



The Dusty Young Universe

-Herschel-PACS GTO Key Project – 175 hours

-Coordinator: Klaus Meisenheimer (MPIA)

-Collaboration between MPIA, U Liege and MPE

-Team: K. Meisenheimer, H. Dannerbauer, U. Klaas, O. Krause, D. Lemke, F. Walter (MPIA), D. Hutsemekers (U Liege), L. Tacconi, D. Lutz, E. Sturm, A. Poglitsch, R. Genzel (MPE) et al.

Introduction:

A Herschel Guaranteed Time Key project is proposed which is targeted towards far-infrared and sub-millimetre photometric and spectroscopic observations of high redshift objects in the early universe. Their properties will be studied in the wavelength range where the spectral energy distribution is dominated by dust emission. It is a coordinated project with separate target lists and comprises three parts as outlined below.

Both the PACS and SPIRE instruments will be used for the photometric observations, while the spectroscopy will use the PACS spectrometer. A total of 175 hours of Herschel PACS Guaranteed Time will be devoted.

Projects and Science Objectives:

I. Far-IR – submm photometry of very high redshift QSOs: 95 hours

K. Meisenheimer, H. Dannerbauer, U. Klaas, O. Krause, D. Lemke, F. Walter (MPIA) et al.

- SEDs at $\lambda = 70(110) \dots 520 \mu\text{m}$ of the highest redshift quasars ($z > 5$) including all known quasars at $z > 6$
- dust masses and temperature, FIR luminosities of host galaxies 1 Gyr after big bang; history and frequency of dust production
- comparison: radio-loud / radio-quiet by including RGs and QSRs
- search for close companions/overdensities on mini-maps

II. Far-IR – submm photometry of BAL QSOs around $z = 2.5$: 30 hours

D. Hutsemekers (Institut d' Astrophysique)

- SEDs at $\lambda = 70(110) \dots 520 \mu\text{m}$ of Broad Absorption Line (BAL) quasars ($z \approx 2.3$) and comparison sample
- dust masses and temperatures in BAL systems
- correlation between BAL clouds and dust ?
- evolutionary sequence BALs \rightarrow normal QSOs ?

III. PACS spectroscopy of lensed high-z QSOs & galaxies ($2.3 < z < 3.9$): 50 hours

L. Tacconi, D. Lutz, E. Sturm, A. Poglitsch, R. Genzel (MPE)

- spectroscopic signatures for AGN activity and starbursts ([SIII], [OIV])
- quantify the contribution of star formation and AGN activity in these objects
- study their obscuration and physical conditions
- 1st time: place high-z QSOs and obscured star forming galaxies on excitation diagram

Target List:

