

National Radio Astronomy Observatory
Tucson, Arizona

January 26, 1987

MEMORANDUM

TO: D. Emerson

FROM: John Payne JP

SUBJECT: Bolometer

Jesse Davis has done some measurements on the bolometer. The new element gives about the same sensitivity in the laboratory as the old element and Jesse calculates the sensitivity on the telescope (ignoring atmospheric effects) of "a bit better than 2 Jy in one second". Our existing mixer receiver at 230 GHz has a noise temperature of better than 300K DSB (I have actually measured 230K on occasion) and a bandwidth of 600 MHz. Ignoring the effects of both the subreflector switching and the atmosphere the mixer receiver theoretical sensitivity is

$$\Delta T = \frac{2 \times 300}{\sqrt{6 \times 10^8}} = 25 \text{ m K}$$

and at $\eta_A = 23\%$ the sensitivity per channel is

$$\frac{0.025 \times 25}{0.23} = 2.7 \text{ Jy/sec.}$$

Two channels will give a reduction in $\sqrt{2}$ giving 2 Jy/sec. Atmospheric effects, and subreflector switching will reduce this sensitivity in practice. A direct comparison between bolometer sensitivity and mixer receivers is not simple due to the different nature of the instruments. Different subreflector illumination and grossly different bandwidths are two major differences that favor one instrument over another for different applications.

I believe that NRAO should discontinue work on the bolometer for the following reasons, several of which have been already mentioned by Mark Gordon.

- 1) We do not have the manpower to exploit and develop bolometer technology at NRAO.
- 2) All indications are that the existing best He₃ bolometers give performance that is not greatly superior to existing mixer technology. Our mixer receiver on the 30 meter telescope would give 0.3 Jy/sec and the reported sensitivity of the Krauser bolometer is 0.15 Jy/sec.
- 3) The mixer receiver is simpler to use, needs less maintenance and gives results that are easier to understand and interpret than the broad band bolometer.
- 4) Improvements in our mixer receiver for continuum use are simple and straightforward and simply require a commitment from NRAO to implement. Some ways in which a dedicated continuum 230 GHz mixer receiver could be made more sensitive than our existing receiver are listed below.
 - 1) Built in fast beam switcher.
 - 2) Broad band HEMPT I.F. amplifiers.
 - 3) Mixer optimized for one frequency.
 - 4) Cooled polarization splitter.
 - 5) Switchable optics -- point source or mapping.

I think it would be more profitable for NRAO to invest any spare manpower in (4) rather than expend further effort on the bolometer.

JMP/mt

c: Phil Jewell ✓
A. R. Kerr
M. Balister