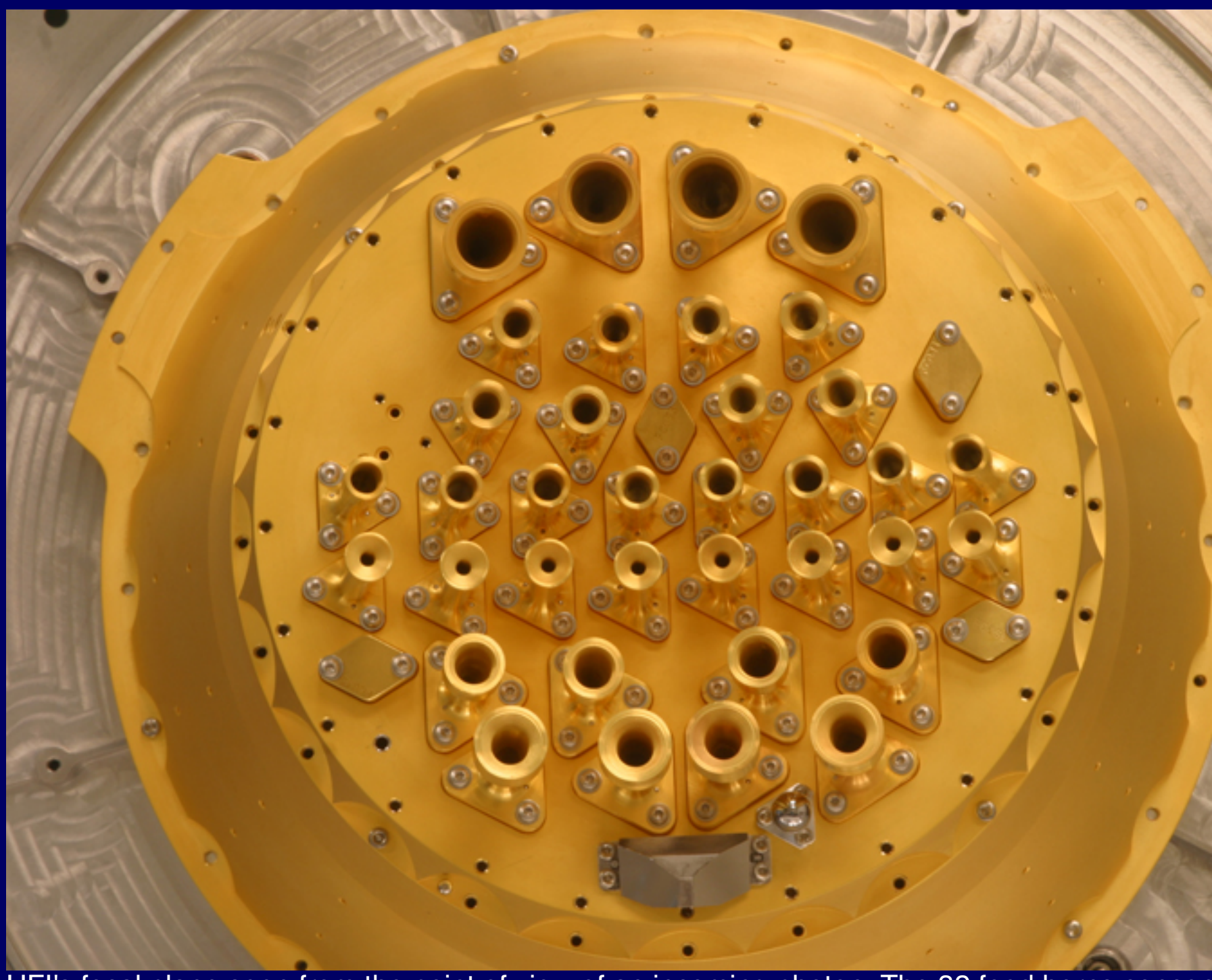
PLANCK

The Planck High Frequency Instrument (HFI)

The High Frequency Instrument (HFI) aboard Planck uses Jet Propulsion Laboratory spide
bolometers cooled to 0.1 K to map the sky in six frequency bands from 100 to 857 GHz (3 mm
detectors in the focal plane was fabricated at JPL's Microdevices Laboratory (MDL).

