Apples to Apples: Comparing the Cores of Nearby Galaxies

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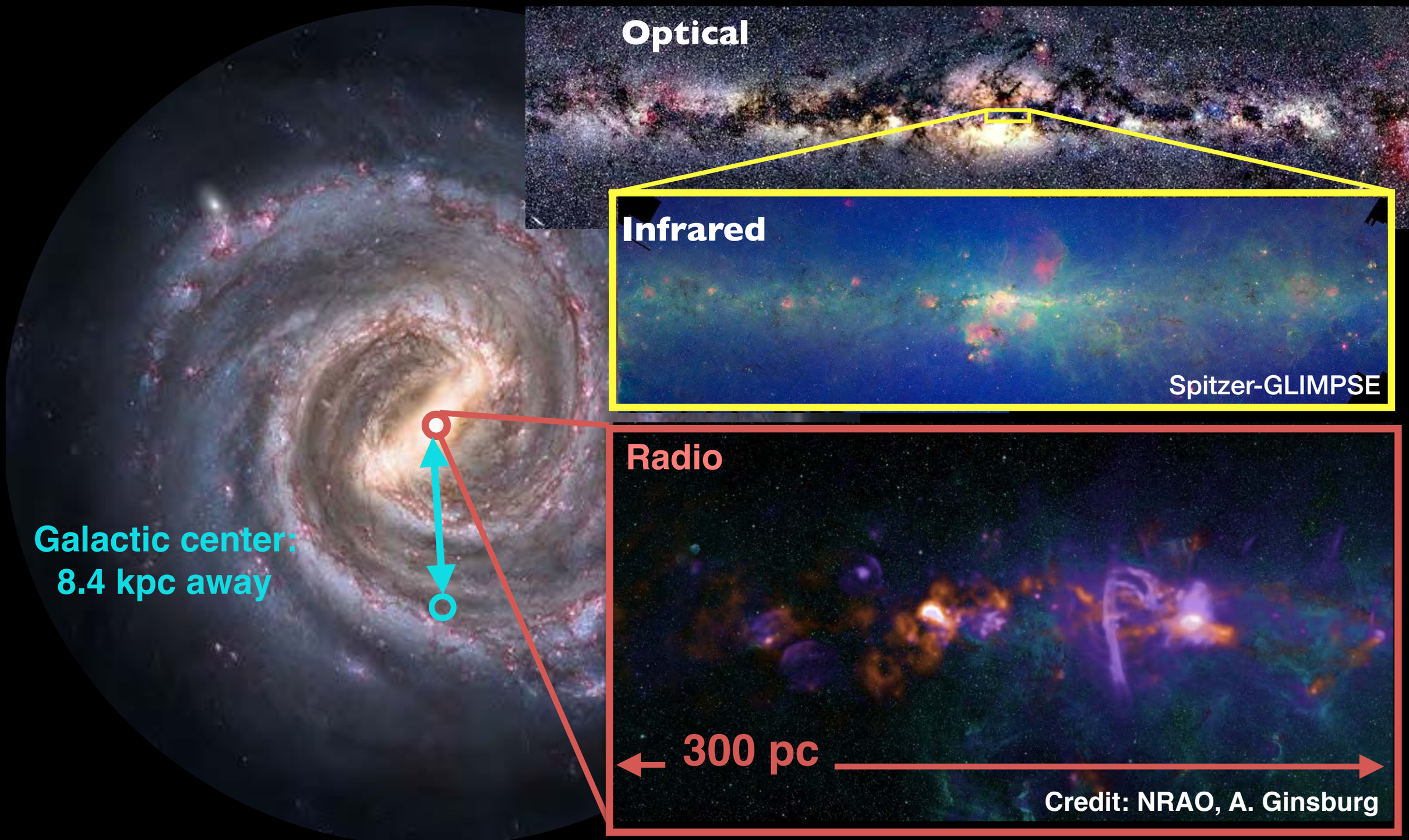
The Milky Way center: the nearest galaxy nucleus



Artist's conception of the Milky Way. Credit: Nick Risinger

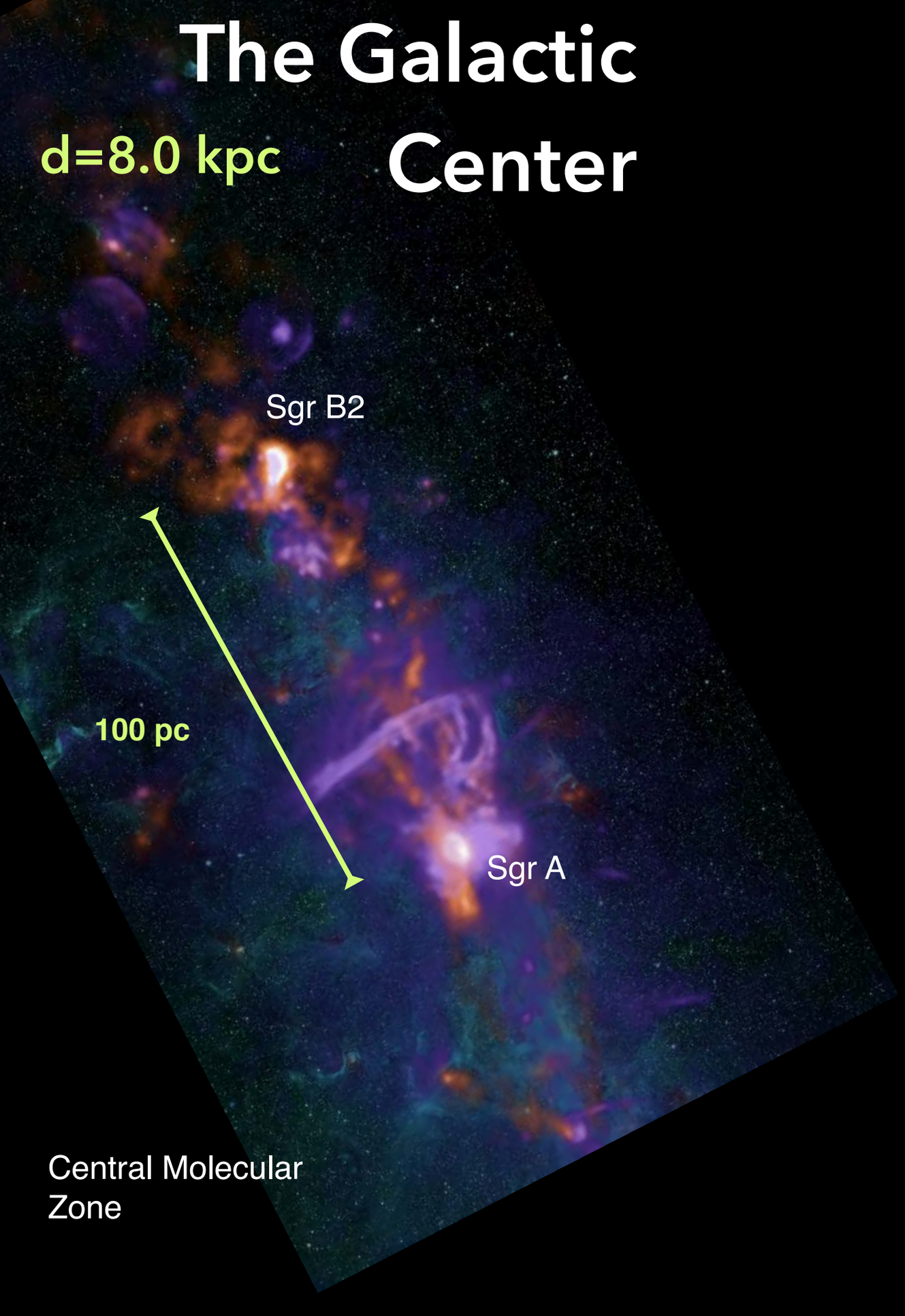
Millimeter : cold dust/gas

Infrared : hot dust, stars

Radio : hot gas, plasma

The Galactic Center

d=8.0 kpc



The Galactic Center

d=8.0 kpc

Sgr B2

100 pc

Sgr A

7 pc

Sgr A East

Central Molecular Zone

The Galactic Center

d=8.0 kpc

Sgr B2

100 pc

Sgr A

Central Molecular Zone

7 pc

Sgr A East

3 pc

Circumnuclear Disk

The Galactic Center

d=8.0 kpc

Sgr B2

100 pc

Sgr A

Central Molecular Zone

7 pc

Sgr A East

0.5 pc

Minispiral

3 pc

Circumnuclear Disk

The Galactic Center

d=8.0 kpc

Sgr B2

100 pc

Sgr A

Central Molecular Zone

7 pc

Sgr A East

0.15 pc

Sgr A*

Central lightyear

0.5 pc

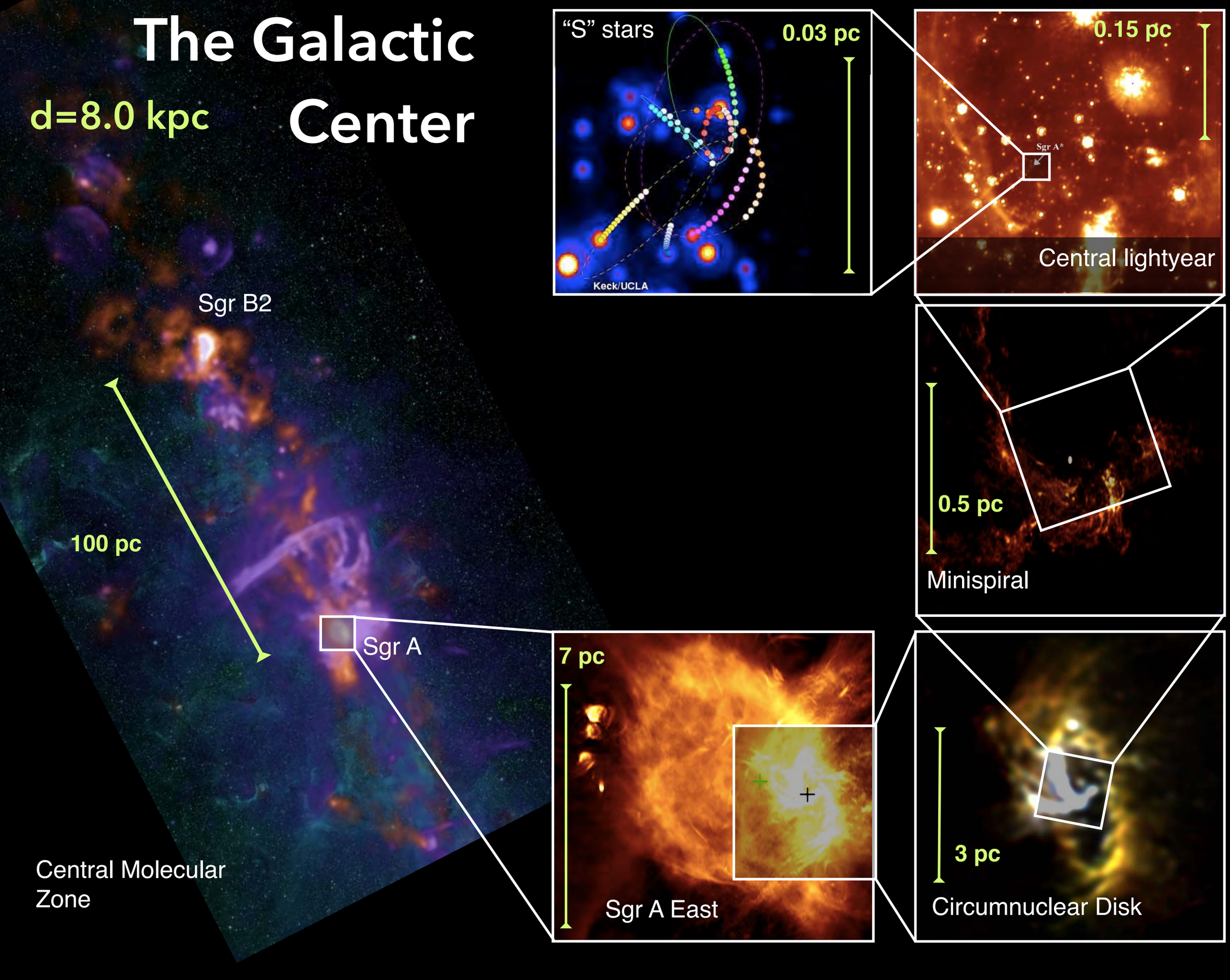
Minispiral

3 pc

Circumnuclear Disk

The Galactic Center

d=8.0 kpc



The Galactic Center

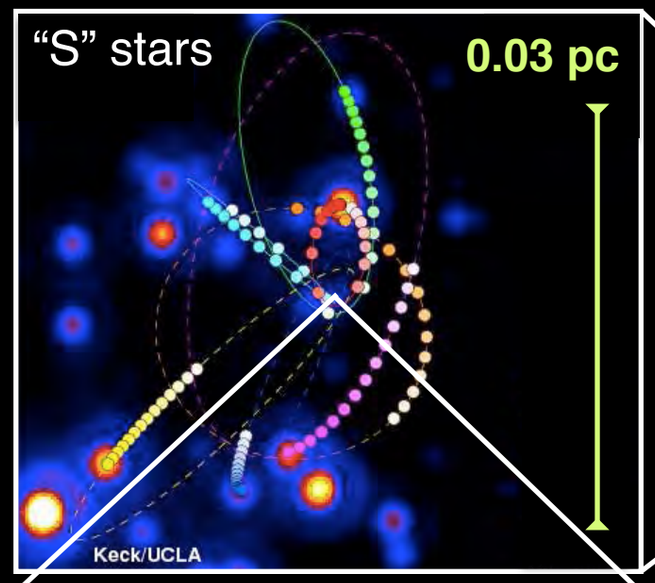
d=8.0 kpc

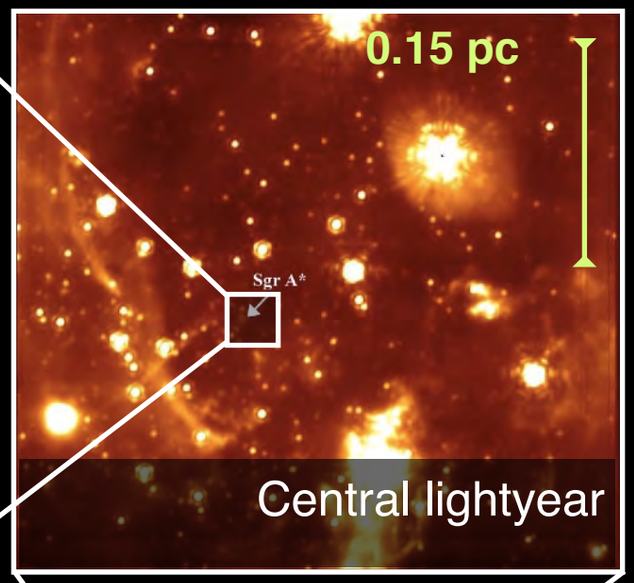
Sgr B2

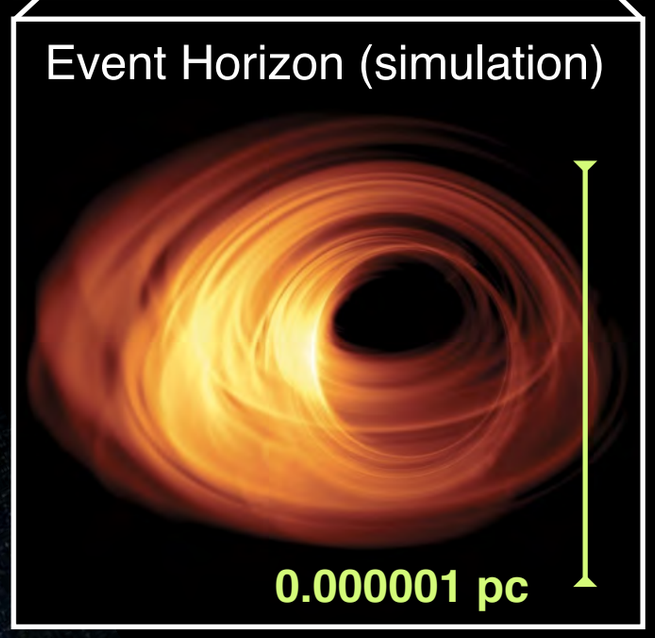
