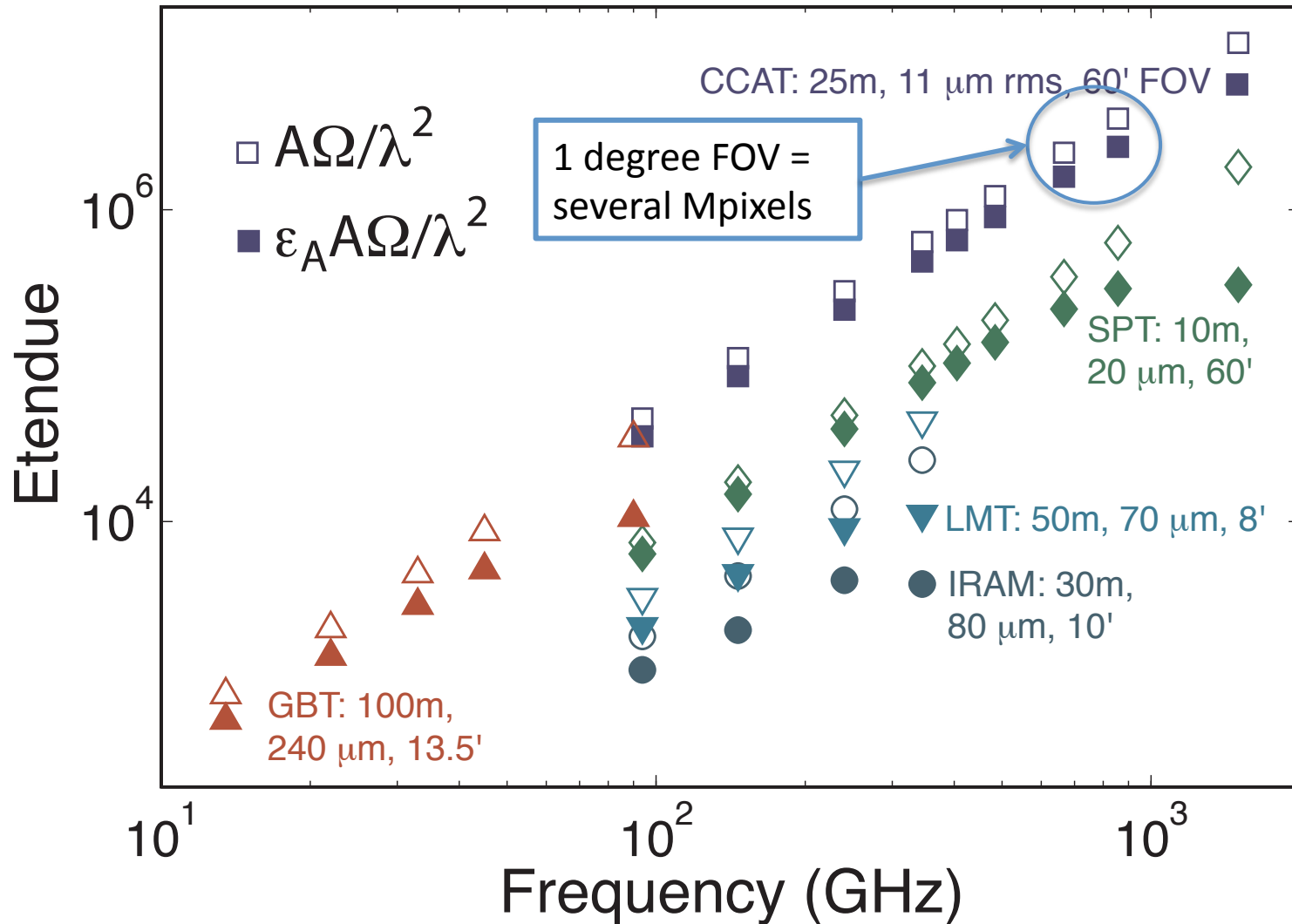


Emerging Technologies

Jonas Zmuidzinas

Caltech

CCAT's wide field in context

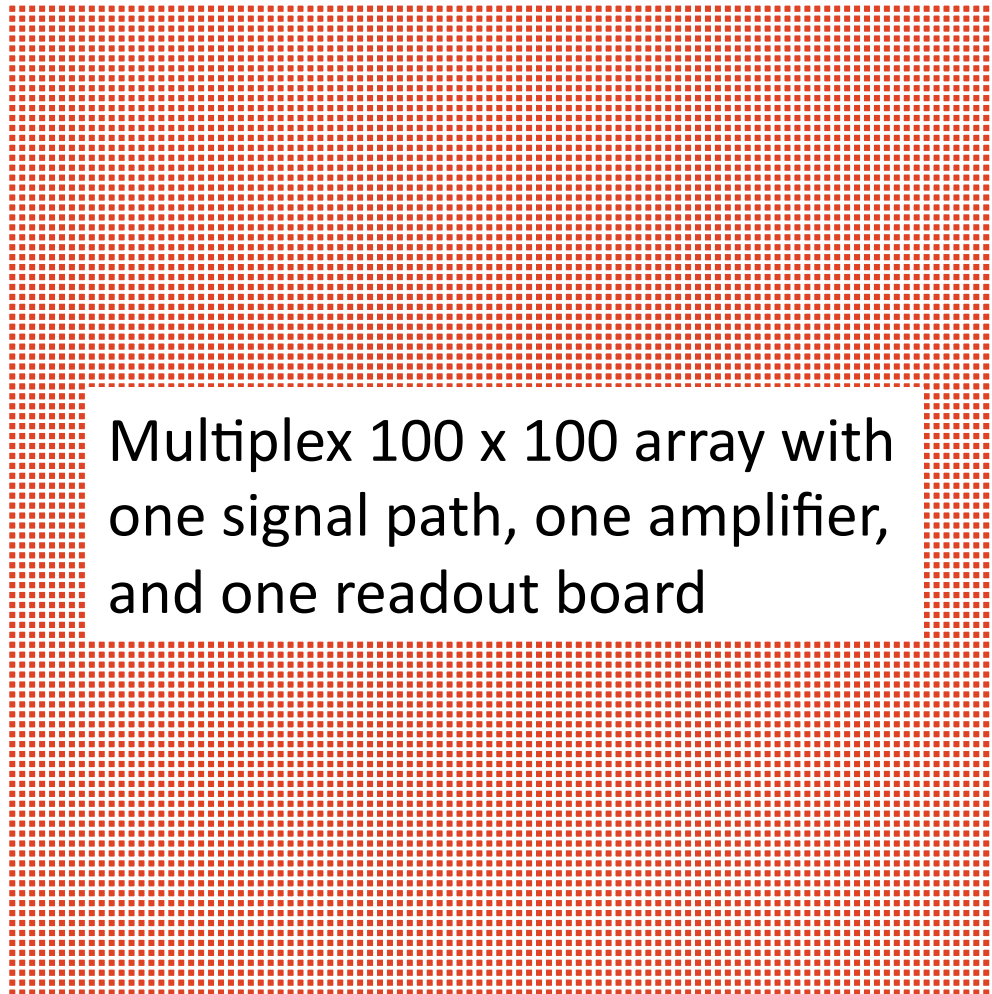


How do we get there ?

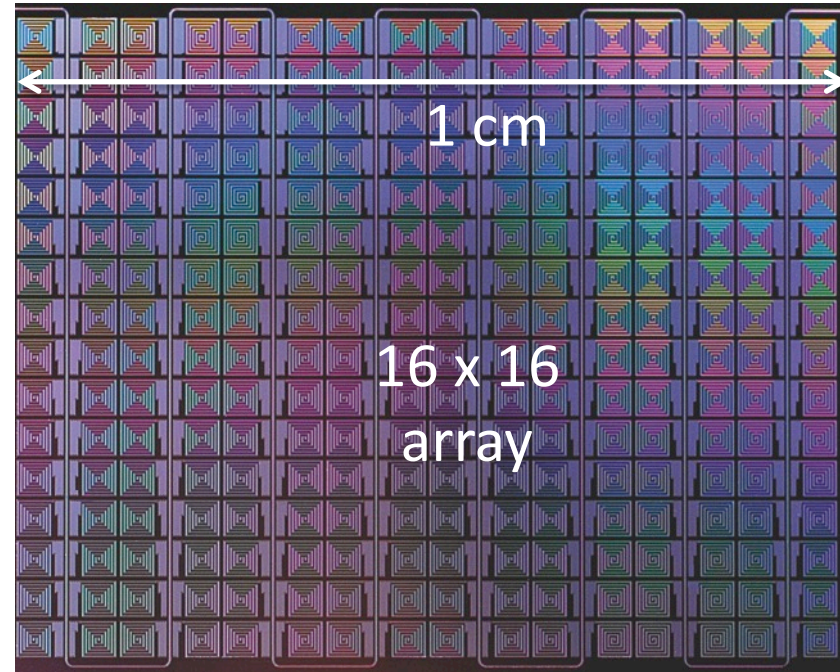
- SCUBA 2
 - 10^4 pixels, ~1000 wires, ~\$3k/pixel
- CCAT
 - 1 deg FOV = several $\times 10^6$ pixels @ 350 μm
 - Total instrument cost: < \$10/pixel
 - Push detector production cost and readout electronics cost to < \$1/pixel
 - MKID production cost is already sufficiently low
 - Electronics cost dominates; need high-density multiplexing

