DUNES

DUst around NEarby Stars

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UAM & MPIA

on behalf C. Eiroa and DUNES consortium

DUNES People

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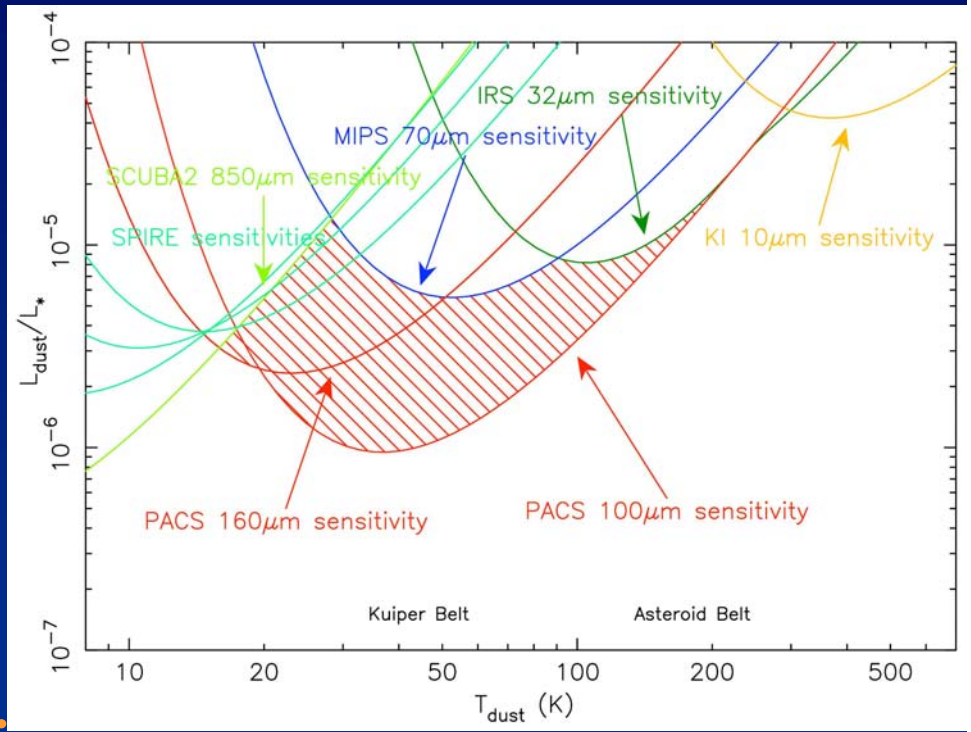
DUNES

-Main Goal: detect and characterize faint exo-solar analogues to the Edgeworth-Kuiper belt

-Sample: 133 FGK stars
- d < 20 pc
- stars with planets
- Spitzer faint debris disks (< 25 pc)

-Strategy: reach photospheric level. Constrained by background confusion.



DUNES - DEBRIS complementary

Motivation

i. dependence of planetesimal formation on stellar mass

ii. collisional and dynamical evolution of exo-EKBs

iii. presence of exo-EKBs versus presence of planets

iv. dust properties and size distribution in exo-EKBs.

SDP targets

Task	Target	Obs. Mode	Exptime	Photospheric flux [mJy]
Sensitivity	HIP 113357	PACS100 PS	1989 sec	10.8
PSF	HIP 99240	PACS100 SM	3749 sec	68.7
Binarity	HIP 110109	PACS100 SM	1989 sec	10.9
Spitzer 70μm excess	HIP 15371	PACS100 PS+SM	1824 sec	12.1
Extended disk	HIP 7978	PACS100 PS+SM PACS70 PS SPIRE PS	5124 sec 882 sec 591 sec	7.5

