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The Dusty Young Universe – IR and Sub-mm Photometry of High-z Quasars

1) Aim of the Herschel GT Key Project

Soon the IR-space observatory Herschel will be launched (planned: April 2009). Our approved Herschel GT Key Programme will collect far-IR and submm photometry of more than 100 high-z quasars using the PACS and SPIRE instruments. It targets three samples of QSOs: (i) all z>5 quasars known to date , (ii) a dozen radio loud quasars and galaxies, and (iii) 29 Broad Absorption Line (BAL) quasars plus a comparison sample of 17 non-BAL QSOs. This large program is a collaboration between MPIA, MPE and U Liege. At MPIA we focus on obtaining photometric observations with PACS and SPIRE of sample (i) and (ii). Complementary mid- and near-IR observations are currently collected with Spitzer and from the ground. Thus the three most important components of the quasar spectrum: (1) emission from the hot accretion disk, (2) radiation from hot dust close to the AGN core, and (3) dust emission from cooler dust will be covered. This unique data set will allow a comprehensive study of quasar related star formation. Thus it probes the earliest phases of black hole growth and galaxy formation, which are a central theme of the Priority Programme.

- SEDs at λ = 100, 160, 250, 350, 490 μm of the highest redshift quasars (z > 5) including all
- known quasars at z>6
- sample includes 16 QSOs with z>6; 61 QSOs at 6>z>5; 17 radio-loud QSOs with z > 3.5
- 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

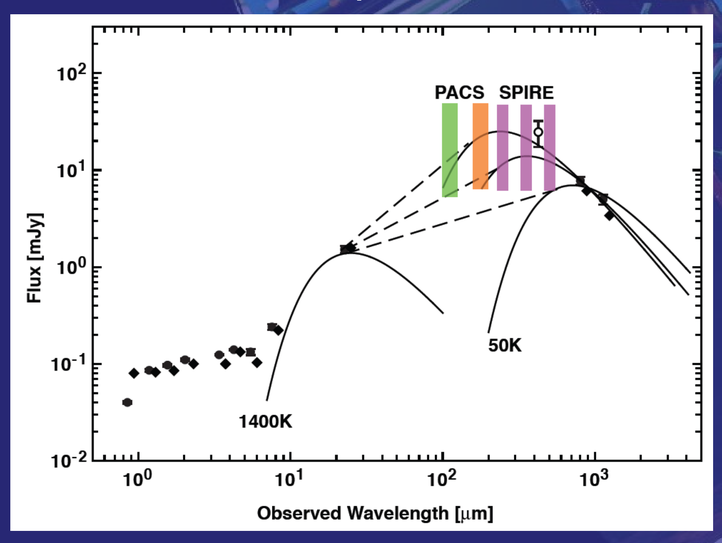

Fig.1 --- Typical SED of a dust-rich QSO at redshift z = 6 (combined measurments of SDSS J1148+5251 (z = 6.41, dots) and SDSS J1044-0125 (BAL at z = 5.71, diamonds), shifted to z = 6). The far-infrared to sub-mm wavelengths are essential for determining the dust temperature. The 5σ limits to be reached by PACS (100/160) and SPIRE (250/350/490) are shown as the lower edge of vertical bars.

2) Research Core Team

PI Meisenheimer, Klaus, Dr. apl Prof. (MPIA)

Burtscher, Leonard (MPIA)
Dannerbauer, Helmut, Dr. (MPIA) *Presenter*
De Rosa, Gisella (MPIA)
Haas, Martin, Dr. (Uni Bochum)
Jester, Sebastian, Dr. (MPIA)
Klaas, Ulrich, Dr. (MPIA)
Krause, Oliver, Dr. (MPIA)
Walter, Fabian, Dr. (MPIA)
+
two funded SPP positions:
N. N., Dr. (requested postdoc at MPIA) **!**
M. M., (requested PhD student at MPIA)

3) Detailed work packages of the two SPP funded positions

In order to harvest the Herschel data rapidly, two supplementary positions are required in the core team:I:

WP-1 Analysis of SPIRE data – Postdoc Position

1st Phase (6 months) • preparation and optimization of the SPIRE observations
2nd Phase (6 months) • ramp up to routine observations for the Herschel KP
3rd Phase (12 months) • data reduction and scientific analysis of KP observations

WP-2 Multi-color maps of the entire field-of-view – Ph.D.Position

- learn basic tools which are required for reducing imaging data
- catalogue production from IRAC and MIPS data
- construct mosaic maps from pointed PACS observations

4) Spitzer Observations – First results

- we have been awarded 70.0 hours of Spitzer observations in order to collect for all sources IRAC/MIPS 24 μm photometry (to secure the necessary short wavelength)
- to date (January 2009) 90% of the observations have been carried out and the greater part of them is reduced
- 98% of our observations is scheduled – only 2 MIPS 24 μm observations are missing
- first analysis of our data shows that all quasars are detected in the four IRAC bands
- only handful of sources is NOT detected in the MIPS 24 μm band
- typical rest-frame ~0.5-4 micron SEDs we show in Fig. 3

