SMA SCIENCE HIGHLIGHTS: THE GALACTIC CENTER

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The Galactic Center on Three Size Scales

1. Circumnuclear (molecular) Disk (CND) and Minispiral (ionized streamers)  
   120 arcs / 5 pc  
   Zhao, Blundell, Downes, Schuster, Marrone

2. Black hole accretion envelope (100 R_s)  
   1 mas / 0.3 micro pc  
   Marrone, Munoz, Zhao, Rao

3. SgrA* radio source  
   37 microarcseconds / 0.01 microparsec  
   Doeleman et al.
Nine Field Mosaic Image of Circumnuclear Disk in Galactic Center

CN
H$_2$CO
SiO

SMA Data
Sergio Martin Ruiz

3 arcmin field
3 arcs resolution
1.3 mm wavelength
Galactic Center CND with 230 GHz Continuum from Ionized Minispiral
Velocity Distribution of Gas Traced by H30α Emission
Keplerian Radial Velocity Model
Three-Dimensional Geometry of Minispiral Arms

Observer above

Gray image is in the sky projection
- Very faint source still detectible at most astronomical observing bands
  - SED measurements span 10 decades in frequency
- $L_{\text{SgrA}^*} \sim 300 L_{\text{Sun}} \sim 10^{-9}$ Eddington limit

Genzel et al. (2004)

IR flare (Hornstein et al. 2007)
Polarization Images at Various Wavelengths from the SMA
2005 SMA Measurements of Faraday Rotation in Sgr A*
Accretion Rate and Faraday Rotation

\[ \chi(\lambda,t) = \chi_0(t) + \lambda^2 \ RM(t) \]

\[ RM = 8.1 \times 10^5 \int n_e \mathbf{B} \cdot d\mathbf{l} \]

\[ RM = -5.1 \times 10^5 \text{ rad/m}^2 \]

Assumptions:
- equipartition
- density power law
- inner radius cutoff of Faraday screen

Accretion rate = \(10^{-9} - 10^{-7} \ M_{\odot}/\text{yr}\)
Polarization of Sgr A* at 230 GHz (1.3 mm) (SMA)
Polarization Track for 3/31/07 Observation of SgrA*
Circular Polarization of Sgr A*

(red) Stokes I
(blue) Stokes V

Fractional Circular Polarization vs. Frequency
Observations of Cygnus A with the Jodrell Bank Intensity Interferometer

Square of visibility
125 MHz

Jennison And Das Gupta, 1952, see also Sullivan 2010
The Synchrotron Emission from Cygnus A
Imaged with the VLA at 6 cm Wavelength
1.3mm\(\lambda\) Observations of SgrA*

VLBI program led by a large consortium led by Shep Doeleman, MIT/Haystack
Day 97, 2009

Gauss: 2.74 Jy, 42.3 uas  
Disk: 3.05 Jy, 48 uas (outer), 105 uas (inner)

Baseline (x10^6 λ) vs Correlated Flux Density (Jy)