First Science Results from the Submillimeter Array

Alison Peck
Harvard-Smithsonian CfA

Presenting for:
Daisuke Iono, Henrik Beuther, Charlie Qi, Kazushi Sakamoto,
Peter Sollins, Mark Gurwell, Jun-Hui Zhao
and the rest of the SMA team

May 20, 2004
Eight Antennas

6m dishes composed of 72 aluminum panels

Carbon fiber backup structure

Assembled in summit hangar

For more info, see Peck and Schinckel poster #11
Four configurations
based on Reuleaux triangles

Baselines ranging from 7 to 500 m
Can move 3 antennas per day
Pointing checked optically, then using single-dish radio measurements
Baseline parameters determined to fraction of a wavelength by tracking quasars
Automated Tuning
For the 230 and 345 GHz LOs

Six receiver inserts

170-240 GHz
2x 260-350 GHz
300-420 GHz
650-710 GHz
820-910 GHz

SMA Receiver System

Mirror 5 (curved)
Mirror 6 (flat)
LO micros
LO chains
Grid combiner
Mirror combiner
VME rack
Receiver inserts
Cryostat
Mixer micro
Vacuum gauges
Refrigerator (closed-cycle JT)
UPS

Automated 230 GHz Local Oscillator

Microcontroller
Harmonic mixer
Attenuator
Multiplier
Isolator
Gunn oscillator
Linear actuator
Digital phase lock loop
6-8 GHz / 109 MHz diplexer
Correlator

2 GHz bandwidth in 24 IFs in each of 2 sidebands.

- Allows mixed resolution setups, with between 8 and 512 channels in any IF, for high continuum sensitivity as well as sub-km s$^{-1}$ velocity resolution on lines.

- Soon 2 receivers simultaneously for dual-band observations, or dual polarization
Interferometric Imaging at 685 GHz

Observations made in late 2002 using 3 antennas during phase closure demonstration

Imaging difficult, but uvplots show CS(14-13) emission is spatially resolved at central frequencies

Observations of CO(6-5) (691 GHz) and water masers at 658 GHz made this winter with 5 antennas available soon

Young et al. 2004

May 20, 2004
High Redshift Galaxies

APM08279+5255: Continuum at 335 GHz
Well-known lensed galaxy at $z=3.9$
Feasibility study for astrometry on high-z galaxies discovered w/ single-dish:
4 hours on source

Peck et al 2004

BR1202-0725: Continuum at 332 GHz plus redshifted CII?
(rest freq=158 $\mu$m)
$z=4.7$

Iono et al 2004
Interacting Galaxies: VV114

CO(2-1) and (1-0) detected toward both galaxies and overlap region.

Velocity dispersion greatest toward overlap region

Significantly more dense gas toward VV114E, optically obscured galaxy.

Iono et al 2004

R-band background image courtesy J. Hibbard; CO(1-0) image courtesy M. Yun
Antennae (NGC 4038/9)

Very preliminary
(April 20, 2004)

CO(3-2) – red
SMA 10 ptg mosaic,

CO(1-0) – blue
courtesy C. Wilson

Optical V-band – grey
courtesy B. Whitmore

Iono et al 2004
CO in M83

CO(2-1)- 3 point mosaic
CO(3-2)- single pointing
Dotted line=primary beam

Diamond marks visible nucleus
Cross is isophotal center in K-band

Sakamoto et al 2004

May 20, 2004 Explores the Cosmic Frontier
SgrA*: Monitoring and Imaging

340 GHz continuum contours from March 2004 shown with VLA 23 GHz background

Intraday Variability
SgrA* flux shown in red, calibrator in blue

Zhao et al 2004
Orion-KL at 347 GHz

Continuum image with sub-arcsecond resolution, April 2004

Source I clearly resolved from the hot core, and several new components identified

Beuther et al 2004

May 20, 2004

Exploring the Cosmic Frontier
Massive Outflow in G5.89

227 GHz continuum and resolved molecular line emission

All lines integrated over full velocity range except SiO(5-4), where blue contours show –25-5 km s\(^{-1}\) and red contours show 15-45 km s\(^{-1}\)

Sollins et al 2004

8.4 GHz free-free emission image:
Wood & Churchwell (1989)
Hot Core in IRAS 16293-2422

Class 0 young stellar object

Panel 1 shows continuum (also shown in grayscale)

SMA images reveal chemical differentiation between the two hot cores

Kuan et al 2004
Solar System: Mars at 230 GHz

First 8 element image obtained, Nov. 2003

Resolved continuum plus emission and absorption show strong diurnal temperature contrast

8 minutes on source

Gurwell 2004

May 20, 2004 Exploring the Cosmic Frontier
Comet Observations: May 2004

Daytime observations: weather sufficiently good for 235 GHz until 13:00 HST

Qi et al 2004
That’s fine, but when can I use it?

First open call for proposals expected
August/September 2004

Observing info:
http://sma1.sma.hawaii.edu

Results shown (and others) can be found at: