Extragalactic SMA

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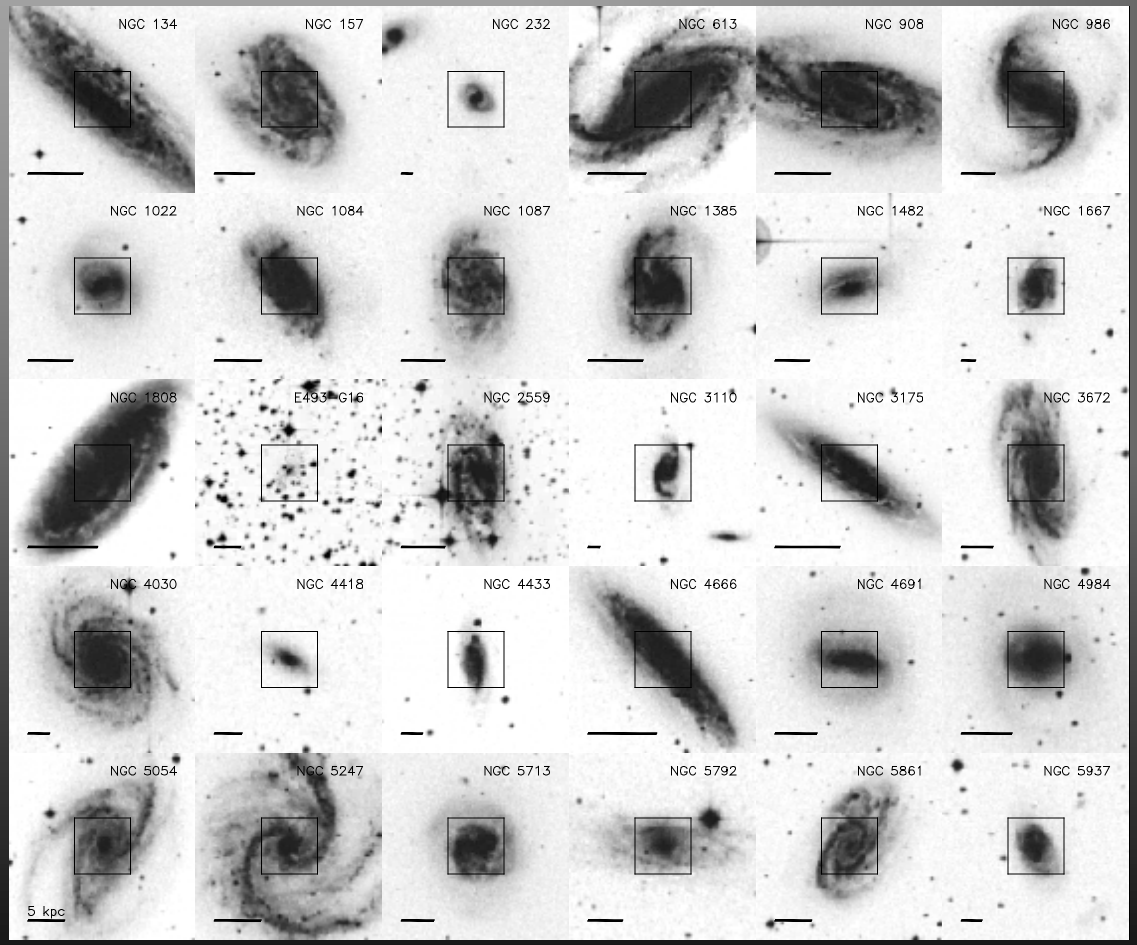
European Southern Observatory

Submillimeter Array Advisory Committee Meeting

Wednesday 13th, October 2010

NEARBY GALAXIES: CO 2-1 Mapping

BODEGA: Below 0 DEgree Galaxies (PI D. Espada)



Imaging of CO 2-1 in the central regions (1') of the ~70 IR brightest nearby galaxies of the southern sky.

Completes the 150 sources with high angular resolution (<5") CO observations from surveys in the last 2 decades

SMA Capabilities

Fast 8 antenna mapping of bright objects (2-3 h per source)

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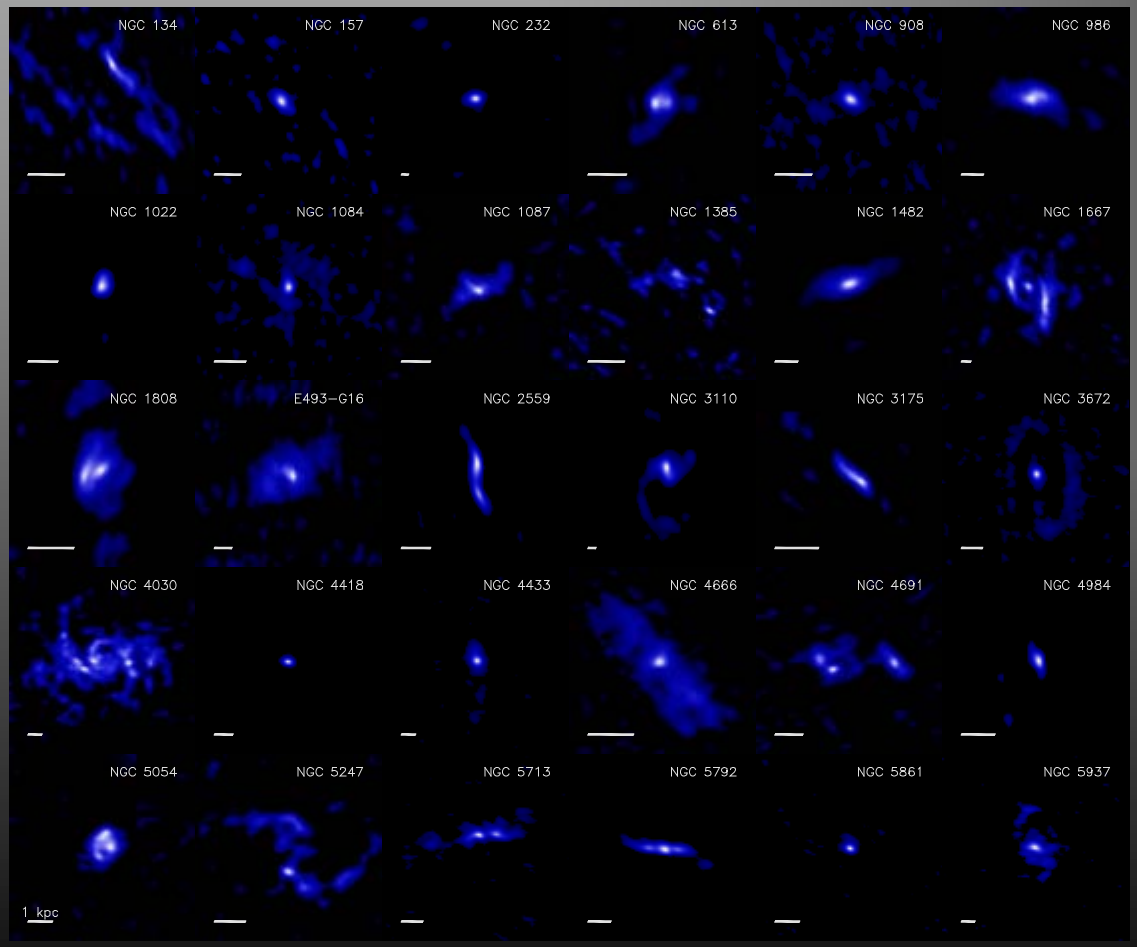