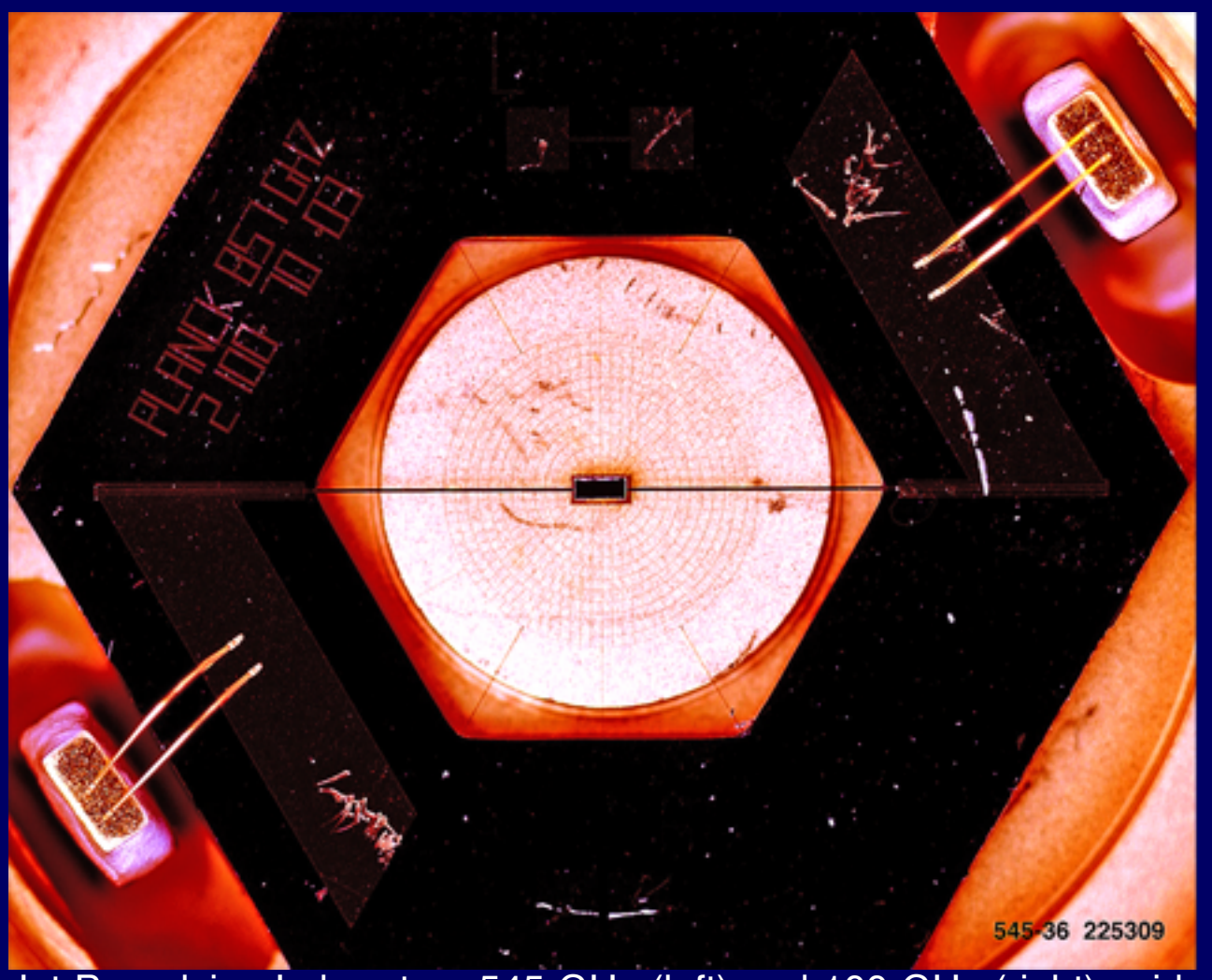


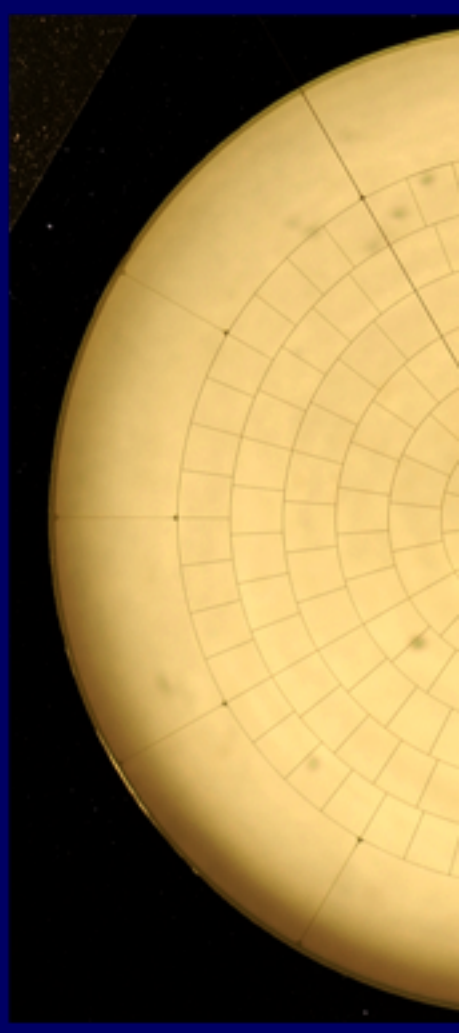
HFI's focal plane seen from the point of view of an incoming photon. The 32 feed horns concen
detectors. (Image credit: ESA)

A bolometer detects infrared and mm-wave light by detecting its heat, much like feeling the wa
The light is absorbed on the surface of the bolometer (which looks like a spider web), heati
temperature increase of the bolometer is detected by a tiny thermometer (thermistor) in the c
temperature of the bolometer depends on the intensity of the incoming light.

Bolometers detect any source of heat – including cosmic ray particles that can hit the bolome
web design allows long-wavelength thermal radiation to be absorbed, but high-energy cosmi
web design also makes the bolometers much lighter and less sensitive to the vibrations of a roc

