The Dusty Young Universe

Overview & People Involved

K. Meisenheimer[1], D. Hutsemekers[2], L. Tacconi[3]

A. Contursi[3], H. Dannerbauer[4],
X. Fan[5], R. Genzel[3], M. Haas[6],
C. Jean[2], U. Klaas[1], O. Krause[1],
C. Leipski[1], D. Lemke[1], D. Lutz[3],
A. Poglitsch[3], E. Sturm[3], M. Stickel[1],
F. Walter[1]

[1] MPIA
[2] Institut d' Astrophysique, Liege
[3] MPE
[4] CEA Saclay
[5] Steward Observatory, University of Arizona
[6] Astronomisches Institut, Universität Bochum

The Dusty Young Universe

Overview & People Involved

K. Meisenheimer[1], D. Hutsemekers[2], L. Tacconi[3]

A. Contursi[3], H. Dannerbauer[4],
X. Fan[5], R. Genzel[3], M. Haas[6],
C. Jean[2], U. Klaas[1], O. Krause[1],
C. Leipski[1], D. Lemke[1], D. Lutz[3],
A. Poglitsch[3], E. Sturm[3], M. Stickel[1],
F. Walter[1]

z = 6.42 !!

[1] MPIA
[2] Institut d' Astrophysique, Liege
[3] MPE
[4] CEA Saclay
[5] Steward Observatory, University of Arizona
[6] Astronomisches Institut, Universität Bochum

The Dusty Young Universe

Science Objectives

I. Far-IR – submm photometry of very high redshift QSOs

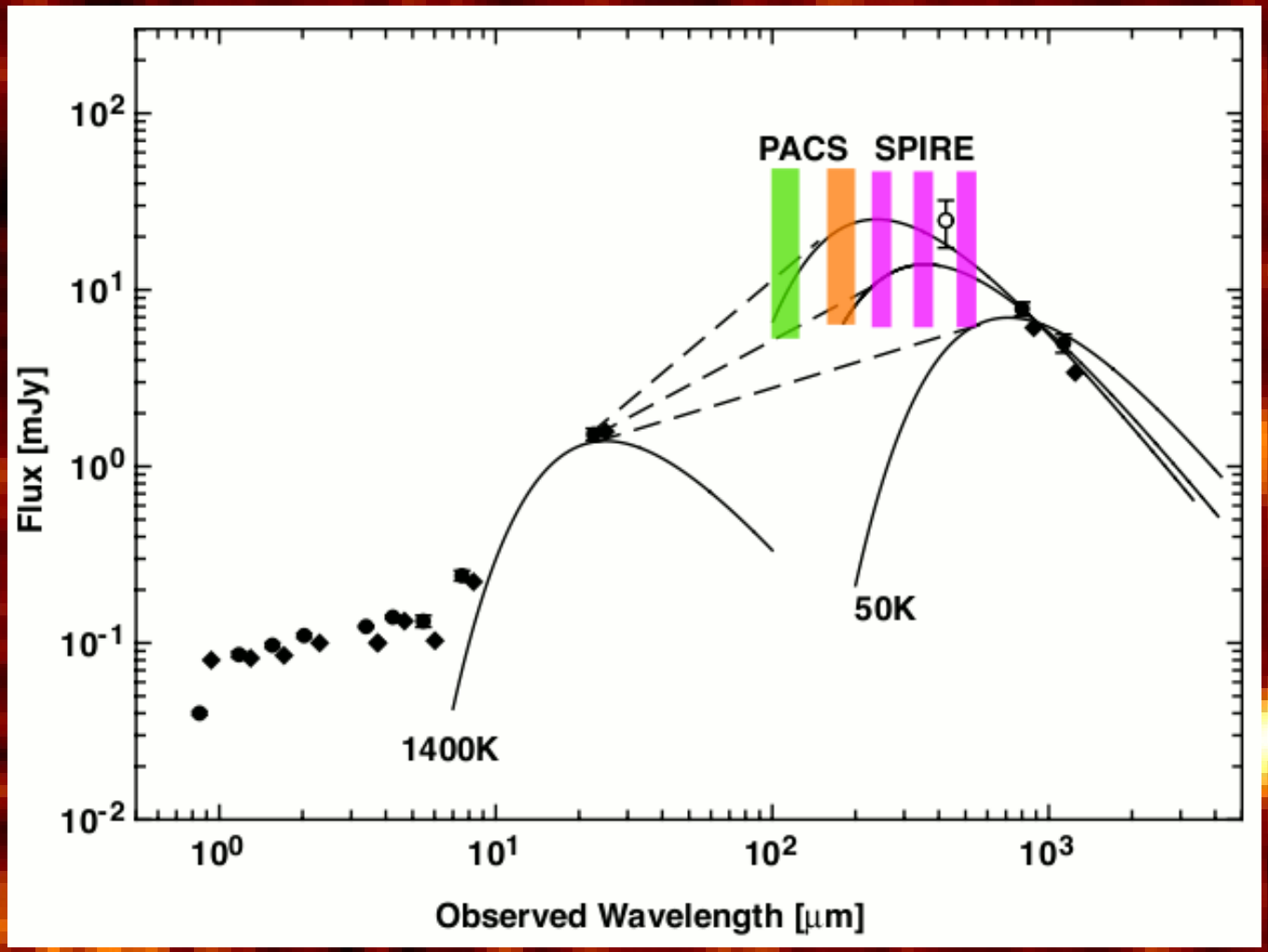
Lead: K. Meisenheimer (MPIA)

