



Spider-Web and Polarization- Sensitive Bolometers for Planck/HFI

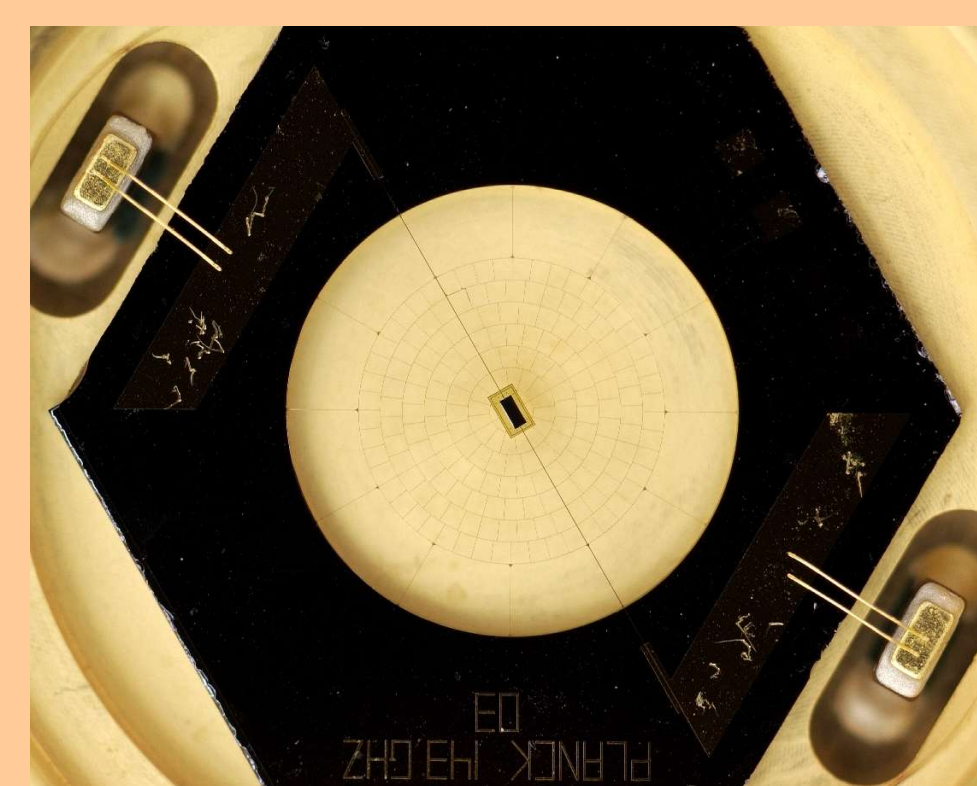
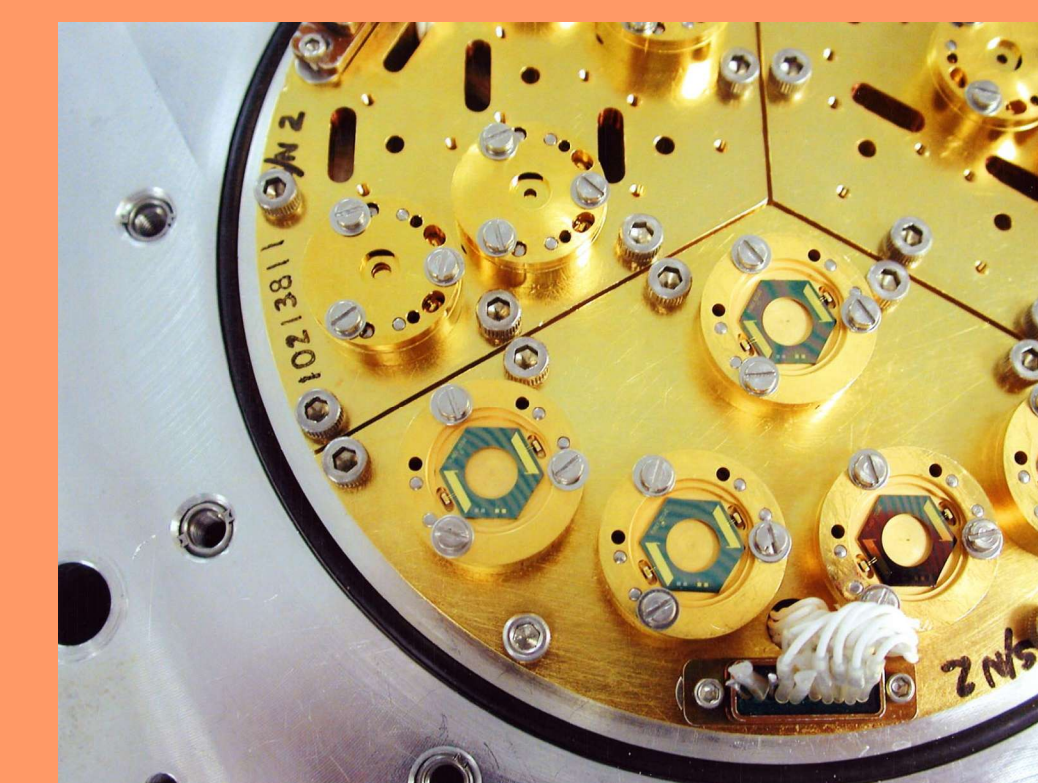