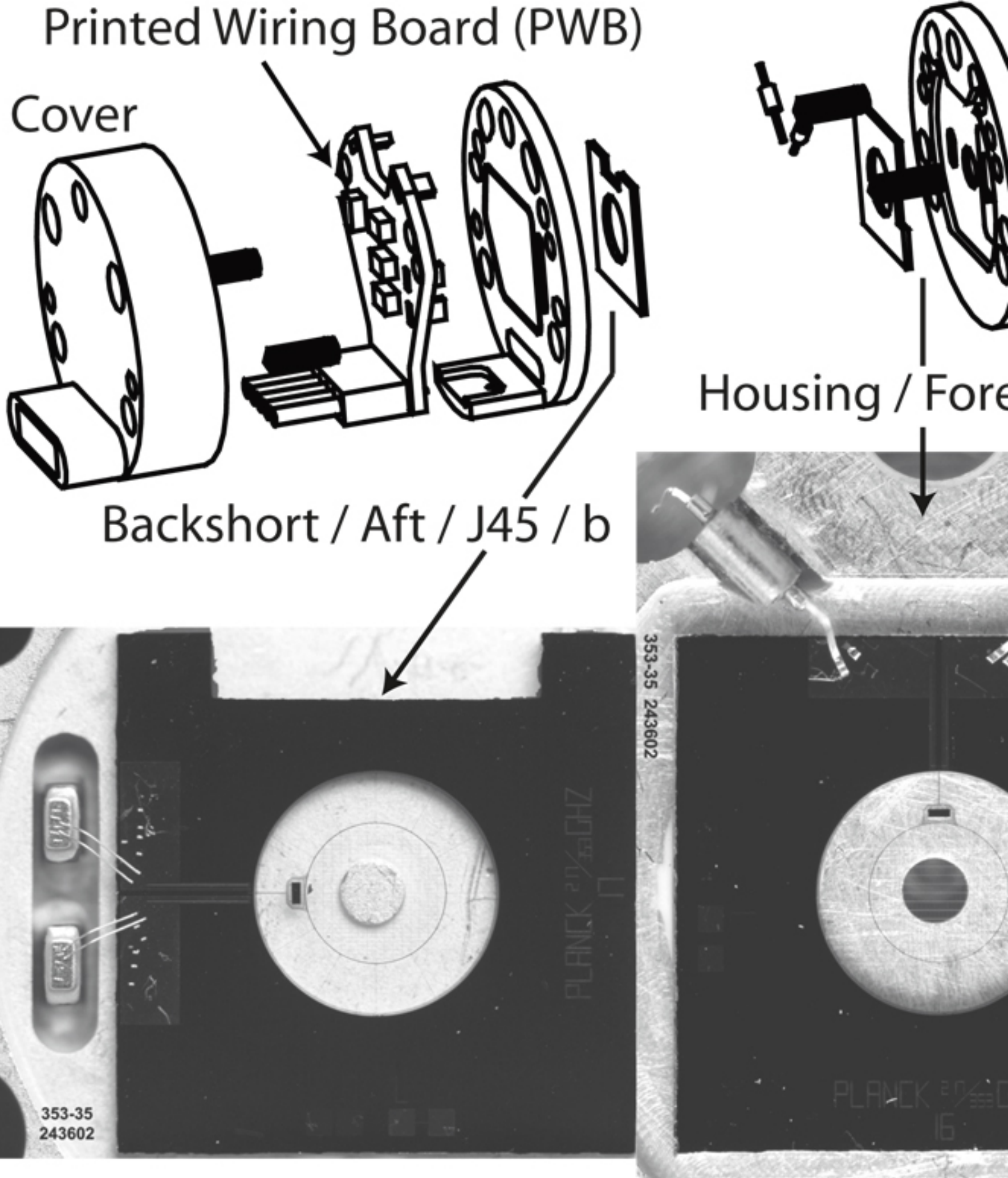
The spider web consists of 1 micron thick silicon nitride, coated with gold. The thermistor i
neutron transmutation doped (NTD) germanium, and is connected to the spider web with indiu
diameter and grid spacing varies depending on the frequency of operation of the device.