- SEDs at λ = 100 ... 500 μm of the highest redshift quasars (z > 5)
  - Dust masses and temperatures, FIR luminosities of host galaxies 1 Gyr after big bang. History and frequency of dust production.
  - Comparison: radio-loud / radio-quiet by including 6 RGs and 6 QSRs
  - Search for close companions/overdensities on mini-maps

The Dusty Young Universe

Science Objectives

I. Far-IR – submm photometry of very high redshift QSOs



Data:
2 QSOs @ z ~ 6
Combined

Spectra:
BB @
T = 50, 100, 150K
+ hot dust

Limits: 5 sigma

The Dusty Young Universe

Science Objectives

II. Far-IR – submm photometry of BAL QSOs around z = 2.5

Lead: D. Hutsemekers (Institut d' Astrophysique, Liege)

- SEDs at λ = 70 ... 500 μm of Broad Absorption Line (BAL) quasars (z ~ 2.5) and a non-BAL comparison sample
  - Dust masses and temperatures in BAL systems
  - Connection between BAL clouds and dust?
  - Evolutionary sequence BALs → normal QSOs?

The Dusty Young Universe

Science Objectives

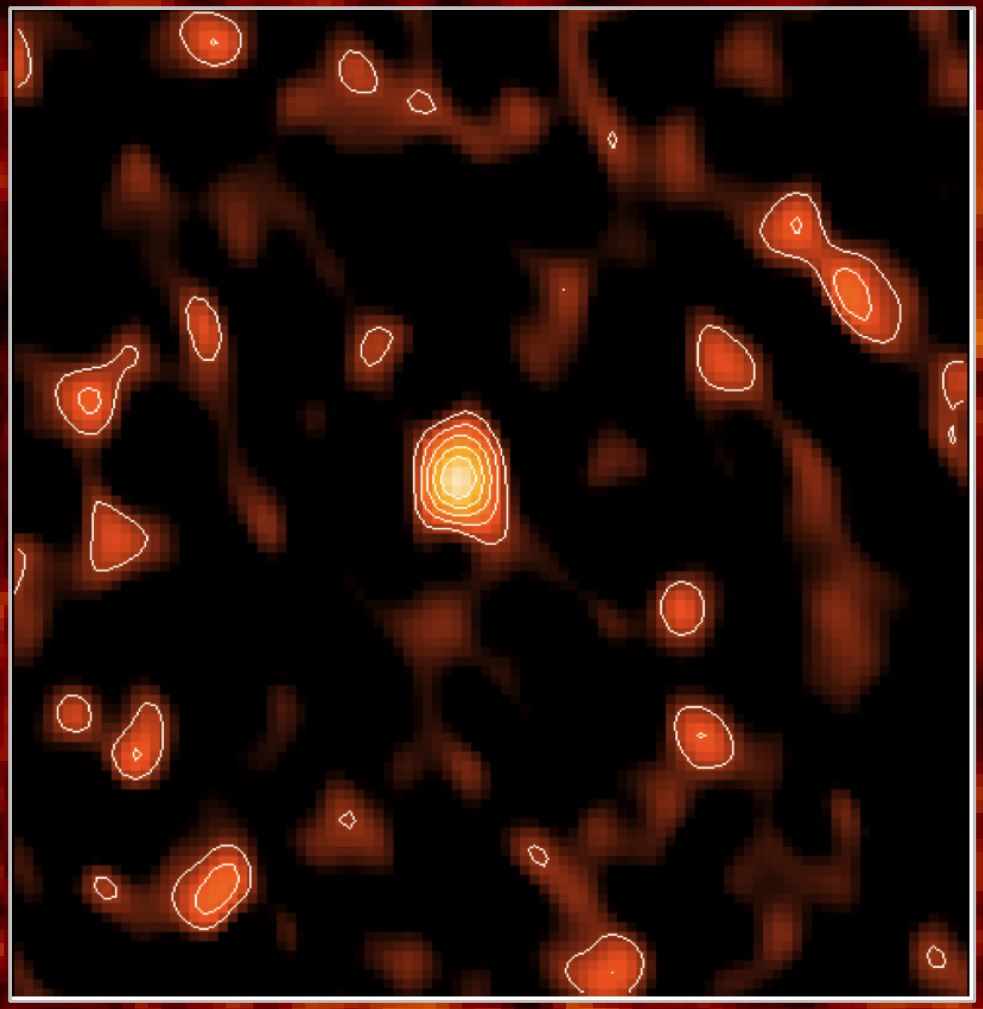
III. PACS spectroscopy of lensed high redshift QSOs & galaxies

