GBT Memo No. 9

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

August 24, 1989

MEMORANDUM:

TO: Addressee

FROM: J. Payne

SUBJECT: 100-m Structure

During the late 1960's and the early 1970's, NRAO invested tens of man-years in developing the concept of homology. This concept was applied to two telescope designs, the 65-m and the 25-m, which, although never built, were fully analyzed using conventional engineering methods. The computing limitations which were troublesome during the design of the 65-m and 25-m have been removed by passage of time; in fact, one would imagine that the new generation of computers would enable more complete solutions than were previously possible.

The purpose of applying homology is, of course, to "beat" the gravitational limit, and most telescope designs do this to some extent anyway. It's interesting to see how well various telescopes do in this respect.

TELESCOPE	DIAMETER	DESIGN METHOD	IMPROVEMENT OVER GRAVITATIONAL LIMIT
Effelsberg	100 m	Trial and error	4
Pico Veleta	30 m	Iterative homology	8
Nobeyama	45 m	Iterative homology	8
NRAO	65 m	Iterative homology	11
Proposed Telescope	100 m	?	4

If NRAO could do as well with the proposed design as it did with the 65-m design, the 100-m telescope would work at 66 GHz with an uncorrected primary.

I would have thought that a sensible way to proceed with the design of the 100-m would be to build on NRAO's previous work and produce a design for a fully homologous telescope. At least then we would be in a position to compare the very best telescope, designed with the most modern tools, with the telescope outlined in the proposal. It seems wrong to build a scaled version of the VLBA antenna and equip it with actuators to remove gravitational

deflections that we know can be largely removed by a design that is "more homologous." It also seems ill-advised to be proposing a telescope that relies on hundreds of actuators whirring around every time the instrument is moved in elevation - especially when we don't have to.

Lee estimates that a fully homologous telescope of 100-m in diameter that will work up to 60 GHz could be built for 25% more than the actuator equipped telescope described in the proposal. It seems far more sensible to build a 60 GHz telescope and tweak it to work at 100 GHz, rather than build the 20 GHz telescope described in the proposal and attempt to tweak it to 100 GHz. Lee sees no fundamental problem in the application of homology to the clear aperture case.

I think an ideal solution would be to design a primary reflector that is good to 50 GHz without any active correction. The thermal limit is 60 GHz (GBT Memo No. 6) and the atmosphere precludes operation from 50-70 GHz. Above 70 GHz active correction would be applied, probably to a tertiary reflector, based on measurements made to the primary reflector by some means.

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