Wide variety of morphologies (nuclear arms and bars, rings, and asymmetries)

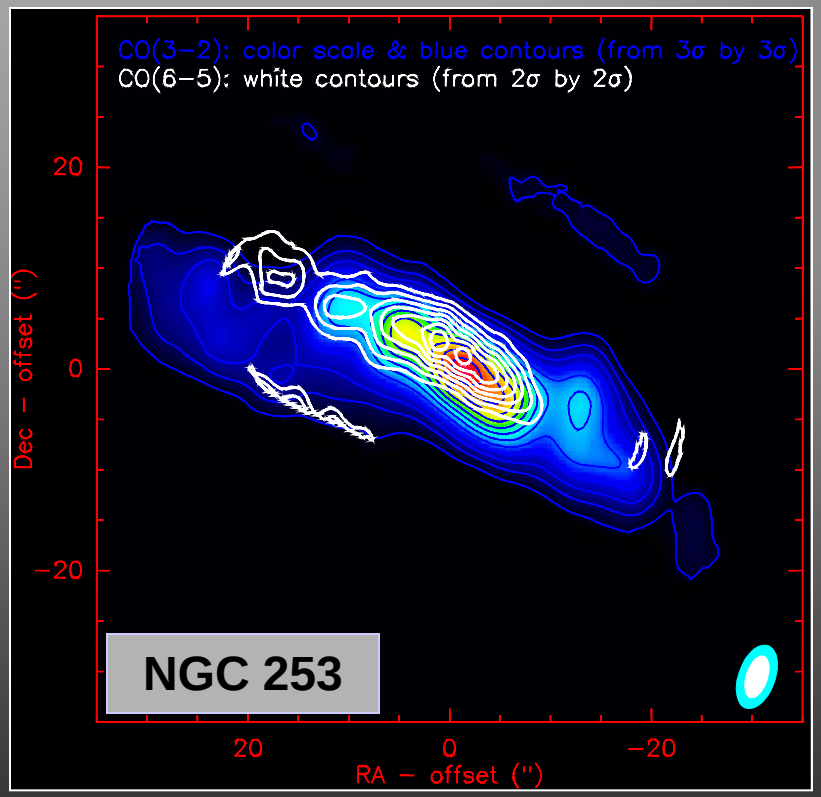
86% show centrally peaked concentration in 0.5-1kpc scales (55% in BIMA-SONG)

SMA Capabilities

Fast 8 antenna mapping of bright objects (2-3 h per source)

NEARBY GALAXIES: 690 GHz

CO 6-5 Imaging (PI M. Krips)



Challenging observations due to the calibration difficulties at these frequencies…not only for SMA

Planets as gain calibrators. "Semester of oportunity"

CO *J*=6-5
E_u ~120 K
$N_{crit}>10^7$ cm^{-3}

Densest molecular material…associated with star formation?

<u>SMA Capabilities</u>
Only available facility for high resolution 690 GHz

NEARBY GALAXIES: 690 GHz

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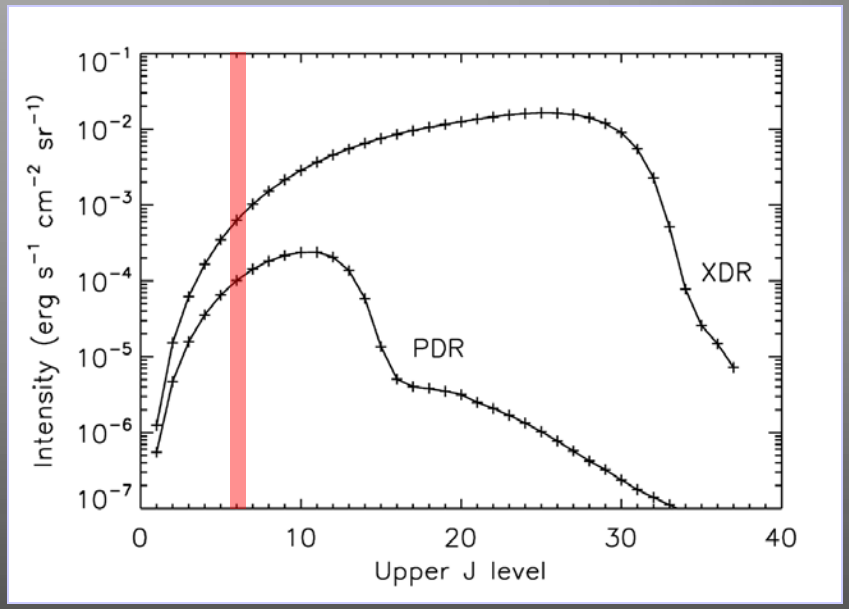
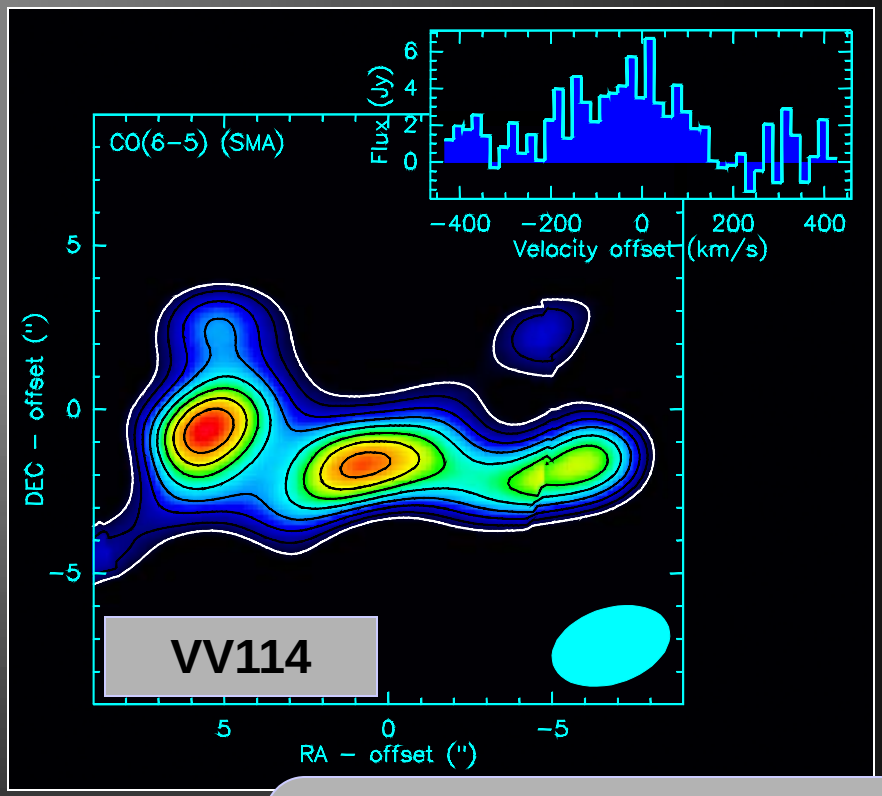


