Thermophysical properties of
162 173 (1999 JU3) &
4015 Wilson-Harrington

Based on the experience from 25 143 Itokawa

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Experience from 25 143 Itokawa

Input:

- $H_v$ mag, G-slope (Bernardi et al. 2008) from visual photometry
- Shape, spin-vector, $P_{s_i g}$ (Kaasalainen et al. 2003; 2005) from lightcurve inversion technique (and radar measurements by Ostro et al. 2004; 2005)
- 30 thermal, remote, disk-integrated mid-infrared observations (ESO 3.6m, Subaru, IRTF, Akari)
Thermophysical Model (TPM) output:
(Müller et al. 2005, 2009):

- effective size = equal volume sphere:
  - 320±30 m (without Akari-data)
  - 331±25 m (with Akari-data)

→ true value: 327.5±5.5 m (Hayabusa; Fujiwara et al. 2006)

- geometric albedo p_V: 0.247±0.035

- thermal inertia: 1000 J m^{-2} s^{-0.5} K^{-1}
  (→ surface temperature distribution)

- clear confirmation of the sense of rotation

- strong indications for the absence of dusty regolith
25143 Itokawa is the "benchmark" for thermo-physical model techniques!
Input:

- $H_v$ mag, G-slope (Kawakami et al. 2008) from visual photometry
- $P_{sid} = 7^h37^m38^s$
- Shape models: sphere, ellipsoid, various shape and spin-vector solutions from lightcurve inversion techniques
- 17 thermal mid-infrared observations (Subaru, Akari)
**Thermophysical Model (TPM) output (Hasegawa et al. 2008):**

- effective size: $0.92 \pm 0.12$
- geometric albedo: $0.063^{+0.020}_{-0.015}$ (typical for C-type asteroids)
- indications for prograde sense of rotation
- thermal inertia: $>500 \text{ Jm}^{-2}\text{s}^{-0.5}\text{K}^{-1}$
- predominantly covered by boulders and bare rocks, while areas with thick dust regolith are less common
But:

- thermal mid-infrared observations have only small coverage in phase angle and wavelength (Spitzer observations will help)
- shape and spin-vector solutions are not unique
- → diameter might be somewhat smaller (0.7 km with a geometric albedo of 0.09...0.10)
- one possible spin-vector solution would also allow much smaller thermal inertias, consistent with a dusty regolith
Input for radiometric technique:

- $H_v$ mag, G-slope (APC 5, Lagerkvist et al. 2001) from visual photometry
- $P_{sid} = 6.1$ h (Osip et al. 2005)
- Shape models: sphere with various spin-vector orientations
- 5 thermal mid-infrared observations (Campins et al. 1995, MSX, ISOCAM)
Thermophysical Model (TPM) output
(Müller et al. 2009, in prep.):

- effective size: $2.87 \pm 0.14$ km
- geometric albedo $p_V$: $0.089 \pm 0.009$
- strong indications for retrograde sense of rotation
- thermal inertia: $20 \ldots 40 \ldots 80 \text{ Jm}^{-2}\text{s}^{-0.5}\text{K}^{-1}$

→ consistent with either a thick dust regolith on the surface or with a cometary surface
But:

- thermal mid-infrared observations have only small coverage in phase angle and wavelength (Spitzer observations will help)
- no shape and spin-vector solutions are available
- ground-based lightcurve programme is ongoing
- proposals for additional thermal data are submitted
Summary

- the radiometric techniques is very powerful for pre-encounter characterisation of small bodies
- physical and thermal properties can be derived with high accuracy
- characterisation of any target is possible (NEOs, MBAs, TNOs, cometary nuclei, ....)

But:
→ a set of high quality mid-infrared observations is required! (covering phase angles, wavelengths, rotational phases)
→ lightcurves are required for shape and spin-vector solutions
→ reliable visual photometry is needed for reliable H-G values