# CELT Science Working Group Report

*September 12, 2000*

## Membership


- Mike Bolte - UCSC
- Mike Brown - Caltech
- Judy Cohen - Caltech
- Richard Ellis - Caltech
- Andrea Ghez - UCLA (Co-Chair)
- Mike Jura - UCLA
- Chuck Steidel - Caltech (Co-Chair)

# Science Working Group Activities

*Four meetings*

- Kick Off Meeting, 1999 December 17 at Caltech
  - Introduce objectives
  - Look at decadal report as starting point for science motivations
  - Begin to identify what telescope issues will have science trade-offs

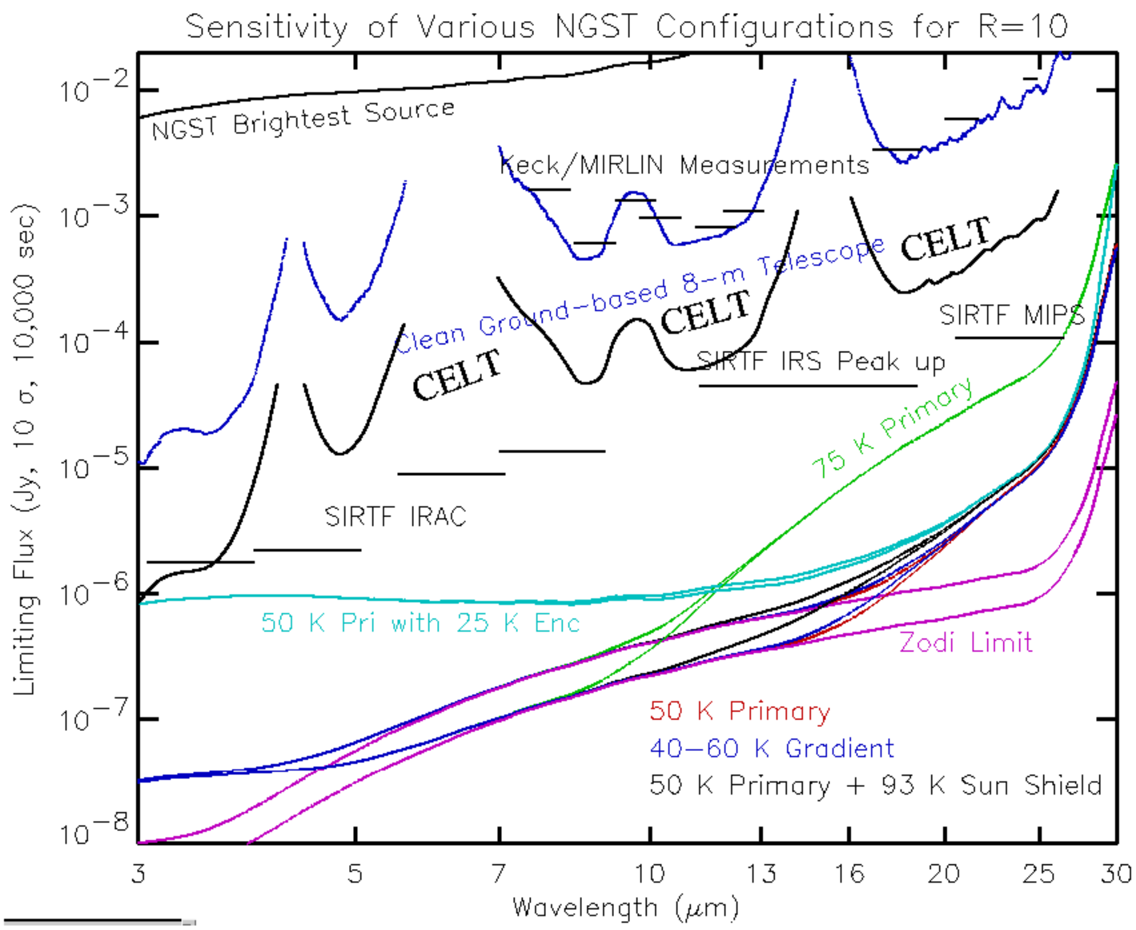
- Telescope & AO Design Issues Meeting, 2000 January 27 at Caltech
  - Reports of Homework Assignments
    - HET-style telescope trade-offs (Mike Bolte)
    - Arecibo vs. VLA usage (Mike Jura)
    - Interferometry trade-offs (Andrea Ghez)
    - Summary of Last IWG (Richard Ellis)
  - Guests Presentations
    - Rick Dekany on AO
    - Jerry Nelson on Telescope Design
      - OK if there were no Cass focus for CELT?
      - Is a silvered tertiary mirror OK?
      - Do we need more than one secondary?
      - Is a prime focus desired?
      - What field of view is required for seeing limited applications? For AO-corrected applications?
      - What should the horizon limit be?
      - Should the secondary be over-sized?
      - What should the final f/ratio be?