Lead: L. Tacconi (MPE)

- Spectroscopic signatures for AGN activity and starbursts ([SIII], [OIV]) at high z
- Determine fraction of AGN luminosity

The Dusty Young Universe

The highest redshift quasar known: SDSS J1148+5251



λ = 1mm, FOV 5´´ x 5´´
Walter et al. 2008

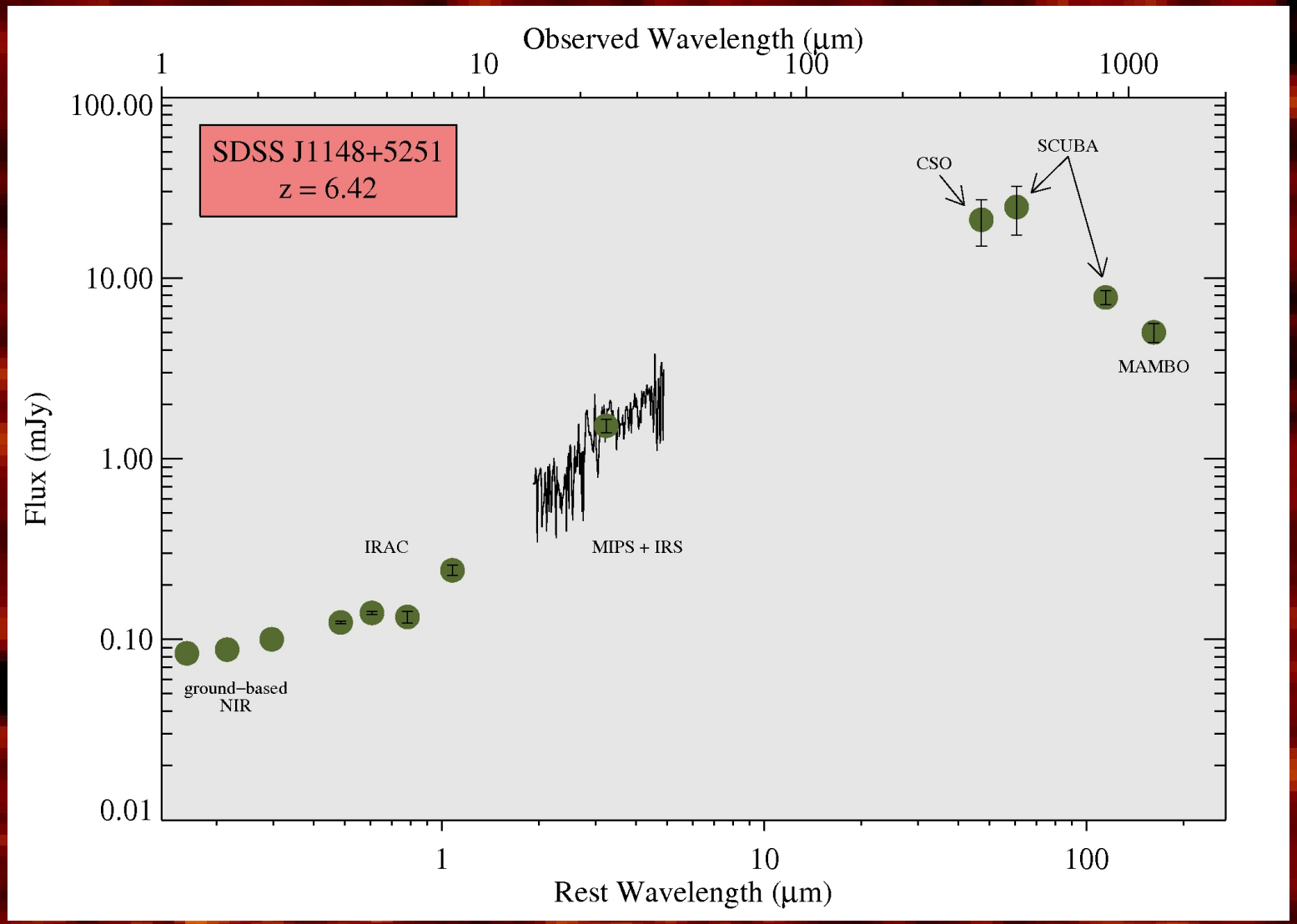
880 million years after big bang!