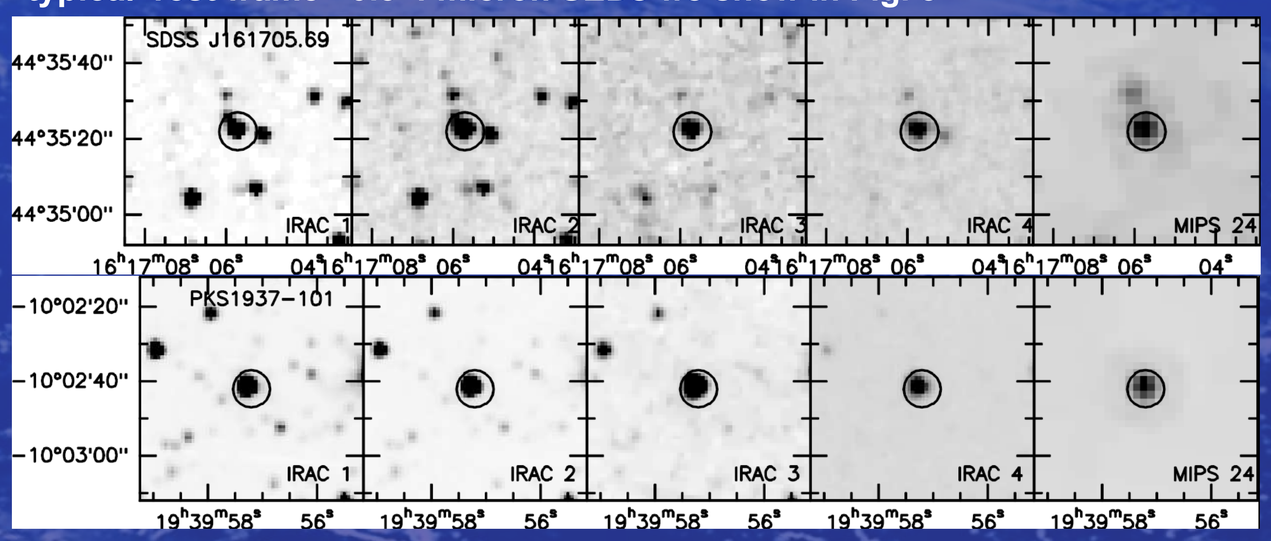

Fig. 2 --- First results of our complementary Mid-IR photometry. We show 60"x60" IRAC 3.6, 4.5, 5.8, 8.0 μm and MIPS 24 μm images of the field of SDSS J161705.69+443522.6 (z=5.49, top) and the radio-loud PKS 1937-101 (z=3.79,bottom). The QSOs (encircled) are well detected in each of the five Spitzer bands. Note the relatively strong 24 μm source only 10" north of SDSS J161705.69+443522.6.

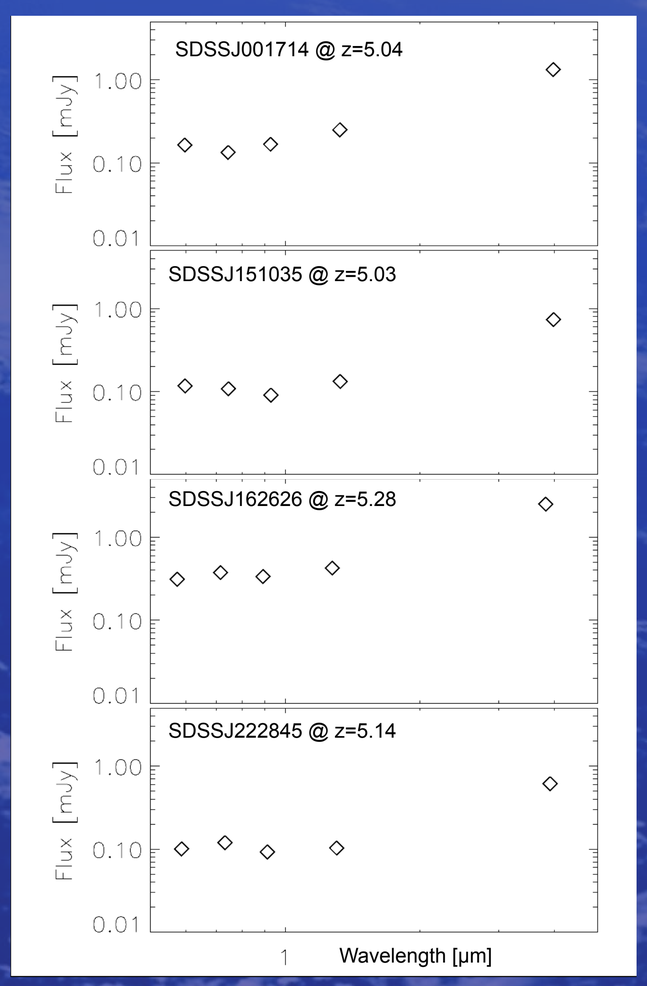

Fig. 3 --- We show typical rest-frame ~0.5-4 micron SEDs of four Quasars at z>5 based on our IRAC four band and MIPS 24 μm observations.