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The focal plane of Planck/HFI will contain 20 spider-web bolometers and 32 polarization sensitive bolometers operating at 6 different frequency bands from 100 - 857 GHz. The devices are fabricated at the Jet Propulsion Laboratory (JPL) in Pasadena, CA, USA. JPL is responsible for delivering detectors with a measured optical time constant and dark noise equivalent power (NEP)

right: bolometers mounted in a vibration test facility at JPL



Predicted Spider Web Bolometer performance

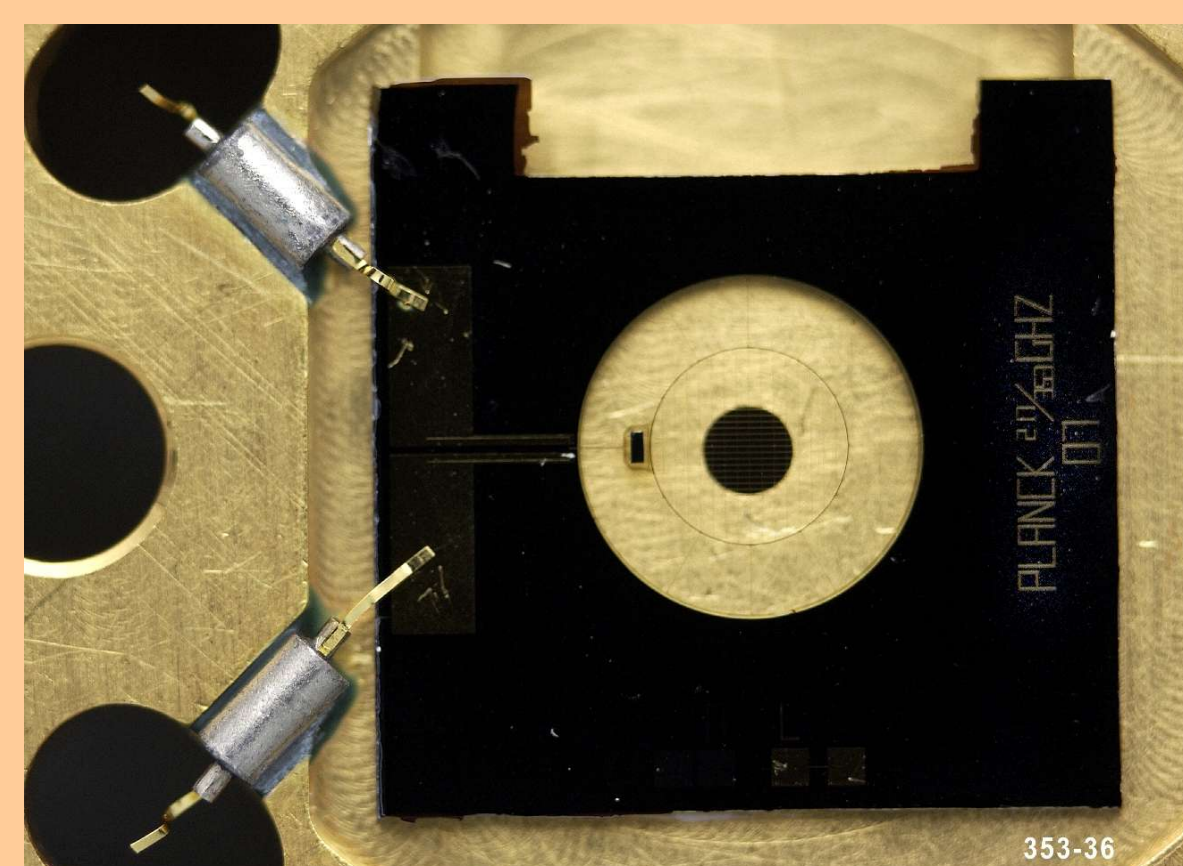
HFI channel	GHz	143	217	353	545	847
# finished		4	4	4	4	4
# spares		2	3	1	4	4
requirement τ	(ms)	6.2	4.4	4.4	4.4	4.4
Average τ	(ms)	4.5	1.7	2.5	1.7	2.7
		3.2 - 5.4	1.5 - 1.8	1.7 - 4.1	0.9 - 2.8	2.2 - 3.4
Dark NEP	aW /rt Hz	14.4	15.1	18.9	26.5	32
		11.7 - 18.3	12.0 - 18.3	18.5 - 19.6	20.1 - 35.6	25.7 - 39.8
NEP/BLIP		0.92	0.8	0.8	0.45	0.24
NET goal	μ K rt s	60	92	280	32	21
NET	μ K rt s	39	53	176	4.6	3
		36 - 44	49 - 57	174 - 178	4.4 - 4.9	3.0 - 3.1

