Emissivity vs. emergence angles
for asteroid analogues

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The PEL complete set-up

- Instrument Bruker VERTEX 80V coupled via a shutter with evacuated emissivity chamber containing blackbody, stepper motor, sample holder carousel, webcam, and an induction system to heat the samples to high T
- Instrument Bruker IFS 88 coupled with purged emissivity chamber, calibration blackbody, sample heater, and moving mirror
- Full set of detectors and beamsplitter to cover from 0.4 to above 100 µm in emissivity, reflectance and transmission measurements
- Four standard mineral grain sizes: <25, 25-63, 63-125, 125-250 µm
The Previous Experiment

• Emissivity measurements of 2 very different endmembers: quartz 250-355 µm and a magnetite < 500 µm grain size, plus a binary mixture (50%+50% in volume) of the 2 endmembers

• Measurements in vacuum (100 Pa) at asteroid typical temperature (373 K)

• Measurements for plane (0° inclination), 5°, 10° and 15° inclination for all the samples

• Calibration body measured in the same conditions of pressure, surface temperature and inclination of the samples
Samples and wedges
Quartz

Emittance vs. Wavelength (μm)

- quartz 0°
- quartz 5°
- quartz 10°
- quartz 15°
- 1-R quartz (13°+13°)
Magnetite

Magnetite 0°
Magnetite 5°
Magnetite 10°
Magnetite 15°
1−R magnetite (13°+13°)
Mixture 18

mix 15°
50%quartz+50%magnetite 15°
23%quartz+77%magnetite 15°
25%quartz+75%magnetite 0°
25%quartz+75%magnetite 5°
25%quartz+75%magnetite 10°
1−R mix (13°+13°)
Conclusions on first experiment

• Emerging angles up to 15° seems **not to be** the major driver of differences observed in measured emissivity

• Dark material is masking the brighter one: problems for linear deconvolution methods

• Test the experiment again with endmembers having the same grain size fractions (very fine and a larger as optimum)

• Extend angle of inclination to 25° (feasible) or even 35° (difficult)

• Calibration respect to a flat blackbody, like in space
New Experiments

• Emissivity measurements of 2 asteroid analogues: synthetic enstatite <25 µm and meteorite millbillillie (fine)
• Emissivity measured in air and in vacuum (100 Pa) at asteroid typical temperature (373 K)
• Measurements for plane (0° inclination), 5°, 10°, 20°, 30°, 40°, 50°, 60° inclination for all the samples (had to encrust them) !!
• Calibration body measured in the same conditions of pressure, surface temperature and inclination of the samples (flat also)
Some of the Wedges

50°  40°  30°  20°  10°
• To avoid samples slipping away from the cups, we had to encrust them: mixing with ethanol, preparing the cups gently packing the moistured powder, letting dry at 30° C for one day.
Enstatite (flat BB) - Air

![Graph showing emissivity versus wavelength for enstatite in air with different angles and conditions.](chart14.png)
Millbillillie (flat BB) - Vacuum

Emissivity

Wavelength (μm)
Conclusions

- Calibration vs. flat blackbody does not alter the nature of experiment and best reproduces orbiter conditions.
- For both samples, calibrated emissivity in air show remarkable variations for $e \geq 40^\circ$.
- Measure in vacuum (more complicated) confirm the same trends.
- $1-R$ for both samples shows large differences occurring for phase angles $> 70^\circ$.
- With increasing $e$ we note trends in band shifts and band shapes.
- Reflectance with minimum incidence and increasing emission angles.