Meijerink & Spaans et al. 2005

Tracing the PDR around star forming sites but significantly enhanced in the presence of an AGN



SMA Capabilities

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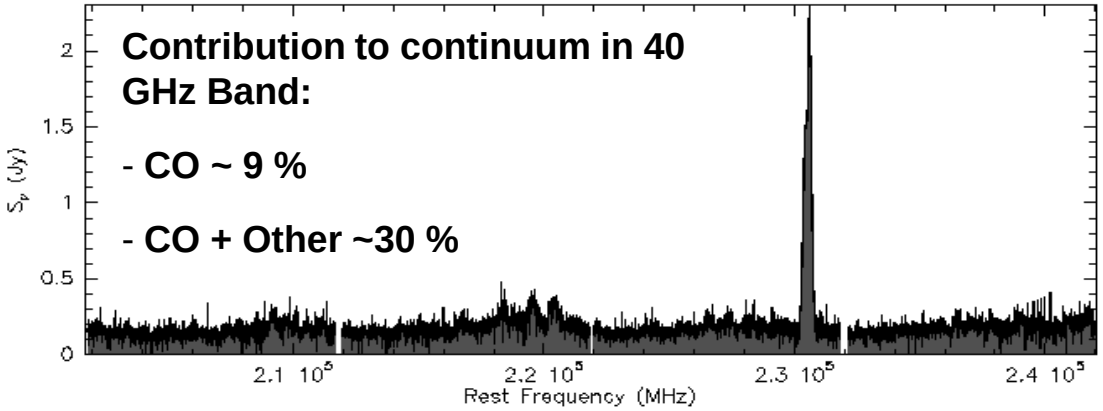
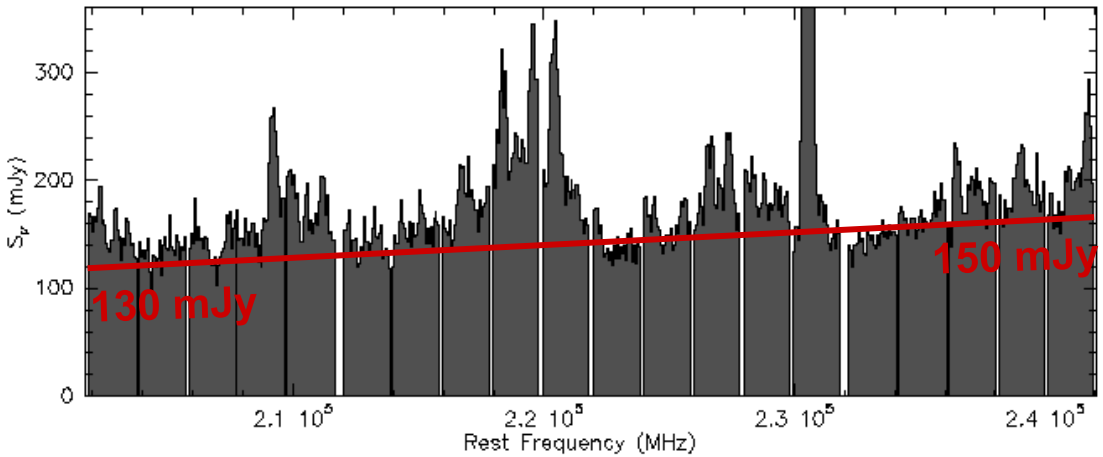
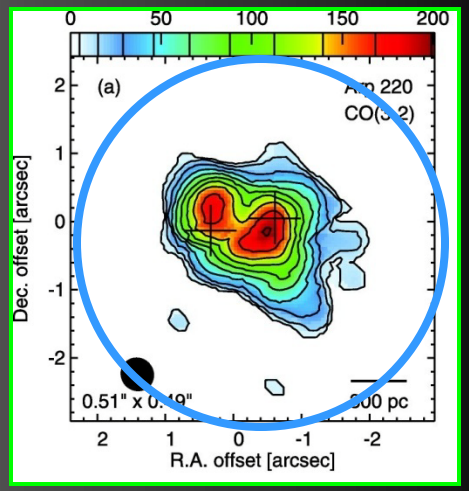
NEARBY GALAXIES: Chemistry

Arp 220 1.3 mm line survey (PI S. Martin)







Sakamoto et al. 2008

10 Half Tracks

Low resolution (~5")

SMA Capabilities
2x2GHz bandwidth
At the time of the Survey

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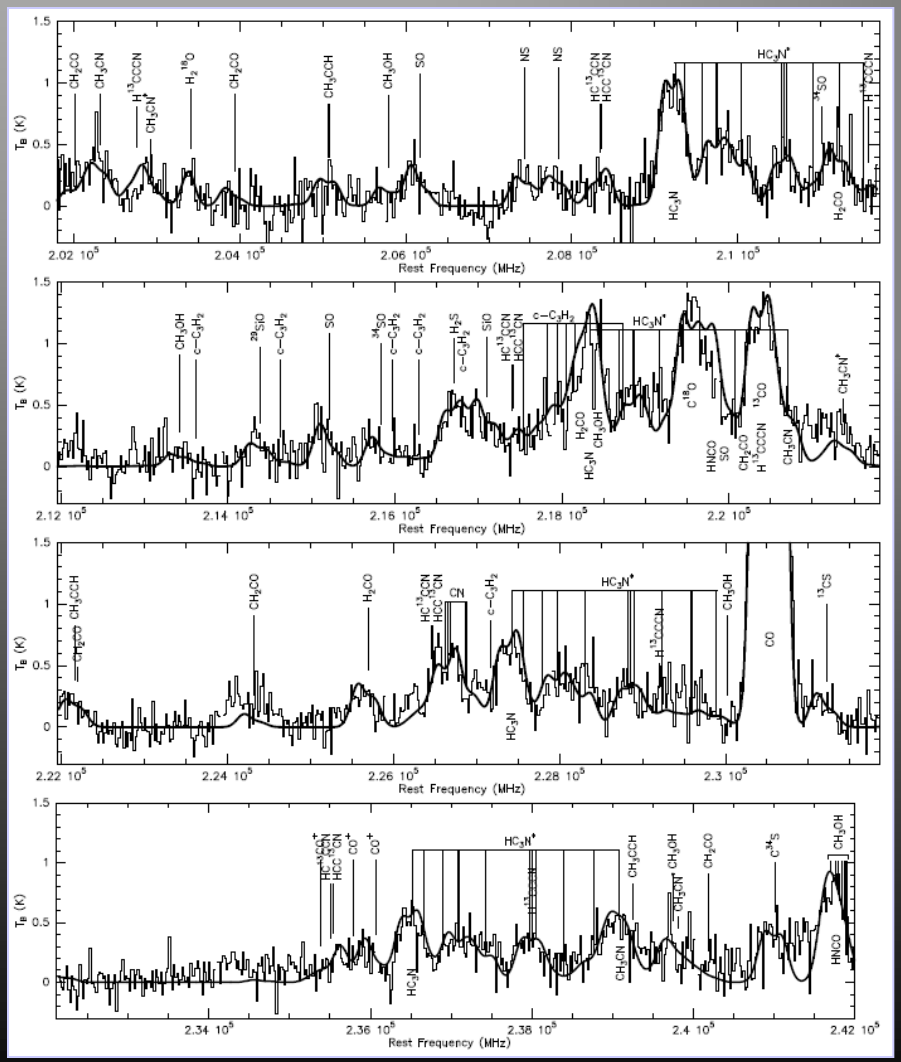