I. Far-IR – submm photometry of very high-z QSOs: 94 objects

N = 16 QSOs, $z > 6$

N = 61 QSOs, $z > 5$

N = 17 radio-loud QSOs with $z > 3.5$

Final list: 48 sources Priority I; 46 sources Priority II

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

N = 25 BALs, $2.0 < z < 2.5$

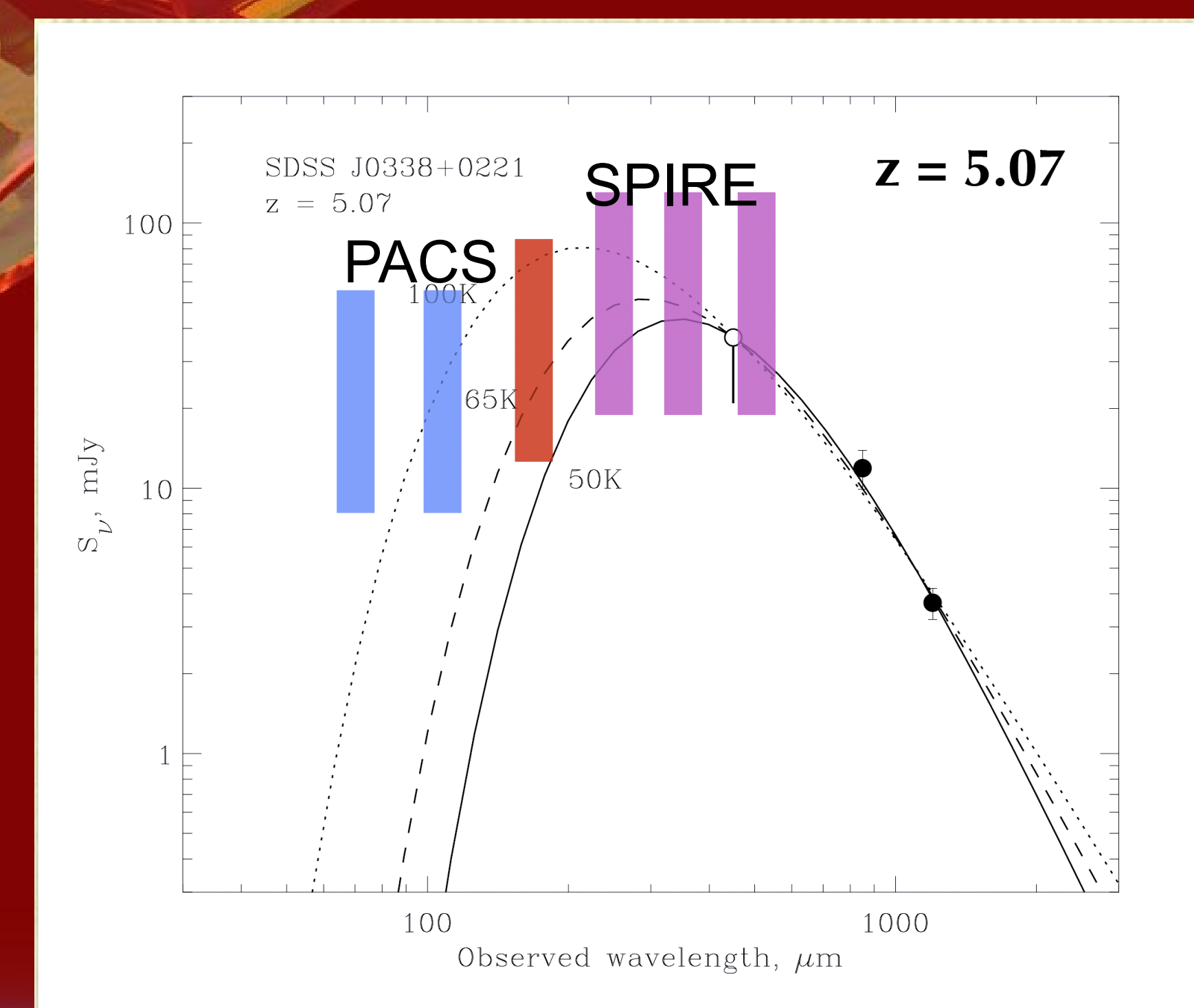
N = 6 BALs, $3.6 < z < 3.8$

N = 21 noBALs, $2.0 < z < 2.5$

III. PACS spectroscopy of lensed high-z QSOs & galaxies

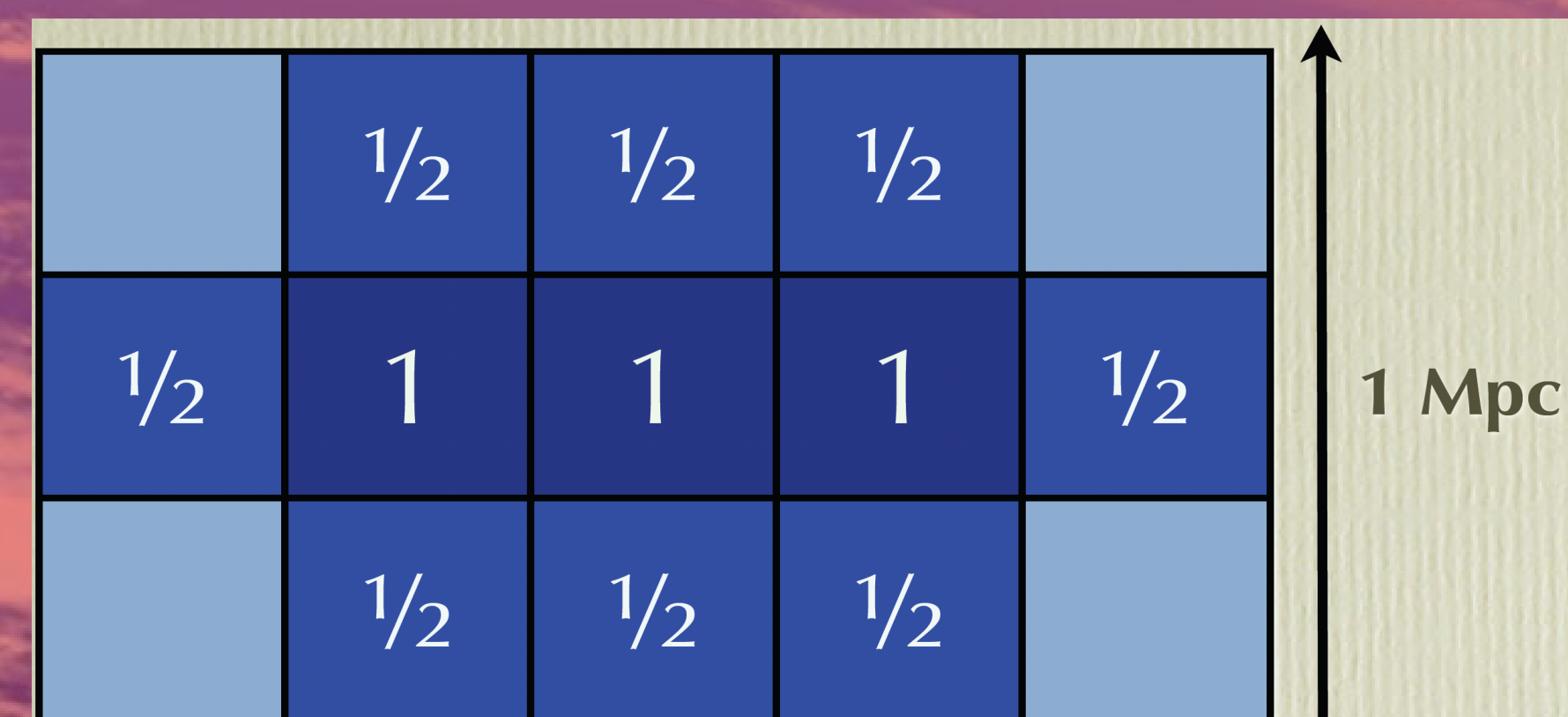
N = 5 lensed QSP/galaxies, $2.3 < z < 3.9$

Observations of high-z QSOs with Herschel



10 σ / 1 hour sensitivities \rightarrow
need 2 hours per source

PACS observations: mini maps



Multi-wavelength coverage of high-z QSOs:

- 1/3 of sources have Spitzer IRAC/MIPS 24 μm coverage \rightarrow medium Spitzer proposal submitted last week to collect for remaining sources IRAC/MIPS photometry
- 1/3 of our sources have submm/mm continuum and/or CO coverage \rightarrow submm/mm follow-up planned for the remaining sources
- for a large fraction of our targets additional NIR photometry is available; where necessary, we will add more H- and K-band photometry from ground based telescopes