- Science Case, 2000 March 27 & May 9
  - Mid-IR Important
    * Although limited sensitivity, unrivaled resolution!
    * Adaptive Secondary vs. NIR optimized AO system (emissivity and complexity)
    * Science
      - Solar System - not strong enough to influence telescope design
      - Extra Solar Planets - possibility of detection ozone in earth-like planets in nearby star forming regions
      - Protoplanetary Disks : imaging to see gaps and spectroscopy to measure mass of central star
      - Regions of Obscured Star Formation ("super star cluster" or forming globular clusters in nearby galaxies)
      - AGN Accretion Disks (NIR vs. MIR)

– Wide Field Seeing Limited Important

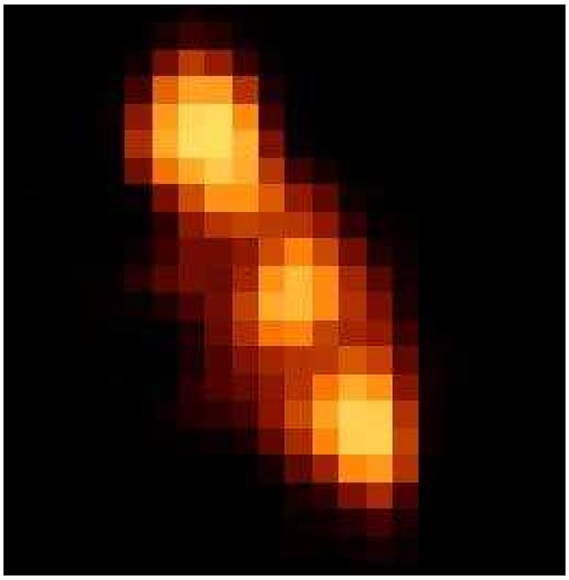
- Figure of Merit (Area x Solid Angle)
  - Keck - 5 units
  - AAT - 16 units (with 2DF)
  - Subaru - 14 units
  - Magellen - 15 units
  - CELT - 79 units
- Science
  - low mass stars (e.g., BD's) in open clusters – as many as 100/deg$^2$ to H=21-22
  - stars in the halo of M31 (I 24): chemistry, kinematics
  - intracluster planetary nebulae (m=25– distances, kinematics, etc.) in nearby clusters of galaxies
  - extragalactic globular clusters (the systems of nearby galaxies out to ?? distances)
  - QSO absorption lines: R=30,000 spectra to m=22, where surface density of QSOs is up to several hundred per square degree (tens per CELT field of view). Mapping diffuse baryons, dark matter using the Lyman alpha forest, relation to galaxy structure
  - cool white dwarfs (spectroscopy) in the Galaxy
  - desire to work in blue/near UV at R 30,0000

- NIR AO very high priority
  - 2' field
  - usage of narrow field vs. wide field (50-50% split?)
  - Science (not yet a specific homework assignment)
    - Evolution of central black hole/galaxy formation
    - General Relativity in our own Galaxy
- No strong case for prime-focus focal station
- Need for R>100,000 narrowly focused

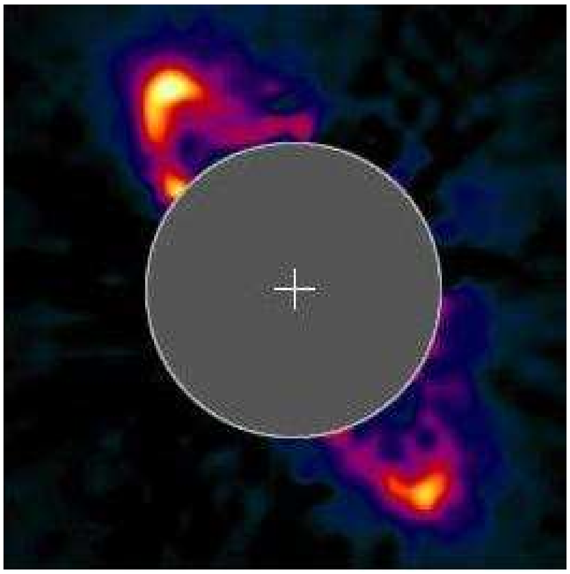


Sensitivity of Various NGST Configurations for R=10
NGST Brightest Source
Keck/MIRLIN Measurements
Clean Ground-based 8-m Telescope
CELT
CELT
CELT
SIRTF MIPS
SIRTF IRS Peak up
75 K Primary
SIRTF IRAC
50 K Pri with 25 K Enc
Zodi Limit
50 K Primary
40–60 K Gradient
50 K Primary + 93 K Sun Shield
Limiting Flux (Jy, 10 σ, 10,000 sec)
Wavelength (μm)

