NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

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MEMORANDUM:

TO: M. Balister, D. Hogg, P. Jewell, J. Lamb, H. Liszt, S-K. Pan, J. Payne, P. Siegel, B. Turner, S. Weinreb

FROM: A. R. Kerr

A.R.K.

SUBJECT: Notes on Millimeter Receiver Work for Tucson

On 18 March the Ivy Road millimeter group met with John Payne to discuss present receiver problems and to decide priorities for the work we are doing for Tucson. The following notes summarize the discussion and also my subsequent discussions with Peter and Pan.

3mm Mixer:

This has been top priority for six months. When it was sent to us for repair, the diode was covered with an unrecognizable substance. After attempting to remove this with organic solvents, alkaline detergents, and O_2-plasma etching, we found that dilute acid would dissolve it slowly. Alas, it dissolved the solder holding the chip faster, and we lost the chip. No more diodes of the same type are available. Using other diodes we have not been able to approach the old performance ($T_M \simeq$ 100K SSB). It was decided, as the mixer will now be used as a backup, that a value of $T_M \leq$ 250K would be acceptable. Peter now has it operating with T_M = 220K at 115 GHz.

We have three more mixer blocks, and will use them to evaluate the new "stress-relieved" diodes being made by Greg Sherrill in Mattauch's lab, as time permits.

285-310 GHz Receiver:

There is strong demand for a receiver in this band for next observing session. Present indications are that the existing mixers for 200-270 GHz and 340 GHz will not operate well in the 285-310 GHz range. It is not clear whether the quasi-optical triplers (nominally 200-280 GHz and 260-350 GHz) can be made to operate over 285-310 GHz. Peter will look into this as soon as the receiver components are returned from Tucson -see next item.

345 GHz Tripler:

While the published results for this tripler show it giving useful power from 260-350 GHz, it has not been possible to get sufficient power to drive the Schottky receivers except (barely) at ~ 345 GHz. A large amount of second harmonic seems to be present, even with Peter's improved dichroic plate, and we are wondering whether this may not have been included in John Archer's earlier measurements. Peter will investigate this.

270-290 GHz Mixers:

One of these, optimized by Marek Faber, has T_M = 900K SSB. We have not been able to get better than ~ 1500K for the other. This looks like a situation where the SEM could be used to advantage to look for mechanical differences between the two mixers.

130-170 GHz Mixer:

We will continue to defer this until there is time to work on it.

225 GHz Site Testing Receivers (3):

Liu is building a prototype. Mixer and tripler blocks, feed horns, LO diplexers, and waveguide adapter sections are complete. Neil should mount diodes in, and whisker, the mixers and multipliers as time permits, and assemble the bias-T's.

115 GHz SIS Receiver (not discussed at March 18 meeting)

I discussed the SIS receiver situation with Pan after his week in Tucson. He and James have the receiver operating with T_R = 141K and 154K SSB in the two channels. This includes ~ 30° from the beam splitter and lens. We believe the better of these mixers would give $T_R \simeq$ 90K on the Columbia/GISS telescope . The losses of the vacuum window, feed horn and LO coupler need to be checked, and also the IF cables and isolator. The IF amplifier noise temperatures should be measured. Apparently there is a marked difference between the two channels, not attributable to the mixers.

The bias supply needs modifying to eliminate the lethal (to an SIS junction) transient when the junction protection switch is thrown. Low-pass (100 kHz) feed-through filters should be inserted in all bias lines. John felt the unused dewar port could be used if there was not room for the filters among the existing vacuum feed-throughs.

Charlottesville priorities for Tucson equipment:

Peter:

1. Investigate the operation of the 345 GHz quasi-optical tripler and try to reproduce Archer's results.

2. Make mixers and triplers for 285-310 GHz.

3. Continue trying to optimize 270-290 GHz mixer.

4. Evaluate stress-relieved diodes at 3 mm in the hope of eventually achieving $T_M \simeq$ 100K again.

Pan:

1. Evaluate new Hypres junctions.

2. Make two more spare mixers for the receiver.

3. Test IBM inductively shunted junctions when they arrive.