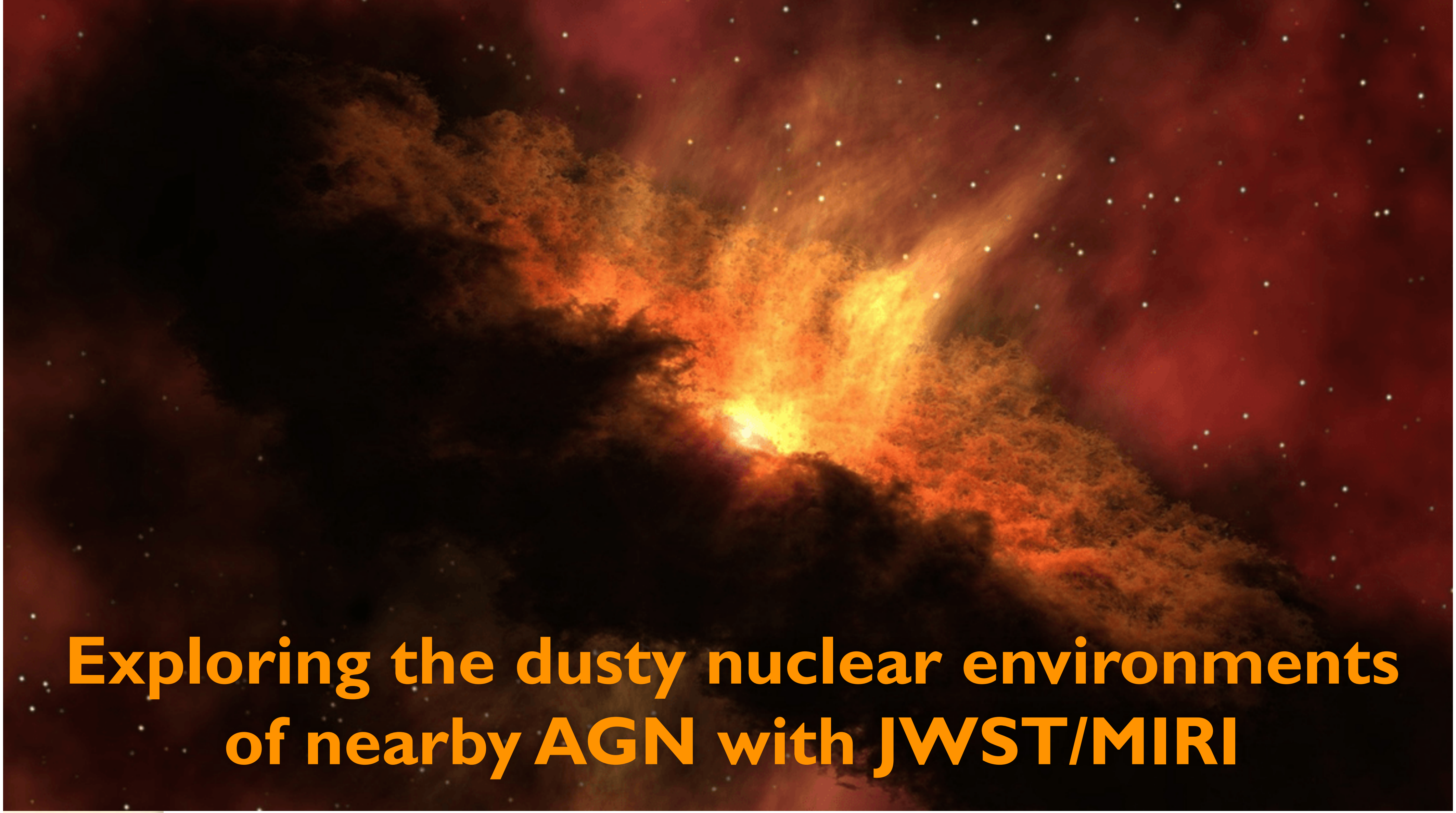

Exploring the dusty nuclear environments of nearby AGN with JWST/MIRI

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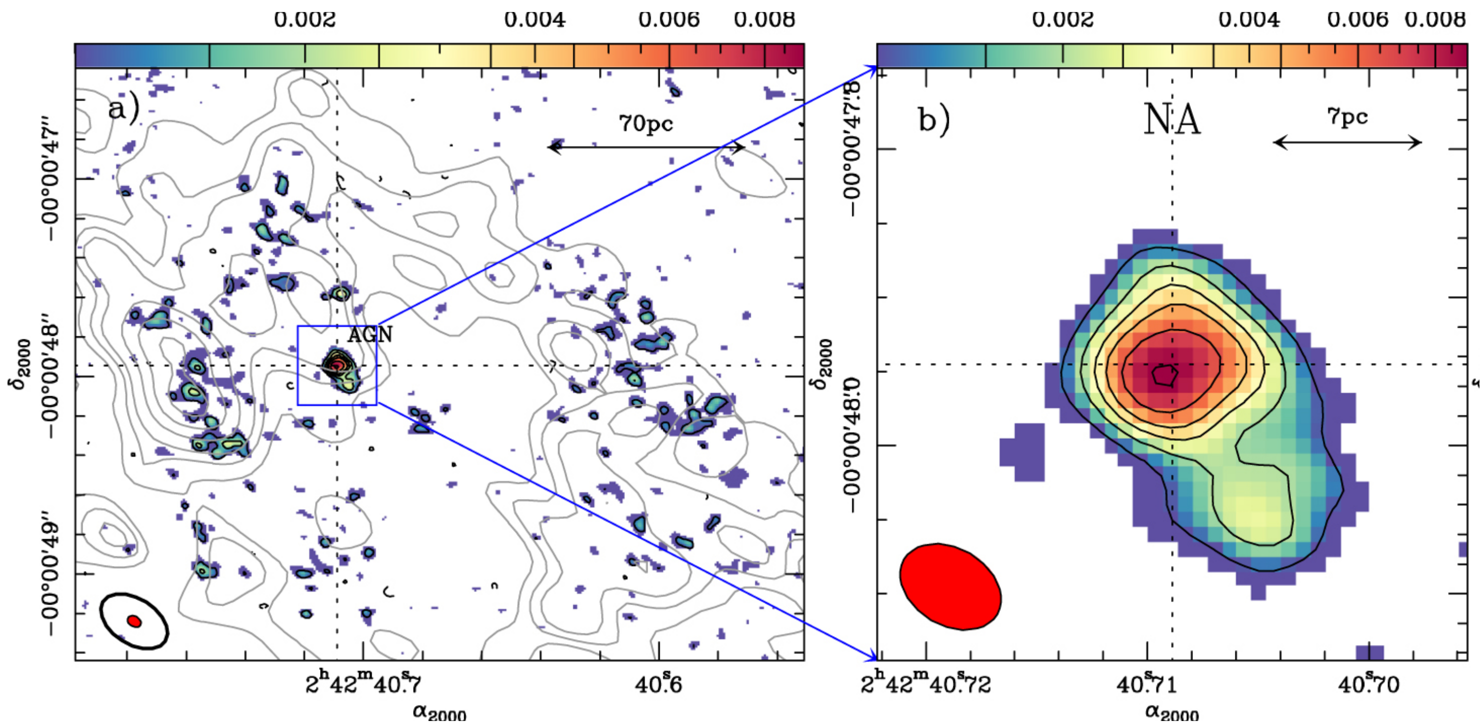
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