- z = 6.42
- M_{BH} ~ 3 x 10^9 $M_\odot$
- M_{CO} ~ 2 x 10^{10} $M_\odot$
- M_{dust} ~ 4 x 10^8 $M_\odot$
- L_{FIR} ~ 2 x 10^{13} $L_\odot$
- SFR ~ 1700 $M_\odot$ yr^{-1}
- T_{dust} ~ 60 K

Willott et al 2003, Bertoldi et al. 2003, Beelen et al. 2006, Walter et al. 2003/09, Carilli et al. 2004

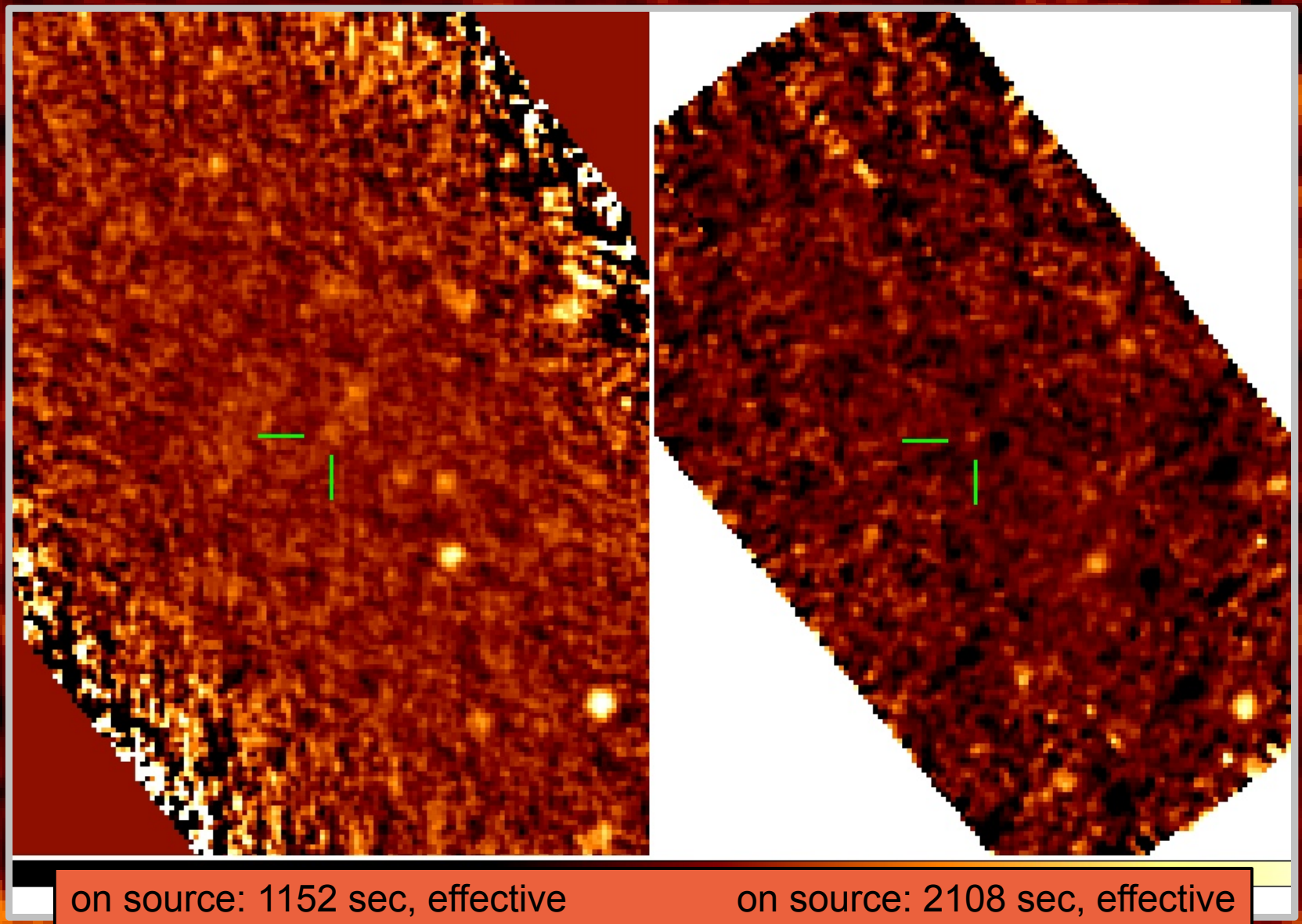
The Dusty Young Universe

SDSS J1148+5251



The Dusty Young Universe

SDSS J1148+5251: PACS 100μm → 5.0 ± 0.6 mJy

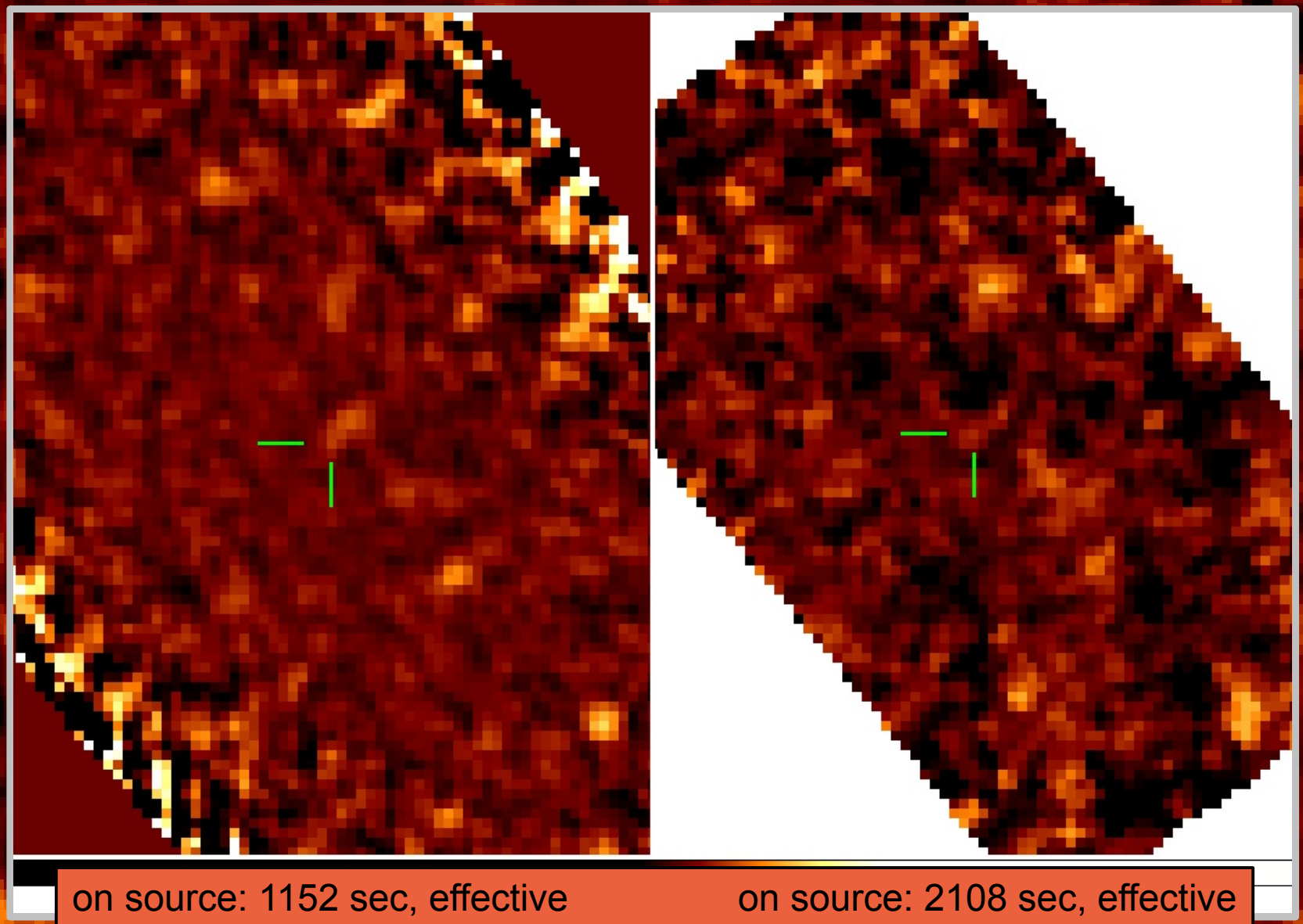


on source: 1152 sec, effective
