Circumnuclear Disk in NGC 5128 (Centaurus A)

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Huge Radio Source
image: Cen A & Moon (ATCA, Feain et al 2011)

Post-merger galaxy Giant Elliptical Host Nearest Radio Galaxy Source high-energy CR

Key representative of an entire object class
Cen A Radio Jet and Inner Lobes
(Burns & Price, 1983, 8''x8'' VLA)
Central Engine:
SMBH $5 \times 10^7 \, M_{\text{sun}}$  
(Capellari et al, 2009)

How is it being fed (inflow)?
How much:
* falls into BH?
* is ejected in jets?
* is consumed by SF?

Processes in CND and Nucleus are key!
HST optical
SPITZER mid-infrared
CENA 12CO(2-1)

Espada et al. 2009
CND 400 pc diameter
central 'hole'  75 pc diameter
CO lines from SEST, JCMT, APEX
Circumnuclear Disk Models

temperature 100-300 K

density range $3 \times 10^2$ – $1 \times 10^5$ cm$^{-3}$

mass $8.4 \times 10^7$ M$_{\odot}$
$M_{\text{dust}} = 3.5 \times 10^5 M_{\text{sun}}$

$T_{\text{dust}} = 36 \text{ K}$

$GDR \ 240$

$\beta = 1.2$
Circumnuclear Disk Mass Budget

CND total : $8.4 \times 10^7 \, M_{\text{sun}}$

cold shocked gas : $3 \times 10^6 \, M_{\text{sun}}$

fully ionized gas : $6 \times 10^5 \, M_{\text{sun}}$

warm shocked gas : $4 \times 10^5 \, M_{\text{sun}}$

in Jet outflow:

$(0.2 - 2.6) \times 10^7 \, M_{\text{sun}}$
CenA *inflow* from CND
HCO+ smooth [CI] histogram
Molecular dissociation?
Dynamical Mass Budget

CND total: $8.4 \times 10^7 \, M_{\text{sun}}$

Inflow: $0.5-1.0 \, M_{\text{sun}} / \text{year}$

BH accretion: $\sim 10^{-4} \, M_{\text{sun}} / \text{year}$

Star formation: $0.3 \, M_{\text{sun}} / \text{year}$

Jet outflow: $0.5-6.5 \, M_{\text{sun}} / \text{year}$
Quillen et al 2004: [SIV] + 5 GHz

Krajnovic et al 2007: Pa-beta
Secular changes jet position angle 
\( \sim 2 \) degrees/arcsec

corresponds to jet precession period

25 – 55 million years
(close to Haynes et al, 1983)
CONCLUSION

Mass CND: 5% ISM = 0.1% total
Mass in Outflow: (2 – 30)% of CND
Mass SMBH: 60 % of CND
Dynamical timescales for both outflow and jet precession ~4x10^7 yr

Efficient outflow!
Inefficient BH accretion:
timescale at present rate ~10^{11} yr