HIP 99240

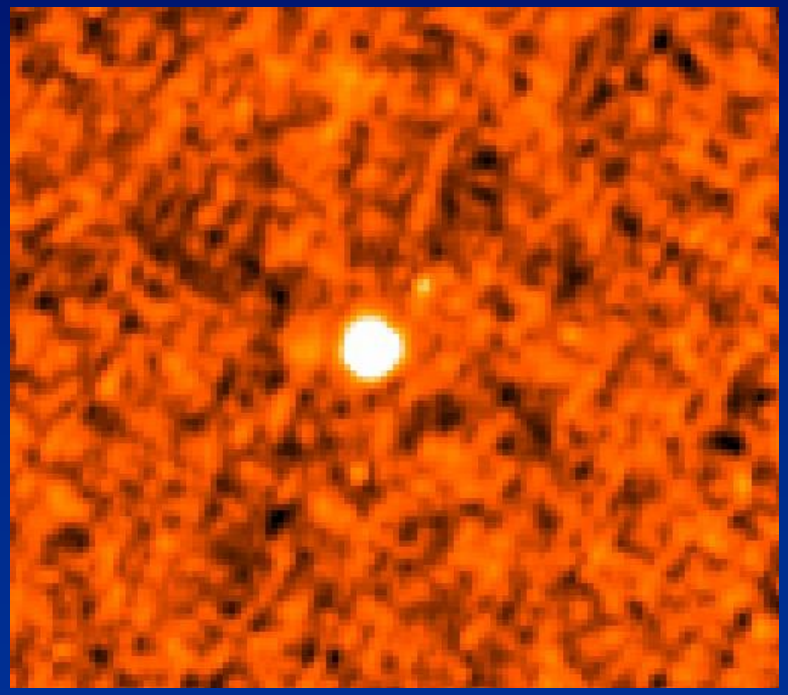
G5V
D = 6.11 pc
Age ~ 7 Gyr

F(Spitzer, 70 μm)	138.5 mJy
F(predicted, 100 μm)	68.7 mJy

Scan-map

Tot. Execution time	4073 sec
On-source time	1153 sec
STD background	3E-5 Jy
F(observed, 100 μm)	67 mJy

PACS 100

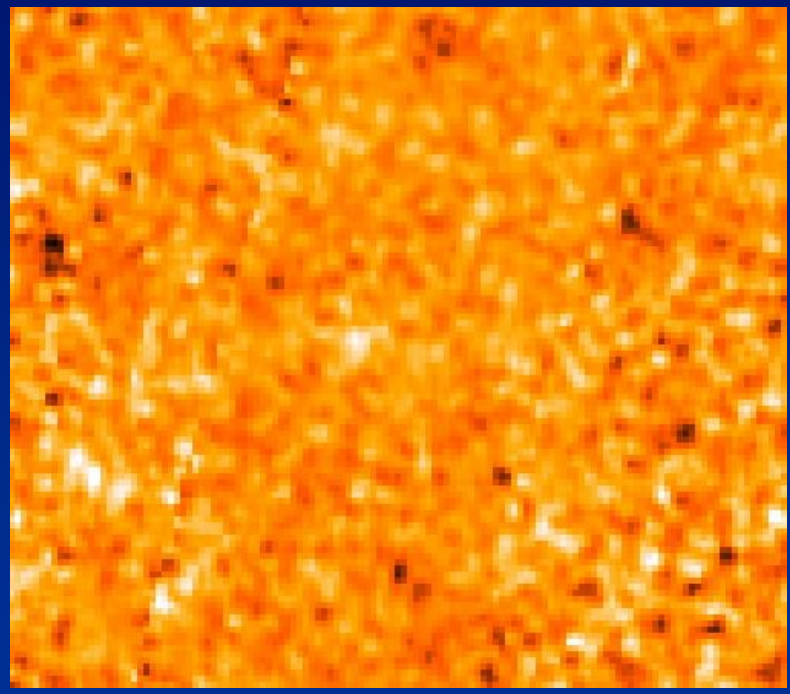


HIP 113357 (51 peg)

G2IV
D = 15.60 pc
Age ~ 4 Gyr
F(Spitzer, 70 μm) 28.1 mJy
F(predicted, 100 μm) 10.8 mJy

Point-source
Total int. time 1989 sec
On-source time 1364 sec
STD background 5E-5 Jy
F(observed, 100 μm) 12 mJy