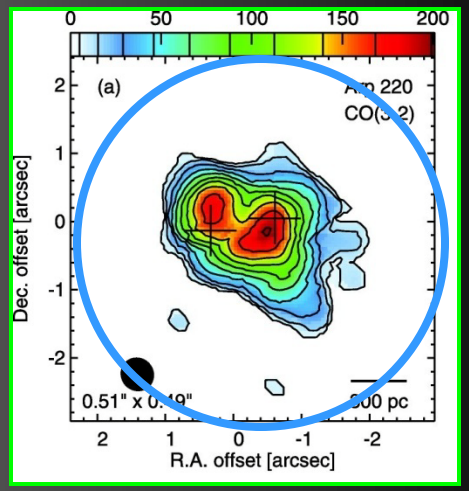
More than 70 individual or groups of molecular transitions

15 species and 6 isotopologues

1.8 lines/Ghz = Partially confusion limited

Previously unidentified species: $H^{13}C_3N$, $H_2{}^{18}O$, ^{29}SiO, CH_2CO

New detections in Arp220: NS, CH_3CCH,SO



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HOT CORE CHEMISTRY
Vibrationally excited HC3N and CH3CN
Large Abundance of H2O similar to that in Galactic hot cores

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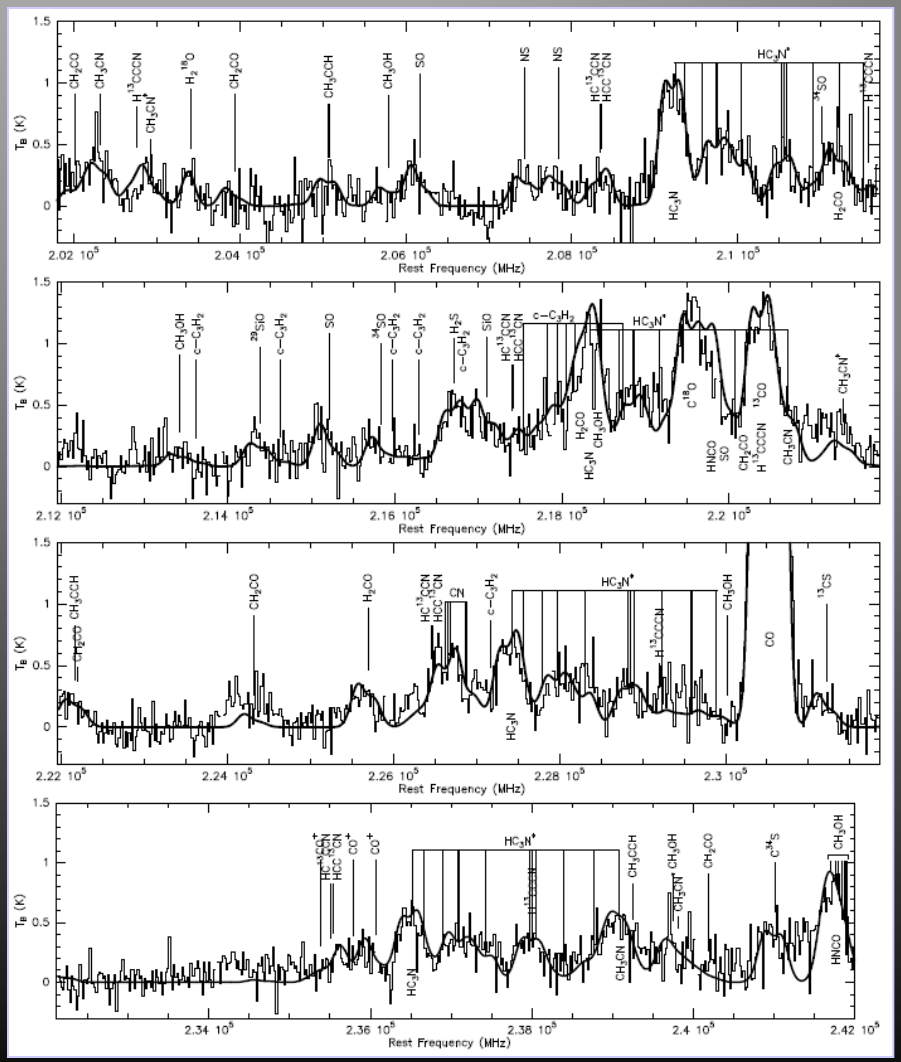
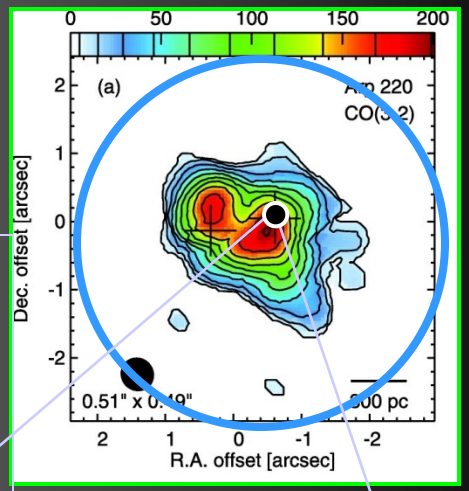
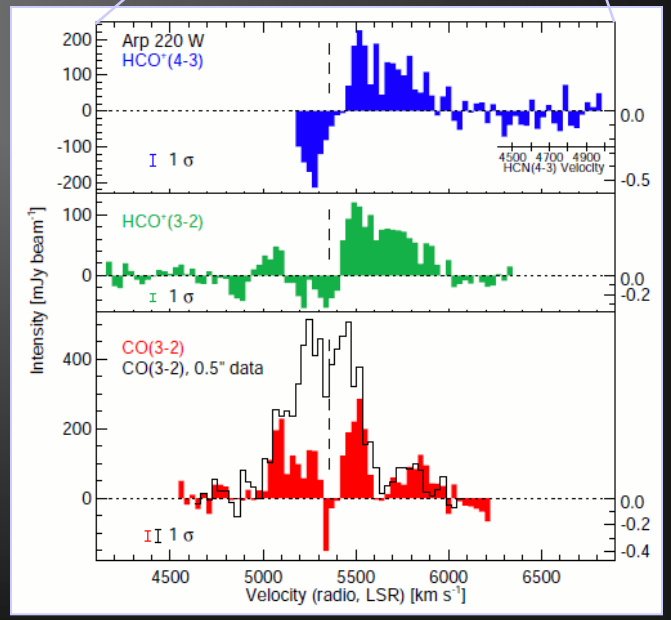


