Transients in CMB Surveys

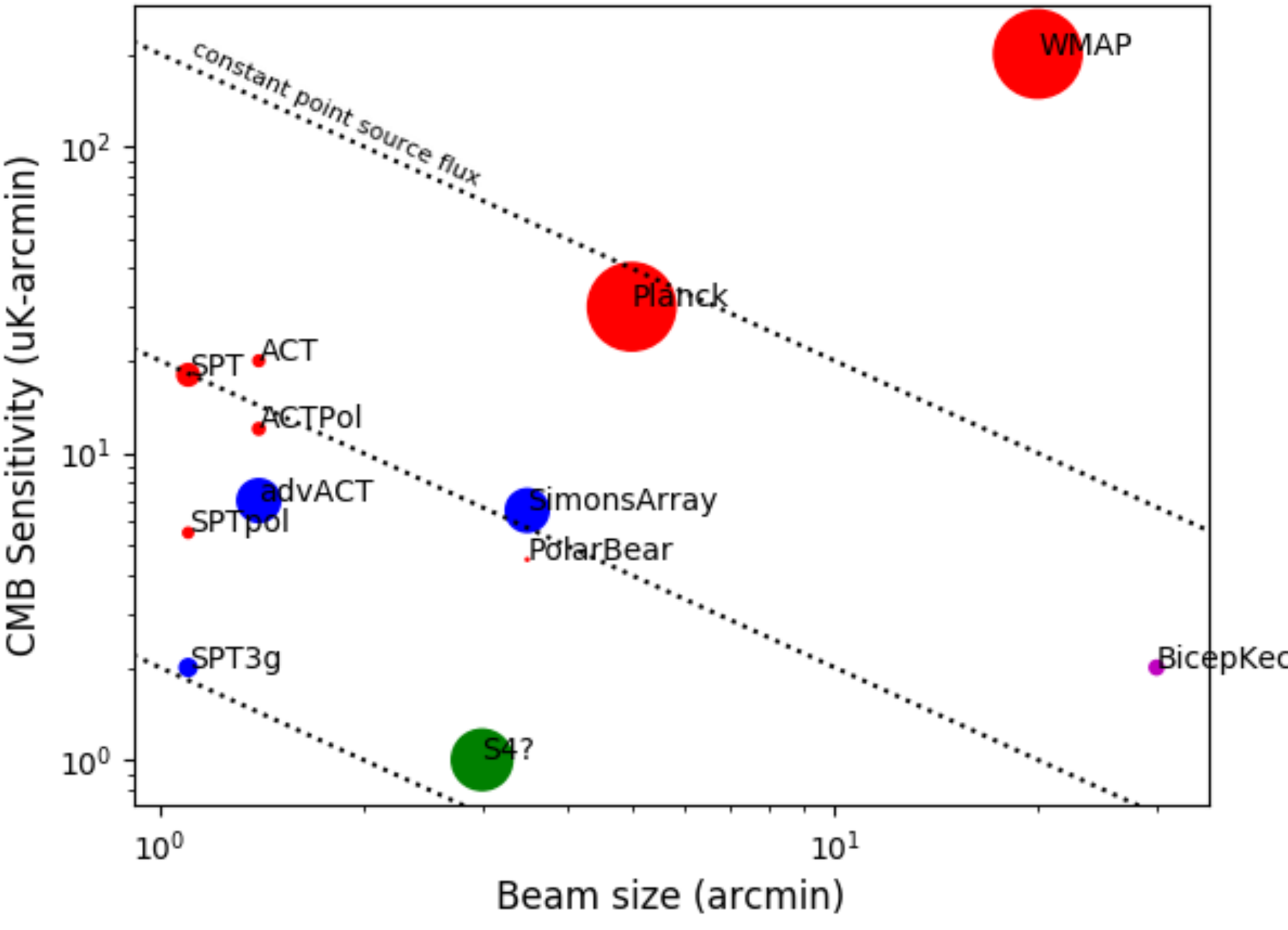
Gil Holder

University of Illinois at Urbana-Champaign

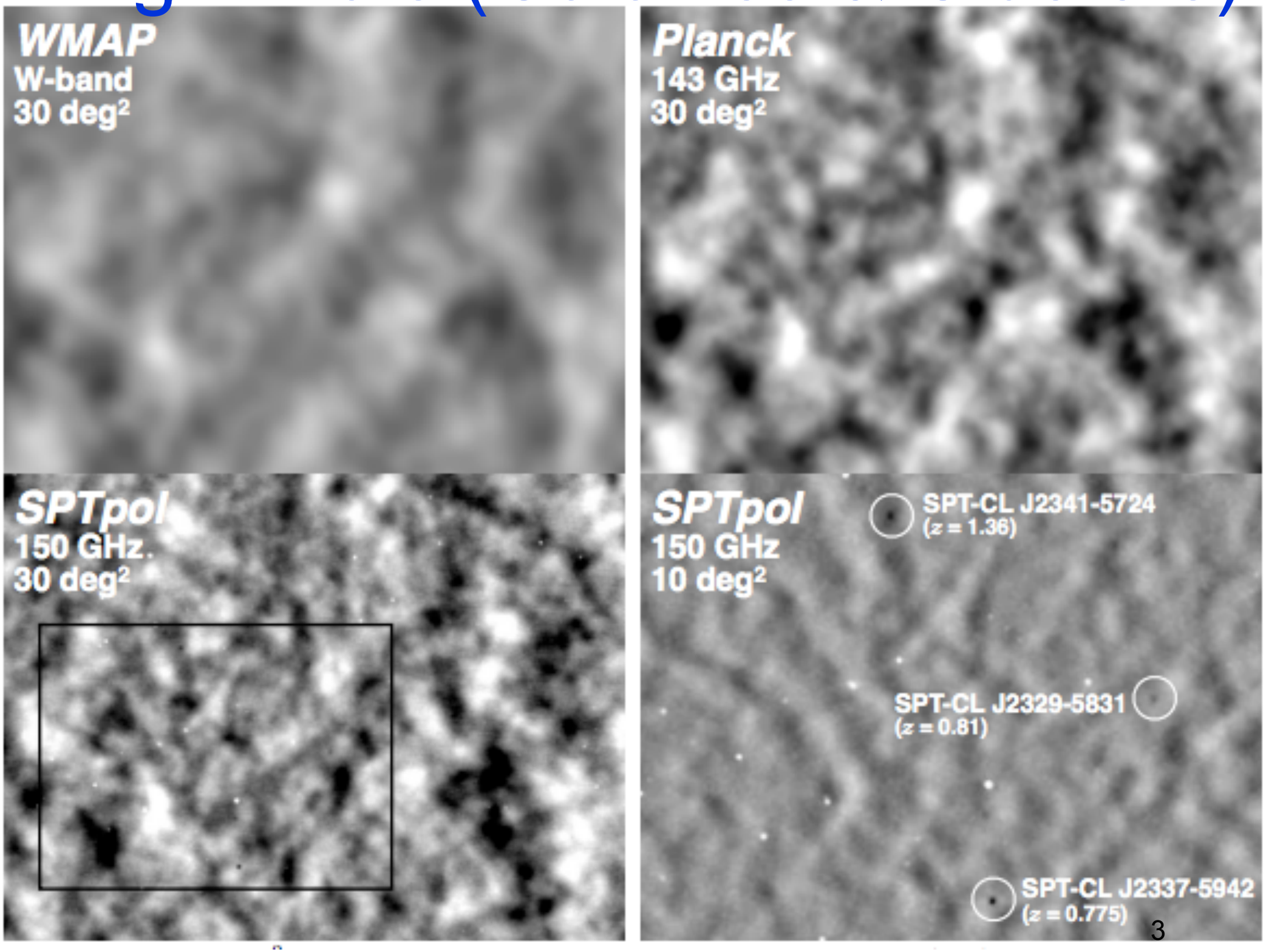
CMB Surveys

- higher sensitivity comes from more detectors or more concentrated survey