total: 3810 sec

on source: 2108 sec, effective
total: 2673 sec

The Dusty Young Universe

SDSS J1148+5251: PACS 160μm → 9.5 ± 1.6 mJy

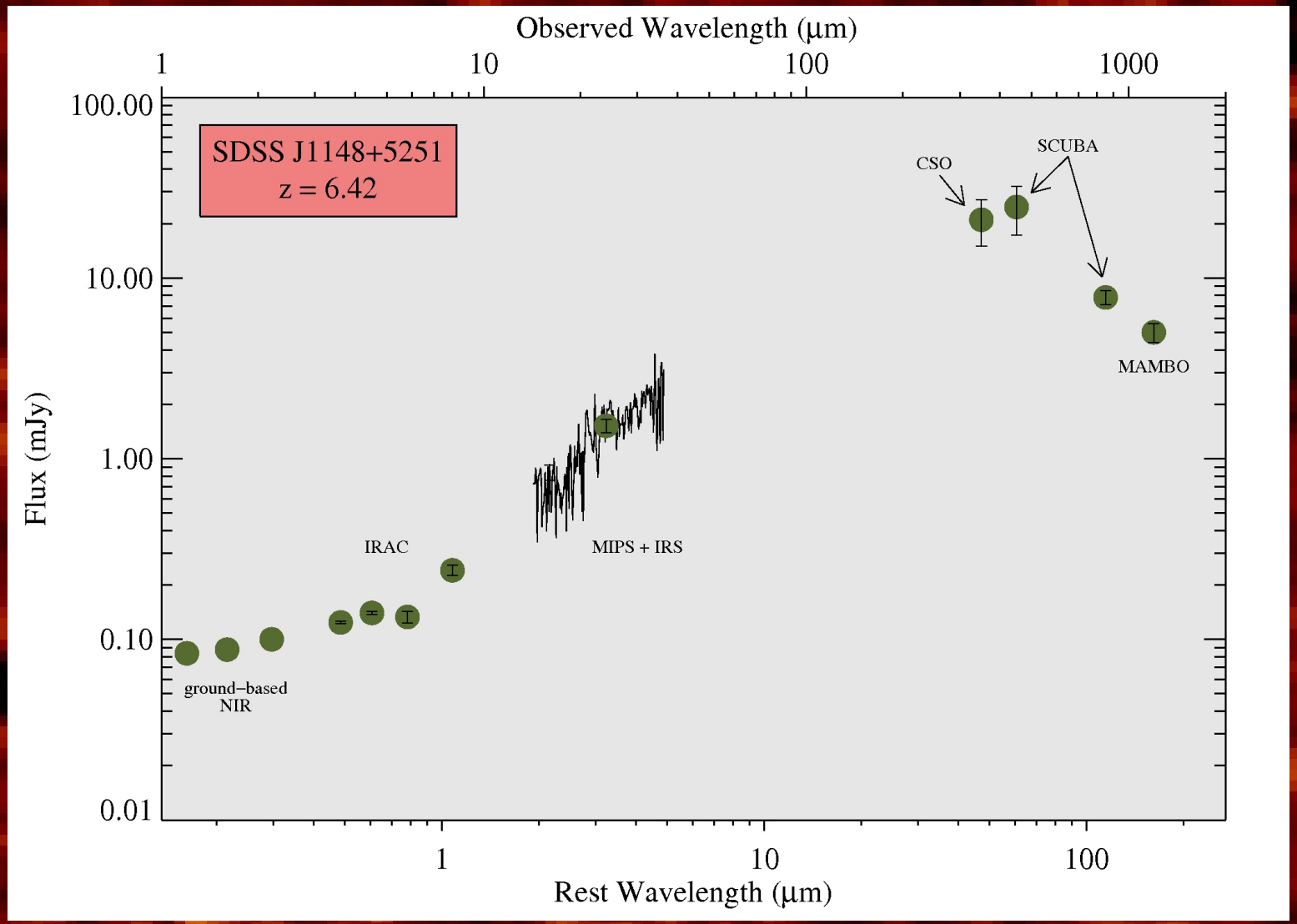


on source: 1152 sec, effective
total: 3810 sec

on source: 2108 sec, effective
total: 2673 sec