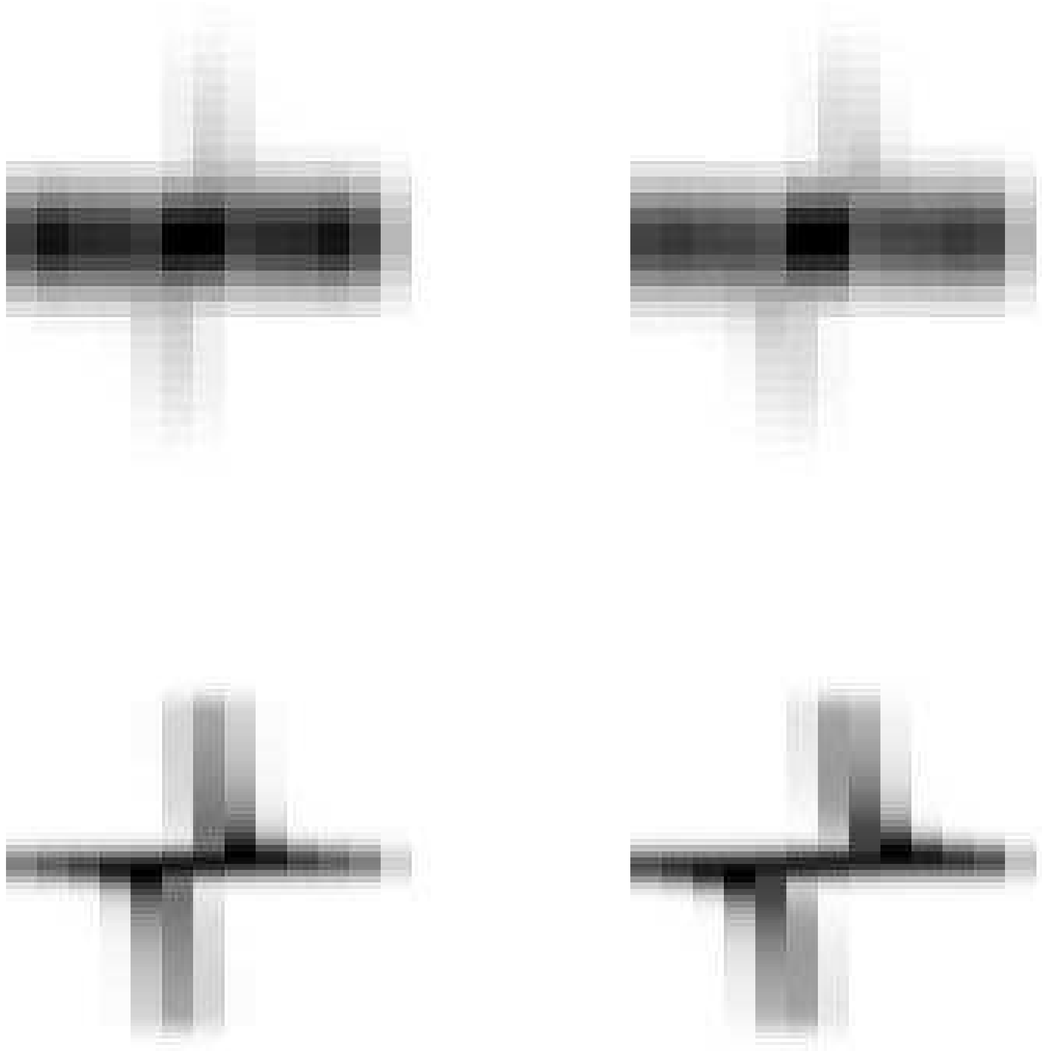
# HR 4796 - Nearby Debris Disk



Keck
(20 $\mu m$)



NICMOS
(1 $\mu m$)



