21 Lutetia and other M-type asteroids:
Their sizes, albedos, and thermal properties from new IRTF measurements

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This is a modified version of a talk given at the 37th mtg. of the DPS.

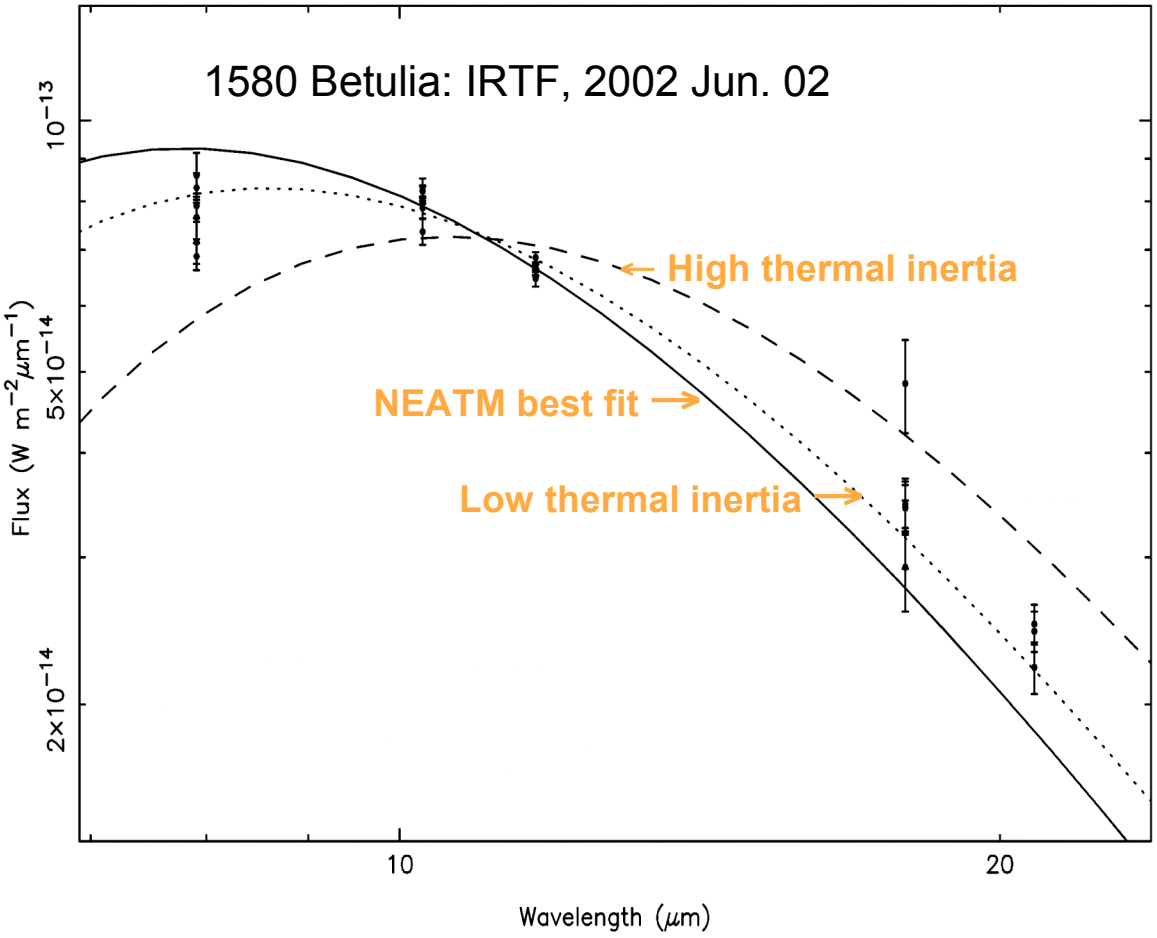
M is for Metal

Are M-type asteroids metallic or not?

