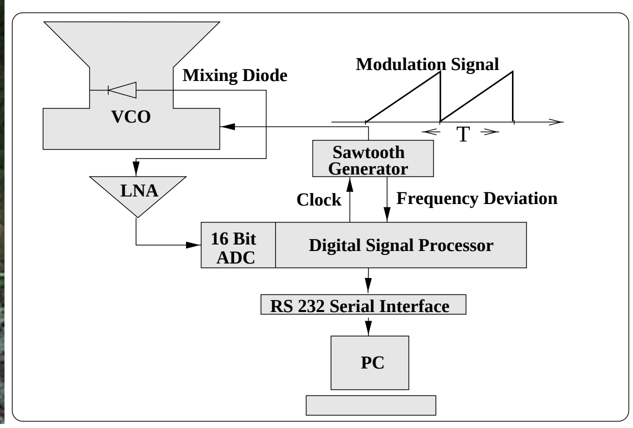

Figure 6: Block diagram of the Micro Rain Radar (MRR) at the Onsala site.

2.3. A New Microwave Radiometer

A second microwave radiometer for observations of the atmospheric emission around the 22 GHz water vapor emission line is being developed [4]. The main application will be comparison measurements at the Onsala site. Temporary measurement campaigns at other sites, e.g. in the Swedish GPS network, are also planned. A major difference compared to the existing Onsala radiometer is that the half power antenna beam widths are approximately 2° instead of 6°. Figure 7 shows the design of the instrument and Figure 8 shows the microwave part.

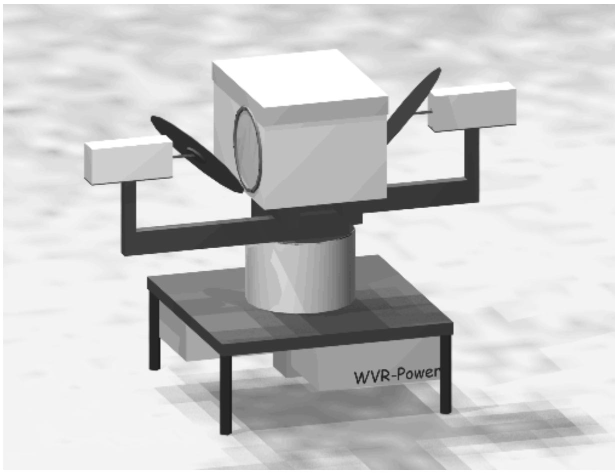

Figure 7: The design of the new microwave radiometer. Using two synchronized flat mirrors the antenna beams will be sensing the sky in the same direction.

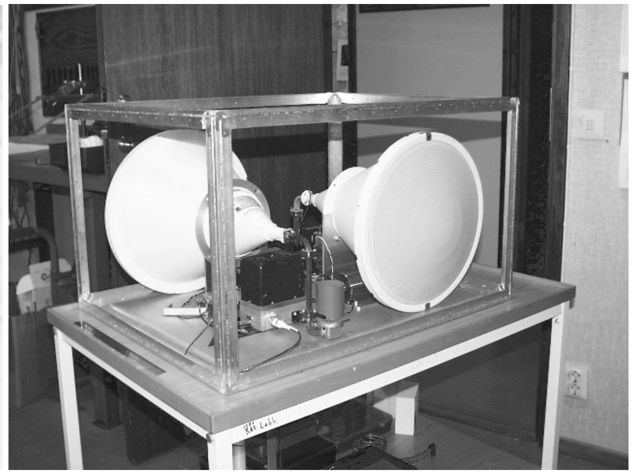

Figure 8: The microwave part of the new radiometer. The horn antennas are equipped with lenses and are looking in opposite directions.

References

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