P-Cygni profiles at high angular resolution observations of HCO^+ "OUTFLOWING MATERIAL"



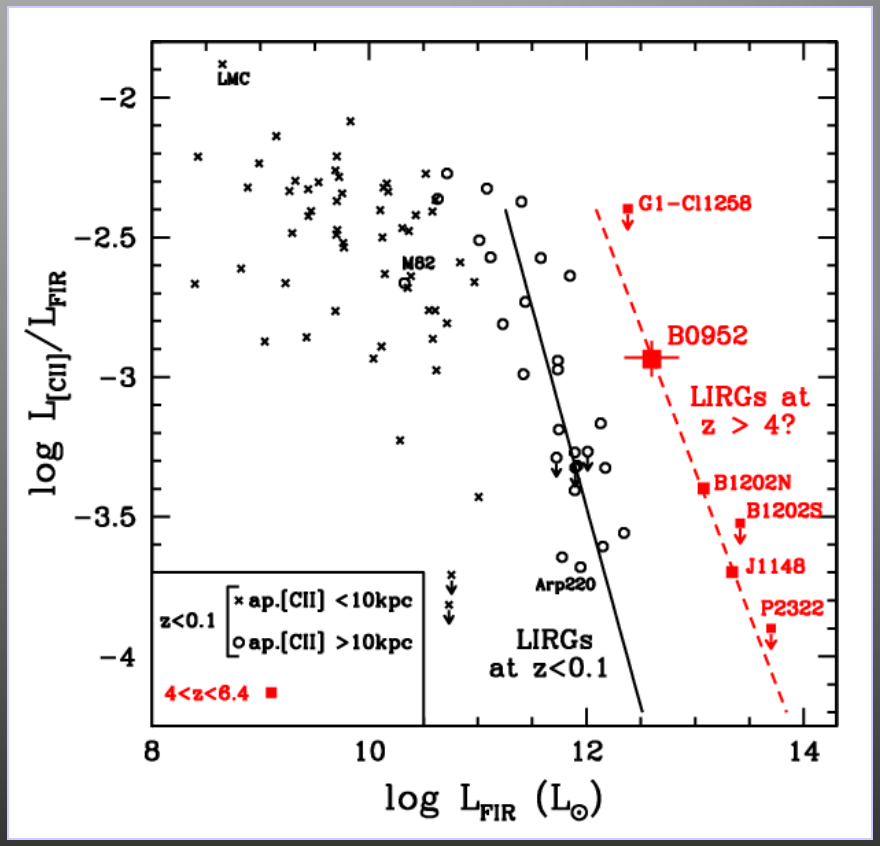
Sakamoto et al. 2008



Sakamoto et al. 2009

High Z: [CII]

BRI 0952 -0115 @ z=4.4337 (PI R.Maiolino)



Fine structure line [CII] at 158 um is generally the brightest emission line in galaxies

Tool to detect star forming galaxies at high-z BUT the $L_{[CII]}/L_{FIR}$ drops for $L_{FIR}>10^{11.2}L_o$

APEX first detection for a high-z source of $L<10^{13}L_o$

SMA Capabilities

System+Atmospheric stability

To detect faint high-z sources

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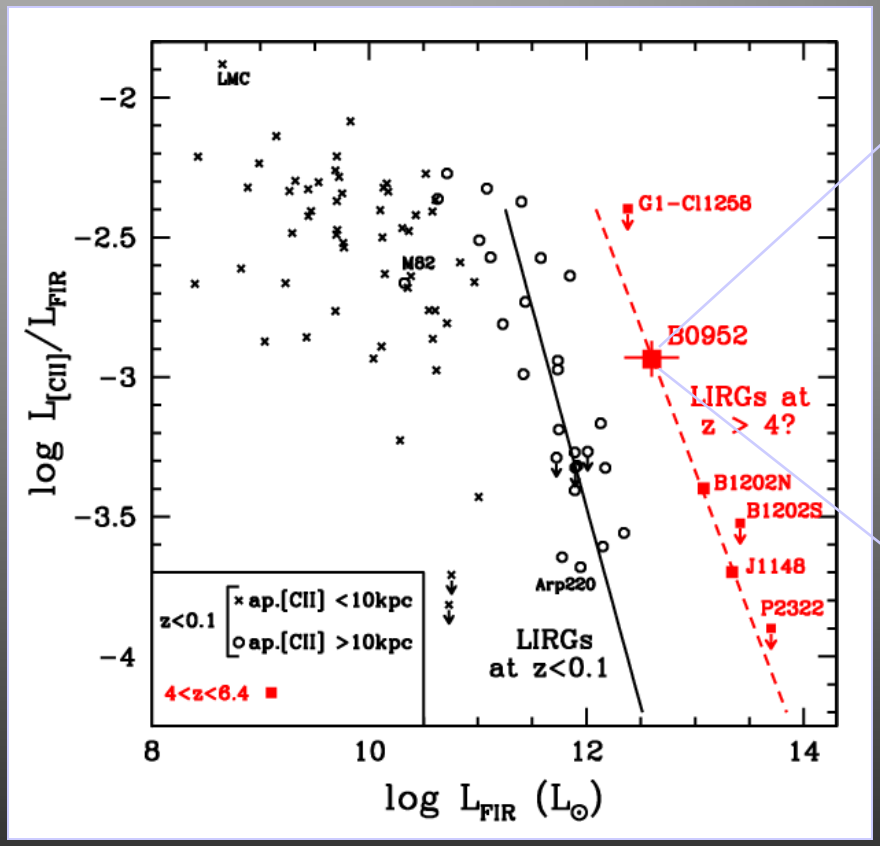
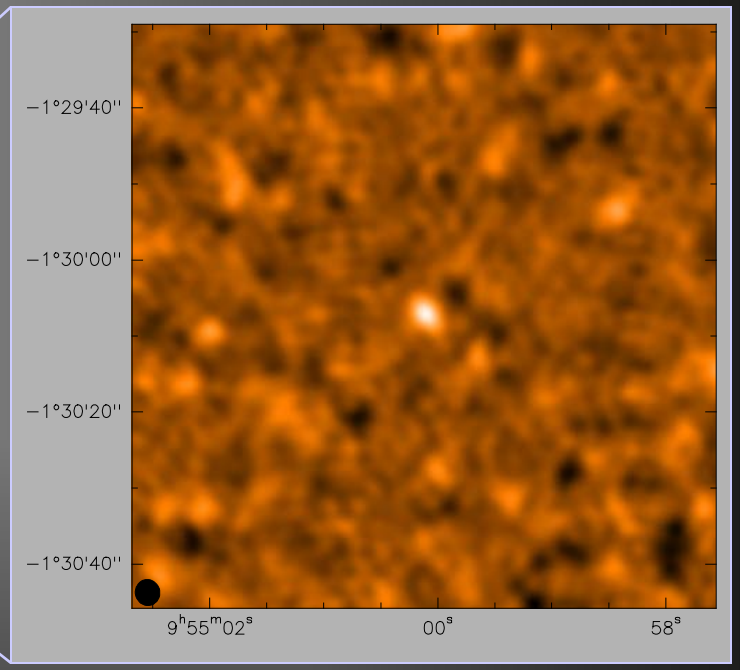