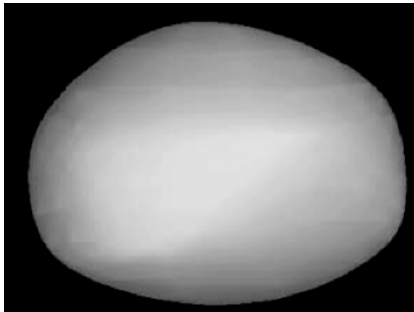
- Some appear to be metallic (Kleopatra, Psyche),
- some may be non-metallic (Lutetia),
- and some may be both (Antigone, Zwetana).

How do we know?

- reflectance spectroscopy
- radar albedo
- thermal inertia (IRTF observations)



From the observed asteroid thermal continuum we determine the apparen color temperature T_C, size, and albedo.



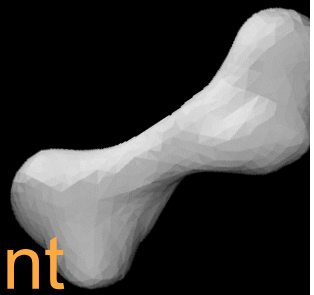
Metallic M-types: 16 Psyche and 216 Kleopatra

16 Psyche:	**D = 218 ± 33 km** **p_V = 0.166 ± 0.050**	**(IRAS: 253 km!)**
216 Kleopatra:	**'D' = 137 ± 21 km** **p_V = 0.182 ± 0.055**	**(IRAS: 135 km)**

The thermal inertia in both cases is larger than 50 J m^{-2} K^{-1} $s^{-½}$; all other main belt asteroids thermal inertia measurements are 5—25 J m^{-2} K^{-1} $s^{-½}$.

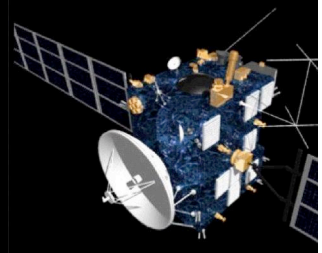
So, Psyche and Kleopatra have the

- highest known radar albedo
- highest known thermal inertia consistent with a "metallic" surface.



Non-metallic M-types: 21 Lutetia (Rosetta Target) and 201 Penelope

21 Lutetia:	D = 98.3 ± 5.9 km p_V = 0.208 ± 0.025	(IRAS: D = 95.8 km, p_V = 0.221)
201 Penelope:	D = 65.8 ± 9.9 km p_V = 0.173 ± 0.052	(IRAS: 68.4 km)



Neither asteroid displays an elevated thermal inertia.

» So our results are compatible with Rivkin et al. 2000: Lutetia and Penelope are apparently hydrated, i.e. non-metallic.

Lutetia has spectral features similar to those of carbonaceous chondrites. *Could Lutetia actually be a C-type*
No! Our albedo measurement confirms the IRAS value (p_V = 0.22).

129 Antigone and 785 Zwetana

129 Antigone:	D = 139 ± 21 km p_V = 0.156 ± 0.047	(not observed by IRAS)
785 Zwetana:	D = 46.9 ± 7.0 km p_V = 0.134 ± 0.041	(IRAS: 48.5 km)

129 and 785 have radar-dark *and* radar-bright patches.

We observed both asteroids twice, at the corresponding rotational phases:

- No significant difference in color temperature (preliminary result)
- No indication for elevated thermal inertia

Thuse these asteroids have characterics of both a regolith-covered and metallic surface.

Conclusions

We have determined the sizes and albedos of 6 M-type main belt asteroids from new mid-IR data.

- The size estimates from IRAS data were mostly confirmed.
- 21 Lutetia (Rosetta fly-by target):
  IRAS-albedo seems inconsistent with recent spectroscopic findings, but it is confirmed by our data: $p_V = 0.208$.
- 16 Psyche: IRAS diameter is slightly too high→ previous density estimates are too low.

Furthermore the asteroids' apparent color temperatures were determined:

- 16 Psyche and 216 Kleopatra have the highest known thermal inertia i the main belt, consistent with metallic composition.
- The other targets were not found to have an elevated thermal inertia.
- Among M-types, radar albedo may indeed correlate with thermal inerti