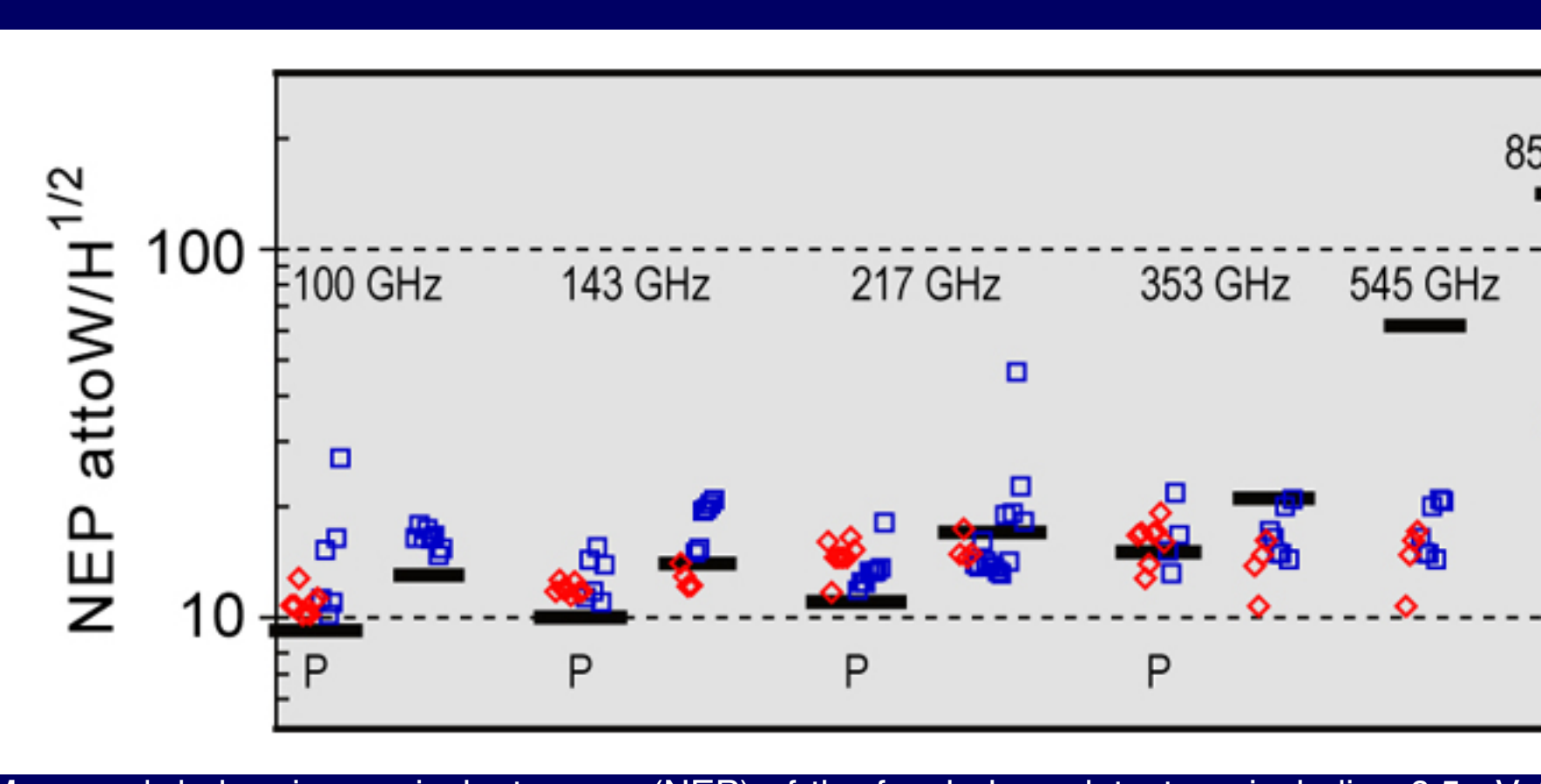
Jet Propulsion Laboratory 545 GHz (left) and 100 GHz (right) spider-web bolometers for HFI. web absorbs the light and the thermistor (small rectangle in the center of each web) mea temperature. (from Holmes et al. (2008))

The 32 polarization sensitive bolometers (PSBs) aboard Planck can also measure the polariza a circular spider-web grid, a PSB consists of a square grid which is only metallized in one dire to only absorb a single polarization of incoming radiation. Every PSB works in a pair so that eac simultaneously.



A polarization sensitive bolometer (PSB) module (from Holmes et al.(2008)). Two PSBs a together and each absorbs one polarization of the incoming light. (from Holmes et al. (2008))

The mission of Planck is to measure tiny fluctuations in the 2.7 Kelvin Cosmic Microwa bolometers must be cooled and operated at 0.1 Kelvin in order to minimize sources of noise. the limit of background photon noise during operations at L2.



Measured dark noise equivalent power (NEP) of the focal plane detectors, including 6.5 nV /

noise at nominal bias. The open diamond symbols are the NEP for detectors installed in the
open square symbols are the NEP of spare bolometers. The thick solid line segments in
background limit from a 35 K telescope and astrophysical sources in each band for a 30% ban
band optical efficiency. Unpolarized detectors at 100 GHz were made and delivered but
polarized detectors. (from Holmes et al. (2008))

For more technical background:

- W.A. Holmes et al., Initial Test Results on Bolometers for the Planck High Frequency Instrur
(2008)

- J .M. Lamarre et al., in "The Cosmic Microwave Background and its Polarization", New Astron
and R.A. Olive) astro-ph/0308075v1 (2003).