- sensitivity to point sources reduced as beam size gets larger

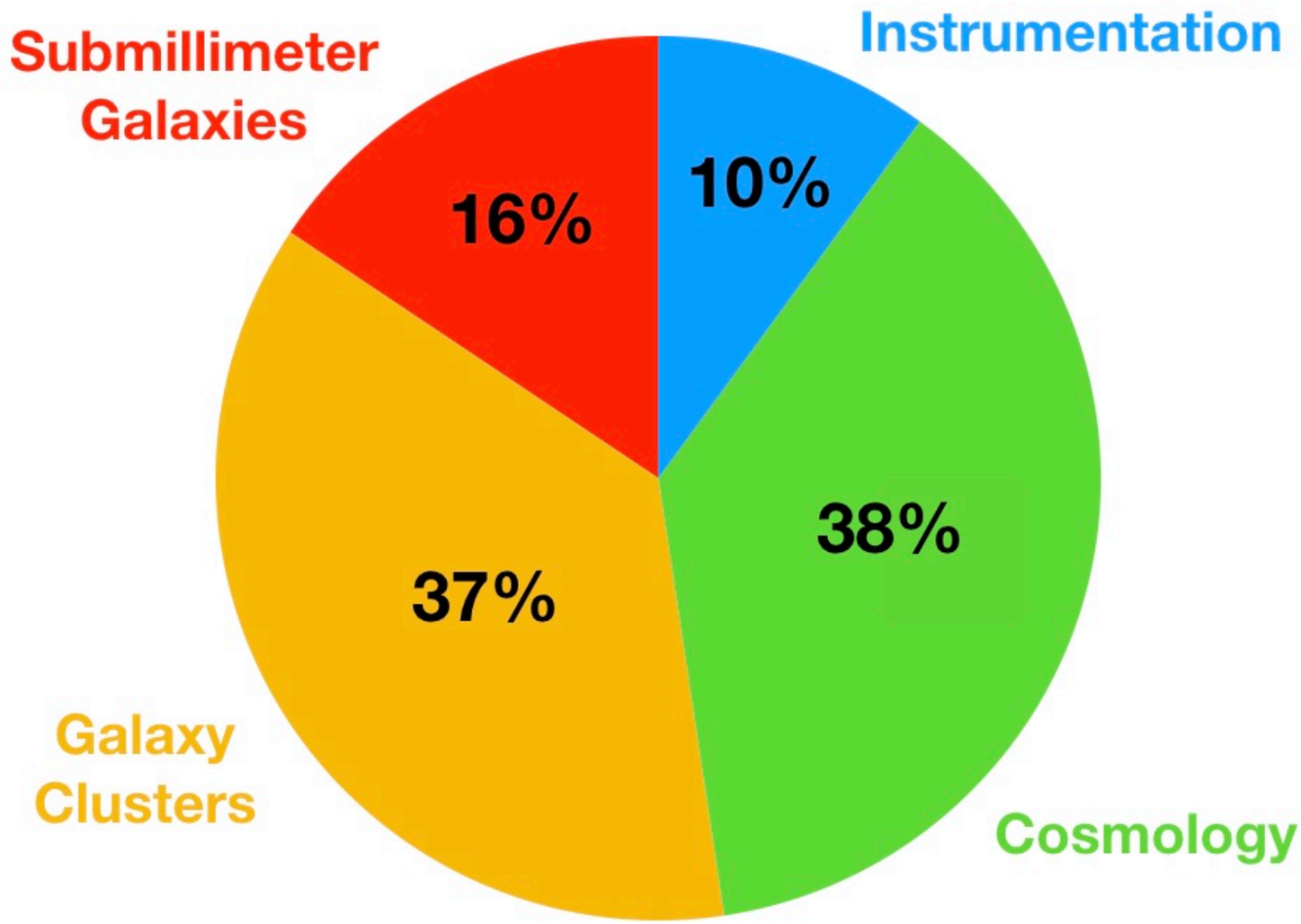


Fuzzy Diffuse Stuff (CMB) & Bright Dots (Galaxies & Clusters)



Benson et al 1407.2973

“CMB surveys” = ”Surveys”