The torus and immediate surroundings

ALMA 432μm view (0.04-0.06" res) of central 2" of NGC1068

•Torus of dust and molecular gas (7-10pc)

•Circum-nuclear disk (300pc x 200pc) with on-going/recent SF activity

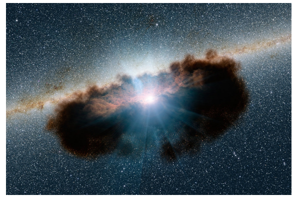


García-Burillo+2016

✤**Torus dust emission peaks in MIR**

✤Angular res of JWST/MIRI IFU(0.3"-0.5", similar to MIR instruments on 10m class telescopes) of AGN **cannot fully resolve these structures!** **For reference at D=50Mpc, 0.3"=70pc**

Open questions about the nuclear regions of AGN



- Unification of AGN: Does ONE torus explain it all?

Implications for z evolution of type1/type2 AGN

- Low luminosity AGN and the origin of the torus
- Nuclear SF and connection with torus/AGN properties
- Role of inflows/outflows in feeding the AGN and quenching/ triggering SF

Implications for BH growth and connection to galaxy evolution

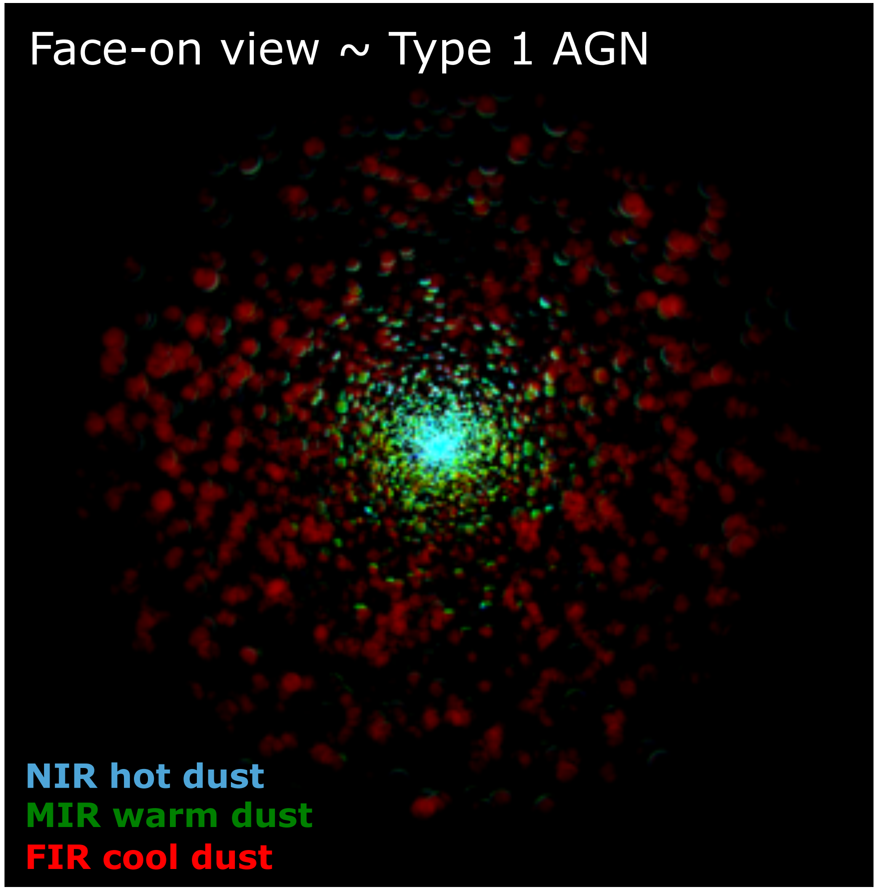
- Properties of dust in the nuclear regions of AGN and surrounding host galaxy

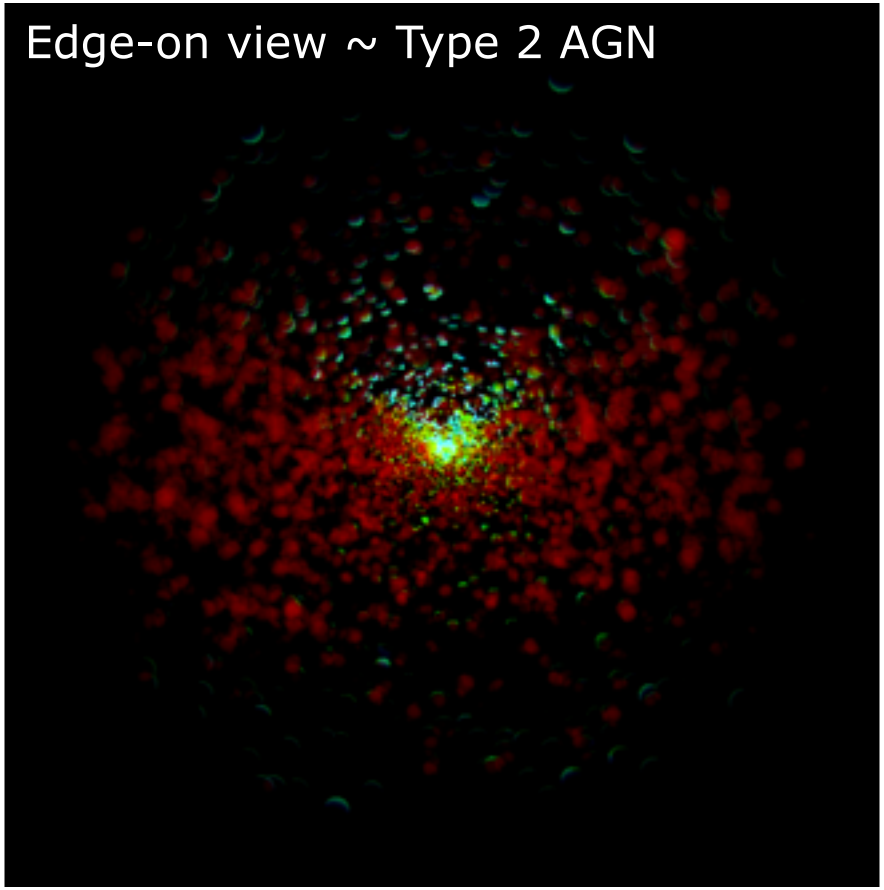
Talk by Daniel Asmus

Infrared emission from clumpy dusty torus

Modelling of unresolved IR emission of AGN allows to derive:

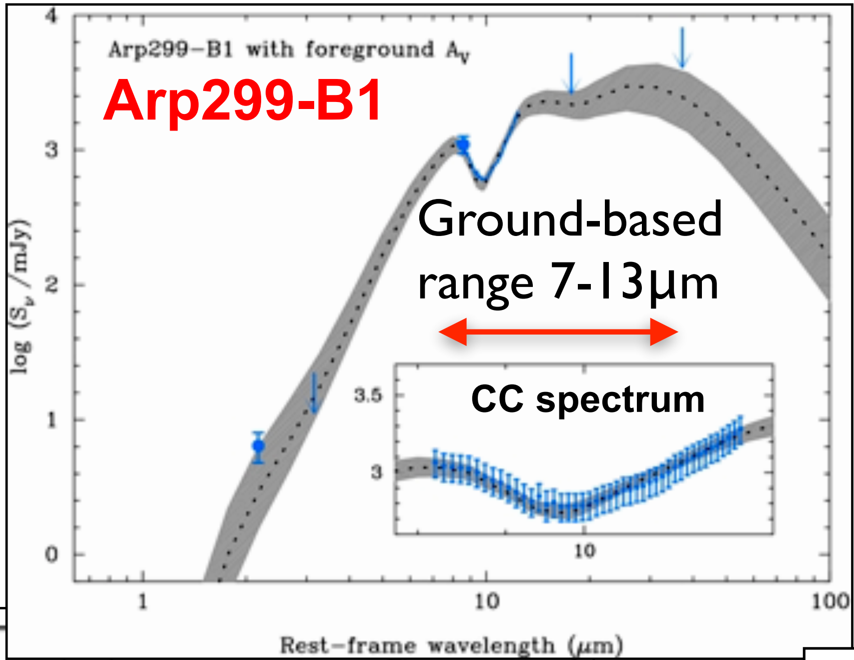
- geometric properties of the torus: angular size, physical size
- distribution of clouds, optical depth, number of clouds
- AGN viewing angle and bolometric luminosity

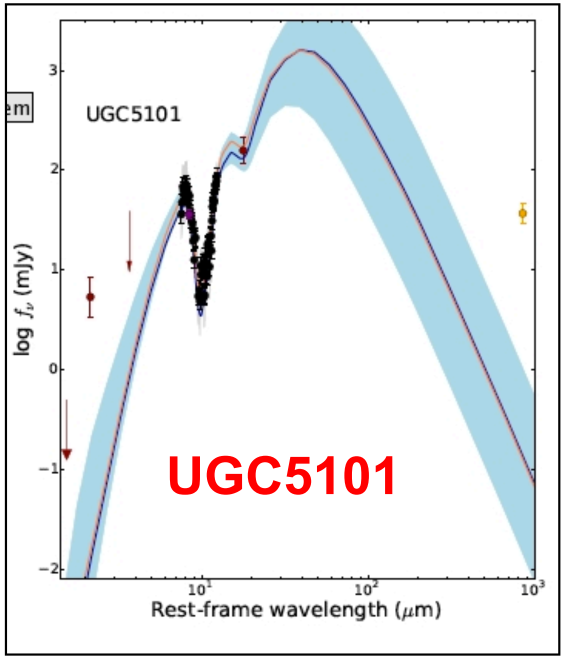


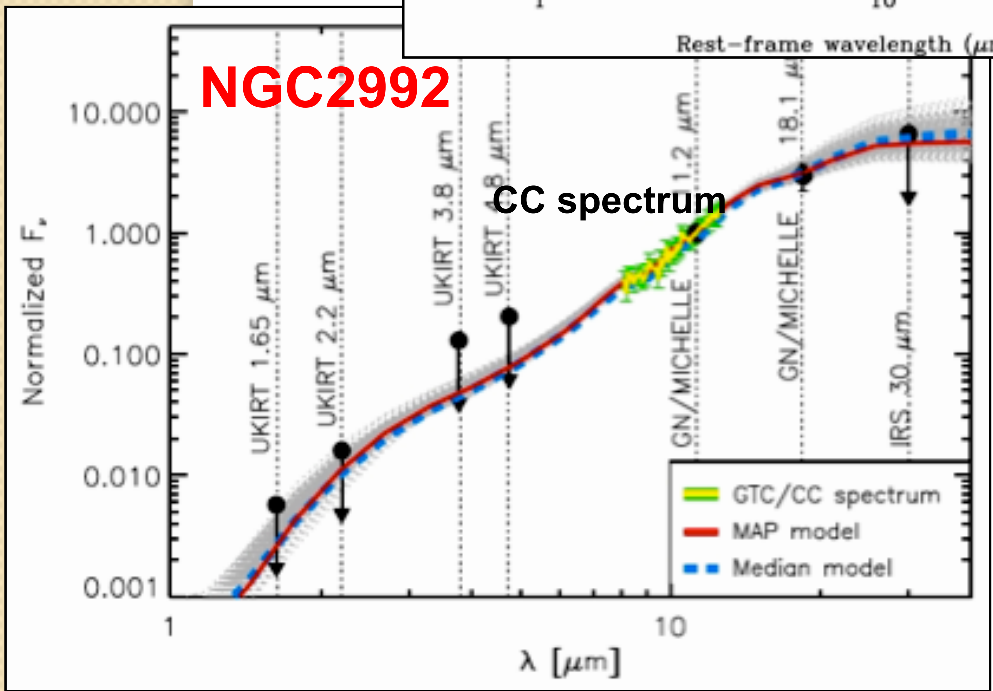


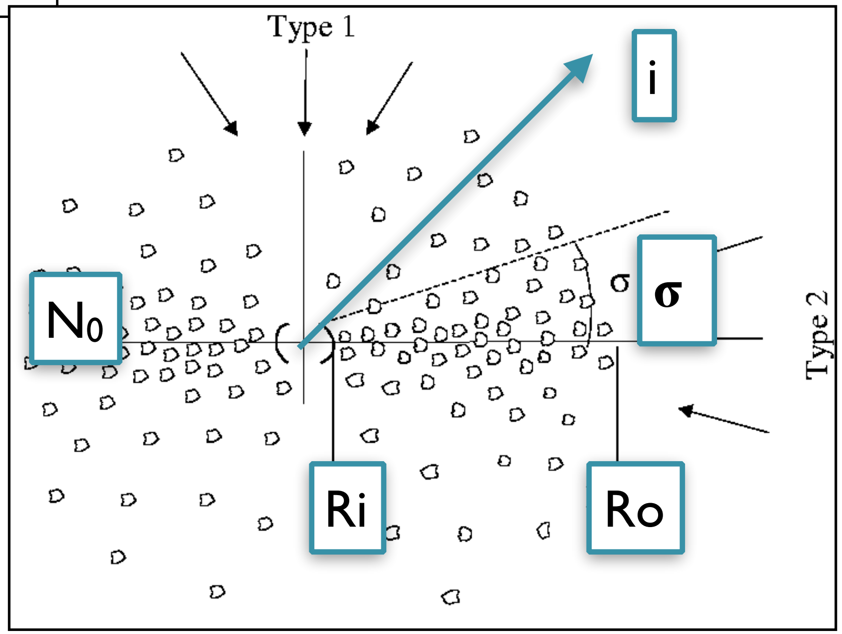
Hönig & Kishimoto 2010 http://www.sungrazer.org/CAT3D.html
and review Hönig (2013)

