

“Starbursts and AGNs, Near and Far”

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Science Goals:

- examine the nature of starburst and AGN activities associated with luminous infrared galaxies and their evolution;
- survey the nature of the circumnuclear material surrounding nearby AGNs and examine their relation to the observed activities

ALMA/GSMT Workshop (July 9, 2001)

Key Measurements:

Imaging and Spectroscopy at High Resolution
to derive:

- spatial extents of SB and AGN disks
- density and temperature distribution
- gas and stellar masses
- velocity field and gravitational potential
- magnetic field

Resolution:

10 mas = 0.15 pc at 3 Mpc

10 mas = 1.0 pc at 20 Mpc

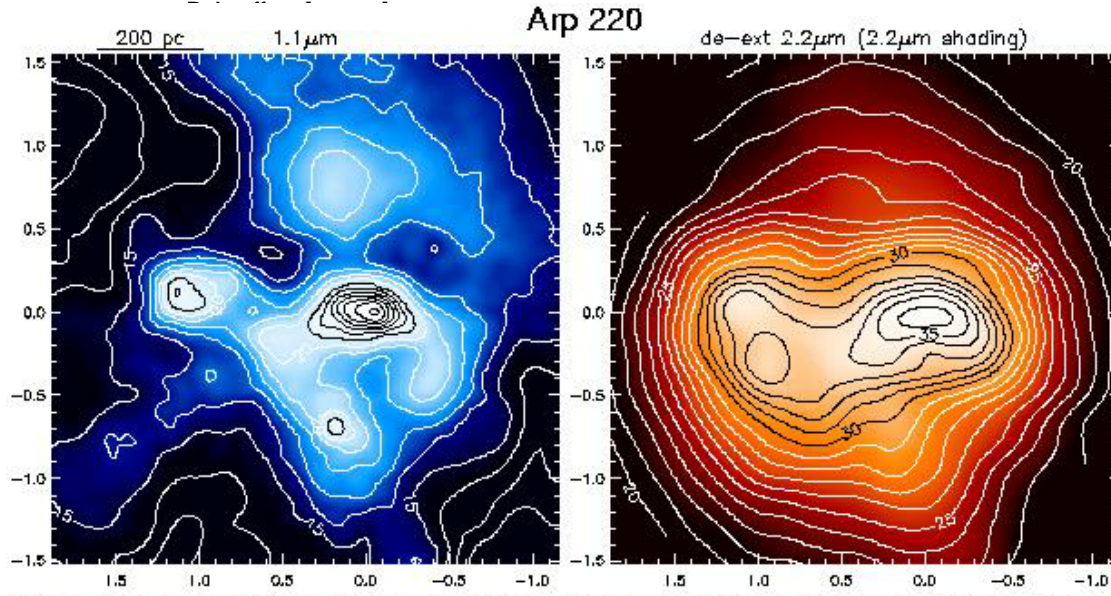
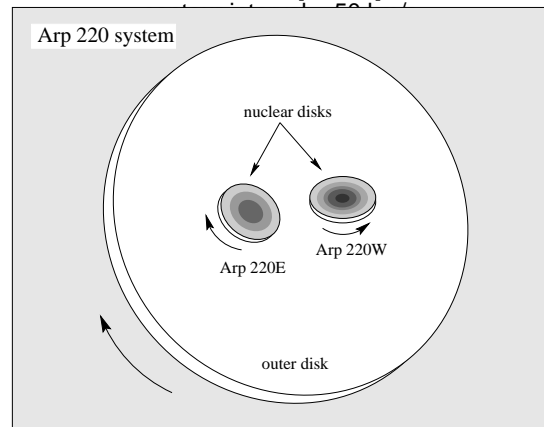
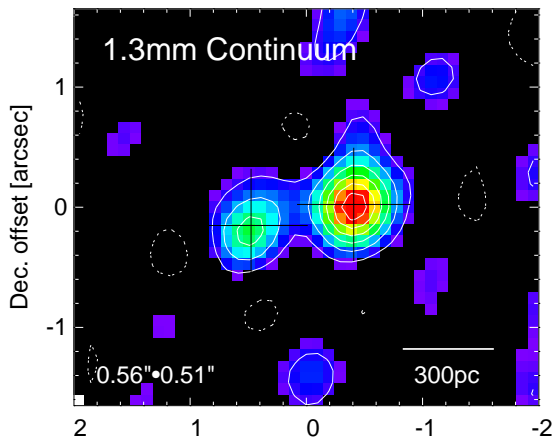
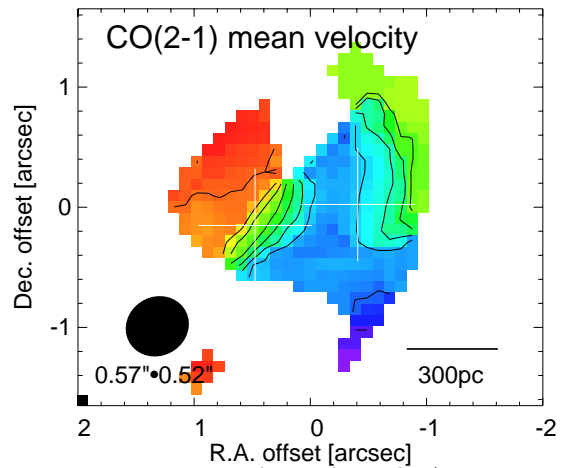
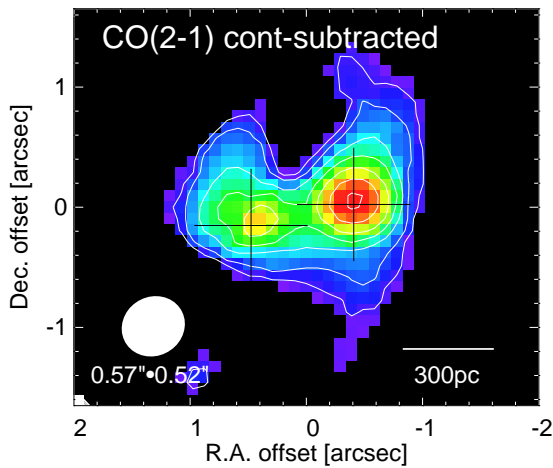
10 mas \sim 100 pc at $z > 1$

