Task Allocation Overview (Campus)

1.1 SIS Junctions (*Attila, Jacob, Rick LeDuc, Bruce Bumble*)
Mask set finished (R. LeDuc). Bruce busy with Jc/SiO cal at JPL/MDL
Junctions are expected Aug/Sept 2003

1.2 Mixer Blocks (*Jacob*)
HFSS/RF designs finished.
Physical layout nearly complete.
Integrate junction/probe with split-block hybrid? Decision shall have to wait until we get hybrid test structures back from Custom Microwave Inc (CMI). Pending results a 230 GHz and 350 GHz mixer block order shall be placed with CMI in mid Summer 2003.
(Alternative to CMI is the JPL machineshop. Long lead time and expensive.)

1.3 Quadrature Hybrids (*Jacob*)
RF design complete on all units (350, 450 650 GHz bands).
Physical layout complete.
May 19-22: Visit CMI and discuss/order test devices from CMI (see 1.2). Verify software 3D export and discuss pricing/delivery of hardware incl Optics/Grids.

1.4 4-8 GHz IF/Bias (*Jacob*)
IF design 80% complete, based in a large part on work done for HIFI band 3, 4.
Supermix required IF impedance is 20 Ohm real (Attila). May however need to be updated pending fabrication and FTS measured results (see 1.10).
Bias will be 6 wire with enhanced EMI/RFI suppression.

1.5 4-8 GHz Total Power Box (*Jacob, Jeff, Dave*)
Ten fully tested and integrated units have been purchased (2002) from CTT Inc.
Nominal Output power is -10 dBm with +/- 0.50 dB passband ripple. The gain is variable by as much as 60dB (pin diode), and the IRL is ~ -20db (Unit has a build in isolator at the input). Units require thermally stable housing. Final assembly of the TP boxes is dependent the electronics interface (See 1.13). The same units are are purchased for the KASIMIR instrument on Sofia.

1.6 Pamtech 4-8 GHz Isolator (*Jacob*)
In house Qty: 2. Ordered 1 extra. Expected delivery date: June 2003.
1.7 **Post LNA MMIC Amplifiers.** *(Niklas Wadefalk/JPL)*
Qty: 10 are on order. Assembly is promised summer 2003. Budgeted thru JPL. Units shall be required winter 2003. Niklas will implement a +4dB gain slope to help overcome frequency dependent dewar loss.

1.8 **Chalmer LNA’s** *(Completed Qty: 13 of the very low noise 2K batch!)*
Qty Needed: 12 (includes one spare for lab)

1.9 **Optics** *(Jacob, SRON/NL)*
Prelim design complete, but will need near-field checkout (SRON) No physical (Mechanical desktop) layout.

1.10 **IR Labs Test Dewar “Barney”** *(Jeff)*

1.11 **RF Testing** *(Jacob, Colin, Attila, Tim)*
To properly characterize the new mixers, one of the first measurements needed is a good quality FTS and pumped/unpumped I/V data set. From it all the SIS junction/mixer block properties can be determined (Supermix-Attila). “Barney” will be the primary test dewar for this purpose. Tests will be done at 230 and 350 GHz on the single pixel mixer blocks ordered from CMI during summer 2003. Data acquisition needs to be setup (Colin)

1.12 **Windows, IR Blocks.** *(Jacob, Jeff)*
Pressure window: Broad bandwidth AR-coated Quartz or HDPE (polyethelene) design. Both have 5% reflection loss. IR blocks will be stacked sheets of Zitex. IR blocks will need hold-time testing (“Barney” and/or CSO cryostat Fall 2003).

1.13 **Electronics** *(Steve Kaye, John Mac, Jeff Groseth, Tim Elling)*
Good progress. Prototype system for SOFIA expected Oct 2003. Summer 2003 will be devoted to testing SIS/Preamp card and digital interfaces. Eventual GUI unclear. IRC or some custom Java/C program. Software will need help Winter 2003/2004 *(Tim, Hiro, Colin, Attila).*
Task Allocation Overview (CSO)

1.14 Precision-Cryo “Blue” Dewar Rewiring CSO (Pat Nelson, Allan Guyer)
Under construction at CSO. Completion date: Sept 2003.
Needs complete rewiring job including a RF checkout of the IF semi-flex coaxial lines (4). Will need a new vacuum gauge (with RS232/482 interface)
Wiring diagrams have been submitted and discussed 5/2003.

1.15 Koln Hybrid AOS Integration (Hiro/Martin/Richard)
Tested at the CSO Hilo Lab.
Needs to be integrated/tested at the observatory (Aug/Sept. 2003).

1.16 CSO IF interface (Melanie, Richard)
Design needs to process the two IF channels from each of the sidecab dewars (two x 4-8 GHz), the 850 GHz receiver, and possibly the Correlation Rx.