100 pc

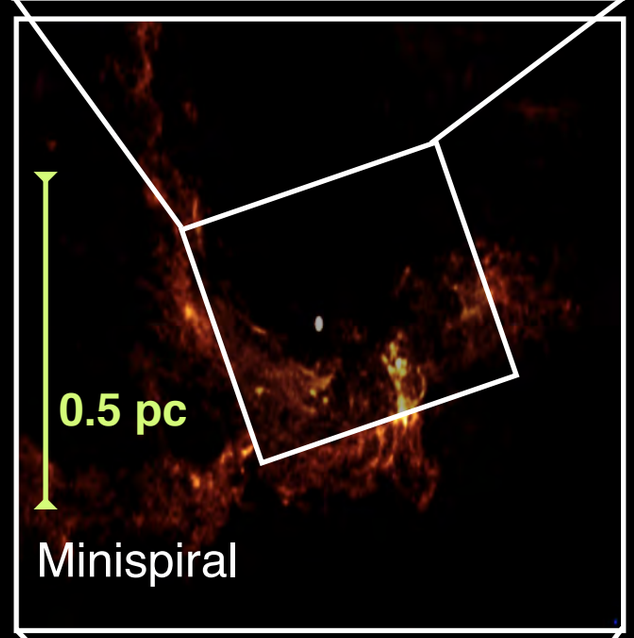
Sgr A

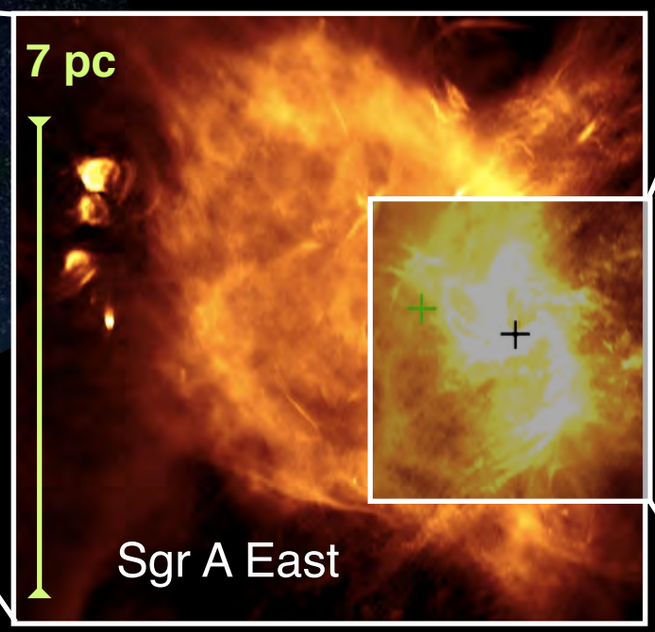
Central Molecular Zone

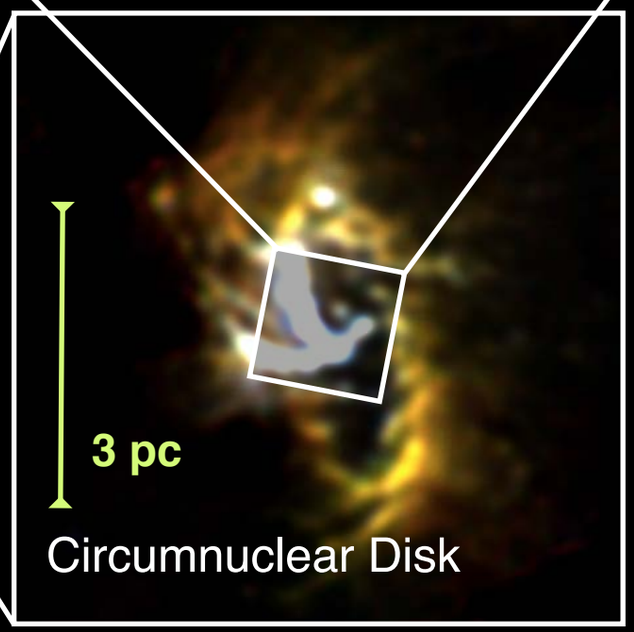






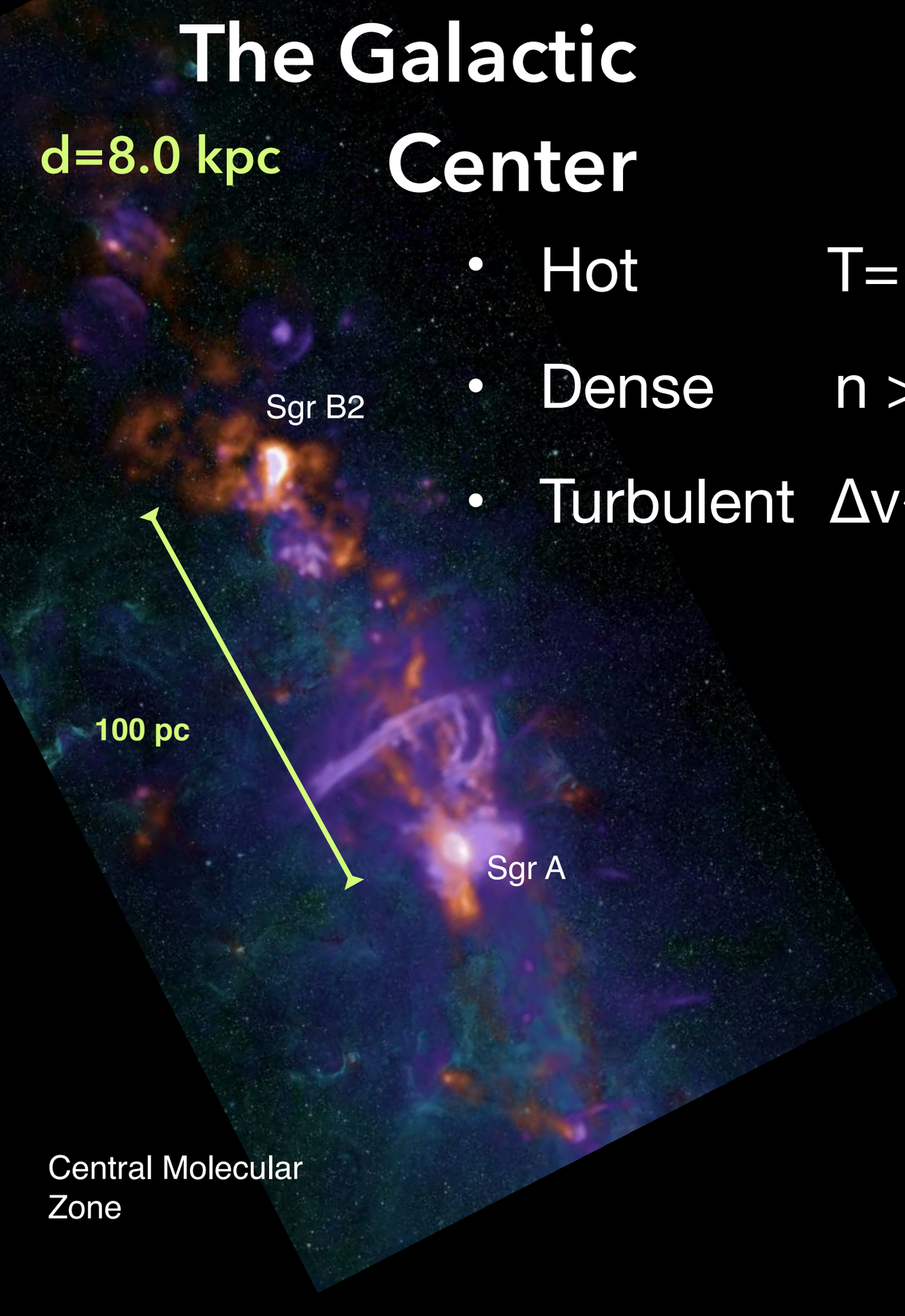




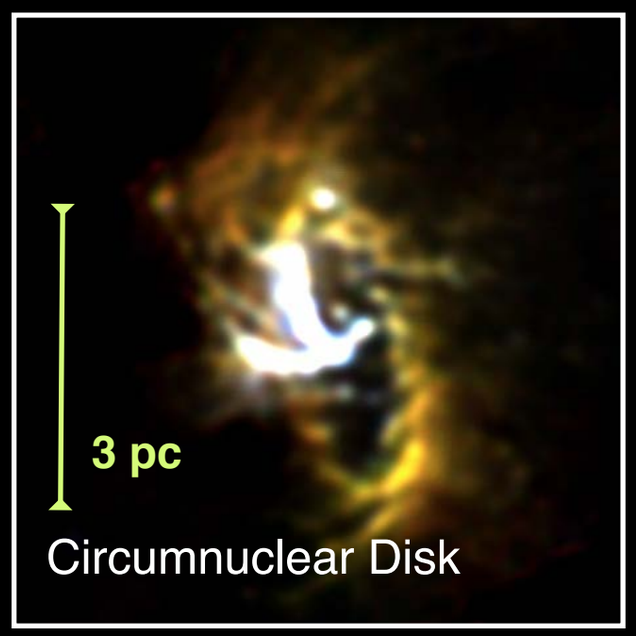


The Galactic Center

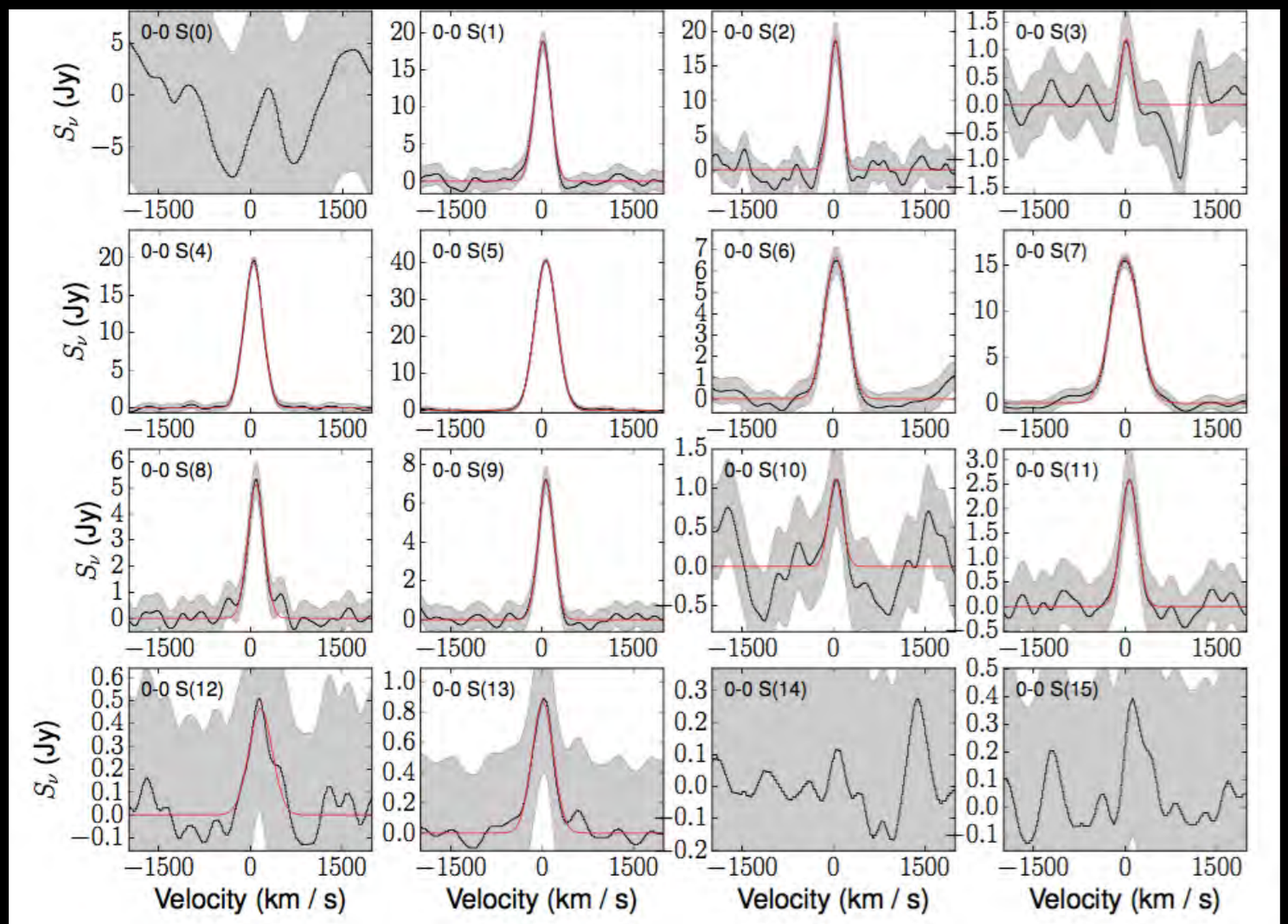
- Hot T= 50 -150 K (Guesten et al. 1985, Huettemeister et al. 1993)
- Dense $n > 10^4$ cm^{-3} (Guesten et al. 1982)
- Turbulent Δv~15-50 km s^{-1} (Bally et al. 1987)

