The central parsec of AGN: challenges to the torus

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PARSEC project

Multiwavelength study of the centre of the nearest galaxies at PARSEC scales ($\theta < 0.5''$):

- from active to quiescent

Sampling: Chandra – HST – (AO-NIR + MIR) – SMA /ALMA – VLA /ATCA

$< 0.1''$

Dust filaments and lanes are ubiquitous to the centre of galaxies. They originate at kpc distances, at the centre they often cross the AGN and obscure it.

Their role:

1. They may naturally cause the type 1/2 classification in AGN.
2. They transport material from kpc distance to the centre, ignite both nuclear star formation and feed the hole.
The central kpc in a typical AGN

NGC 1068

Prieto+ 2014
... and in more normal type 2:

ESO 428-G14 ($L_{bol} \sim 10^{42}$) and MCG-5-23-16 ($L_{bol} \sim 10^{43}$)
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from kpc to pc: dust in type 1 as well....

NGC 3783 \((L_{bol} \sim 10^{44})\) and Sombrero \((L_{bol} \sim 10^{42})\)
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NGC 3783 ($L_{bol} \sim 10^{44}$) and Sombrero ($L_{bol} \sim 10^{42}$)

Prieto+14; Mezcua+15; Nadonly+17
The SEDs show a smooth transition from T2 (fully obscured) to T1 (partial obscuration) to QSO (low dust attenuation)
... demystifying ionization cones

NGC 1386, NGC 3169, Circinus and Sombrero

Ionized gas morphology strictly defined by the dust filaments

Prieto+14; Mezcua+16; Nadonly+17
Dust filaments: on their structure

Lane filling factor $\sim 2\%$ ($\sim 10 \times ff$ ionised gas)

$N_{\text{e,filaments}} \rightarrow 200 \text{ cm}^{-3}$
**Dust filaments: on their nature**

- **Cen A**
  - CO 6-5
  - CO inflow rate ~0.2 Mo/yr (Fathi+13)
  - HCN inflow rate at the ring: ~3 Mo/yr (Prieto+16)

- **NGC 1097**
  - F814W/F438W
  - CO 3-2

- **NGC 1068**
  - K / F550M
  - Mezcua+15
  - CO inflow rate ~0.2 Mo/yr (Fathi+13)
  - HCN inflow rate at the ring: ~3 Mo/yr (Prieto+16)
  - H2 inflow rate ~15 Mo/yr (Muller-Sanchez+09)

**References:**
- Prieto+05
- Mezcua+15
- Izumi+17
- Espada+18
- Mezcua+15
- Imanishi+18

**Images:**
- Mezcua+15
- Prieto+05
- Mezcua+15
- Imanishi+18
- Espada+18
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  - F814W + K
  - CO 6-5

- **Izumi+17**
  - CO 3-2

- **Imanishi+18**
  - HCN 3-2
Large scale dust filaments playing the role of the torus

- Large-scale dust filaments /lanes cross the centre of T1 and T2 sources alike

- Depending on their optical thickness, on nucleus luminosity, the nucleus is total or partially obscured

- Collimation of the ionised gas not caused by a torus: ionised gas morphology strictly defined by filaments

- Filaments run from kpc distance to the central pc: potential major suppliers for nuclear starformation and BH