STEAM-R (Stratosphere-Troposphere Exchange And climate Monitor Radiometer)

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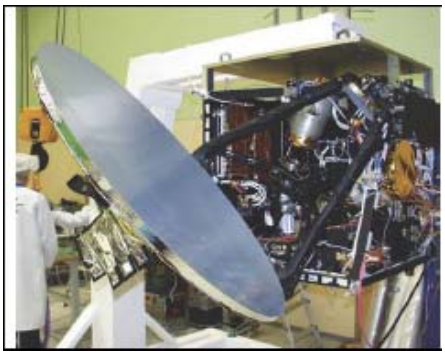
ABSTRACT

The Stratosphere-Troposphere Exchange And climate Monitor radiometer, STEAM-R, is a Swedish national contribution to the PREMIER mission. This is specifically designed to provide accurate measurements of the global distributions of key target species in the UTLS. To achieve good vertical and horizontal resolution, it will utilise a small linear array of receivers, which will image different altitudes simultaneously backward along the satellite track, thereby providing unique information about the 2-D structure of the atmosphere in the orbital plane.

Channel		(1) UT/LS	(2) Stratosphere
Frequency	Lower sideband upper sideband Local oscillator	324.0-332.0 GHz 343.8-351.8 GHz[18] 337.9 GHz	488.25-492.25 GHz 500.25-504.25 GHz 496.25 GHz
Spectral resolution		10 MHz	5 MHz
Lower FOV boundary at		5 km	12 km
Upper FOV boundary at		28 km[19]	35 km
Vertical sampling		1.5 km	1.5 km
Horizontal sampling (along track)		< 50 km	< 50 km

Table 1. Baseline specifications of STEAM-R

The heterodyne array receivers are based on broad band sub-harmonically pumped planar Schottky diode mixers operating in the 320-360 GHz spectral range. A secondary alternative band can be measured in a time sharing mode using the same receiver by electronically selecting the frequency of the local oscillator (LO). The sub-mm channel in the frequency band 485-505 GHz will extend the measurements of O3, N2O, and H2O (Table 1) higher up in the stratosphere from 15 to 37 km, and above all will provide more sensitive measurements of ClO (ozone destruction) and HDO (D/H ratio, tracer for STE).



The signal originating from both sidebands is down-converted to an intermediate frequency (IF) in the range ~6-14 GHz. The IF signal is filtered, amplified and spectrally resolved using autocorrelation spectrometers that provide a instantaneous bandwidth of 8 GHz for the mm band and 4 GHz in the sub-mm band, with a spectral resolution of 10 MHz. The possibility of using side band separation mixers to achieve single sideband detection is under study. The use of frequency multipliers and power amplifiers to generate the LO will offer both simplification and increased reliability. Both bands share pre-optics and calibration targets. We expect the PREMIER radio telescope to be similar to the Odin telescope which is a shaped off axis Gregorian design. It will be constructed of carbon fibre composite material for thermal stability and have a surface accuracy better than 15 μm RMS, a factor of 2 less demanding than for Odin.

The STEAM-R instrument will be presented on system level and key subsystems will be described in detail.