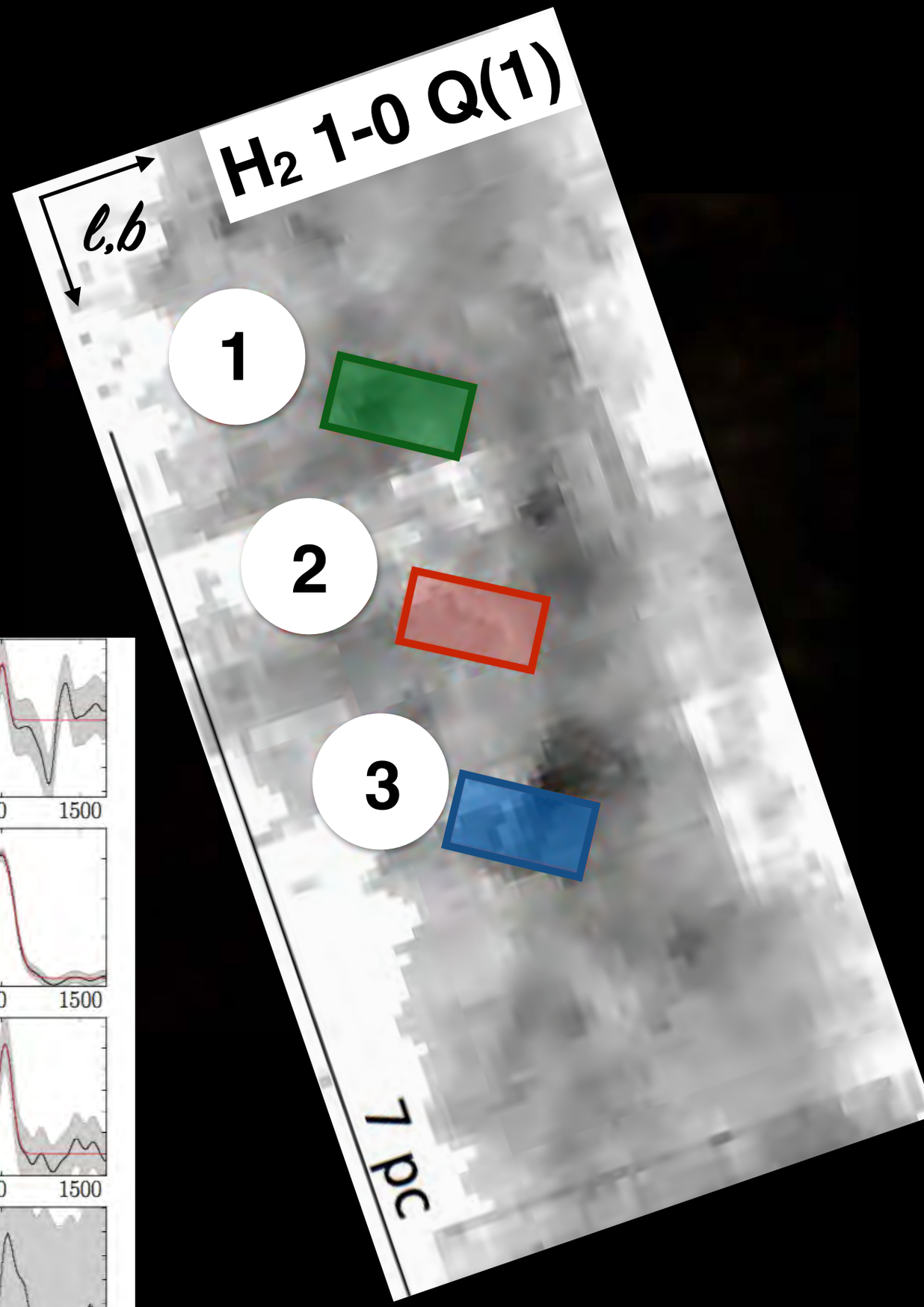


What about gas closer to the black hole?



Analyze archival ISO spectra of H_2 toward 3 positions in the CND to measure temperatures