1.17 IF Switch Matrix (Richard)
As it is impractical to try to connect/disconnect the 4-8 GHz IF signals, a Switch matrix maybe called for. Needs discussion.

1.18 SMA PLL (Melanie, Todd Hunter)
The CSO has 5 SMA PLL modules. The harmonic multiplier LO needs to be outside the 4-8 GHz band. The PLL pass-band filter cuts out at 9 GHz, which may be a problem. It should be possible however to slightly modify the units band-pass filter response to operate up to 10 GHz.

1.19 SMA Interferometry (Richard)
How is the IF send to the SMA? Does this have an impact on the IF down converter design?

1.20 IF Cabling CSO (Richard, CSO Staff)
IF cable length must be minimized (4-8 GHz IF). There shall be:
- 4 IF cables from the Sidecab
- 4 IF cables from the Galaxy Rx
- 1-2 IF cables from the 850 GHz dewar (Shared with the Galaxy Rx?).
The nominal receiver IF output power is –10 dB. Gain slope will be a few dB due to dewar cable loss. Please note that I am trying to have the post-LNA design (Niklas Wadefalk) to incorporate a positive gain to counter this effect (see 1.7).

1.21 HP8510 Cal Kit (Richard)
Assuming that the HP8510 is operational, the NA shall need a proper cal Kit. It is pretty useless without it. There should also be a dedicated PC to Read/store data via the GPIB port (the only possible method of doing so).
1.22 **WASP (2)** *(Andrew Harris, Chip, Martin?)*
On Order. Will have 4-8 GHz interface build in, e.g. no IF needed!
Chip is responsible of interfacing Frank Rice’s wide IF bandwidth receiver to
Three WASP’s. He will be visiting Andy’s lab, and will be familiar with WASP
technical details/operation.

2.1 **Summary Critical Technical Design Details (Campus)**

- Test Cryostat should completed by September 2003. *(Jeff, Jacob)*
- Prototype bias electronics (SIS/preamp, Total Power, Magnet) should be finished by
  October 2003. Initially these shall be needed for SIS junction and FTS
  measurements on campus. *(Jeff, Steve, Johnny, Tim, Dave)*
- FTS/DC/RF tests should be done on both the single 230 GHz and 350 GHz mixers in the
  fall 2003. *(Jacob, Colin, Attila, Tim)*
  Once results are understood final mixer hardware purchase can commence. Assembly of
  the balanced mixers and correlation receiver is planned to be done in the Hilo Lab.
- General Purpose data acquisition data station needs to be setup by Oct. 2003 *(Colin)*.

2.2 **Summary Critical Technical Design Details (CSO)**

- Construction of 4-8 GHz IF Down Converter to handle two 4-8 GHz IF bands.
  *(Richard, Melanie)*
- SMA PLL (at least 2) should be prepared & tested for integration into the telescope
  system by Sept/Oct 2003 *(Melanie)*
- Precision Cryostat should be fully rewired & cold tested by Sept 2003 *(Pat)*
- May need Hiro’s help on campus to write Receiver interface software.
- IF Cabling *(Richard, CSO Staff)*
- Some thought should be given to how the UIP may need to be setup to allow for dual
  Frequency mode operation *(Hiro)*.
3. Planning and Time Schedule

<table>
<thead>
<tr>
<th>CSO Upgrade Major Milestone Dates</th>
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<tbody>
<tr>
<td>11/01/02</td>
</tr>
<tr>
<td>SIS Junctions Design (Attila, Jacob) Complete</td>
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<tr>
<td>Hybrid/mixer Test Hardware to CMI (Jacob)</td>
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<tr>
<td>Test Cryostat build and Tested (Jeff)</td>
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<tr>
<td>SIS Junctions Fabricated (Rick, Bruce)</td>
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<tr>
<td>CSO Cryostat #4, finished (CSO Staff)</td>
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<tr>
<td>Bias Electronics (Steve, J.Mac, Jeff, Dave M.)</td>
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<tr>
<td>FTS/ Supermix Preparied (Colin/Attila)</td>
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<tr>
<td>230/350 Single Mixer RF tests (Jacob, Colin, Jeff)</td>
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<tr>
<td>Order mirrors for 350/650 FPU (Jacob)</td>
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<tr>
<td>Windows/IR Blocks/Grids Ordered (Jacob)</td>
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<tr>
<td>Koln AOS, IF Cabling, SMA-PLL for 2 Rx (CSO Staff)</td>
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<tr>
<td>Receiver GUI, Version 1 (Tim/Hiro/Colin)</td>
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<tr>
<td>WASP, Qty: 2. (A. Harris, Chip)</td>
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</tbody>
</table>

4. Risk Assessment

The primary risk factors are:

1) Junction Fabrication/Delivery/Quality
2) Component Delivery from Custom Microwave
3) Computerized Bias electronics with adequate software.
4) CSO IF (Down converter, New IF cables, AOS software ...)

