SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

Raymond Blundell

SMA Advisory Committee Meeting

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SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

- Decadal survey affirms mm/submm as a key component of US astronomy research
  - Cosmic Dawn, New Worlds, Physics of the Universe
- Decadal survey has 2/24 figures with SMA data
  - Image of SMG, spectrum of massive star forming region
- Recommendations include
  - CCAT and investments to develop technology
- Emphasis on balancing the program
  - Large and medium/small activities
  - Existing and new facilities

SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

- Cannot compete directly with ALMA
  - 50 x 12 m antennas in main array
  - 12 x 7 m in compact array
  - Baselines out to 20 km
- But ALMA will eventually have ten bands
  - Initially six bands from 84 to 720 GHz
- SMA will concentrate on two of these
  - Current observations 50/50 split between 230 and 345 GHz
  - 650 GHz band little used
  - Also, ALMA site much better than Mauna Kea at 650 GHz

SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

- What about IRAM and CARMA ?
  - Both have much more collecting area
  - But mainly operate at 3 mm, 2 mm, and 1.3 mm
  - SMA has clear advantage at 0.8 mm
  - For continuum SMA is currently competitive at 1.3 mm
- IRAM and CARMA both have planned upgrades
  - At IRAM, predominantly based on 6 more antennas
  - At CARMA, predominantly based on more bandwidth and possibly focal plane arrays downstream
- SMA short term plans based on more bandwidth
  - Will continue to have clear advantage at 0.8 mm
  - Will remain competitive at 1.3 mm

SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

Following recommendations of Fazio Committee

- Develop and deploy the most sensitive dual polarization receivers in all frequency bands
- Concentrate initially on 345 GHz, then 230 GHz
- Increase the bandwidth of these receivers as technology develops
- Envision a two-step process
  1) Increase bandwidth from 4 GHz per sideband to 18 GHz
     (Total BW would be: 18x2x2 = 72 GHz)
     This would be a 9-fold increase over current capability
  2) Eventually extend to 30 GHz bandwidth for a 15-fold increase over current performance: 120/8

SMA POTENTIAL IN THE ALMA ERA
LONGER TERM CONSIDERATIONS

Possible additional upgrades include

- Initiate a program to design and install a 3 x 3 focal-plane array at each antenna
- Add two additional antennas
- Establish a closer collaboration with CARMA/ALMA/PdBI particularly in the development of wide-band correlators and possibly 230 GHz receivers

Of the above

- No interferometer currently has array receivers (difficult & expensive)
- Two more antennas too few to make a real improvement
- Collaborations with other groups in progress

Upgrade the SMA bandwidth to 18 x 2 x 2 = 72 GHz
This will enable the SMA to continue forefront scientific research for the foreseeable future
Could be completed in three to four years

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- Technical challenges
  - Receivers – nothing major
    - Current 345 GHz mixer has > 14 GHz BW
    - Receiver in lab has 3-14 GHz IF with good performance
    - Need wider-band IF amplifiers, but could split the band
  - Signal transmission system
    - Tx-Rx pair from Emcore for 18 GHz BW under test in lab
    - Optilab 25 GHz BW system under evaluation at Keck
  - Correlator – more of a challenge, but can be done

SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

- The real challenges (I)
  - Staffing
    - Receiver lab understaffed as is the SMA in general
    - 2007 Advisory Committee – staffing level is limiting progress
    - Identified three immediate key hires
      - SMA site Director (Ant Schinckel replacement)
      - Receiver Engineer (Todd Hunter replacement)
      - Instrumentalist/Observer
    - Also endorsed hiring a senior scientist
    - To date we have hired none of the above
      - Lost Mike Smith (Mech. Eng.), Roger Plante (Mech. Tech.) Abby Hedden (Postdoc in the Lab)
      - Also, Bob Wilson reduced hours – now half time at SAO
      - On a positive note, hired a second-shift observer in Cambridge

SMA POTENTIAL IN THE ALMA ERA – CURRENT PLANS

- The real challenges (II)
  - Money – how much and where will it come from ?
  - Projected cost of upgrade to 18 GHz BW ~ $5M
  - ASIAA fully committed to upgrades as presented
    - Possible larger contribution from ASIAA ?
  - SAO
    - Reprogramming of lapsed salary funds ?
    - Additional MSI request ?
    - Internal Research and Development Funds ?
    - NSF MRI proposal with matching funds ?
    - Another partner ?