

Multi-mode TES bolometer optimization for the LSPE-SWIPE instrument

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LSPE SWIPE in a nutshell

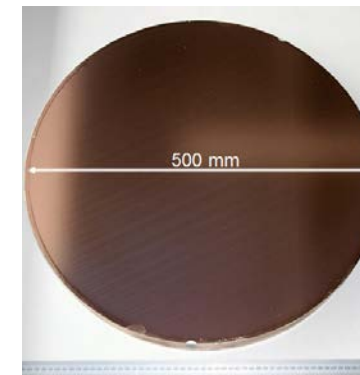
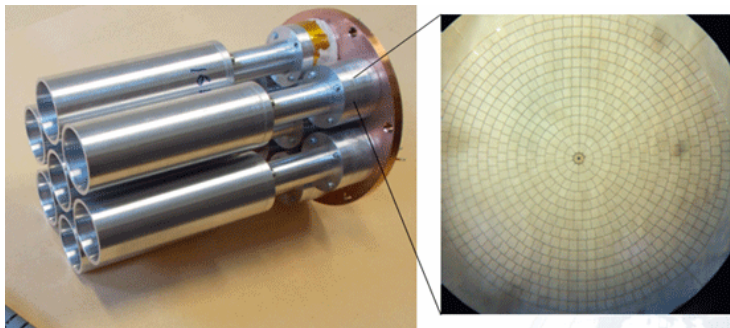
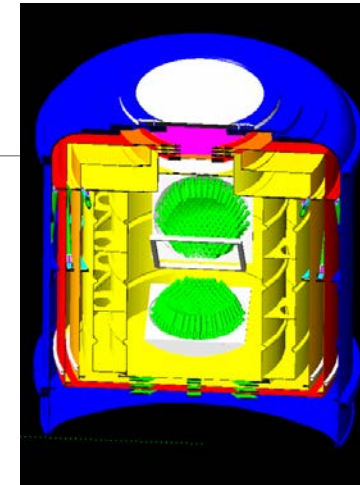
Large Scale Polarization Explorer SWIPE instrument
(<http://arxiv.org/ftp/arxiv/papers/1208/1208.0282.pdf>)

Balloon borne experiment flying during the arctic polar night

Two TES focal planes at 140, 220, 240GHz withdFDM readout

Multimode optics (<http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1891508>)

Cryogenic rotating HWP (<http://arxiv.org/pdf/1006.5392v3.pdf>)