PACS 100

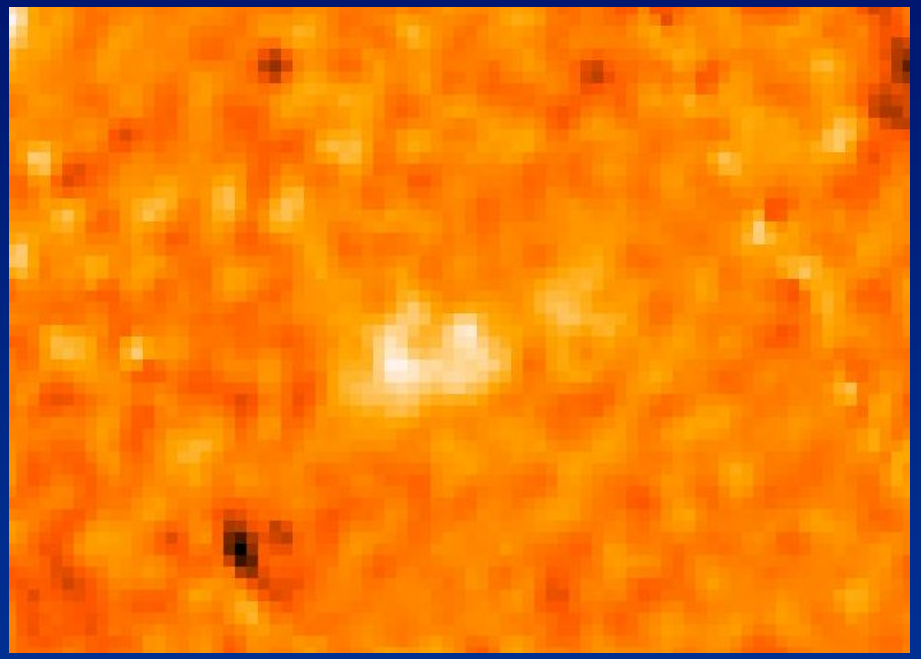


HIP 15371

G1V
D = 12.03 pc
Age ~ 3 Gyr
F(Spitzer, 70 μm)
45.4 mJy (excess)
F(predicted, 100 μm) 12.1 mJy

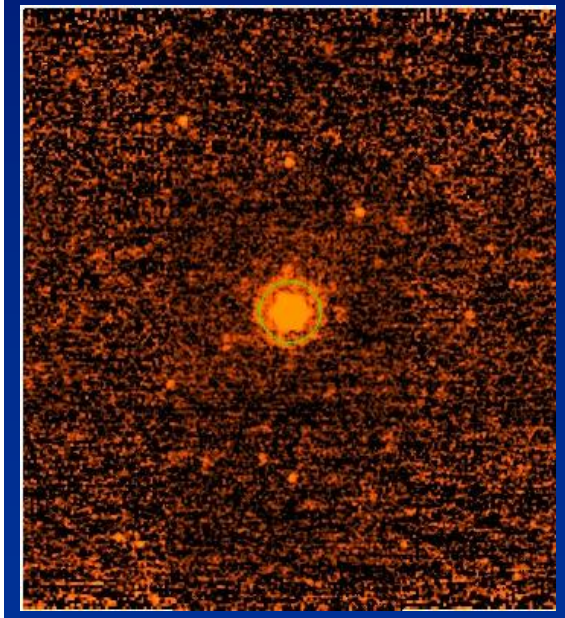
Point-source
Total int. Time
1824 sec
On-source time
1240 sec
STD background 6E-
5 Jy
F(observed, 100 μm) 34 mJY