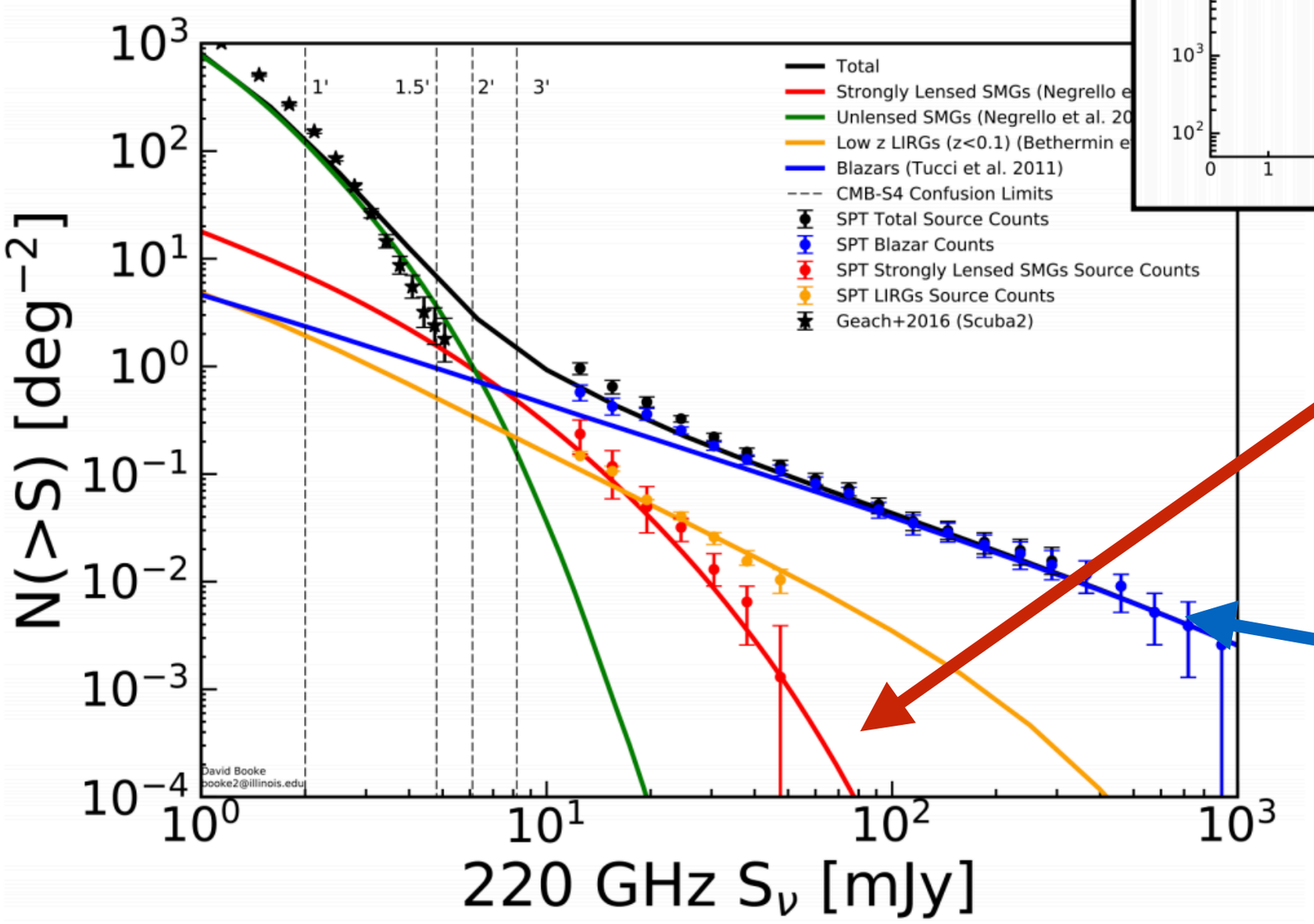


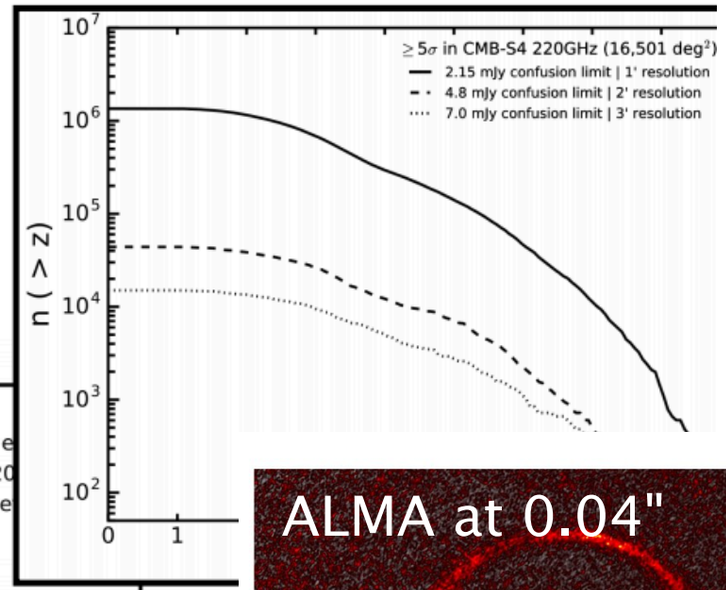
breakdown of citations to SPT

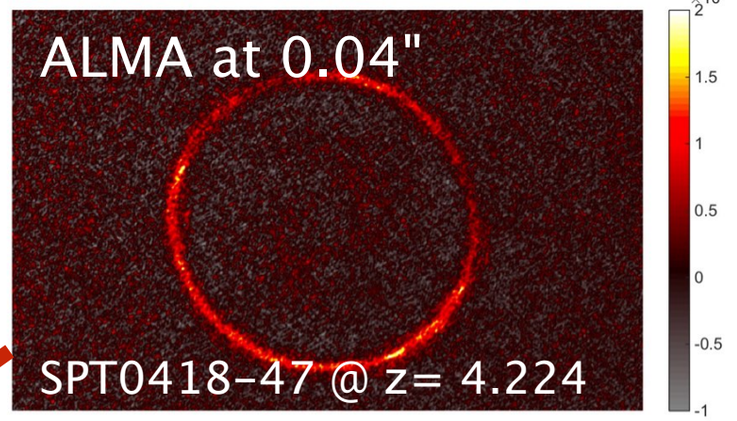
trend not new, but deeper surveys see more

A mm-wave galaxy survey

Extragalactic Sources







Figures from Joaquin Vieira

CMB survey cadences

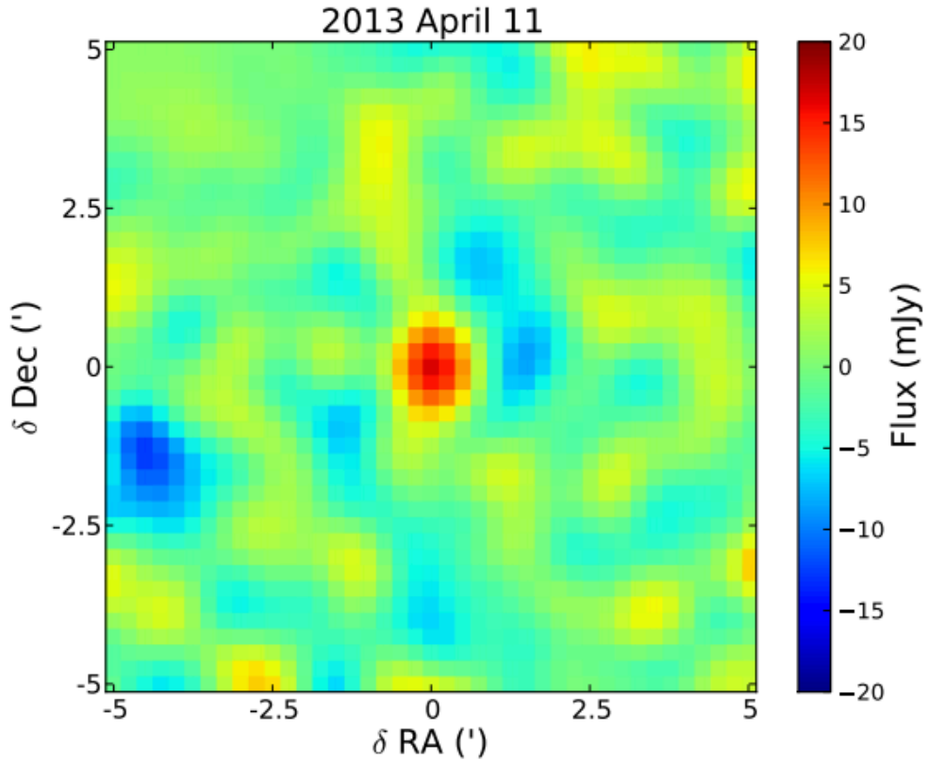
- observations stretch over several years 90, 150, 220 GHz, Stokes I/Q/U at resolution of 1-2’
- instantaneous field of view measured in square degrees; e.g., Simons Observatory FOV diameter ~8 deg
- sampling at 100 Hz within a given field of view (FRBs?)
- coverage on a single pixel for several minutes per observation set (forecast <10 mJy)
- repeat ~daily [total sky coverage, repeat cadence, etc., depends on survey]