Sensitivity:

ALMA: 1 K (10 K, lines) in 10 hrs

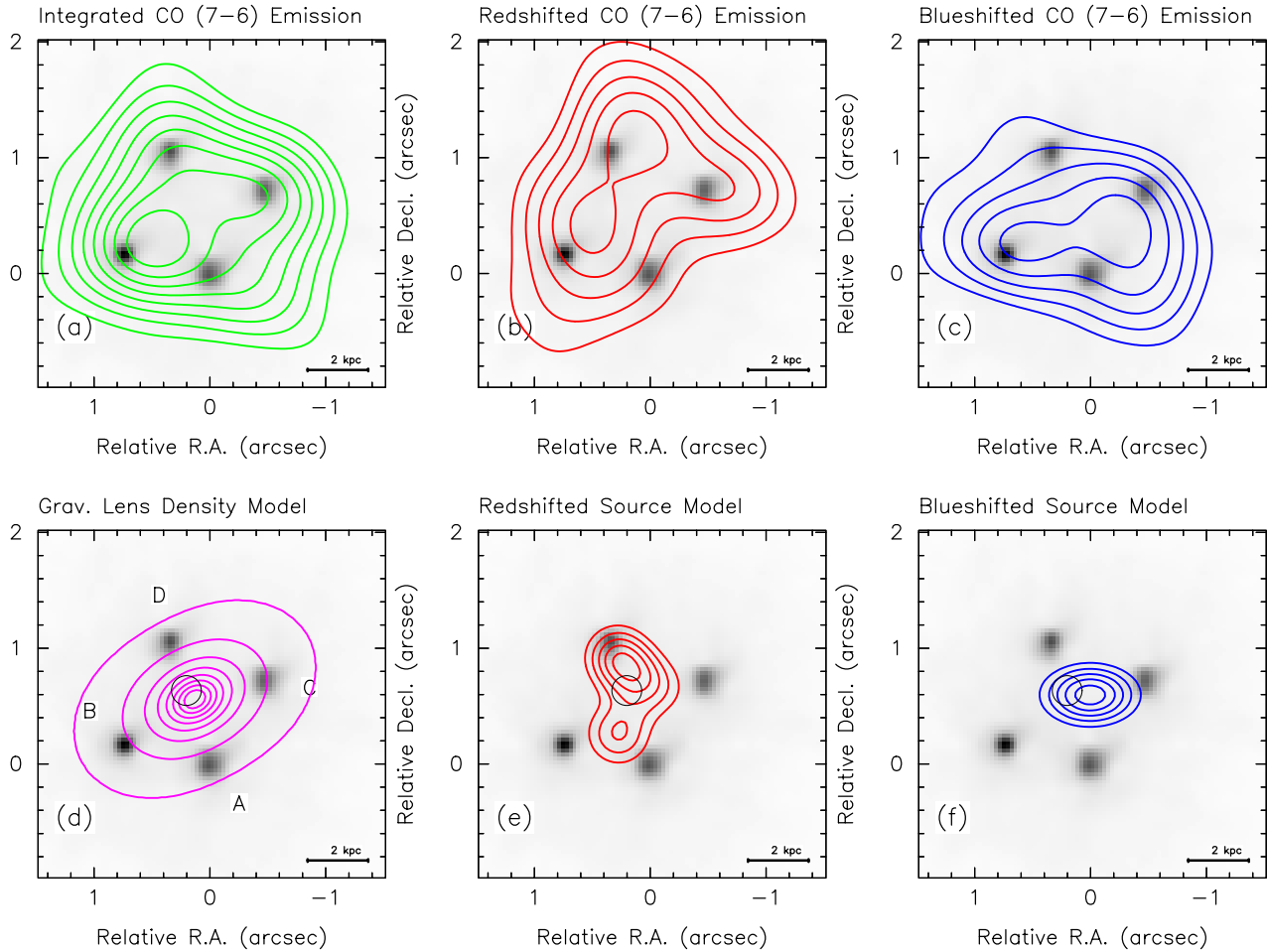
High-z Starburst Galaxy: **ARP 220**

(Sakamoto et al. 1999; Scoville et al. 2000)



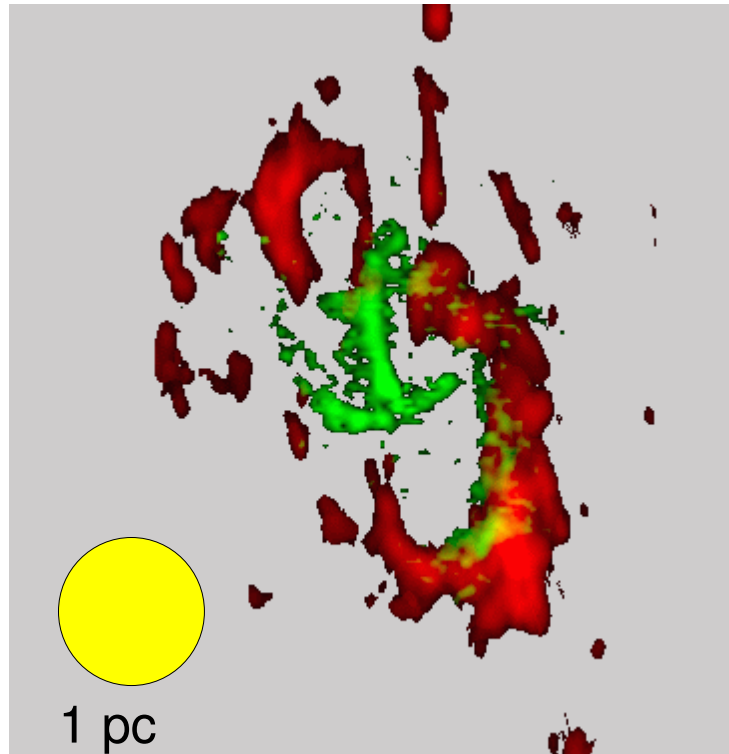
High-z Starburst: **The Cloverleaf**

(Yun et al. 1997)



- $R_{CO} = 700 h^{-1} \text{ pc}$
- $\Delta V_{CO, FWHM} = 350 \text{ km s}^{-1}$
- $M_{H_2} = 2 \times 10^{10} h^{-2} M_{\odot}$ (for $\alpha = 4$)
- $n_{H_2} \geq 10^5 \text{ cm}^{-3}$, $T_{ex} \geq 100 \text{ K}$