- Testing at JPL is complete!
- Dark NEP = detector NEP + amplifier NEP
- NET includes detector NEP + amplifier NEP + photon NEP
- NET for 545 and 857 in K_{RJ} rt s, others in K_{CMB} rt s
- NET assumes 50% optical efficiency

Predicted Polarization-Sensitive Bolometer performance

HFI channel	GHz	P100	P143	P217	P353
# finished/# to deliver		4 / 8	8 / 8	8 / 8	8 / 8
# spares / # to deliver		0 / 4	4 / 4	2 / 4	2 / 4
# in testing		8		2	2
requirement τ	(ms)	8.4	6.2	4.4	4.4
Average τ	(ms)	7.4	4	4.3	4.1
		5.6 - 10	3.2 - 4.8	3.7 - 5.0	3.8 - 4.4
Dark NEP	aW /rt Hz	12.6	11.5	12.9	16.3
		9.7 - 24.2	10.3 - 14.9	11.1 - 15.3	15.2 - 17.7
NEP/BLIP		1.64	1.25	1.16	1.17
NET goal	μ K rt s	102	83	134	404
NET	μ K rt s	89	77	107	357
		71 - 145	72 - 91	98 - 118	343 - 374

- Testing at JPL will be complete in February 2005
- Dark NEP = detector NEP + amplifier NEP
- NET includes detector NEP + amplifier NEP + photon NEP
- NET assumes 35% optical efficiency