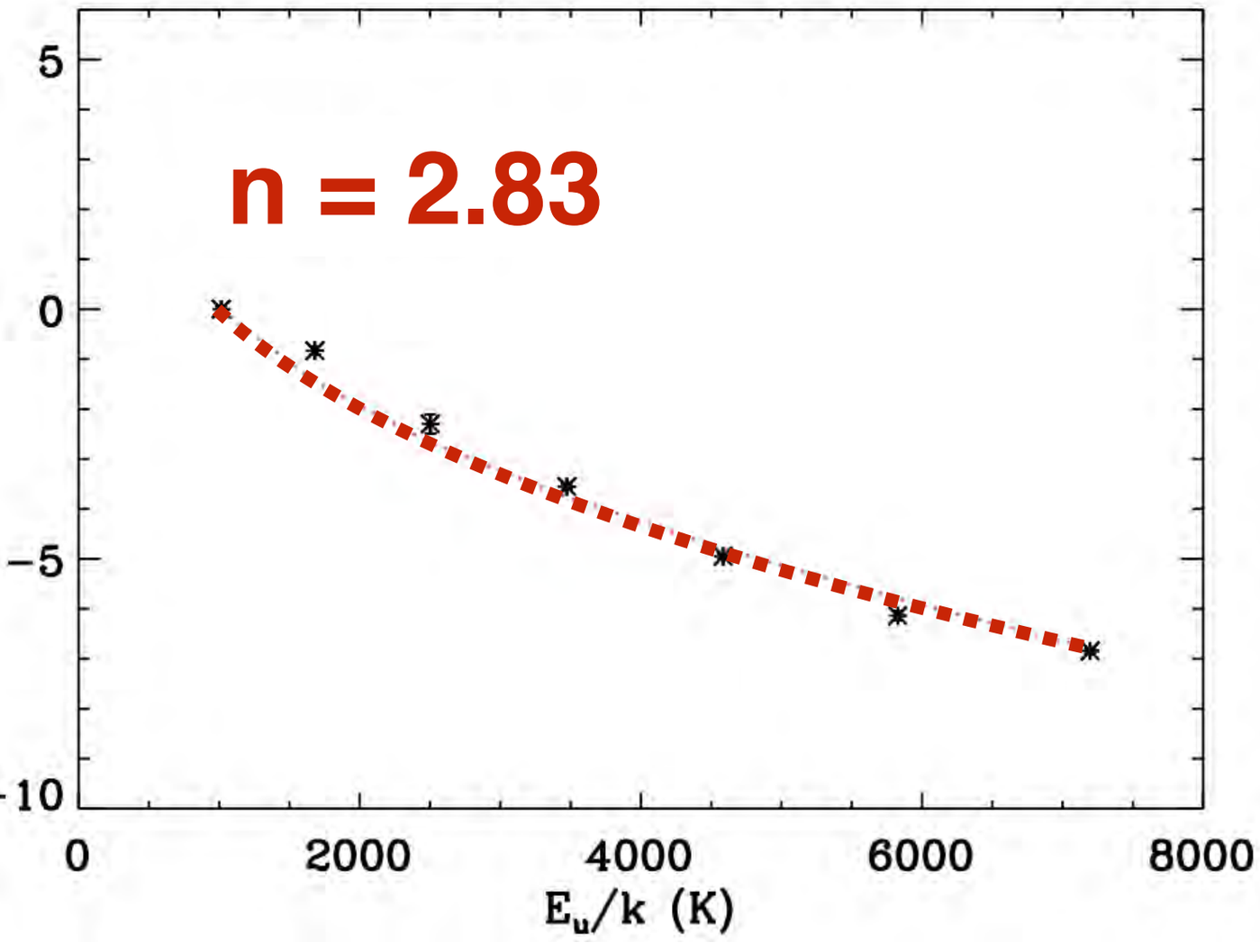


Mills, Togi & Kaufman 2017

Fit a power-law distribution of temperatures

$$dN \propto T^{-n}\, dT$$

Region 3 (Southwest region)



Other Galactic center clouds:

n = 4.7 - 5.0

Gas within a parsec of the supermassive black hole is significantly hotter than gas > 50 pc from the center

