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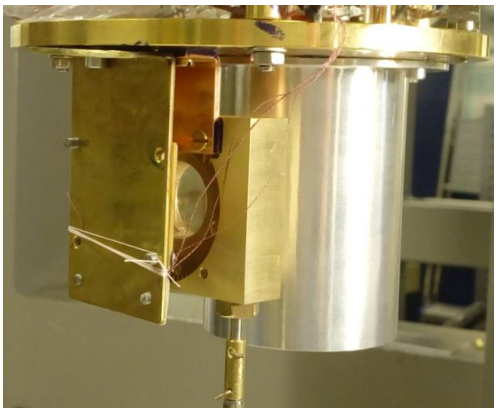
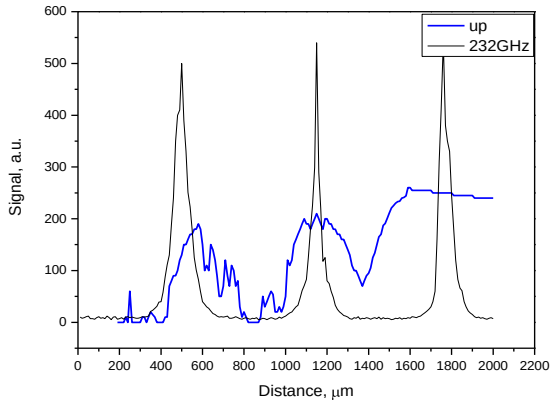
GRID INTERFEROMETER FOR SPECTRAL CALIBRATION OF CRYOGENIC BOLOMETERS

M.Tarasov, *A.Chekushkin, L.Jönsson, , L.Kuzmin*
Chalmers University of Technology, Sweden
V.Kotelnikov Institute of Radio Engineering and Electronocs RAS, Russia

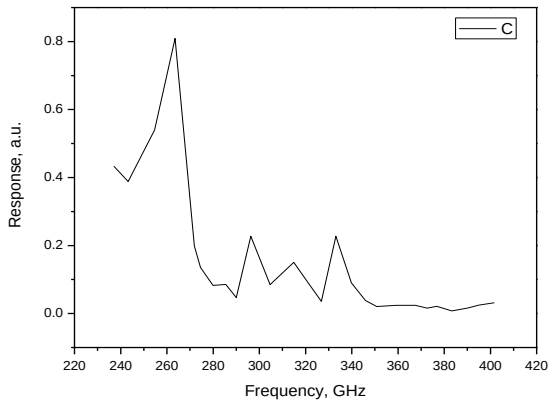
For balloon-borne projects like BOOMERANG and OLIMPO with noise equivalent power below 10^{-17} W/Hz$^{1/2}$ bolometers should be cooled to temperature below 300 mK. Calibration of such receivers is a big challenge, because it requires suppressing room-temperature background radiation by over 3 orders of magnitude. In general the impact of the background should be at the level of thermal background of the cold stage. This means that calibration setup should be completely cryogenic. Spectral evaluation requires frequency tunable source and the only practical solution is using Planck black body radiation source and permanent or tunable spectral filter. We have designed and fabricated a tunable grid interferometer that is intended for spectral evaluation of cryogenic receivers using Planck black body radiation source. The average quality factor of about 25 and transmission at resonance about 50% was obtained in 95-400 GHz frequency range. Interferometer grids with 40 μm period were made of 300 nm thick gold film evaporated on quartz substrates. For fine moving we use a wormgear, cogwheel and thread combination that brings the tuning factor of 10 μm/turn.



View of the experimental setup mounted in the cryostat. In the photo from left to right: fast black body, interferometer, and bolometer placed inside the aluminium radiation shield. Black body holder, interferometer and radiation shield are mounted on a 2.8 K stage of pulse tube refrigerator, and bolometer attached to 280 mK stage of He^3 sorption cooler.



Interferometer response for calibration measurement with 232 GHz IMPATT diode source and pyroelectric receiver (black), and bolometer with black body radiation source (blue).



Spectral response of bolometer measured with a backward wave oscillator source illuminating sample through optical window and three cold neutral density filters.