K-band Phased Array Feed: Planning Document

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Abstract

This document tracks the development and planning for the KPAF project proposal.

History

Version	Date	Notes
0.1	11 June 2016	Original Version (Richard Prestage)

Contents

1 Introduction

This document is intended to plan and track the work in needed for each the KPAF sub-system. The goal of the current work is to produce a preliminary, overall system design, developed to such an extent that any critical research and development items have been identified, and specifications, staff resource allocations, schedule and cost have been estimated to a level of detail sufficient for an NSF ATI proposal.

2 Proposal Development Schedule

- June: initial discussions; basic system specifications and concept
- July / August: elucidation of key components:
  - element design
  - LNA design
  - General beamformer hardware / firmware / HPC approach
- September: Detailed system design
- October: Proposal development
- November: Proposal submission

3 To Do List

- I cannot find any restrictions on number of ATI proposals a single organization can submit. Are there any? Any other administrative rules we need to be aware of?
- Neal Erickson's ATI proposal to complete PHAMAS was declined. We should find out why. Should we invite him to join our team?
- initiate PAF element design
- initiate LNA design
- perform detailed performance analysis (polarization / number of beams / T_{sys} trade-offs).
- agree general beamformer hardware / firmware / software approach (ICEboard, Python M & C software).
- define PAF physical constraints (dewar size, weight)
- define first-cut science specifications (frequency range, resolution, etc)
- initiate high-level system design block diagrams
- agree appropriate sub-systems, and assign sub-system leads to each one

4 Project Scope

The scope of the project is to build a complete K-band PAF, LO/IF system and digital beamformer, installed and commissioned for PI use on the GBT.

In scope:

- all hardware, firmware, and directly associated software
- mechanical, electrical, cryogenic and all other interfacing to the GBT
- any necessary modifications to the GBT receiver room turret
- all necessary observing strategies and calibration algorithms
- monitoring and control through a lightweight GBT system (currently the Python-based "autodealer" and "dealer/player" systems)
- storage of TBD data products on the GBT high-performance filesystem
- beamforming software capable of producing fine-channelized beams
- documentation

Out of Scope:

- 10 MHz, 1 PPS, LO reference and any other reference / control hardware signals
- helium compressor and lines

- support of the instrument for common-user operation
- integration of the instrument into the full GBT monitor and control system
- offline imaging and data reduction and analysis post formed-beams
- long-term data storage and archiving

To Be Determined:

- Provision of a network switch - can we use the GBT (BTL) switch?
- Provision of High Performance Computers (HPCs) - can we assume they already exist?

5 KPAF sub-systems

5.1 Science Case

5.2 System Specifications

5.3 PAF Microwave Components

- single or dual polarization?
- element design, number, spacing
- LNAs
- other frontend microwave components

5.4 Dewar, Cryogenics and Packaging

5.5 Frontend Warm Electronics

5.6 Frontend Monitor and Control

- FE monitor and control hardware
- FE monitor and control firmware
- FE monitor and control software

5.7 LO / IF system

- Receiver cabin components
- Fiber run
- Equipment room components

5.8 Beamformer Hardware

- Analog to digital conversion
- F-engine (coarse / fine channelization)
- X-engine (cross correlation)

5.9 Beamformer Firmware / HPC software

5.10 Beamformer Monitor and Control system