A 10^4 -pixel MKID array chip ?

100 x 100 array

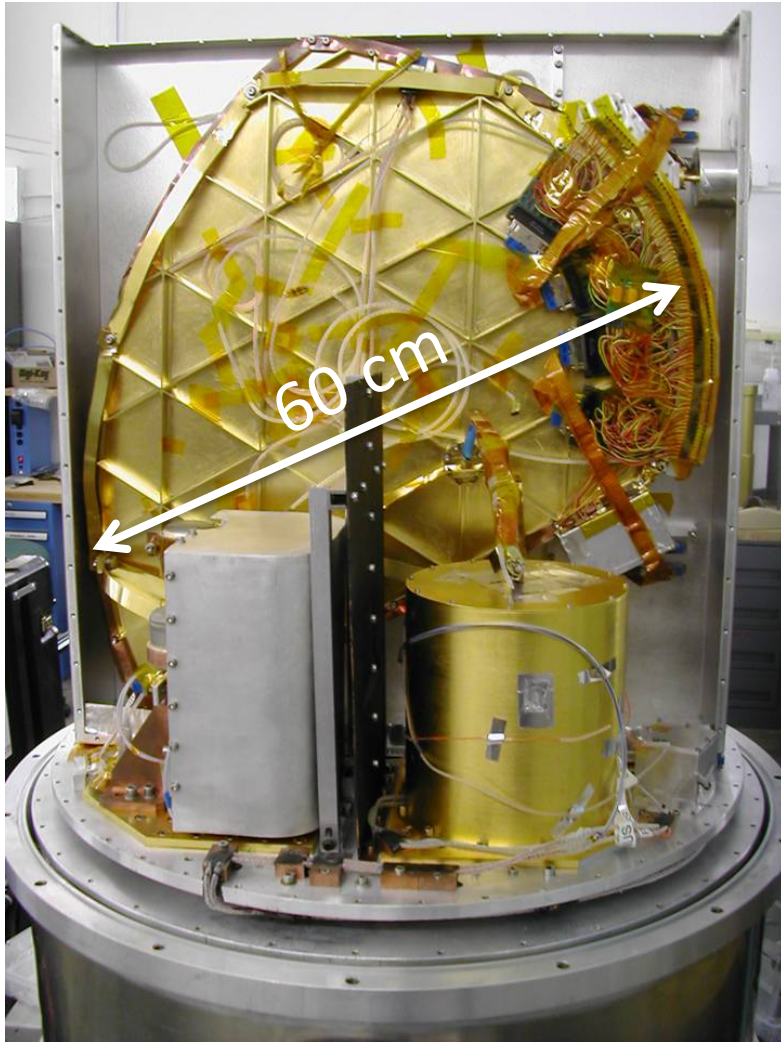


10 cm



16x16 TiN MKID array developed & demonstrated at Caltech/JPL.
Credit: P. K. Day, B. Eom, H. G. Leduc, O. Noroozian