PACS 100

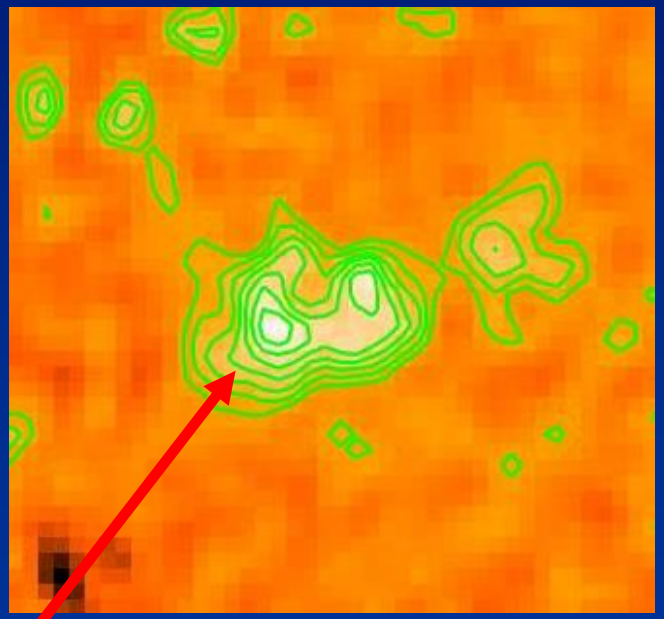


HIP 15371

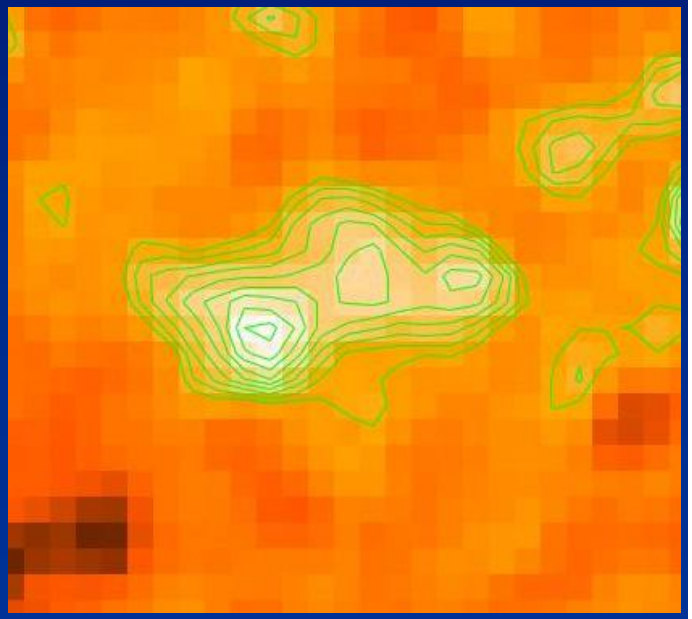
MIPS 24



PACS 100



PACS 160

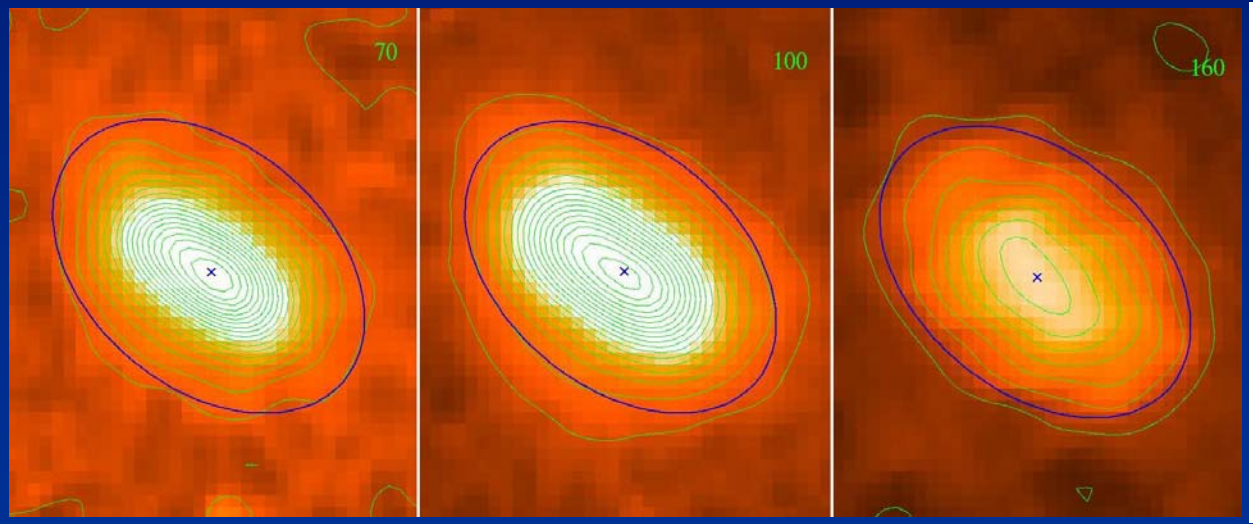


30 – 60 AU; Kuiper Belt ~ 30 - 50 AU !!!

HIP 7978 (q1 Eri)

F8-9V
D = 17.35 pc
Age > 2 Gyr

PACS 70 *PACS 100* *PACS 160* *LABOCA 870*



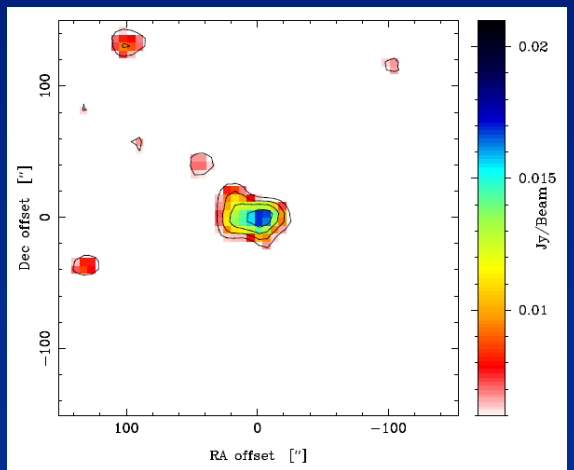


Fig. 1. q^1 Eri observed at 870μm with the submm camera LABOCA at the APEX telescope (HPBW~18″). Within the