Examples of fits to unresolved IR emission





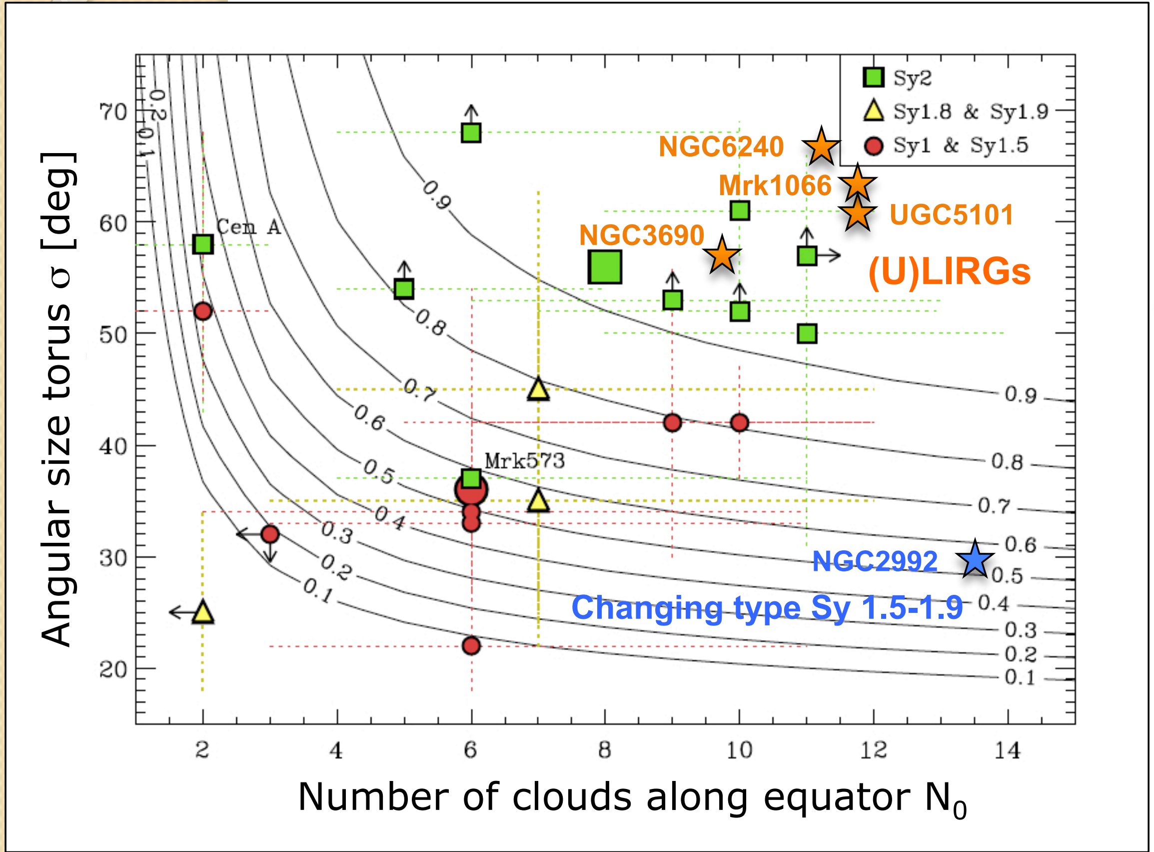




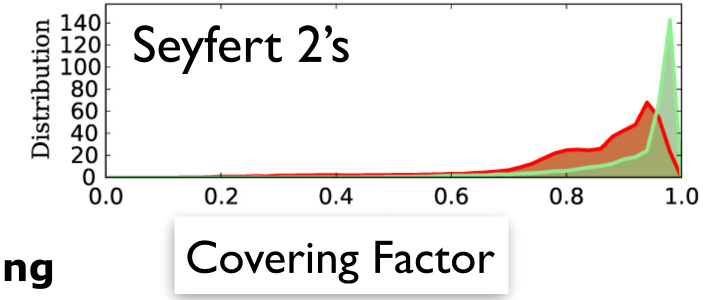
AAH+2011, 2013; Martínez-Paredes, AAH+2015; García-Bernete+2015