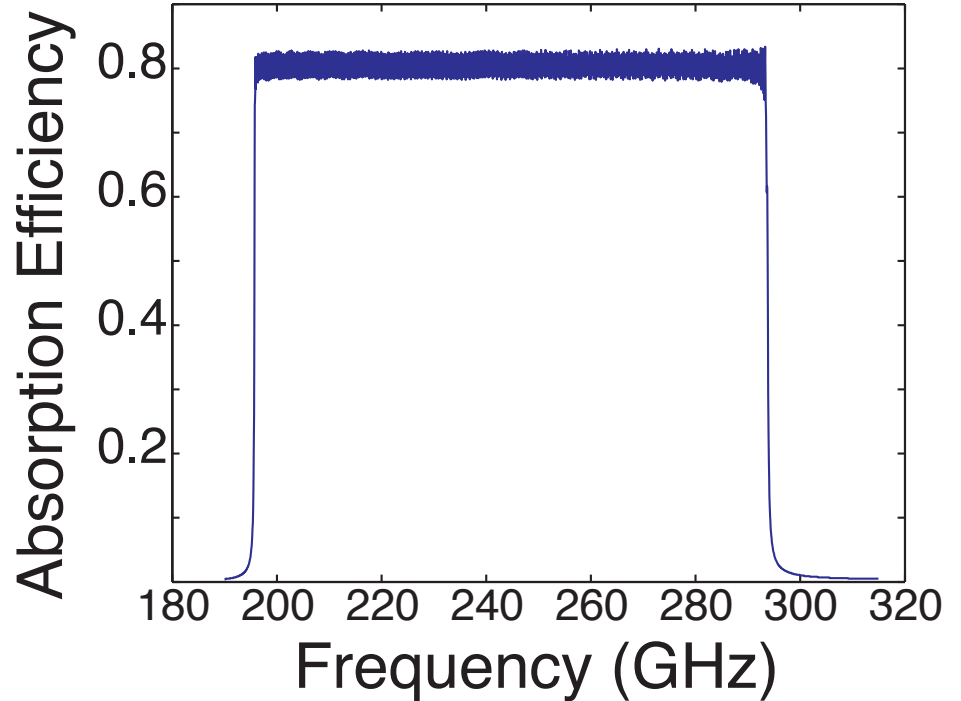
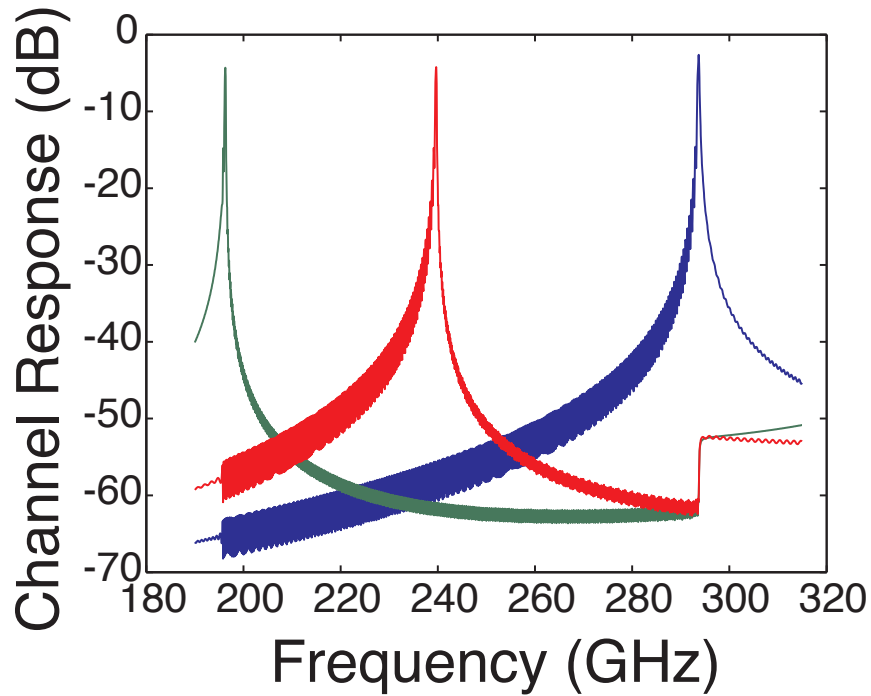
Multi-object spectroscopy



- 1998: Concept for CO redshift instrument using 200-300 GHz superconducting chip spectrometer (Zmuidzinas & Schoelkopf)
- 1999-2010: machined-metal version (Z-spec instrument; +Bock, Bradford, Glenn et al)
- 2011: 1 cm² chip, R=700 with 500 detectors, very simple design (Kovacs & Zmuidzinas)
- Enables IFS with 10³-10⁴ beams

Z-spec waveguide grating, 200-300 GHz, R=250, 160 bolometers

Superconducting Chip Spectrometer



Ultra-wideband mm/submm amplifiers

J. Zmuidzinas & P. K. Day, 2010

Wideband amplifier gain profile: 450 & 350 μm windows