$R_{870} > R_{100,160} > R_{70}$
$R_{max} \sim 300$ AU

Liseau '08

Modelling people at work

-Debris dust detected in 2 (+1?) SDP targets
-Extended emission detected

-Radiative tranfer code
-Collisional and dynamical disk models

One of our modelling expert finding his way in the dust

Lessons Learned

- PACS sensitivity satisfactory for DUNES goal
- PS more sensitive than SM but larger background STD
- PS → SM (but more time on-source needed)

- Debris dust detected in 2 (+1?) / 5 sources
- HIP15371: (candidate) exo-solar EKB analogue
- HIP7978: cold dust up to ~300 AU

With many thanks to
PACS ICC and HSC

Merry Christmas

HIP 7978 (q1 eri)

The star q^1 Eri

Distance, D	17.35 pc
Spectral type and luminosity class	F8-9 V
Effective temperature, $T_{\rm eff}$	6100 K
Luminosity, $L_{\rm star}$	1.2 $L_\odot$
Surface gravity, log g	4.4 (in cm s^{-2})
Radius, $R_{\rm star}$	1.1 $R_\odot$
Mass $M_{\rm star}$	1.1 $M_\odot$
Metallicity, [Fe/H]	−0.08
Age	(> 1 − 2) Gyr

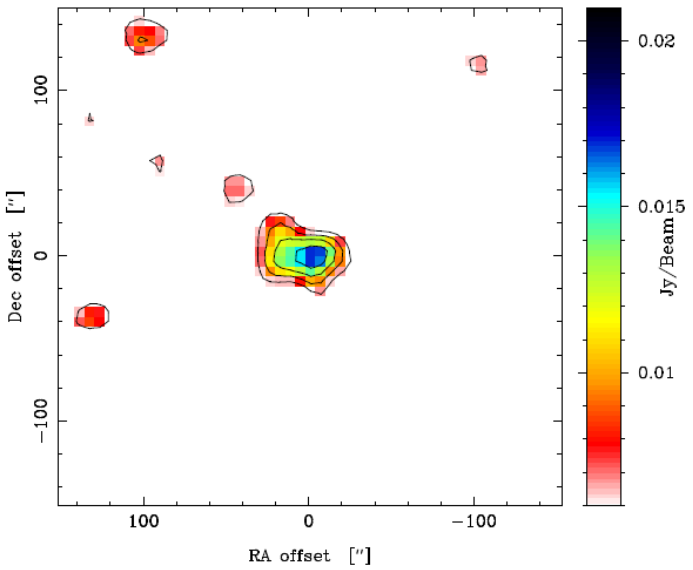
The planet q^1 Eri b

Period, P	2.75 ± 0.15 yr
Semimajor axis, $a_{\rm orbit}$	2.0 ± 0.2 AU
Eccentricity, e	0.2 ± 0.2
Mass, $M \sin i$	0.9 ± 0.2 $M_{\rm Jupiter}$

Table 2. Physical properties of the q^1 Eri dust system

Parameter	Value
Peak offset[a], ($\Delta\alpha$, $\Delta\delta$)	(+4″, +3″), (error: ±4′
Peak flux density[a], $F_\nu(0, 0)$, λ = 870 μm	(16.2 ± 0.8) mJy/beam
Integrated flux density, $\int F_\nu d\alpha d\delta$	(39.4 ± 4.1) mJy, $F_\nu \geq$
Major axis[a] (FWHM)	37″± 2″ (640 ± 35) AU
Position angle[a], pa	55° ± 4° (north over ea
Minor axis[a] (FWHM)	23″ ± 1″
Inclination angle, i	≥ 52° (90° = edge-on)
Fractional luminosity, $L_{\rm bb}/L_{\rm star}$	1.1×10^{-4}
Inner (outer)[b] Temperature, $T_{\rm bb}$	60 K (17 K)
Inner (outer)[b] Radius, $r_{\rm bb}$	25 AU (300 AU)
Inner (outer)[b] Width, $\Delta r_{\rm bb}$	0.02 AU (60 AU)
Inner (outer)[b] Minimum mass[c], $M_{\rm dust}$	0.04 $M_\oplus$ (0.15 $M_\oplus$)

Liseau et al. 2008



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