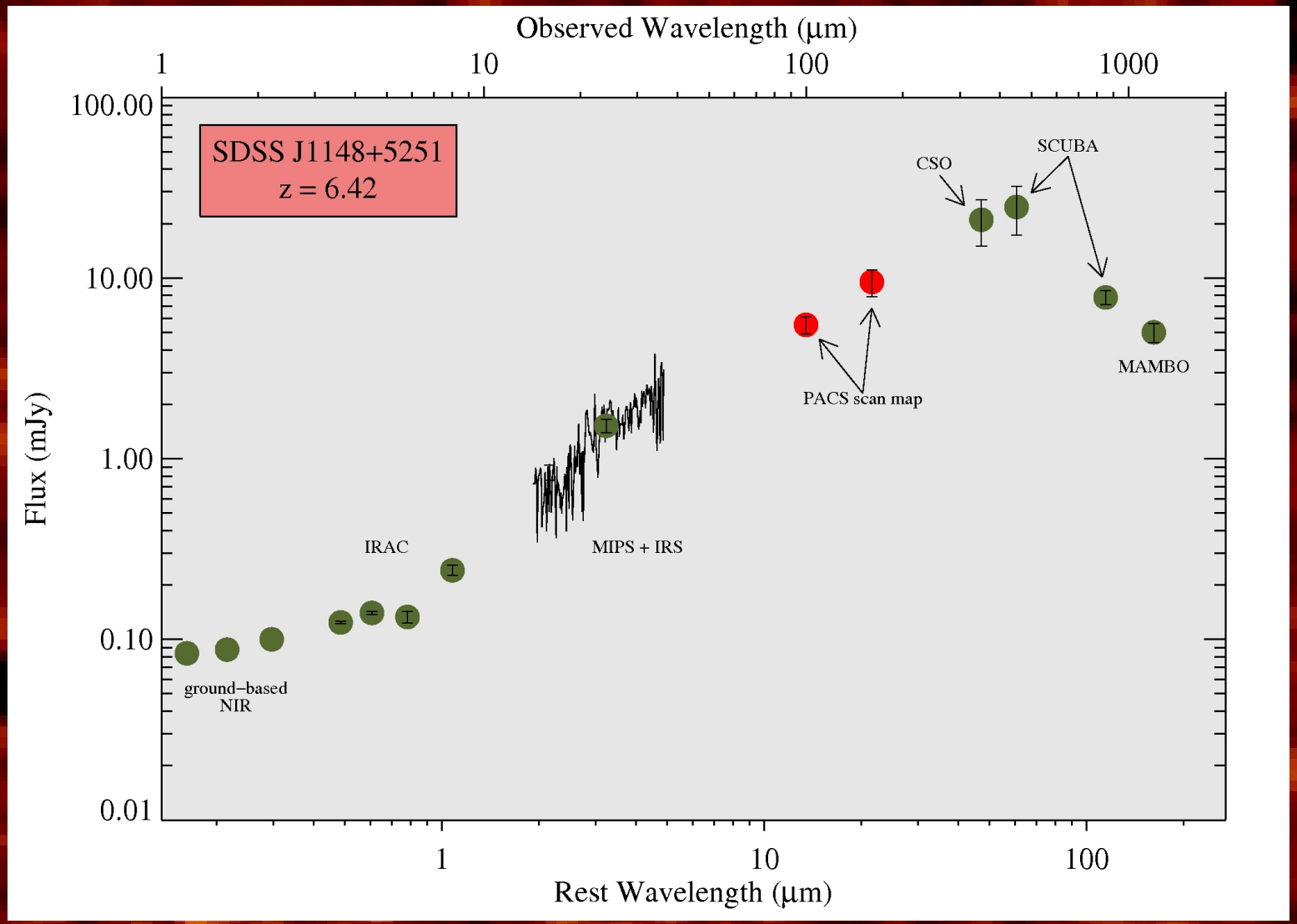
The Dusty Young Universe

SDSS J1148+5251



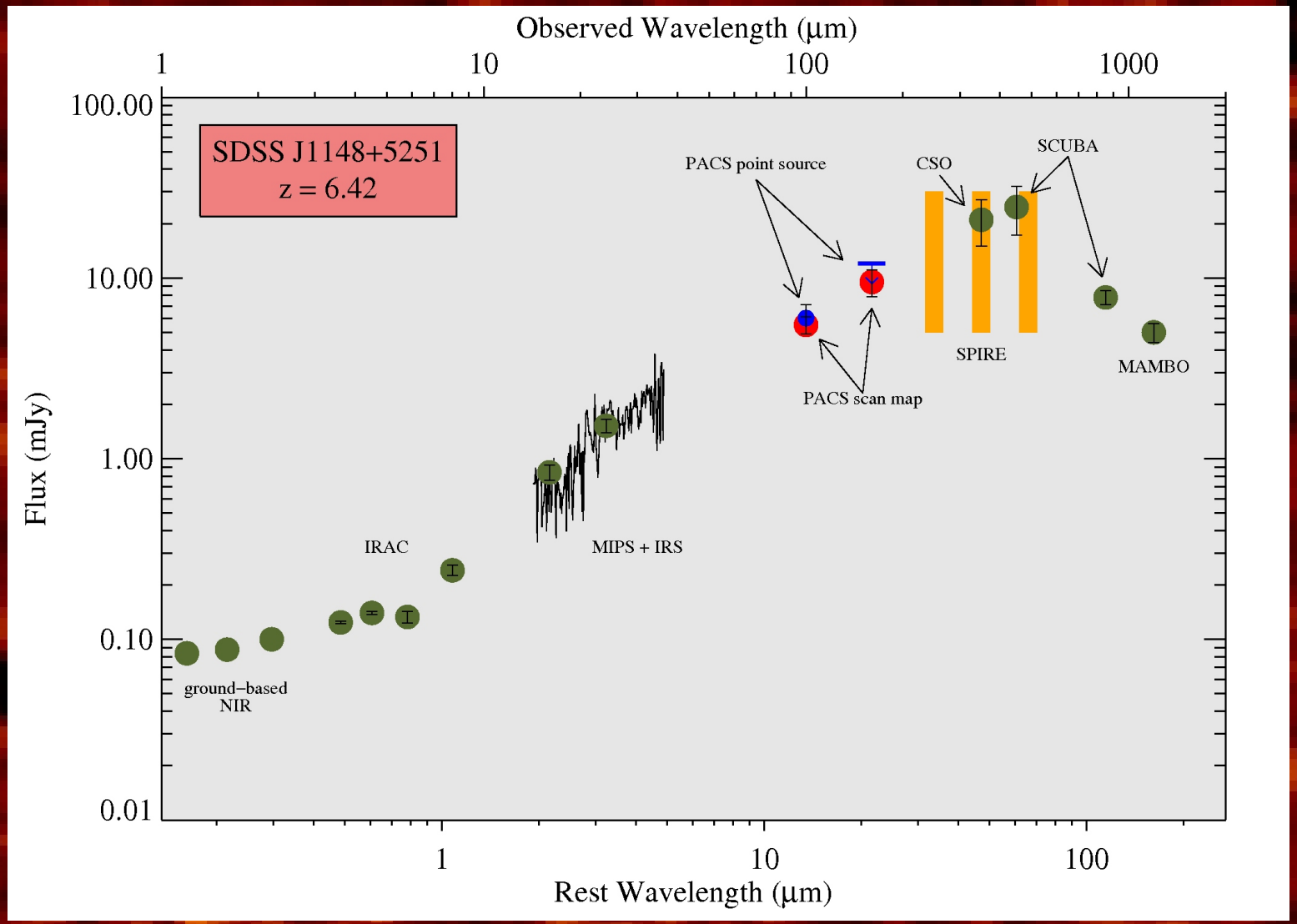
The Dusty Young Universe

SDSS J1148+5251



The Dusty Young Universe

SDSS J1148+5251



The Dusty Young Universe

Outlook

- Highest redshift quasar securely detected in the FIR
- Scan maps provide significant improvement over point source AOT for these faint objects
- PACS & SPIRE bands crucial to determine peak of SED
- Resolution at short λ helpful for identifying contaminating, lower-z sources