None of the required items are technically impossible, it may require a considerably longer delivery time than proposed however. It is unlikely that there is adequate man power (both at CIT and the CSO) to finish all the required tasks by December 2003.

5. References

1. Ansoft’s incorporated.
2. Pamtek, 4053 CalleTesoro, Camarillo, Ca 93012.
3. Lamb J. SSB vs. DSB for Submillimeter Receivers, ALMA memo 301.
6. Kooi, Optics memo’s
6. Technical Details & Task Allocation

6.1 SIS Junctions (Fall 2003) (Jacob, Attila, Colin, Chip)
6.1.1 Design of SIS Junctions Complete
6.1.2 Measurement & Analyses SIS Junction performance

6.2 Mixer Hardware (May 2003) Jacob
6.2.1 Corrugated Feedhorn Design (complete)
6.2.2 Magnet (complete)
6.2.3 Mixer Body (80% complete)
6.2.4 Hybrid (complete)

6.3 Optics (Fall, Winter 2003) Jacob
6.3.1 Order 300K Pressure window
6.3.2 IR Block, 77k & 15K Stage (Ar-Qz vs Zitex)
6.3.3 Frequency Independent (Dewar) Sidecab Optics (Jacob)
   45% Bandwidth (Needs Ordering IR labs)
6.3.4 Frequency Independent (Dewar) Relay Optics (Jacob/SRON)
6.3.5 Grids (Jacob/SRON)
6.3.6 Beam-splitter (Jacob)
6.3.7 LO Dump (Jacob)
6.3.8 Cold Optics Mirror design (Jacob)

6.4 Cryostats (Summer 2003) Jeff/Jacob/CSO-Staff
6.4.1 Test Dewar (Jeff/Jacob)
   IR Labs LHe dewar, Hold time up to 8 hours, Fast Cycle time
   One Window only, limits tests. Wiring identical to CSO dewars.

6.4.2 Precision-Cryo Dewar (CSO Staff/Jacob)
   Rewire with new Connectors (Generic design)
   Twisted pair wiring (minimize microphonics)
   Replace Solid 12K Cu Connection with Flex Straps.
   Leak test.
   Rebuild Cold Head Pressure Gauge
   Maximize Hold time. May require checking of IR Blocks.

6.5 Bias Electronics Hardware (Prototype complete by Oct 2003)
6.5.1 Digital Electronics Hardware (9/1/2003) Steve Kaye, John Mac.
6.5.2 Analog Electronics (9/1/2003) Jeff, Dave Miller, Jacob, Mick
   6.5.2.1 Fiber Optic or Twisted pair with Opto-isolator Interface
   6.5.2.2 SIS Bias Electronics
   6.5.2.3 Total Power Control
   6.5.2.4 LNA Bias Control
6.5.2.5 MMIC Bias
6.5.2.6 Magnet Bias
6.5.3.0 DC Power for above mentioned modules (CSO or Jeff??)

6.6 Software
6.6.1 AOS integration to CSO (Hiro)
6.6.2 Low level control software (Steve Kaye)
6.6.3 User Interface Software (Tim/Attila/Hiro)
IRC from Goddard, Telescope interface

6.7 Mixer FTS measurement/Analyses/Improvement (Fall 2003)
6.7.1 General Purpose Data acquisition software setup and tested.
6.7.2 Attila should prepare for FTS/RF supermix analyses.

6.8 Receiver IF design (Fall. 2003) Jacob
6.8.1 Specified optimal IF match is 20 Ohm, but may change pending FTS measurement results (Attila). Hence IF boards will be ordered last.
6.8.2 IF Matching network (Jacob, see 2.8.1)
6.8.3 SIS Bias/EMI board (Jacob/Jeff)
6.8.4 Cryogenic Isolators, order 3rd (Jacob)
6.8.5 Total Power Integration (Jeff, Dave Miller, Jacob)
6.8.6 Chalmers 4-8 GHz IF amplifier (complete)
6.8.7 Cooled MMIC (Nilkas Wadefalk, Qty: 10)

6.9 Wideband Analog Spectrometer (WASP) Early 2004, A. Harris
6.9.1 Two WASP’s are acquired and will need to be integrated into the CSO backend system by 2004.

6.10 CSO IF (Aug 2003) Richard/CSO Staff
6.10.1 Integrate AOS (4 channels) to CSO
6.10.2 Order new IF Cables (spec to 10 GHz) and reroute
6.10.3 Repair/exchange HP8510, needs Cal-kit.
6.10.4 Frequency down converter to AOS (4)
6.10.5 SMA PLL integration to CSO (5 units total).
Will need two working units initially.

6.11 Local Oscillators (Jacob 2004)
6.11.1 Reconfiguration for dual frequency mode observations.
6.11.2 Possible Upgrade of Carsltrom Gunn Oscillators with micro stepper motors (commercially available).