Simulation of $H_2$ emission (17 $\mu m$) from a disk
Extent 100 AU with 12 AU per pixel
Velocity Resolution = 1.5 km/sec per pixel
Top = Keck; Bottom = CELT

Left = 0.5 $M_\odot$; Right = 0.8 $M_\odot$

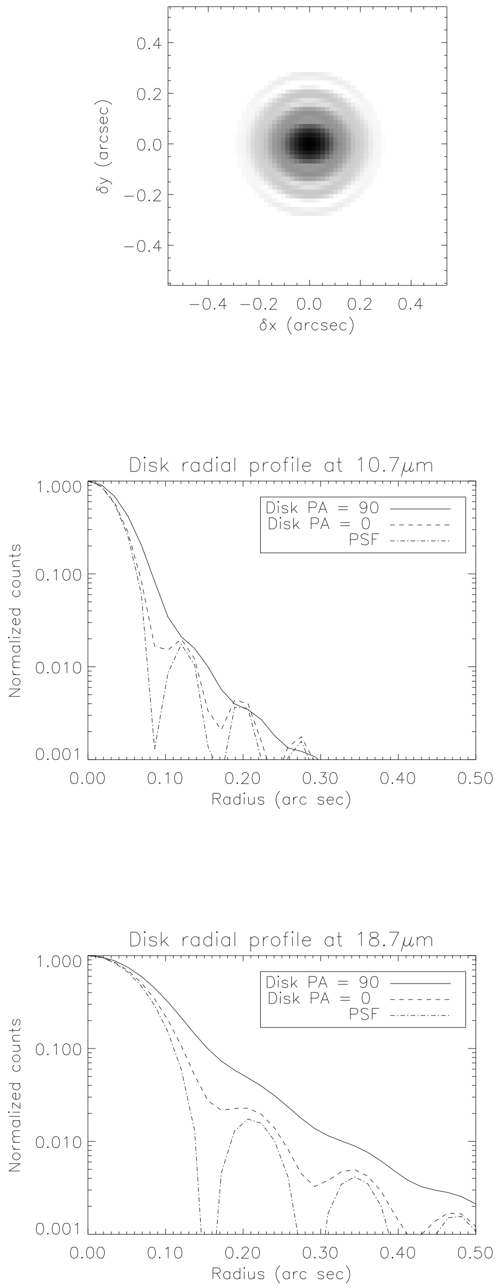



Fig. 3.— Model of T Tauri Star Disk Detection w/CELT

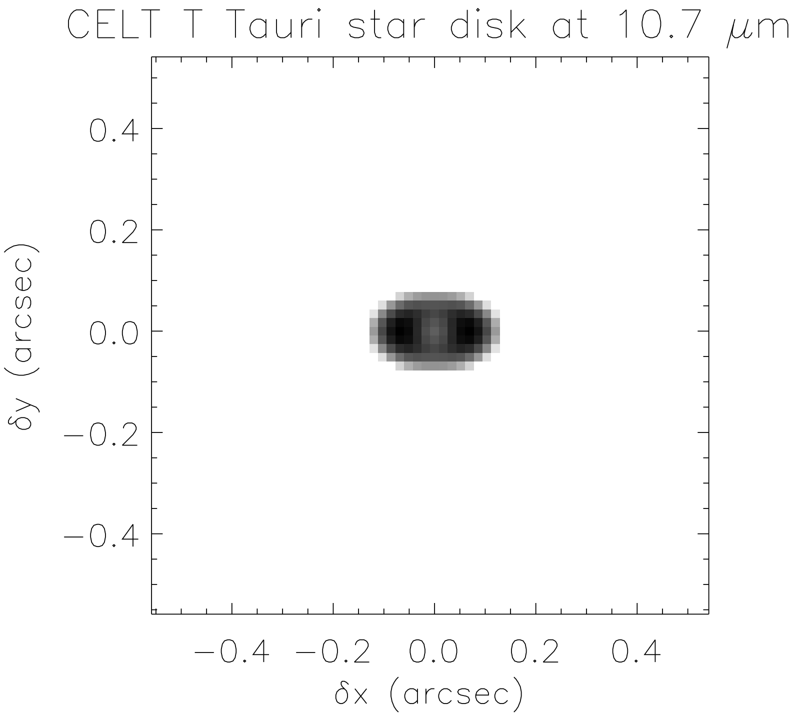



Fig. 4.— Same as previous, expect hole is now 10 AU and inclination is 60 degrees