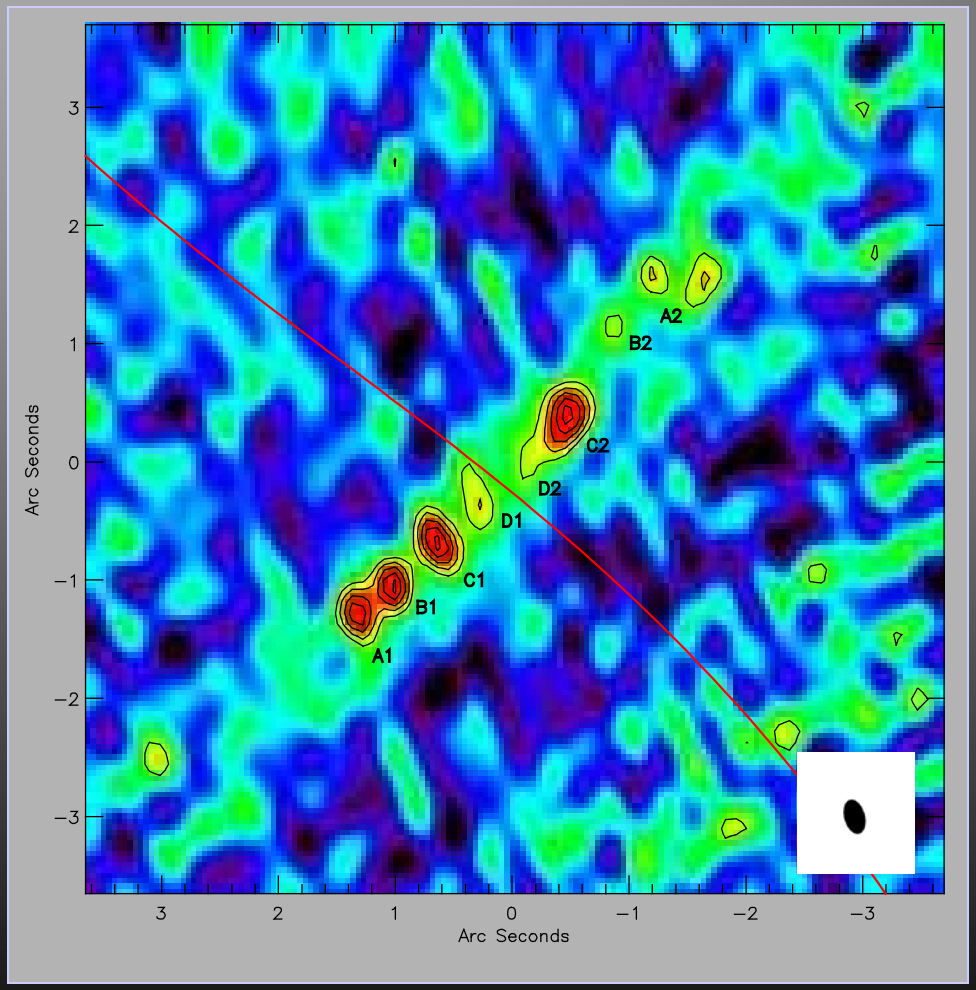


SMA confirmation using SC+C
Resolved out in VEX

SMA Capabilities
System+Atmospheric stability
To detect faint high-z sources

High Z: Spatially resolved

SMMJ2135-0102 (Eyelash) @ z=2.3259 (PI M.Swinbank)



LENSING
Galaxy magnification
Source stretching

Intrinsic 870 um flux ~3 mJy
Lense magnification ~32
Observed 870 flux = 106 mJy

Brightest SMG at that time

SMA beam 0.3”x0.2”
8 components

<u>SMA Capabilities</u>
High Resolution +
System Stability

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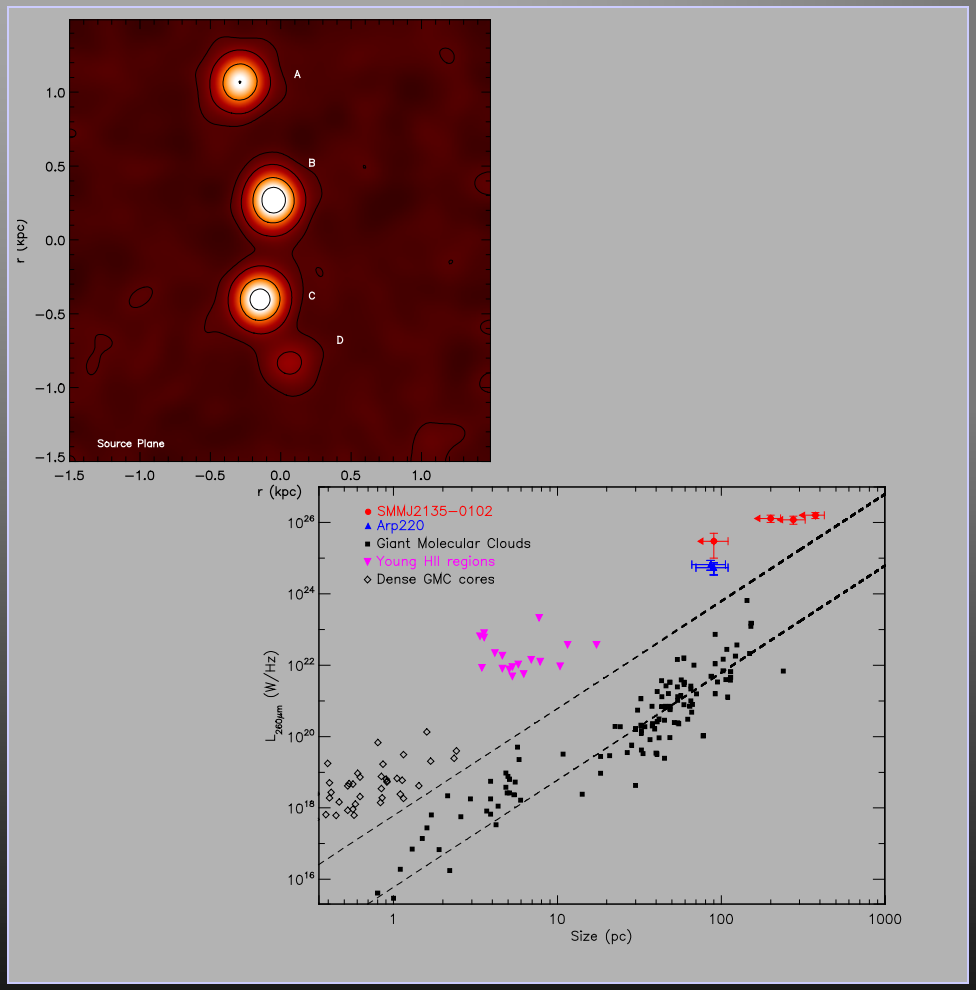


