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HIFI instrument stability as measured during the Thermal Vacuum tests of the Herschel space observatory

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***Abstract*—** HIFI, the high resolution far infrared heterodyne instrument for ESA's Herschel satellite consists of seven dual polarization sensitive mixer bands (SIS and HEB), and fourteen local oscillator channels. It is without a doubt the most complex and unique heterodyne instrument ever put together. To verify instrument performance and observation efficiency, we have investigated the HIFI instrument IF and System stability during thermal vacuum (TV) tests in the European Space Agency (ESA) Large Space Simulator (LSS) at ESTEC, Noorwijk, the Netherlands. During these tests the Local oscillator unit (LOU) was cooled to 110 K, mimicking flight operation.

As part of the Thermal Vacuum tests particular emphasis was given to:

- Verification and operational performance of frequency switch observations in all LO subbands. If successful this observation mode is particular useful in, for example, time efficient mapping of extended line sources.
- Verification of the instrument total power and spectroscopic stability. The results will be compared to that obtained during the instrument level test phase (2007).
- LO warm-up.
- In-band LO settling time.

Complicating the situation is that the local oscillator (LO) injection in HIFI is accomplished via quasi-optical beam-splitters (SIS mixer bands 1, 2, 5) and diplexers (SIS mixer bands 3, 4, and HEB mixer bands 6, 7). Especially in the diplexer bands we find evidence of significant baseline distortion during frequency switching, even when the frequency jump was between two peaks (or troughs) of the dominant optical standing wave between mixer and local oscillator.

In the talk we present an overview of the Allan Variance method, the measured SIS and HEB stability results, LO time constants, and how they impact baseline quality and observation efficiency.