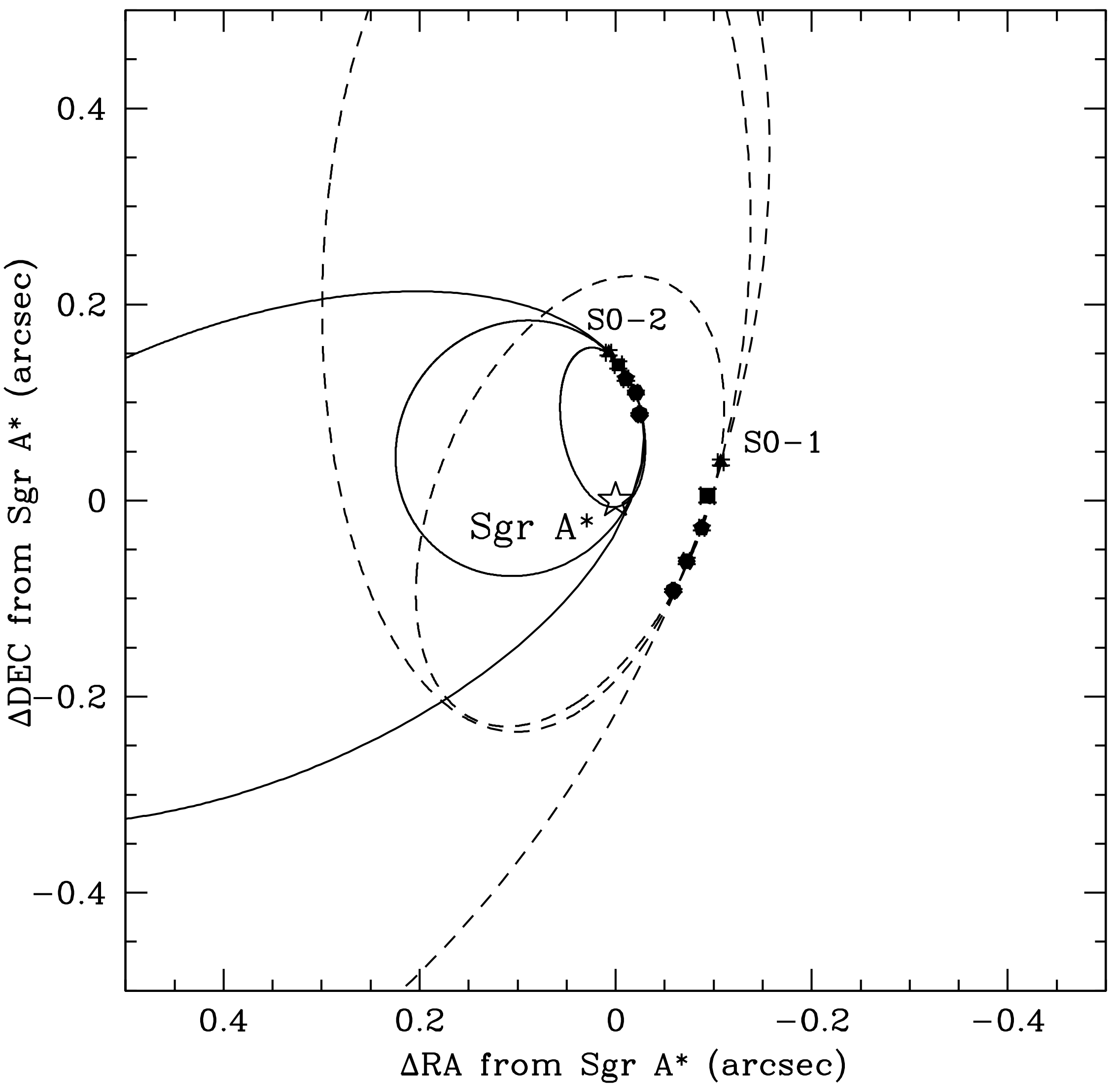



Fig. 1.— A $1'' \times 1''$ region, centered on the nominal position of Sgr A*, showing the motion of S0-1 & S0-2 and possible orbital solutions. Only the measurements obtained in ∼June of each of the 5 years are shown and both stars appear to be moving clockwise about Sgr A*. In the orbital analysis, two constraints are applied, a central mass of $2.6 \times 10^6 M_\odot$ and a true focus located at the position of Sgr A*. Displayed are orbital solutions ith periods of 17, 80, 505 years for S0-2 and 63, 200, 966 years for S0-1. With CELT, sensitive to orbital periods 5 times shorter - precession of the closest approach distance.