SMA imaging allowed source 4 components reconstruction

Luminosity density of SF regions:
x100 brighter than GMC
~consistent with GMC cores

<u>SMA Capabilities</u>
High Resolution +
System Stability

High Z: Bright SMG population

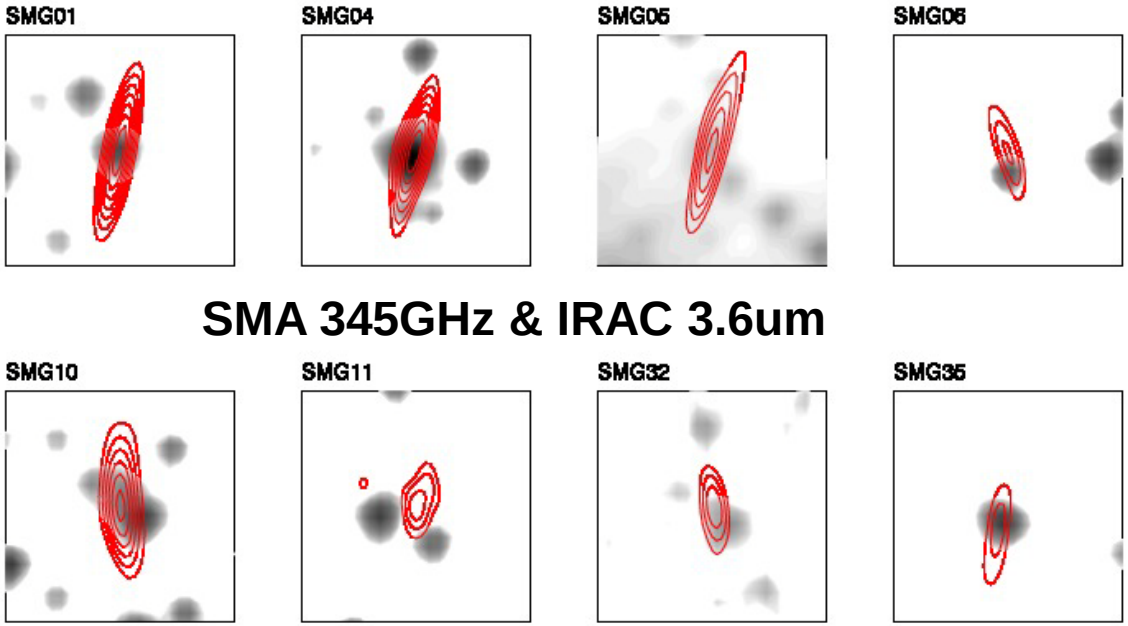
South Pole Telescope SMGs (PI D.Marrone)

1000 deg^2 SPT survey discovered a large number of extragalactic sources

1 order of magnitude than regular SMGs

9 detected with the SMA

Accurate astrometry is key to determine counterparts at other wavelenghts



SMA Capabilities

Observing at dec~-50º

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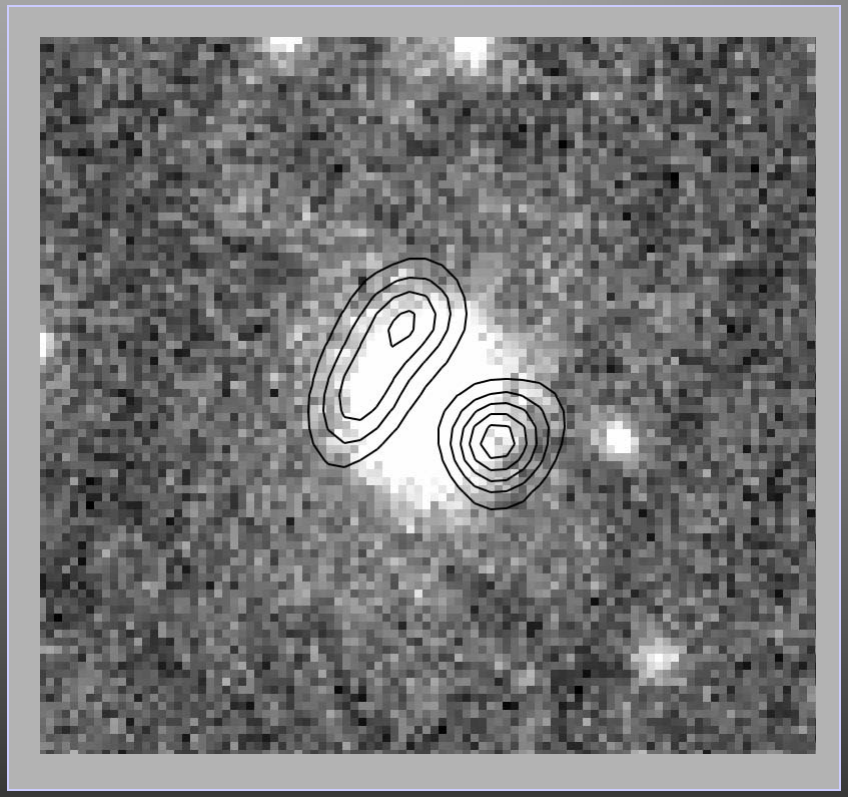


Evidence of lensing of these sources responsible for their brightness.