video by Robert Schwarz (SPT 2014 on vimeo) BICEP winter over (https://vimeo.com/110848020)

mm-wave Transient Astronomy

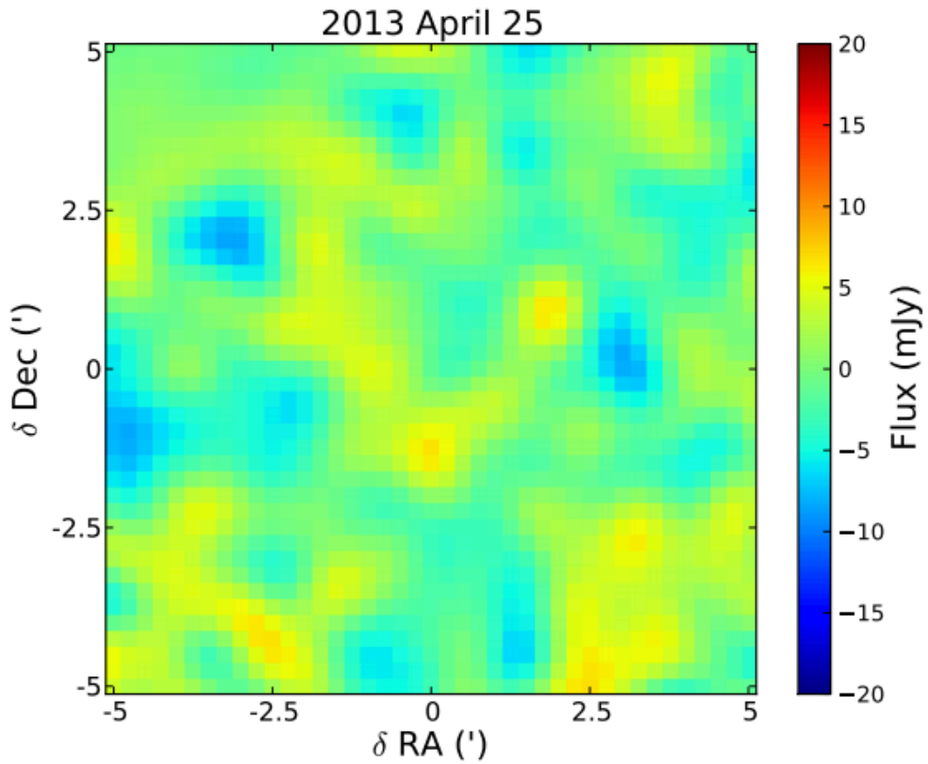
SPTPol saw something blip for ~6 days

detected in post-processing, years after it happened)



1% chance of fluke

SPT work in progress:
real-time analysis (Whitehorn)
FRB search (Harrington)