Geometrical covering factors of local AGN

AAH+2011, 2013; Ramos Almeida+2011;
Martínez-Paredes, AAH+2015; Mori+2015



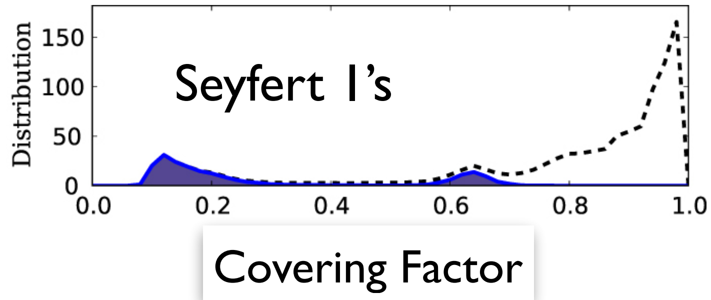
Ichikawa+2015



Increasing covering factors

Type 2s
f_2~0.95

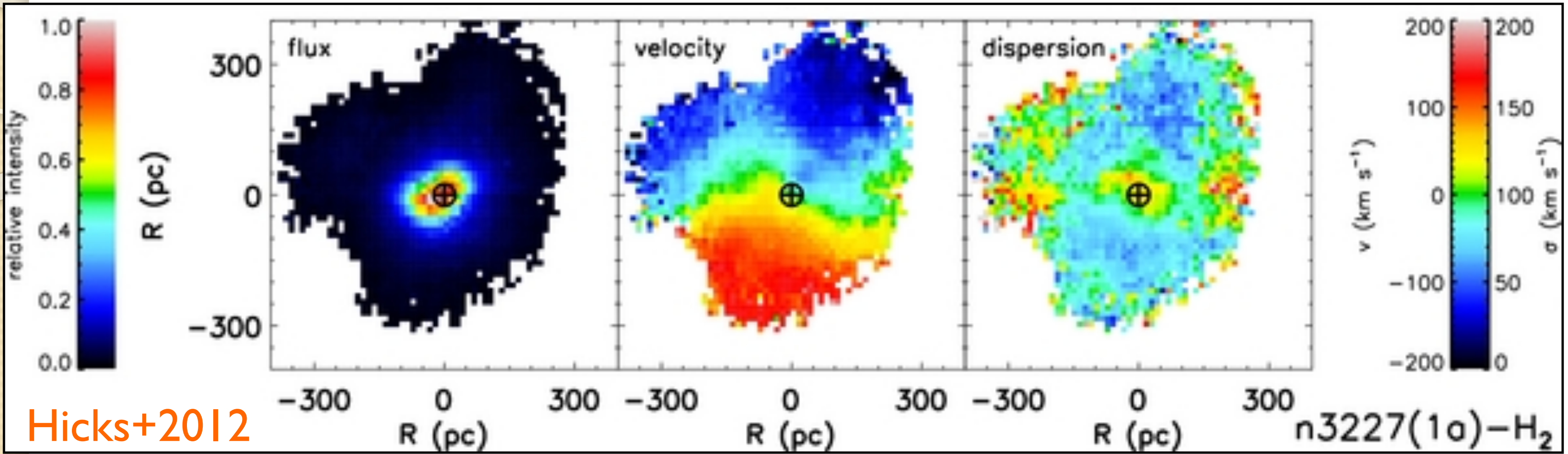
Type 1s
f_2~0.5

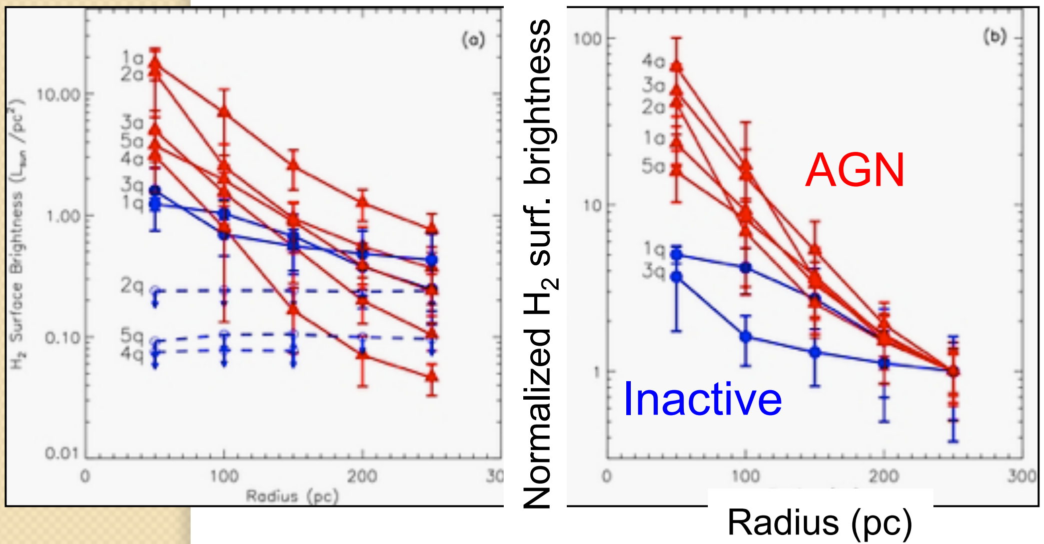


Modelling of unresolved IR 1-28μm emission with JWST will allow to derive torus properties covering:

- **range of L_{bol}: LLAGN to QSO** (receding torus, disappearance of torus)
- **different z's**

Molecular gas nuclear disks and relation to torus





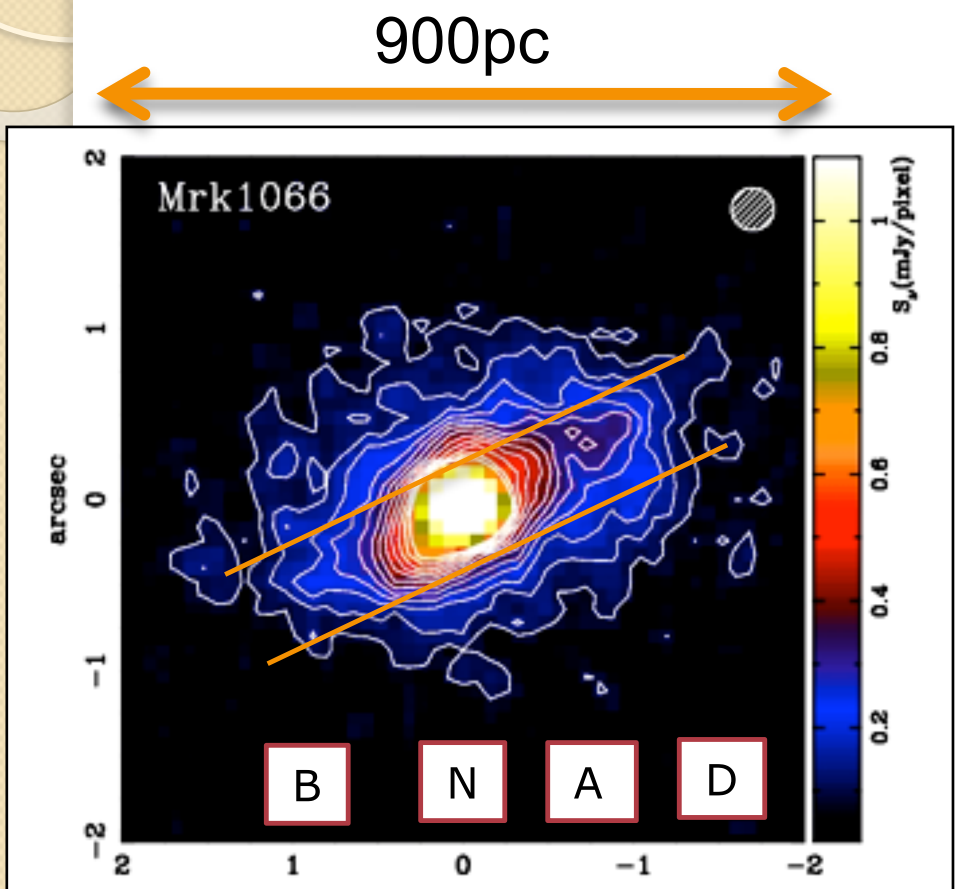
Seyferts show **rotating nuclear thick H_2 disks (d~60pc)** with enhanced H_2 emission compared to non-AGN → feeding AGN, SF?

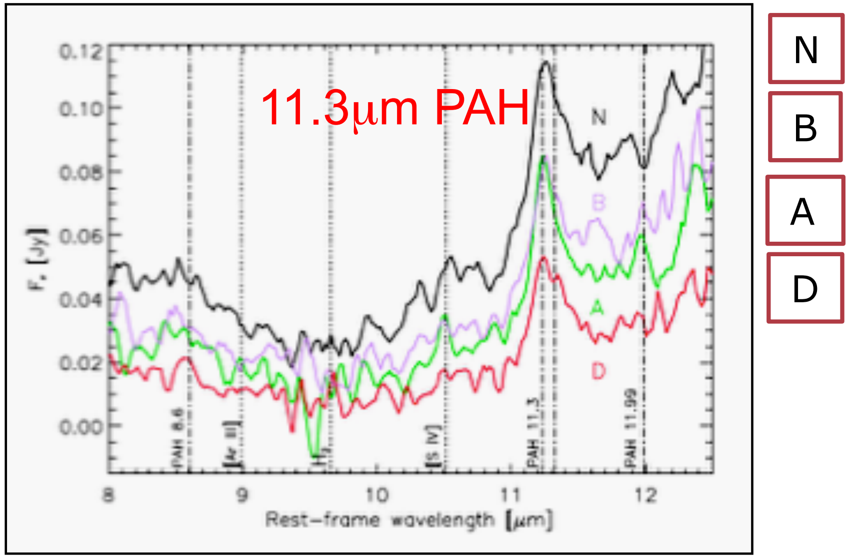
However, H_2 at 2.12μm traces warm (T~1000K) gas and only a small fraction of total molecular gas mass.

