HOT, COOL, DARK AND BRIGHT

THE VARIOUS SHADES OF DUST AROUND AGN

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TORUS 2018, Puerto Varas, 10-14 December 2018





European Research Council









Topics

• I. Silicates and clumpiness — it's not the full story

Does clumpiness solve the silicate feature issue?

• II. Hot & warm dust — not quite the ISM

How can we constrain the hot dust composition? What do we see?

• III. AGN do not destroy (all) PAHs

PAHs where there shouldn't be any

I. Silicates & clumpiness it's not the full story



restframe wavelength (micron)



restframe wavelength (micron)

Hoenig et a;l. 2010

PA 45°

13

12

PA 120°

12

13



Krolik & Begelman 1986

• **clumpiness** alters emission characteristics

→ hot/cold faces exposed, view through holes

- mostly modelled in **extreme/unstable configurations**
- "gospel" says:

clumpiness suppresses silicate features



clumpy models do also overpredict silicate emission features

II. Hot & cool dust — not quite the ISM

II. Hot dust is predominantly graphite



- inner radius of torus scales with L^{1/2} (as expected from dust)
- absolute sizes are smaller than expected from ISM by factor ~3
- emissivity + sizes: large graphite grains

II. Mid-IR dust emissivities



- mid-IR emissivities are quite high
- hints of large grain predominance?

Kishimoto et al. 2011



II. Silicate-poor outflows on parsec scales?



- 3-5um bump as seen in other type 1s (see Daniel's talk) + mid-IR bump (see also Mor & Netzer 2012)
- differential dust sublimation increases emissivity
- pc-scale wind silicate-poor as launched from sublimation region (e.g. Krolik 2007, Dorodnitsyn+12, Marta's poster & David's talk)

II. A look at SEDs: CAT3D-WIND vs. CAT3D



- CAT3D-WIND covers same parameter space as CAT3D...
- ... but opens new SED parameter space: **3-5 µm bump in type 1s**



III. AGN do not destroy (all) PAHs

III. PAHs in ground-based mid-IR spectra



- PAHs weak in AGN nuclear spectra
 - (1) PAH destroyed?

(2) PAH emission swamped by AGN continuum?

III. PAHs in ground-based mid-IR spectra



- a bit of a **mixed bag**, but...
- ... (luminosity) scales do matter!

III. PAHs in ground-based mid-IR spectra



- emission becomes stronger towards the AGN (see also Alonso Herrero+14)
- a universal slope? → at least partial AGN excitation

Summary

- What we learned...
 - ► AGN processes dust composition → not ISM anymore
 - hot dust predominantly large graphite grains
 - mid-IR emitting dust might have deficiency of silicates
 - **PAHs do survive** in the proximity of an AGN \rightarrow (self-)shielding
- What will be coming soon (hopefully)...
 - More complexity: Dust forming around AGN? (Elvis 2000)
 - where does the pc polar dust originate from?
 - → radiative hydrodynamics (e.g. David's talk + others on Thursday)
 - → IR+AGN radiation pressure (e.g. see Marta's poster)
 - real parsec scale images with VLTI/MATISSE & VLTI/GRAVITY
 - ► **JWST** for PAHs