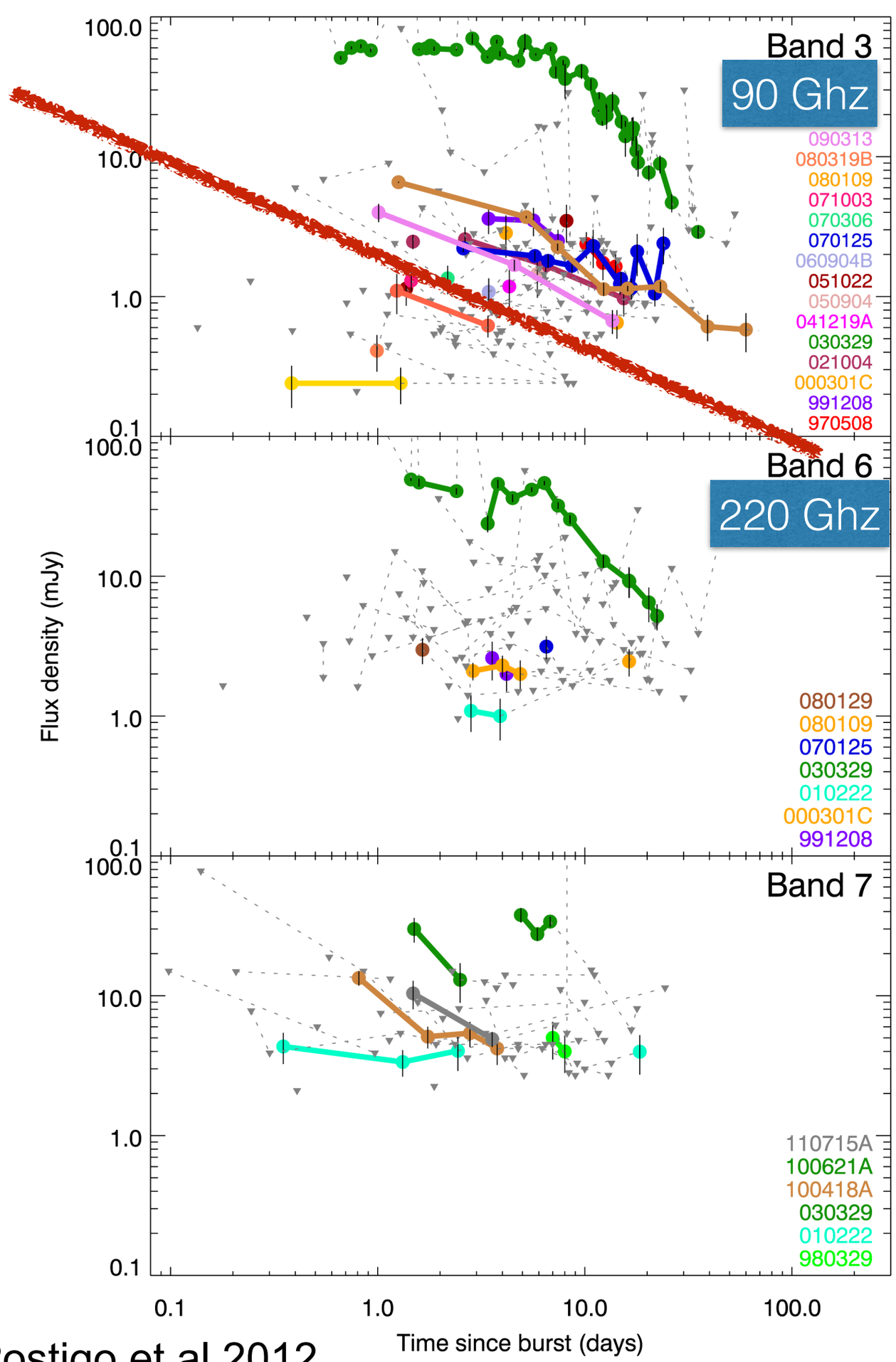


Whitehorn, Natoli et al; 1604.03507

The changing mm-wave sky: some targeted mm-wave follow-up

lots of GRBs have been observed to have detectable flux for S4

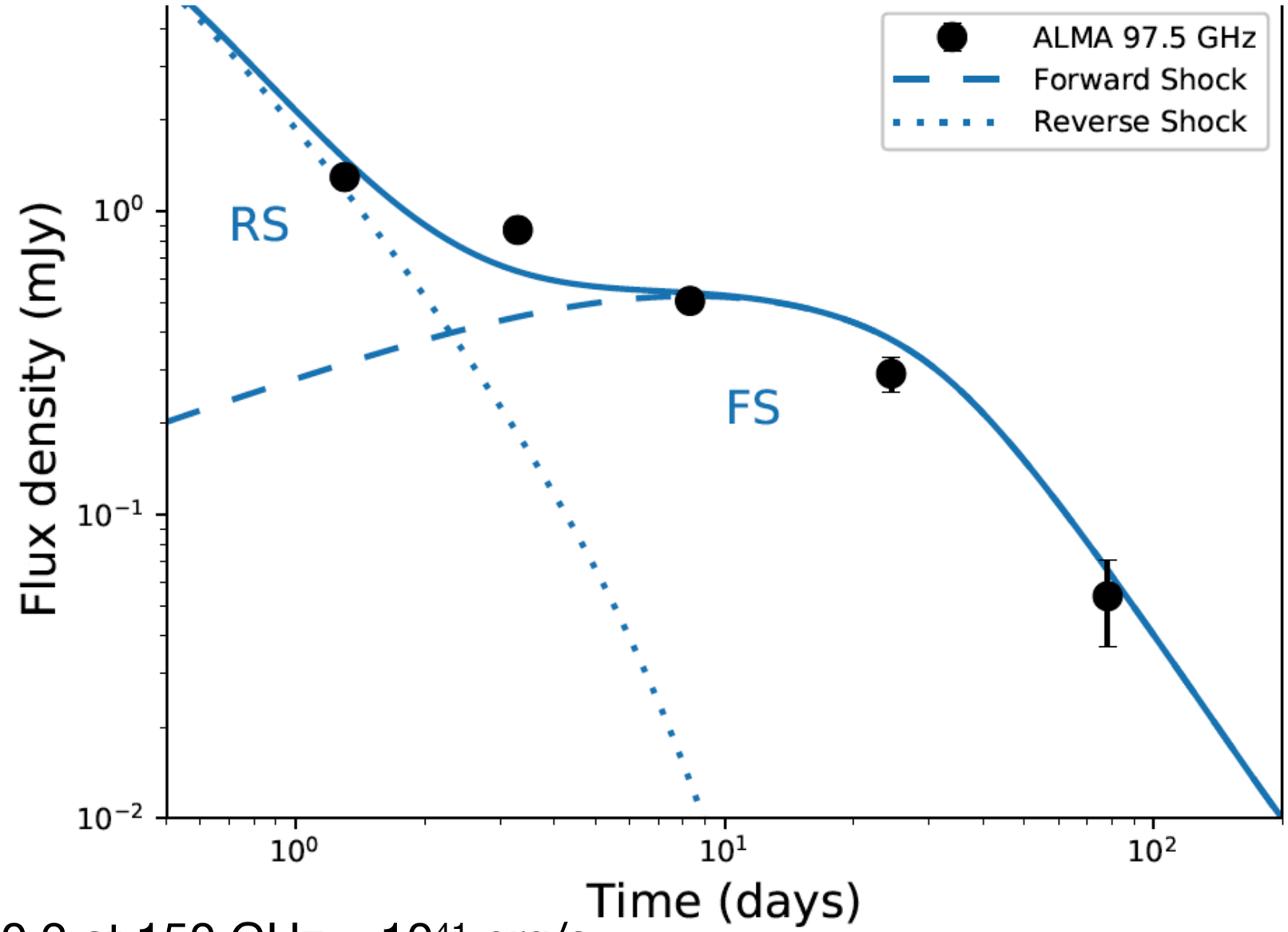
typical uncertainties of a few mJy per day