LSPE collaboration

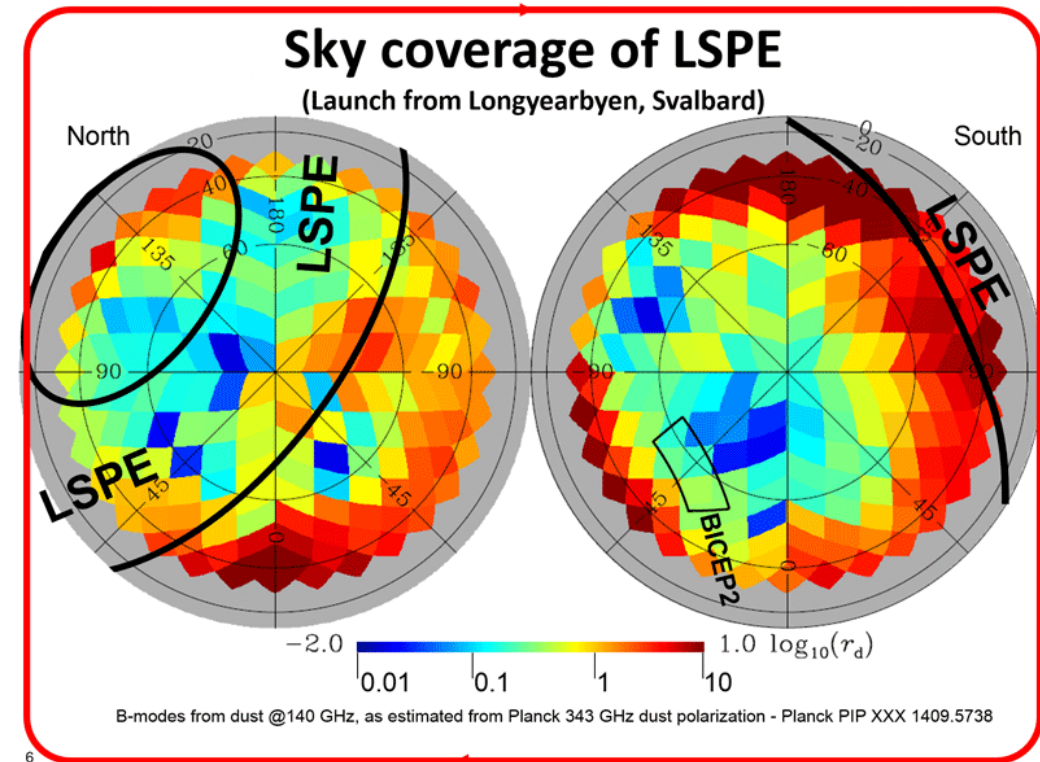


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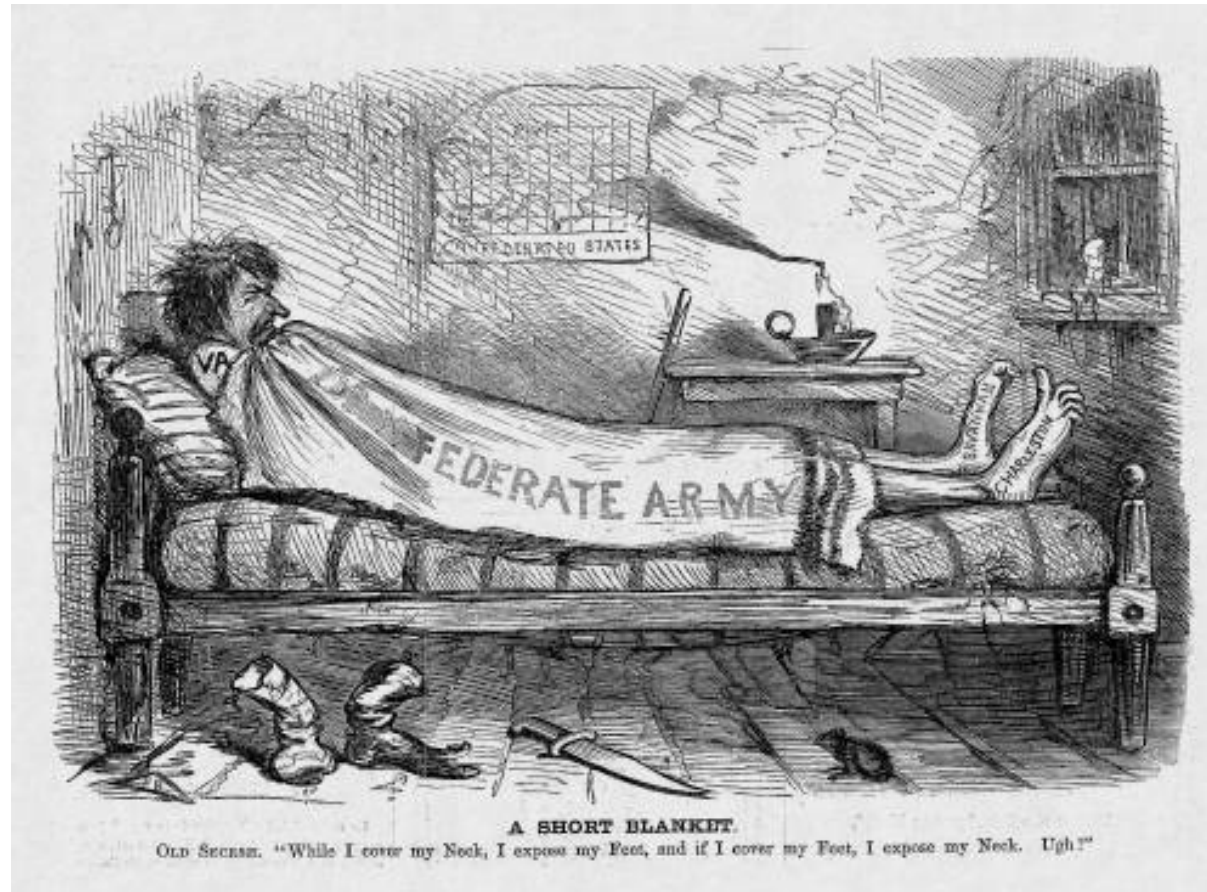


