



NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, West Virginia

MEMORANDUM

DATE: 9 November 2000
TO: Distribution
FROM: Phil Jewell *PJ*
SUBJECT: Beam Forming Array Technical Working Group

As you know, Rick Fisher and Rich Bradley have for several years been working on a beam-forming focal plane array receiver concept. In this concept, numerous planar feeds are used to over-illuminate the primary reflector, and the output of each feed / amplifier module is cross-correlated to synthesize beams on the sky. The scheme is very attractive since it allows the beams to be formed at Nyquist sampling intervals, it can give higher aperture efficiencies per beam than conventional feed-horn systems, and can correct for first-order optical aberrations such as coma and astigmatism. A successful, room-temperature prototype was constructed and demonstrated on the 140 Foot Telescope. The instrument is technically challenging, however, and there is considerable development work remaining to produce a production system.

Focal plane array systems such as this should be an important instrument initiative for the GBT. Progress on the development of beam-forming arrays has been rather slow to date owing to a lack of both available staff and funding. Nevertheless, we have reasonable prospects in 2001 to obtain the resources necessary to begin concerted work on this project.

The time is appropriate for, and the project would benefit from a scientific and technical review leading to a written proposal and project plan. I would like to ask if you would be willing to serve on a technical working group that would be charged with reviewing the technical issues and options, the objectives of the program, and the development of a plan to achieve them. The proposed technical working group (TWG) includes

Rick Fisher, co-chair
Rich Bradley, co-chair
John Ford
Rich Lacasse
Phil Jewell
Mark McKinnon
Richard Prestage
Galen Watts
John Webber
Steve White

I am well aware that no one has much, if any, time to work on this now, but we need to get our thoughts together on this so that we will be in a good position to initiate work early next year. I will take on as much leg-work as possible in preparing the proposal. Considerable thought has already gone into this program and there are already some documents written. I will suggest some broad issues that might be useful to discuss.

A parallel scientific group is also being formed, and there will be the opportunity for the scientific and technical groups to interact as is useful or necessary. I anticipate that each member's involvement would be to participate in the general discussions of the TWG, and to contribute to the development of the technical and project plans. I would like to target 15 January 2001 for the completion of the material.

Please let me know if you can participate. A draft outline of the proposal follows.

Beam-Forming Array Proposal

Proposal editor: Phil Jewell

Proposal Outline

1. Introduction

- General objectives of L-Band Focal Plane Arrays
- Reference to success of Parkes 13-beam Rx
- Full-sampling vs. Conventional FeedHorn Arrays
- General goal of this project

2. Scientific Justification

- Sections prepared by the SWG
 - HI
 - OH
 - Pulsars
 - Continuum

3. Description of the Instrument

- Overview
- Feeds
- Amplifiers
- Cryogenics
- Signal Processing
- Post-processing

4. Development Plan

- JRF 5-year plan
- Risk areas & approaches:
 - cryogenics, competitive noise temps, signal processing

5. Resource Requirements

- Budget
- Staffing

6. Schedule

Appendix

- Rick's technical paper on beam-forming array theory