de Ugarte Postigo et al 2012

mm-wave transients in the local universe

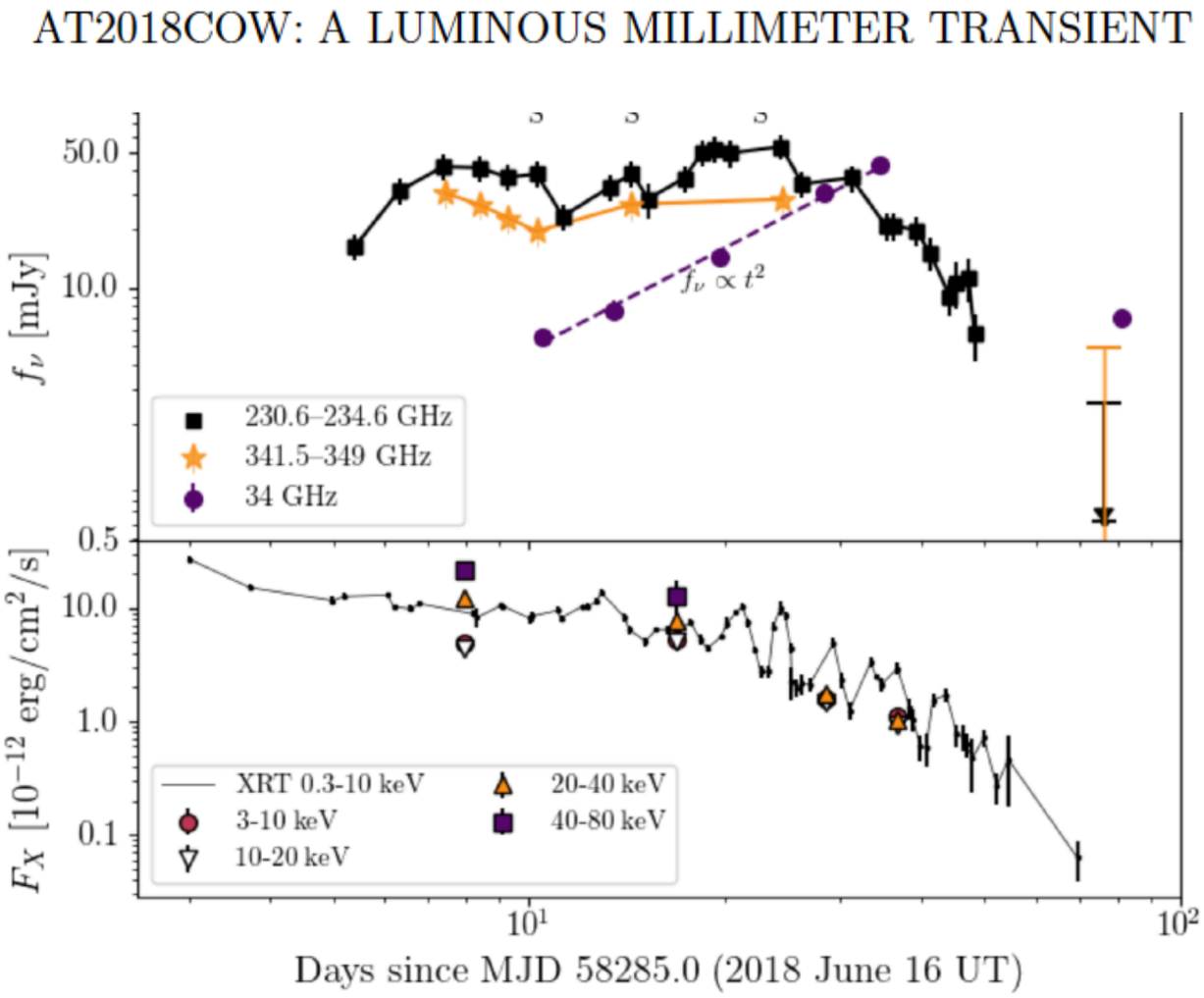
FIRST ALMA LIGHT CURVE CONSTRAINS REFRESHED REVERSE SHOCKS & JET MAGNETIZATION IN GRB 161219B