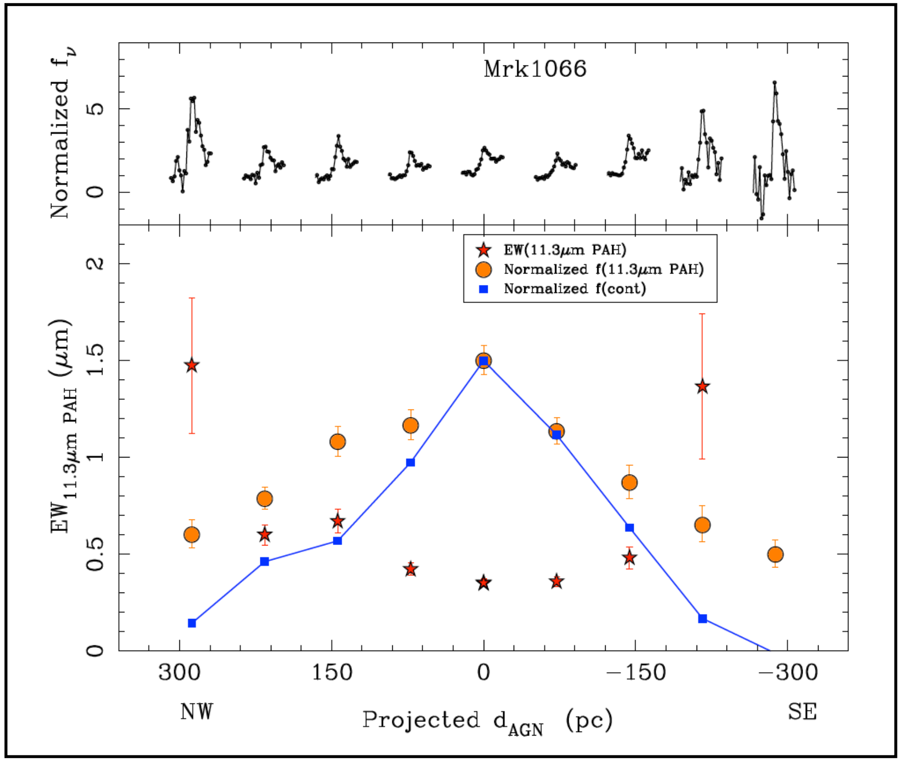
MIRI will observe mid-IR H_2 transitions which probe the bulk of the molecular gas + comparison with ALMA estimates.