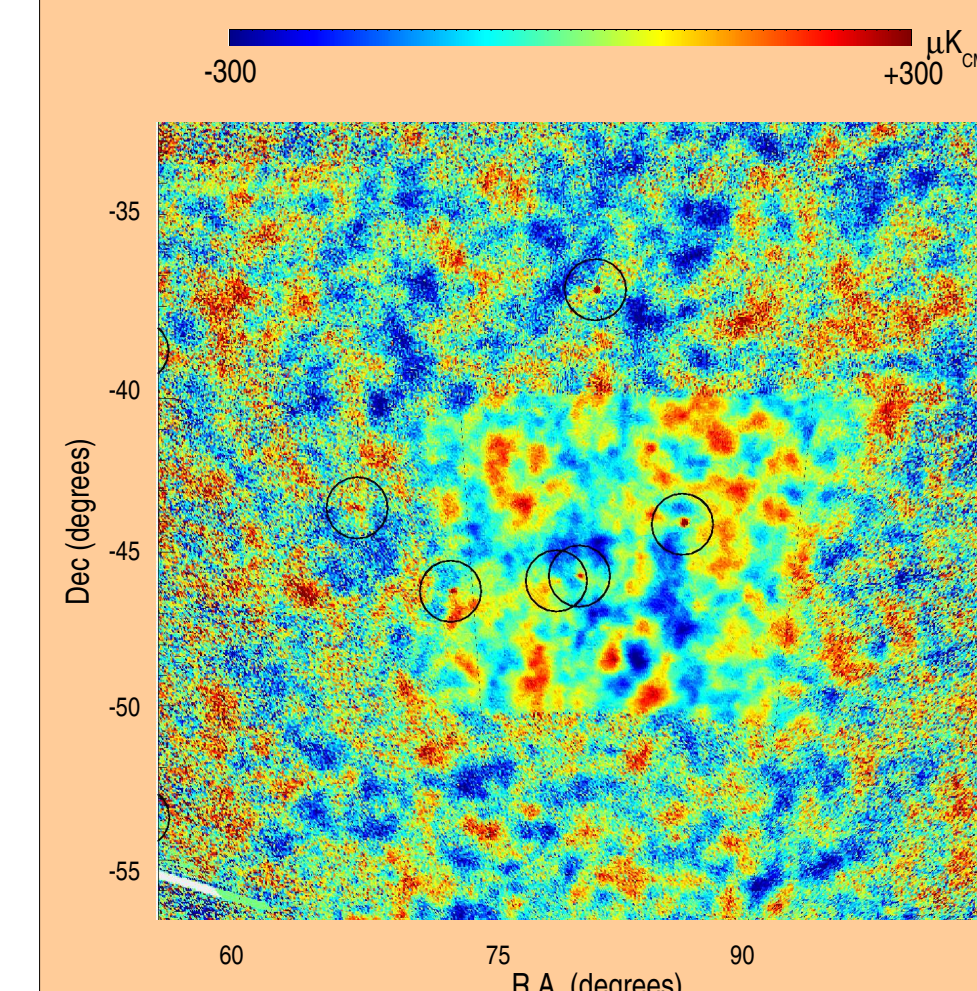


BOOMERANG-2003: Polarization-Sensitive Bolometers in Action

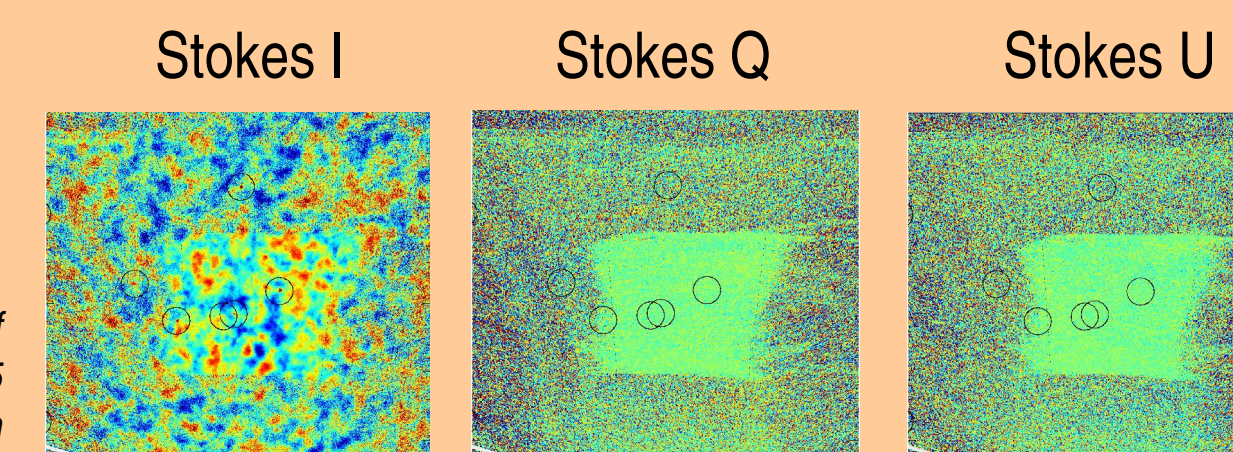
BOOMERANG 2003 is a balloon-borne millimeter-wave telescope and polarimeter designed to measure polarization in the cosmic microwave background. The focal plane of BOOMERANG-2003 includes 4 pairs of Polarization-Sensitive Bolometers operating in 145 GHz radiometers very similar to those that will be a part of Planck/HFI.



above: BOOMERANG before its January 2003 flight from McMurdo, Antarctica



Above: The BOOMERANG-2003 temperature map at 145 GHz. The dominant signal is degree-scale temperature anisotropy of the CMB. Known extra-galactic sources are indicated with circles.



Right: BOOMERANG-2003 maps of I, Q, and U Stokes parameters at 145 GHz. The signal-to-noise per pixel in the Q and U maps is less than 1.

In a 15-day flight from McMurdo, Antarctica, BOOMERANG mapped two Cosmic Microwave Background fields: a shallow field of ~1200 square degrees and a deep field of ~400 square degrees.

At 145 GHz, the BOOMERANG deep field map has similar signal-to-noise per pixel to what Planck/HFI will achieve on the full sky.