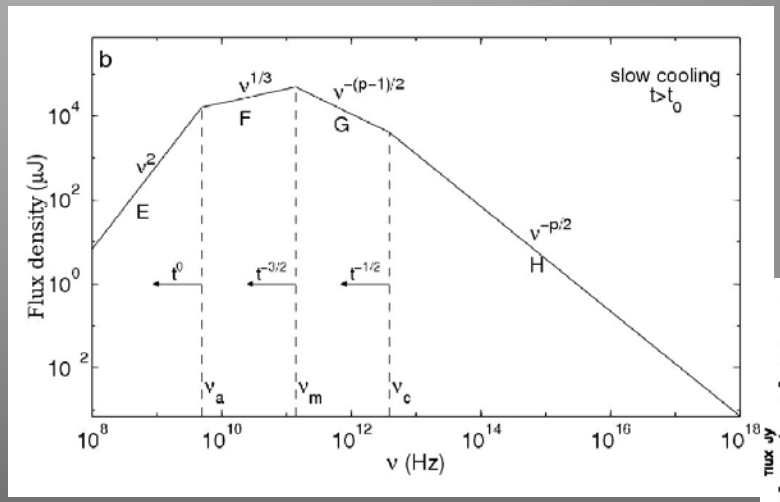
7.4”x1.4” restored with 1.4” beam

z=3.34 (VLT)

SMA Capabilities
Observing at dec~-50^{o}

Target of Oportunity: GRBs

GRB: Target of Oportunity at the SMA (PI S.Martin)



Sari et al. 1998

Compact source releasing 10^{53} ergs within seconds

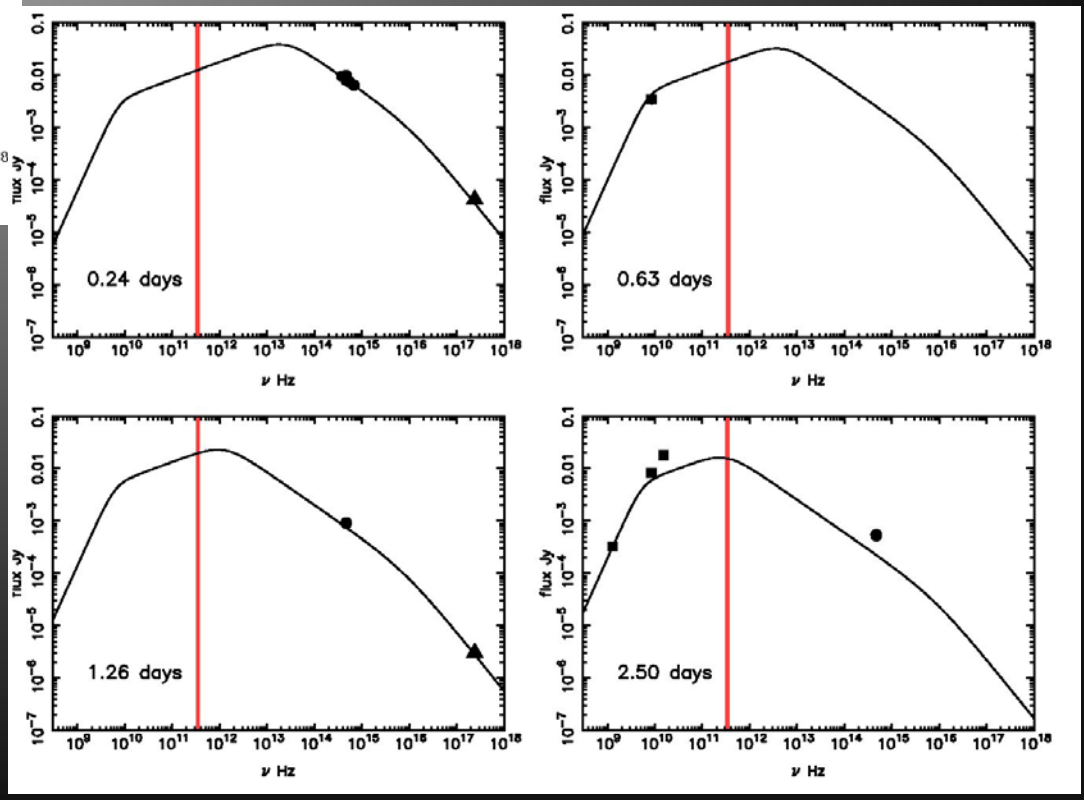
A forward shock ploughs into the medium producing the "afterglow" as the material decelerates.

Synchrotron Emission

SMA could catch the passing maximum at 345 GHz.

SMA Capabilities
Quick response

Willingale et al. 2004



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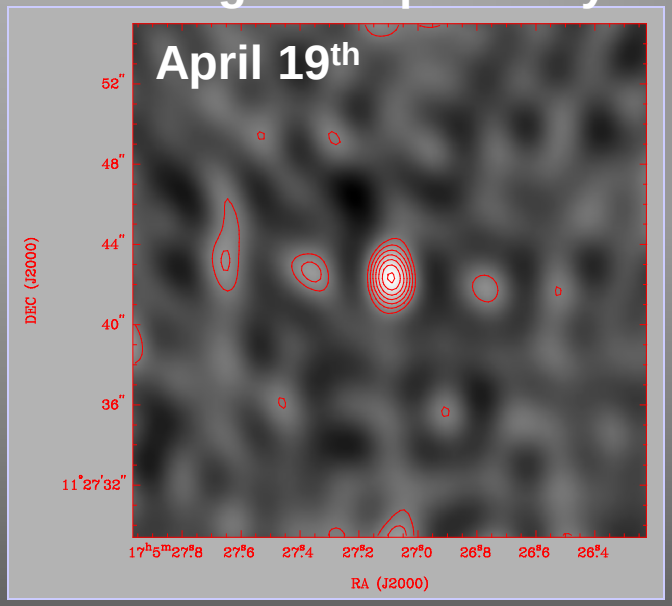

SMA Capabilities
Quick response

On April 18th 21:10 UT Swift Burst Alert Telescope triggered and located GRB 100418A

SMA observations started in April 19th 13:00 UT, two hours after the scheduler was informed.

Resulted to be the brightest submm flux ever detected for a GRB with 14 mJy

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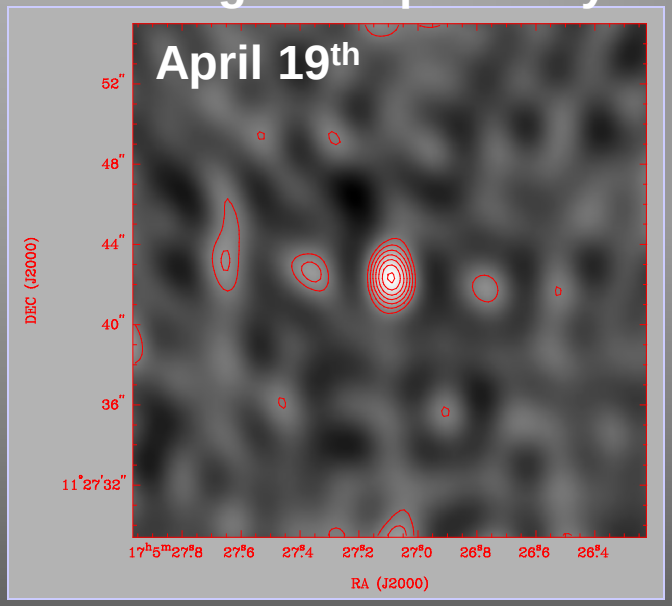

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It was followed down to 3.4 mJy, being the most detailed submm follow up of a GRB.