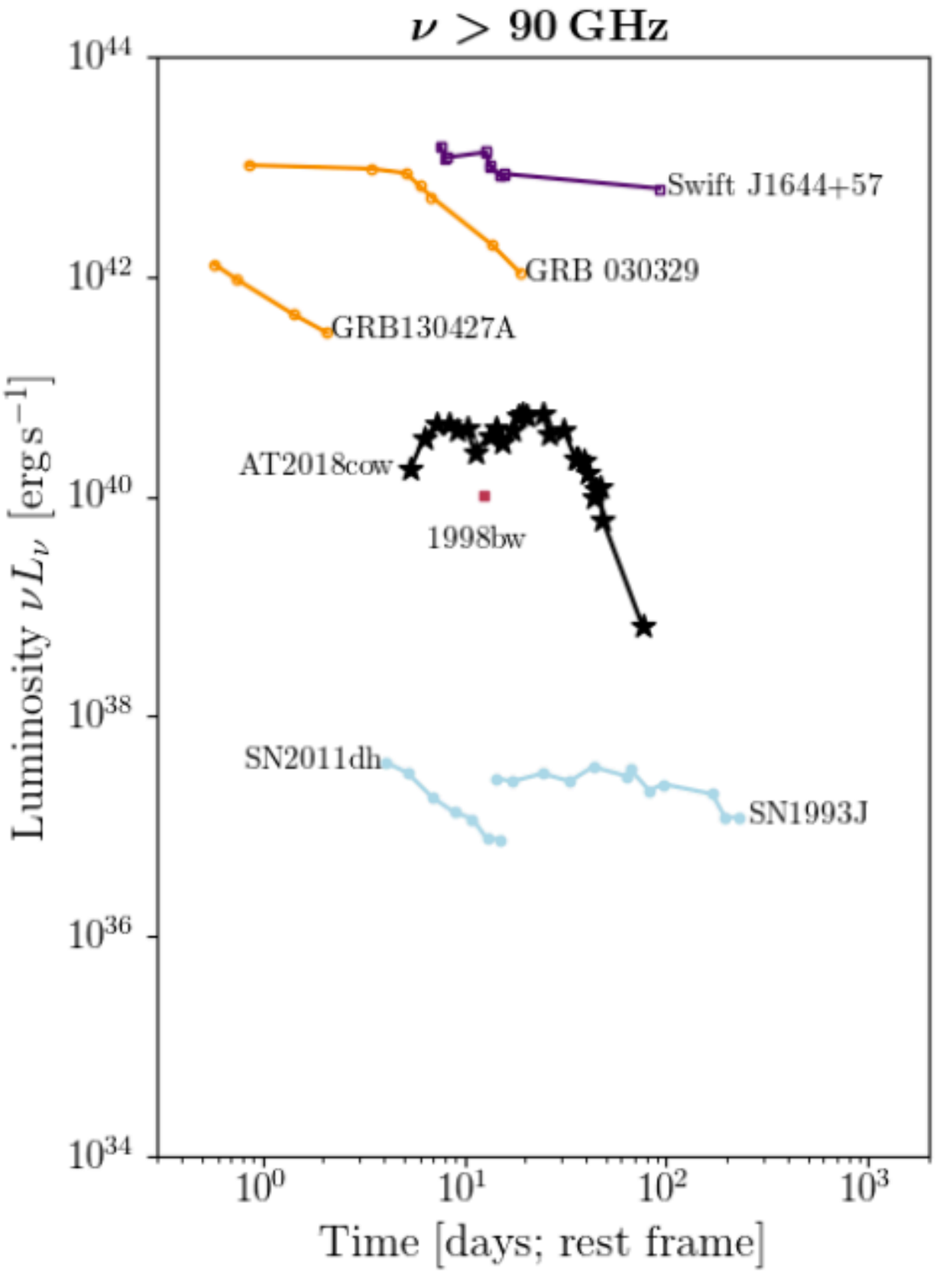


- 1 mJy at z~0.2 at 150 GHz = 10^{41} erg/s
- 1 mJy at 60 Mpc at 150 GHz<10^{39} erg/s

Laskar et al 1808.09476

mm-wave transients in the local universe





- 1 mJy at z~0.2 at 150 GHz = 10^{41} erg/s
- 1 mJy at 60 Mpc at 150 GHz<10^{39} erg/s

Ho et al 1810.10880

“CMB” Surveys

- ~mJy per day transient sensitivity over ~1/2 sky at mm wavelengths for future surveys (e.g., CMB-S4)
    - comparable depth over few % of sky or 5-10x less sensitive over comparable area for current surveys
    - Nathan Whitehorn (UCLA) building a rapid detection pipeline for SPT-3G; ***would a ~daily public archive be useful?***
- possible sources: GRBs, TDEs, Novae, SNe, Stellar Flares, Solar System Objects, Blazars ***what else?***