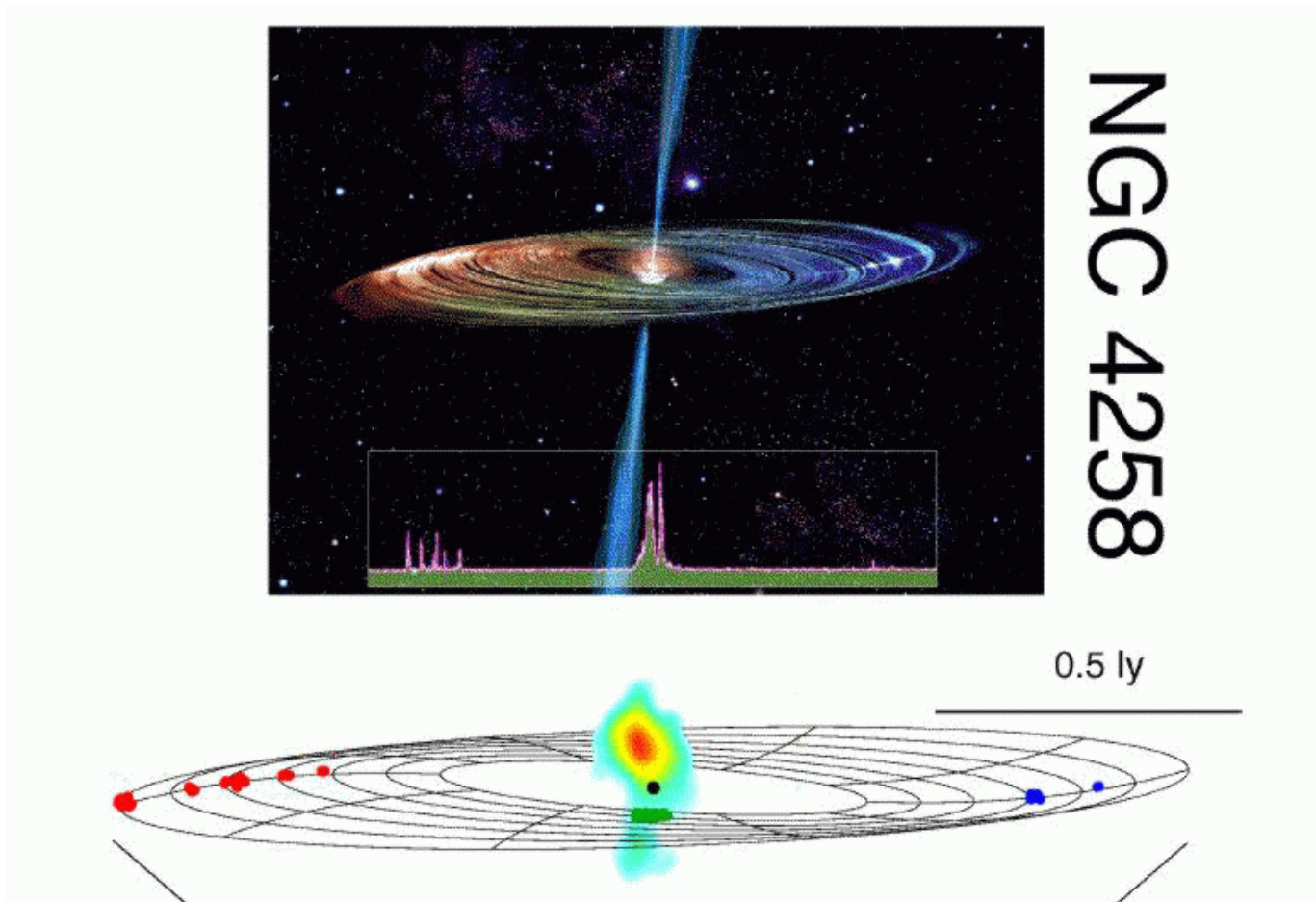
AGN: Sgr A*



Ionized gas Molecular gas

- $R_{CND} \sim 1 \text{ pc}$, $M(\text{H}_2) \sim 10^6 M_\odot$
- $n_{\text{H}_2} \geq 10^4 \text{ cm}^{-3}$, $T \geq 50 \text{ K}$
- $n_e \geq 10^4 \text{ cm}^{-3}$, $T_e \sim 6000 \text{ K}$

AGN: NGC 4258



- $R_{CND} \sim 0.33 \text{ pc}$
- $n_{H_2} \geq 10^9 \text{ cm}^{-3}$, $T \sim 10^{2-3} \text{ K}$

ALMA/GMST Synergy:

- High Resolution Imaging:
 - **ALMA**: molecular gas and dust
 - **GSMT**: ionized gas and stars
- Map Kinematics at High Angular and Spectral Resolution
- Complement other future instruments: **NGST** (hot gas and stars), **SIRTF** (SED), **EVLA** (non-thermal emission and magnetic field), etc.

Issues for Further Studies:

- Sensitivity Requirements
- Technical Challenges and Solutions (e.g. AO, DR/FI)
- Noble Measurement Techniques (e.g. 2D spectroscopy)