Motivations

- LSPE-SWIPE is the first instrument that will take advantage both of TES sensitivity and multimode optics efficiency
- LSPE is a spinning balloon borne experiment so the observational strategy gives a constraint on the bolometer's time constant
- Measuring the faint CMB B-mode polarization signal requires bolometers operating at photon noise limit
- TES bolometers have a small saturation power respect to a semiconductor bolometer
- On a balloon reach a stable temperature of two large focal planes is not trivial, the TES critical temperature must be accurately trimmed



The Short Blanket



Results

TES parameter space in terms of conductivities

From the NEP definition

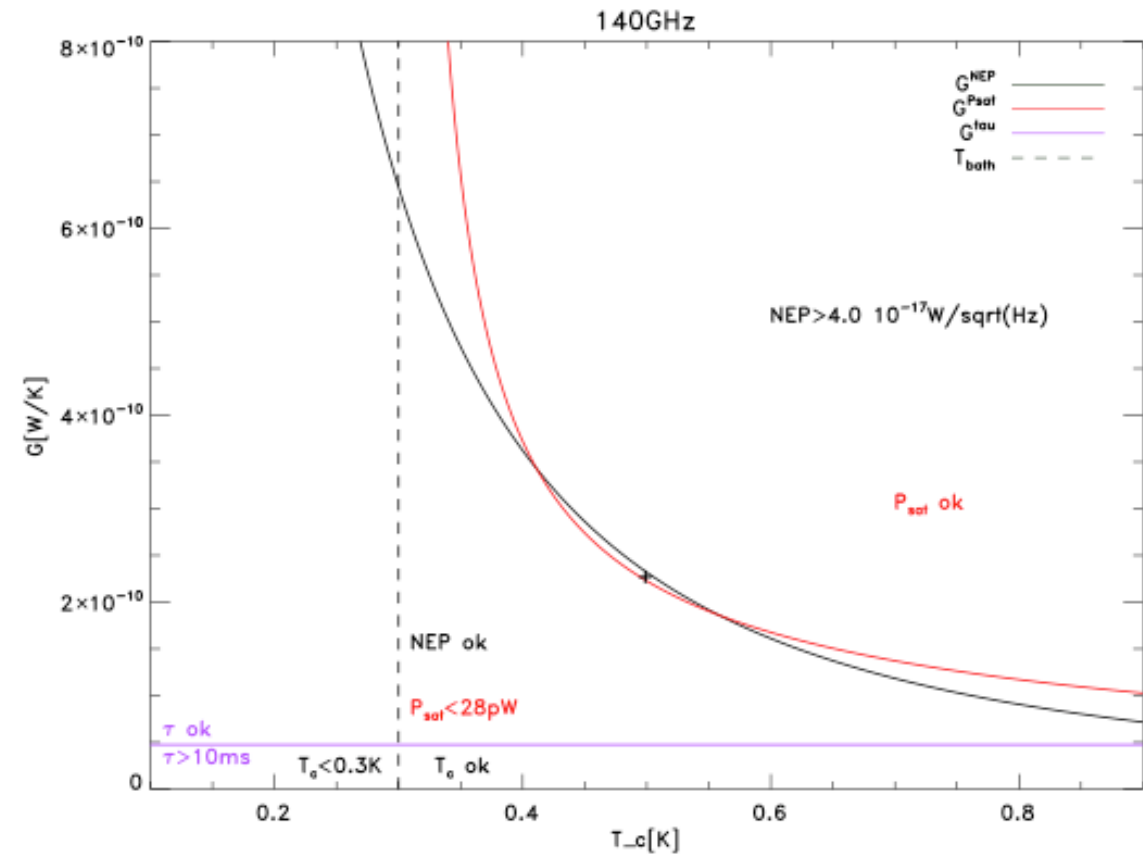
$$G^{NEP} = NEP^2 / (4Fk_b T_c^2)$$

From the P_{sat} formula solving from k

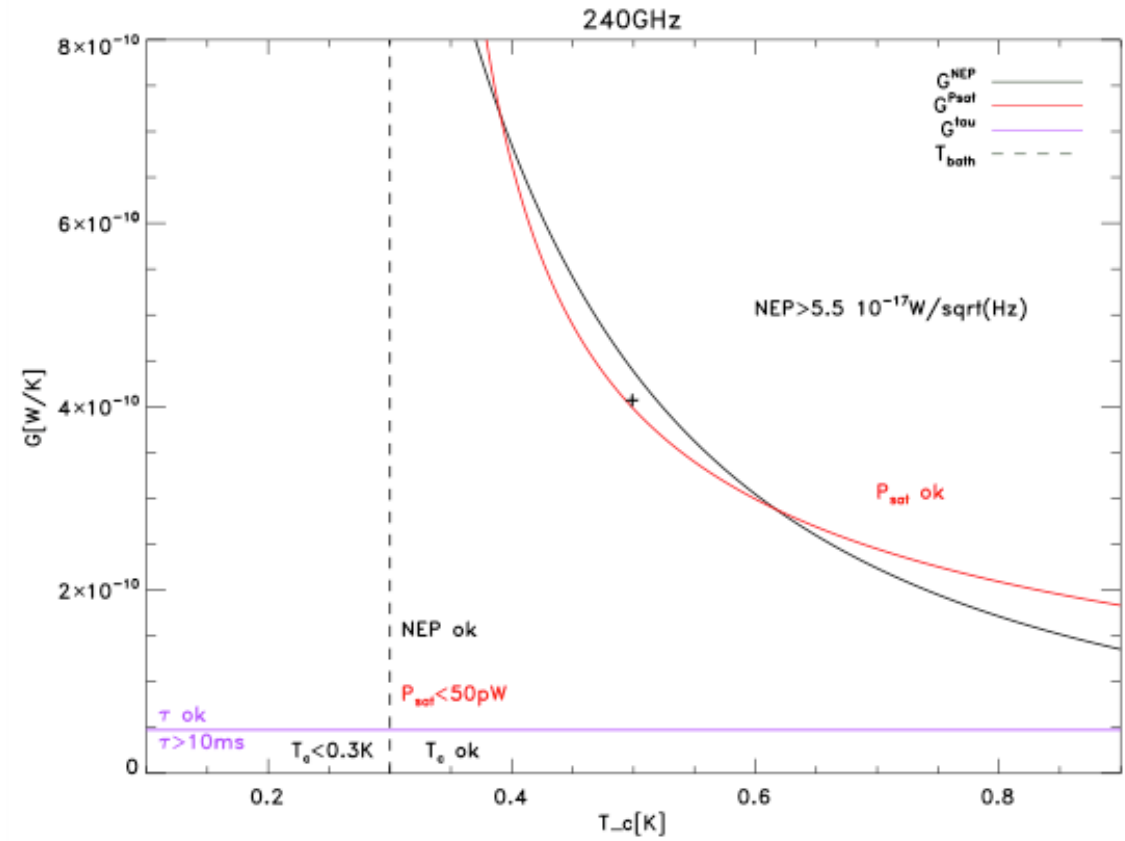
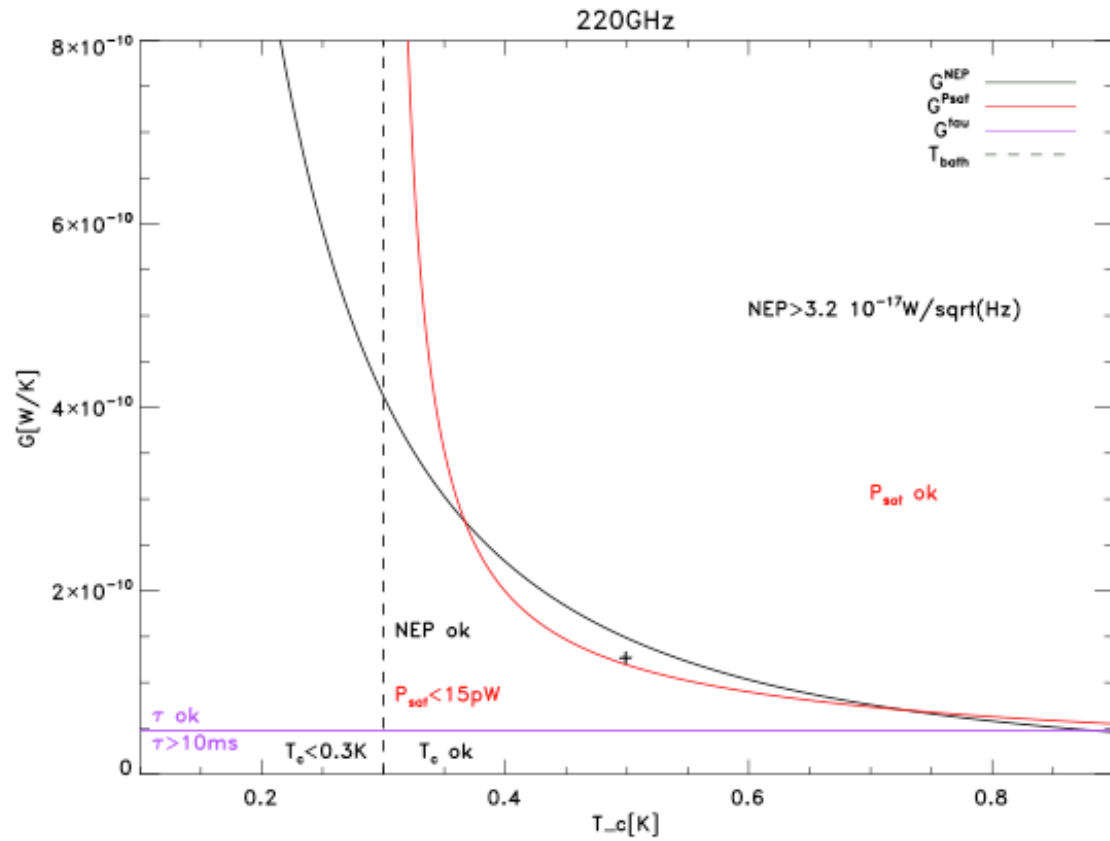
$$G^{P_{sat}} = nP_{sat} T_c^{n-1} / (T_c^n - T_{bath}^n)$$

From the time constant definition

$$G^\tau = C / [\tau(1 + L)]$$



Results



Results in numbers

	140GHz	220GHz	240GHz
τ [ms]	10	10	10
T_c [mK]	500	500	500
Transition width [mK]	10	10	10
P_{sat} [pW]	28	18	53
G[pW/K]	220	140	420
NEP_{th} [W/ \sqrt{Hz}]	$\sim 4,0 \cdot 10^{-17}$	$\sim 3,2 \cdot 10^{-17}$	$\sim 5,5 \cdot 10^{-17}$
R_n [Ohm]	~ 1	~ 1	~ 1

References

- The LSPE collaboration 2012, 'The Large-Scale Polarization Explorer (LSPE)'
- P. de Bernardis et al. 2012,
- 'SWIPE: a bolometric polarimeter for the Large-Scale Polarization Explorer'
- Hanany et al. 1998
- K. D. Irwin and G. C. Hilton 2005, 'Transition Edge Sensors'
- E. S. Battistelli et al. 2015 in preparation

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Thank you!!