Using the 11.3μm PAH feature to probe nuclear SF

GTC/CanariCam data at 0.3" resolution





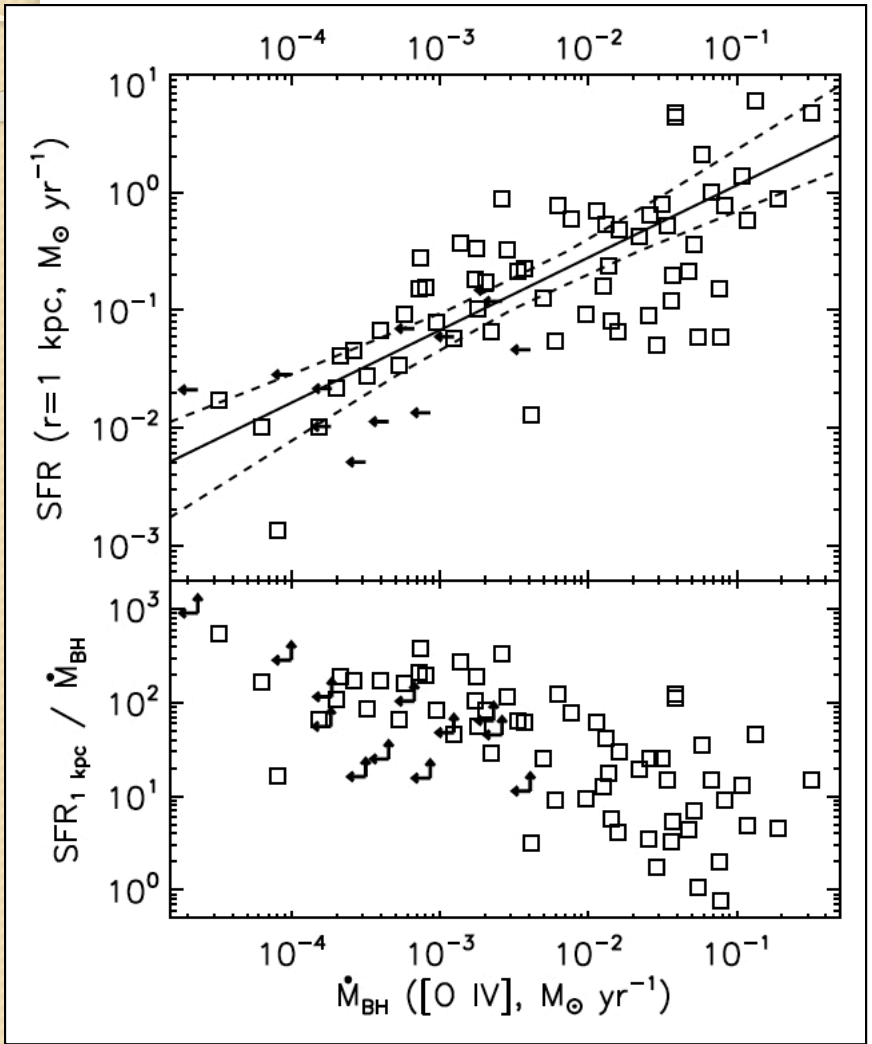


PAH molecules are not destroyed in nuclear regions of AGN

Ramos Almeida+2014; AAH+2014

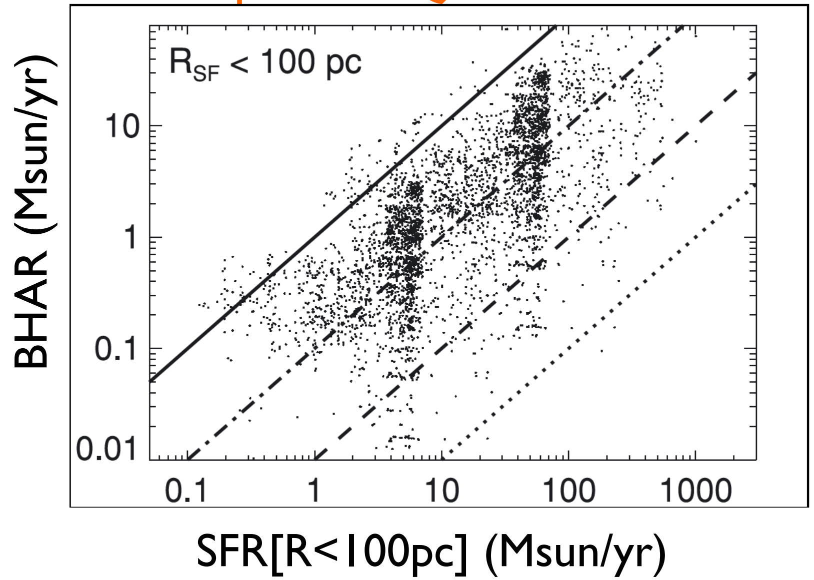
SFR vs. black hole accretion rate

Diamond-Stanic & Rieke 2012

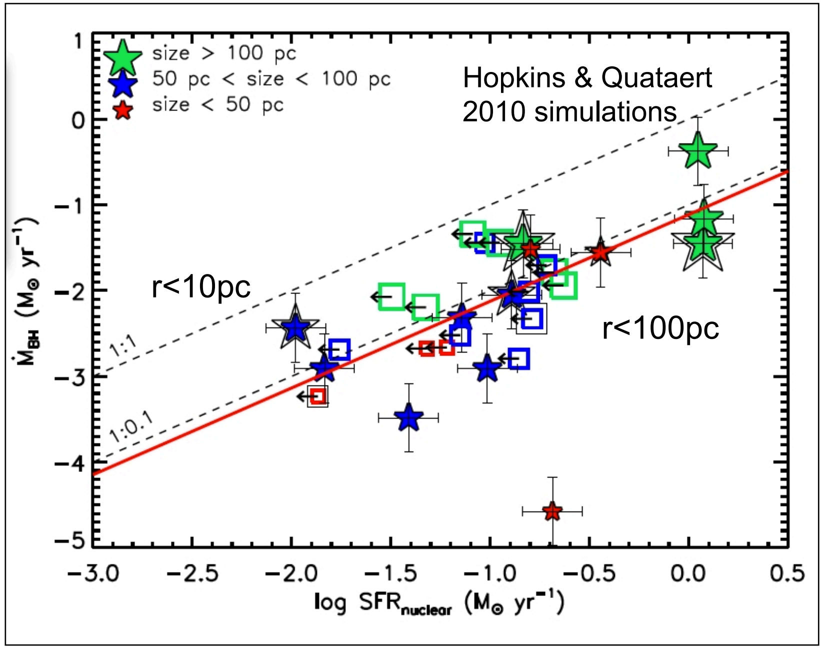


Numerical simulations

Hopkins & Quataert 2010



Esquej, AAH+2014

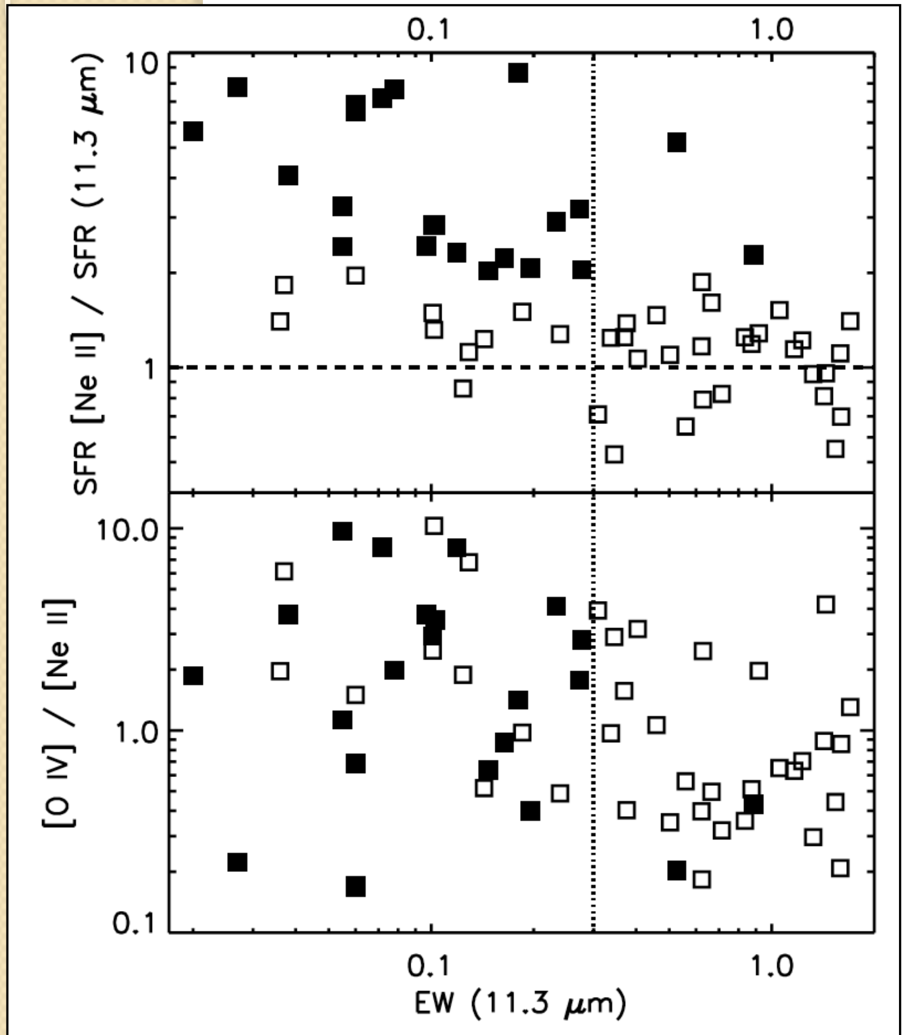


Circumnuclear (r=1kpc) SFR from Spitzer 11.3μm PAH and 24μm

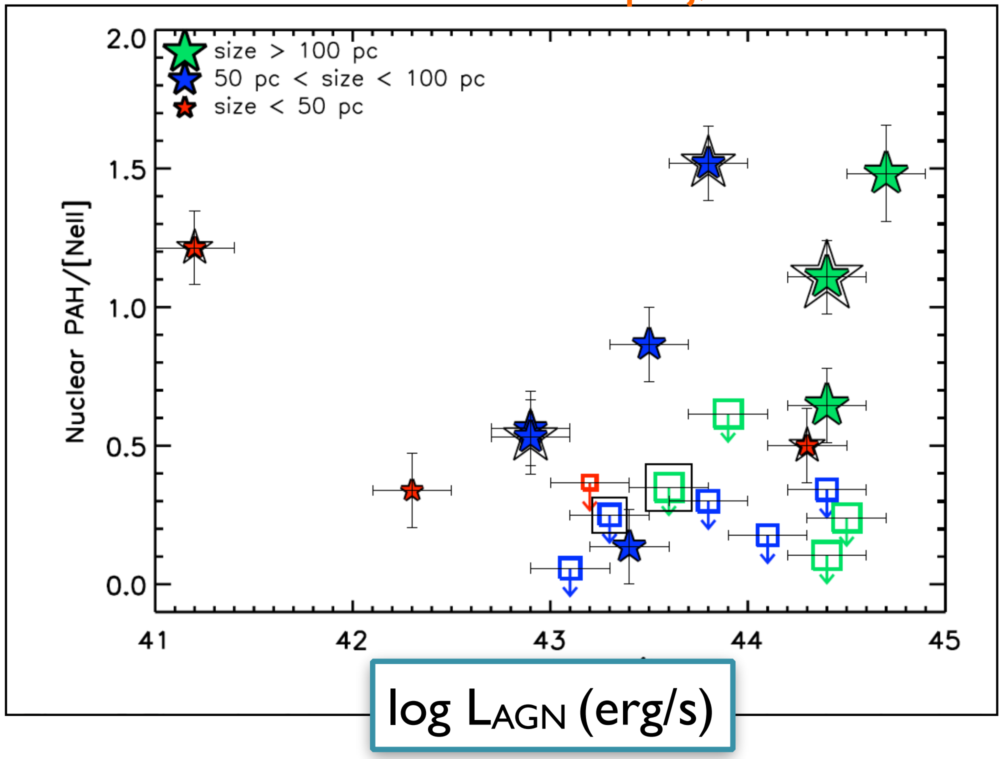
Nuclear (r=50-200pc) SFR from ground-based 11.3μm PAH