Mills, Togi & Kaufman 2017

NGC 253

Barred Spiral
Total mass: 10^{11} M_{sun}

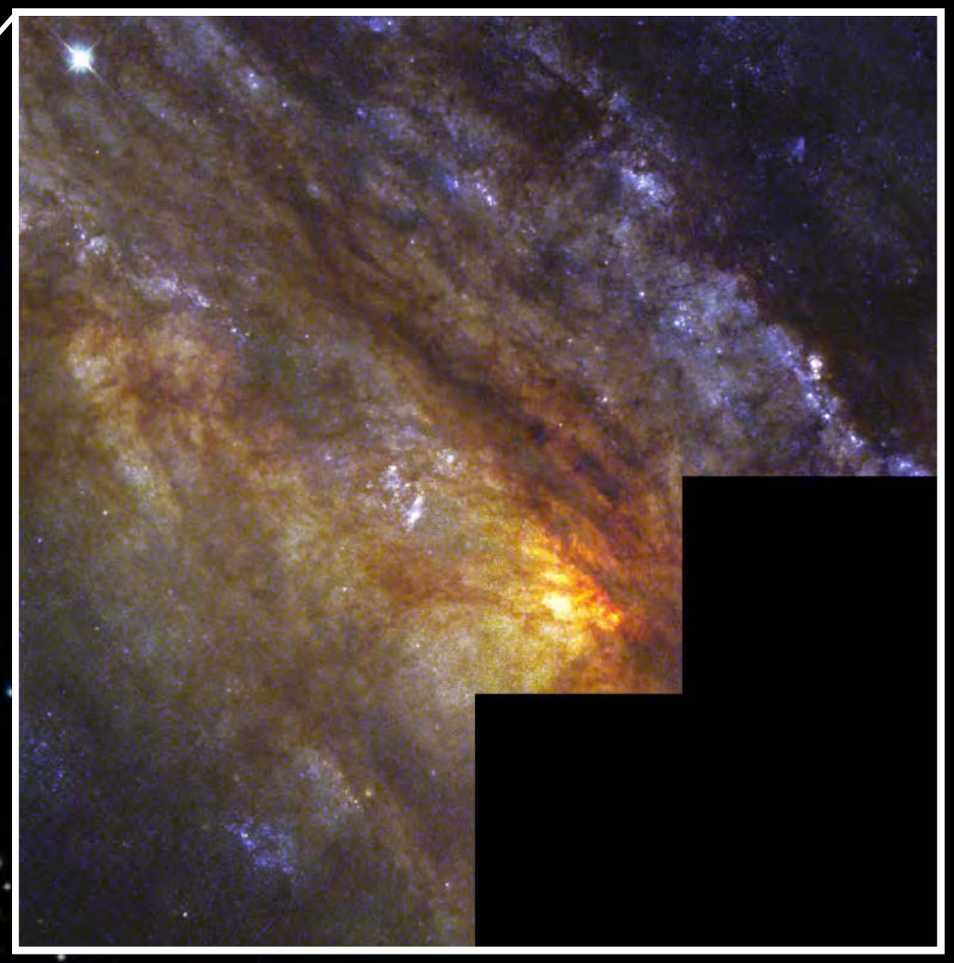
Black hole mass: $5x10^{6}$ M_{sun}

Nuclear Starburst
Star Formation Rate: 2.8 M_{sun}/yr

150 pc

Located 3.5 Mpc away from the Milky Way

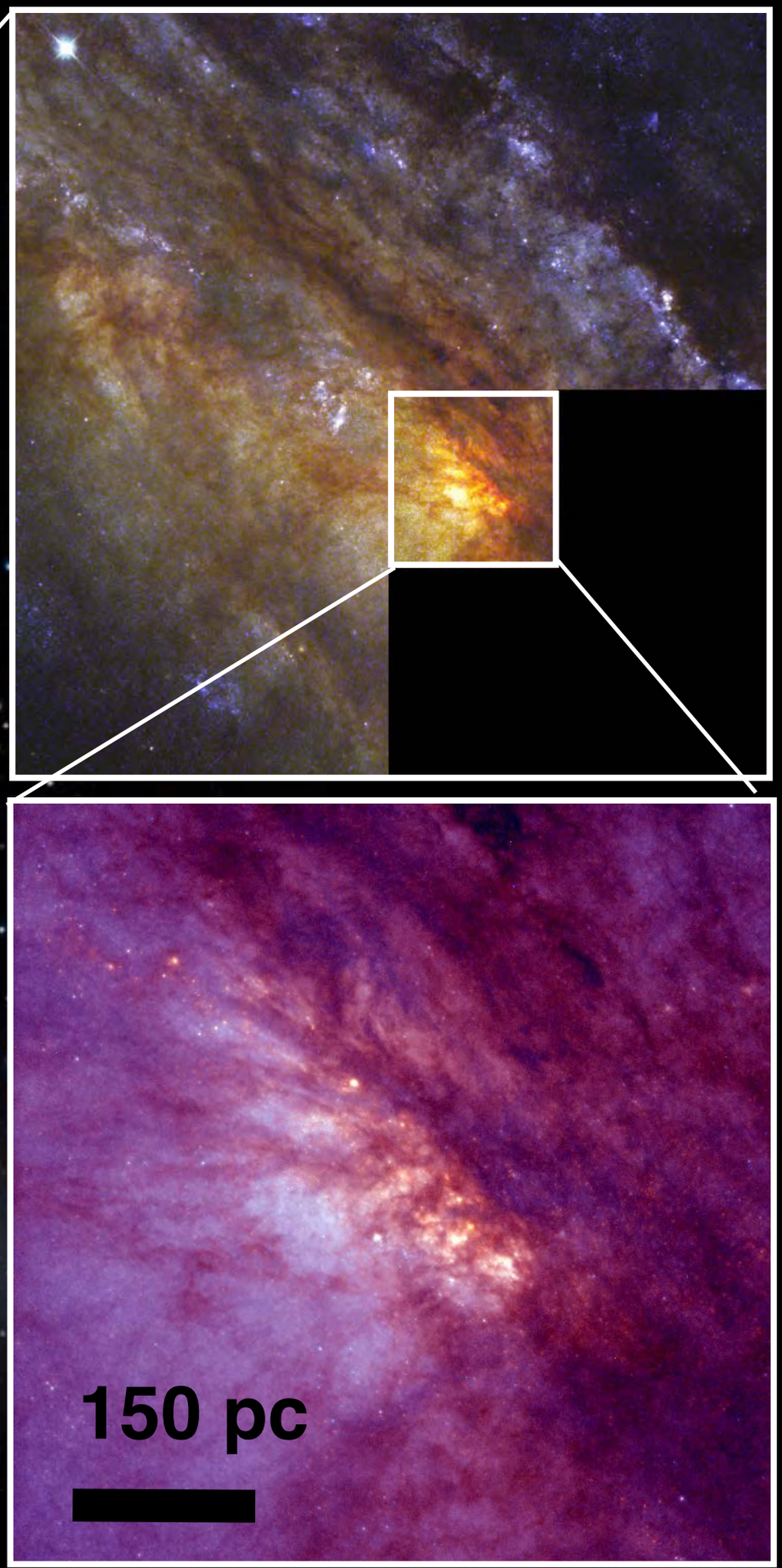
NGC 253



150 pc

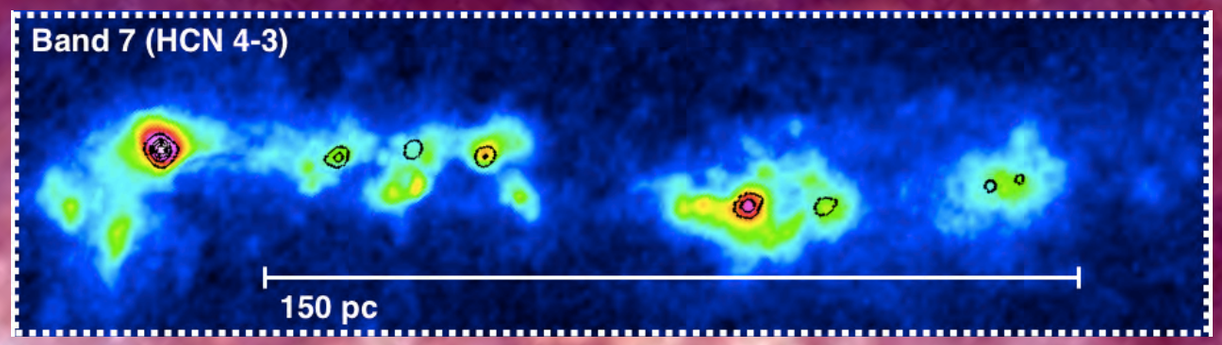
Located 3.5 Mpc away from the Milky Way

NGC 253



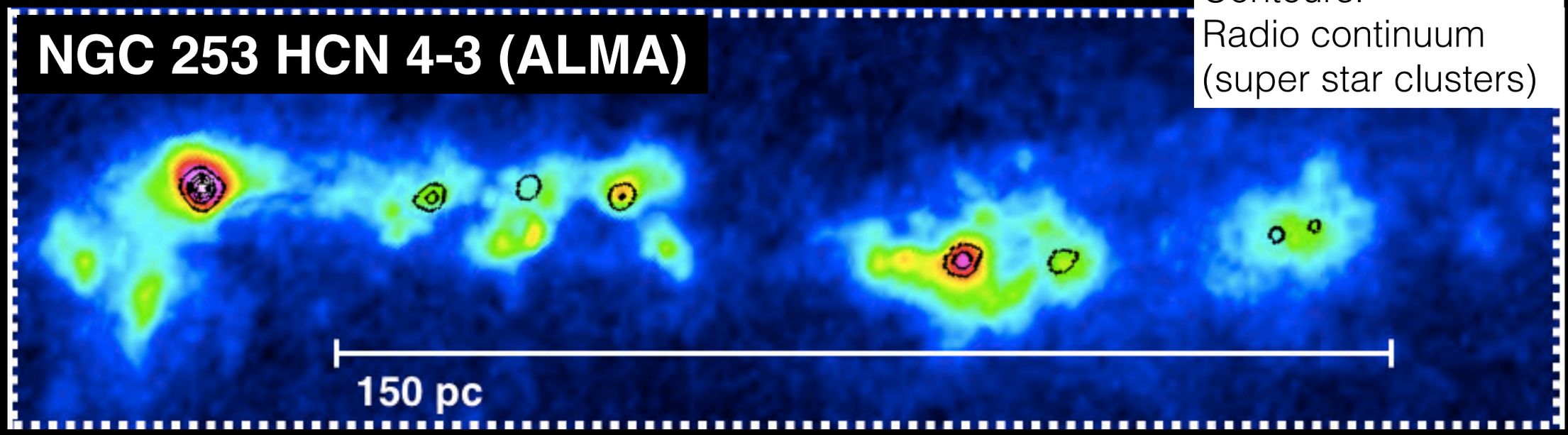
150 pc

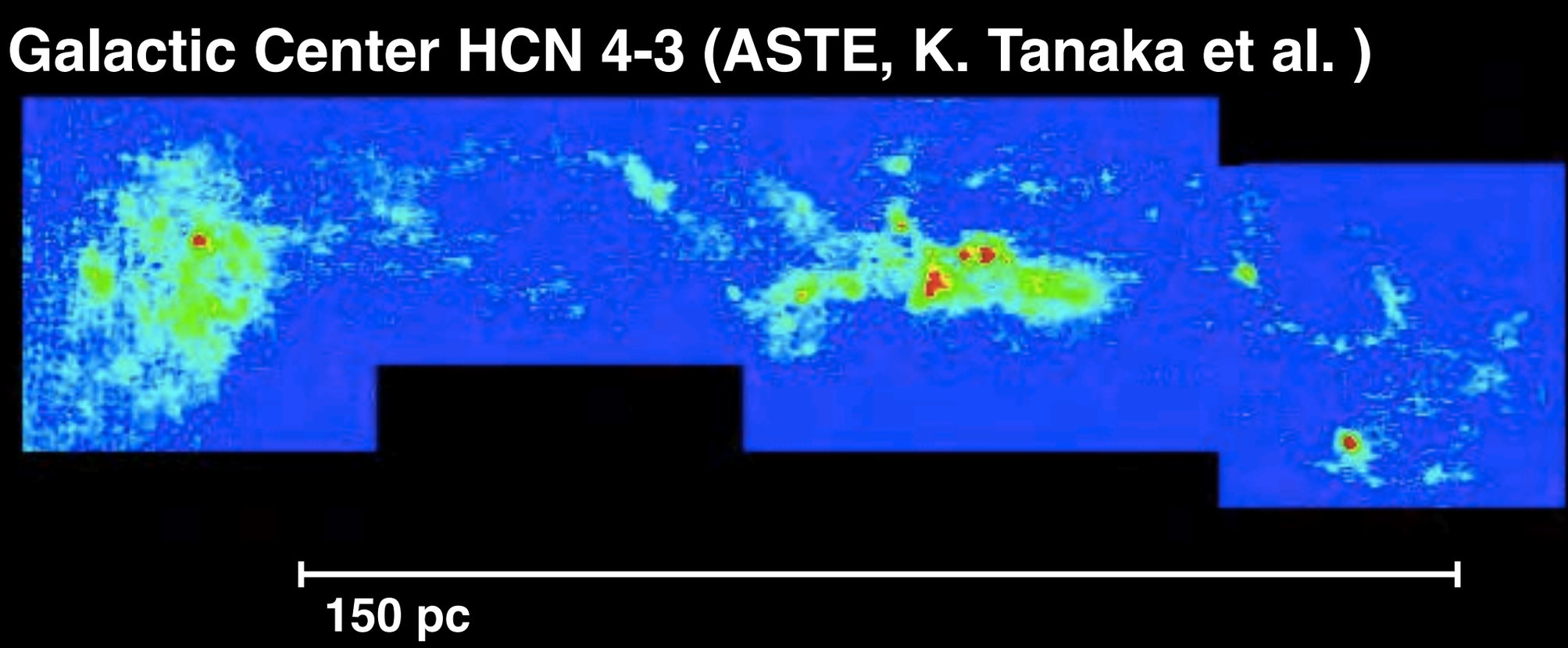
Located 3.5 Mpc away from the Milky Way



