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Integrated frequency agile submillimeter radiometer

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Traditionally, many radiometer systems have been designed and developed in collaboration between several groups, often residing in different countries. The reasons are obvious, but there are also disadvantages, the major one is perhaps to achieve a high level of system integration and optimization.

Omnisys has started a project, funded by the Swedish National Space Board, with the goal to demonstrate the performance of a complete sub-millimeter radiometer, designed as an integrated instrument. It will be demonstrated in lab environment, but capable of operation in balloon, or low cost satellite environment. The radiometer will be tuneable between 300-360 GHz and incorporate high resolution as well as broadband spectroscopy capability. This scientific requirement specification is very similar to Mambo (radiometer for Mars), VEMEX (radiometer for Venus) and STEAM (multibeam radiometer for aeronomy).

The system level design and optimization will be presented, complemented with subsystem and system level test results. It will demonstrate state of the art scientific performance in combination with size, mass, power and cost reductions with orders of magnitude.

The radiometer consists of three sections; the front-end block, the local oscillator subsystem and the spectrometer back-end. The front-end consist of a diode based mixer and passive doublers, together with a LNA. The local oscillator chain is based on a synthesized YIG source, followed by active multipliers and amplifiers. The spectrometer back-end consists of four spectrometer blocks, covering a bandwidth of 4 GHz with 4096 channels.

Table 1. Function and performance

Parameter	Specification
Input frequency:	300-360 GHz
Tsys:	< 2000 K
IF bandwidth:	> 6 GHz
Processed bandwidth:	> 4 GHz
Resolution:	100 kHz -10 MHz
# channels:	4096
Mass	< 1 kg
Power consumption	6-11 W

To our knowledge, the ODIN payload is the only frequency agile submillimeter radiometer in space, but this system will show much improved frequency coverage, while providing state of the art performance (for non cryogenic systems). The spectrometer subsystem will be able to cover both the Herschel/HIFI high resolution and wide bandwidth specifications, with a power budget of less than 11 W and mass of 600 grams.

The demonstrator project has a budget of 600 KEuro and runs over 15 months. This also shows the potential economic and schedule advantages of focusing on an integrated system development.