ALMA OBSERVATIONS OF THE CIRCUMNUCLEAR DISK (CND) OF CENTAURUS A


FEEDING AGNS, OUTFLOWS AND QUENCHING

Star formation
SN, stellar winds

AGN feedback
Radio jets

Baugh06, Eke+06, Jenkins+01

Fountains
Thick torus

Wada15
CENTAURUS A (NGC5128)

- Closest radio-powerful source and Elliptical galaxy, D~3.8 Mpc (1" = 18pc)
- Dust lane. Gaseous disk was likely accreted by a merger event
- Large scale and collimated jet
- Supermassive black hole: ~6x10^7 Mo

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GOALS

1. Molecular gas properties in the disk/torus of Centaurus A
2. Mechanisms for gas inflow from kpc to pc scale
3. Feedback
   - Effect of the jet and starburst on the ISM and Gas entrained
4. GMC physical and chemical properties
5. Star Formation Laws under powerful AGN

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Circumnuclear Disk (CND)

- Size 400 pc x 200 pc, inclination ~60deg
- Perpendicular to the jet (at least in projection)
- Rapidly rotating, ~450 km/s (FWZI)
- Molecular gas mass $M_{\text{gas}}$, $CND = 8 \times 10^7$ Mo
- No CO emission in inner 100 pc???
FROM KPC DOWN TO PC SCALE

Molecular properties in the CND -> torus

Is CO depleted in the inner ~100 pc?

Mechanism feeding the AGN

ALMA observations
CO(3-2), HCO+(4-3), HCN(4-3), CO(6-5)
~0.3” (5pc)
< 6mJy/beam in 20 km/s
2012.1.00225.S (PI. Espada)

H2 (1-0) S(1) VLT/SINFONI Neumayer+07

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MULTI-PHASE CND OF CENTAURUS A

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ALMA CO(3-2)
ALMA CO(6-5)
NIR H2 2.12um
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But $k5/k1$ is unrealistically large (>0.2)

=> non-circular motions,
kinematically distinct components
Regions bright in warm H2 are not present in CO(3-2), CO(6-5) (nor HCN(4-3), HCO+(4-3)).
NON-CIRCULAR MOTIONS

At large scale: warped disk perturbed by non-axisymmetric potential
Espada+09

Ring, nuclear filaments (180 deg rotational symmetry, steeper PV curve)
Espada+17
CHEMISTRY

- HCO+, HCN, HNC, CN, CCH(1-0), … detected towards the CND
- CND chemically distinct to ETD due to AGN
- High CN/HCN, HCN/HNC ratios, …

McCoy+18 accepted ApJ

Daniel Espada - ALMA Observations of Centaurus A
CHEMISTRY: HCO+(4-3), HCN(4-3)

- No HCO+(4-3) HCN(4-3) emission in the inner ~30pc
- HCN / HCO+ (4-3) <~ 0.5
• Dense gas tracer ratios used to identify whether AGN or SB
• HCN/HCO+ > 1 in low luminosity AGNs, likely because mechanical heating
• But in Cen A’s molecular clouds just ~30 pc away, HCN/HCO+ <~0.5
FUTURE WORK

• GMC catalog and SF laws
• Atomic carbon and shock tracers
• Enlarging molecular gas studies for a sample of elliptical galaxies with jets
SUMMARY

- CND of CenA present a network of molecular filaments of \(~100\) pc, spiral features and streamers.

- Ring like structure + nuclear filaments (shocks!) resemble gas under non-axisymmetric potential. Non-circular motions (due to warp itself? or stellar component?)

- Chemistry in molecular clouds in CND is peculiar. e.g. \(\text{HCN/HCO+}<1\) even close to the AGN, unlike low luminosity AGNs. Is it dominated by XDR, time variation?

- The nuclear disk seen in warm \(\text{H}_2\) (~1000K), not \(\text{CO}, \text{HCN},\) and \(\text{HCO+}\) transitions.

- Comparison with simulations needed…