SF in nuclear regions of AGN

Diamond-Stanic & Rieke 2012



Esquej, AAH+2014



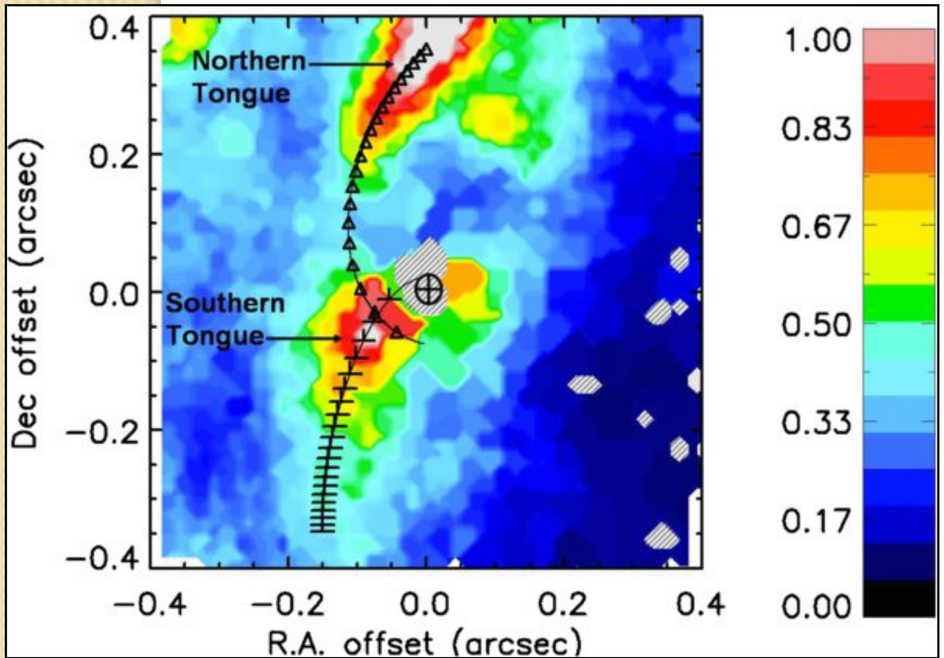
- [NeII]12.8μm contaminated by AGN emission
- Nuclear PAH emission might be excited by AGN (talk by Jens Jensen)

NIRSpec + MIRI IFU observations will allow to study **AGN/SF excitation of nuclear PAH emission and** obtain **accurate SFR** using a variety of indicators: **recombination lines, fine structure lines, stellar populations**

Inflows/Outflows in AGN

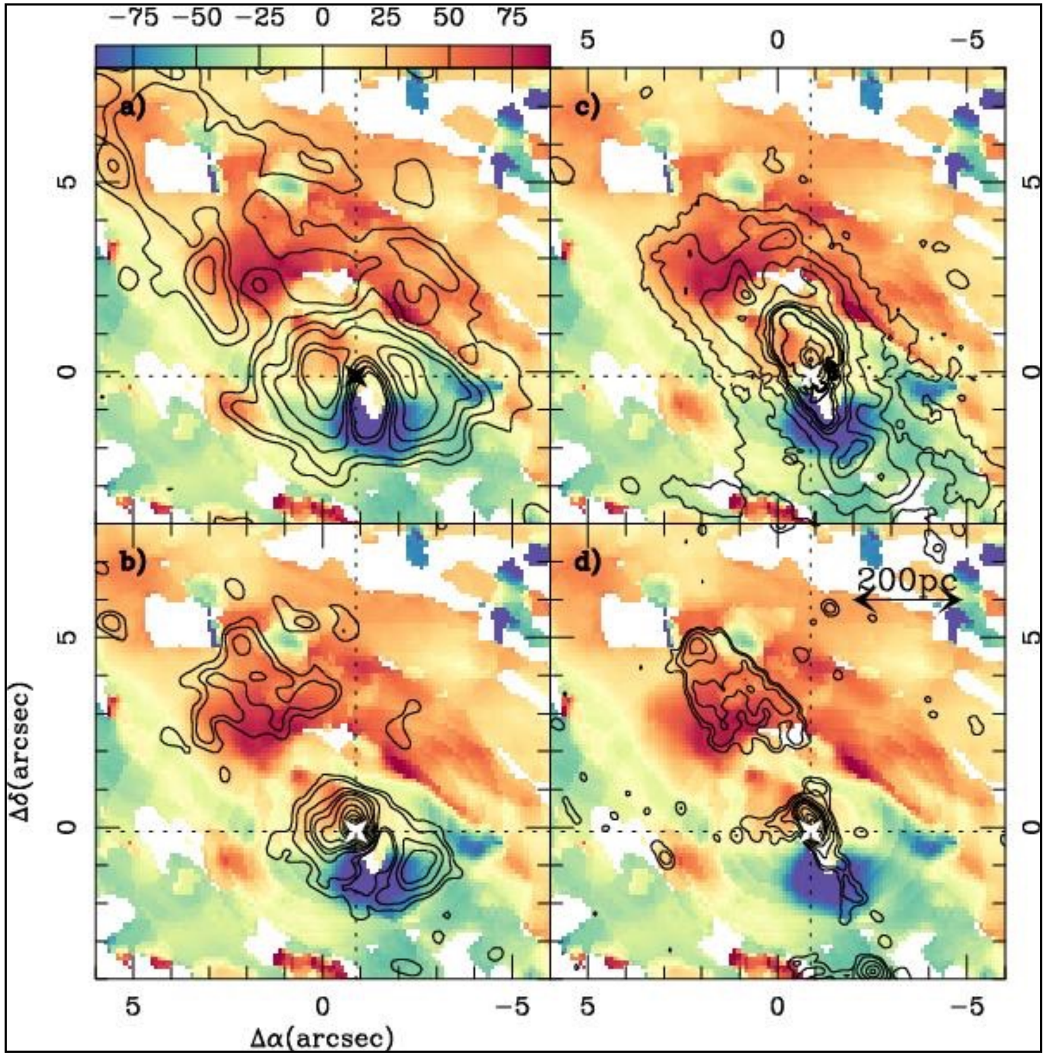
NGC1068

Müller-Sánchez+2009



Inflows detected in H_2 at 2.12μm with VLT/SINFONI

García-Burillo+2014



Outflows detected in CO(3-2) with ALMA

AGN inflows and outflows are largely unexplored in mid-IR: H_2 lines, fine structure lines

Summary

NIRSpec+MIRI IFU (+ALMA) observations of central regions of local AGN will provide an exquisite view into the relation between BH growth and star formation in galaxies