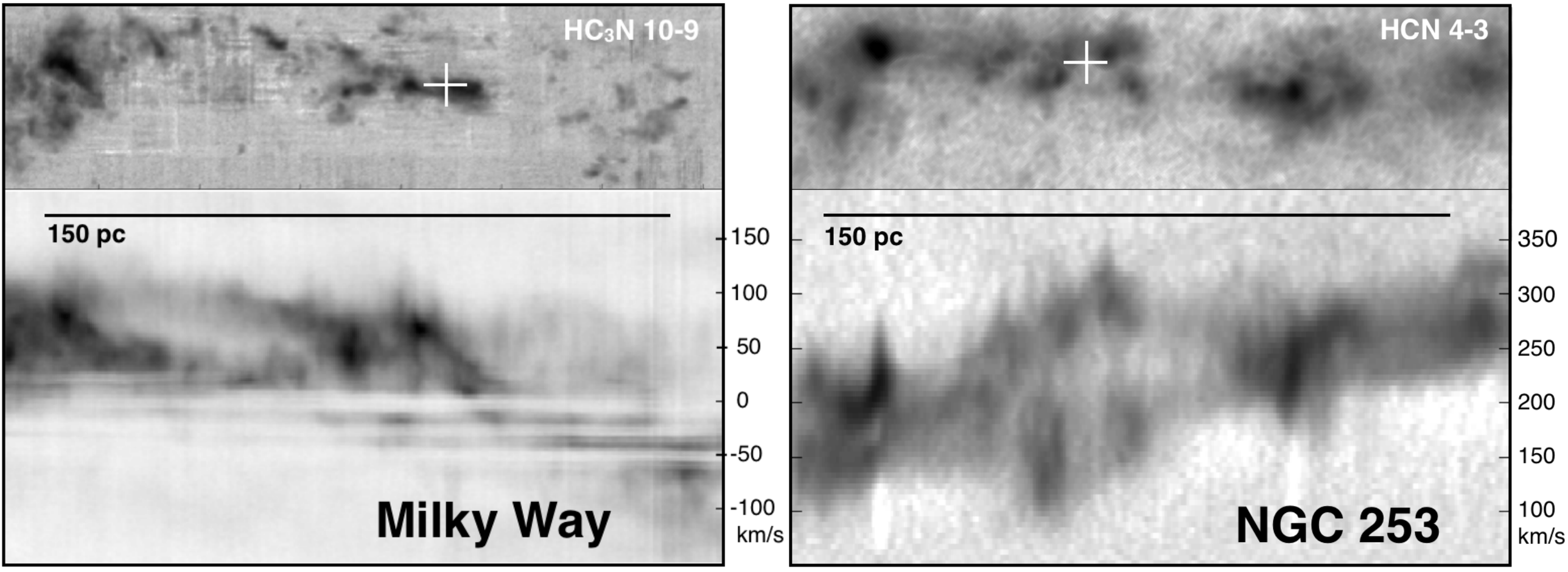
150 pc

NGC253:
An order of magnitude higher molecular mass





With ALMA, can now compare the centers of these galaxies at identical resolutions; working on building up a suite of identical tracers



So far:

- Appears to have a nearly identical orbital stream structure
- Broader line widths

Comparing NGC 253 and the Galactic center

Begin to isolate the effects of an active starburst (minus an AGN) on the gas reservoir

Contrast with ‘initial’ conditions of just gas accretion, without a starburst or AGN