



National Radio Astronomy Observatory

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Date: February 10, 2011
To: FPGA Spectrometer Design Team
From: Jay Lockman
RE: Preliminary Design Review Report – FPGA Spectrometer
CC: Karen O’Neil

On January 31, 2011 a Conceptual Design Review was presented by the NRAO/Berkeley project team working on the FPGA Spectrometer. A cross-disciplinary review panel of NRAO staff unaffiliated with the project was invited to attend and comment. A listing of the reviewers is included at the end of this memo. The reviewers were asked to review the presented materials under the following charge:

Charge to Participants

The purpose of the Preliminary Design Review for the Green Bank Spectrometer is to validate that the designs and plans presented, to the extent they can be evaluated at this point in the project, meet the guidelines for the new spectrometer by:

1. Satisfying the science case
2. Addressing all of the specifications
3. Meeting the requirements of the ATI grant description
4. Appearing to be technically and financially viable
5. Being able to be completed in accordance with the grant and project schedules
6. Identifying the risks of the project, their potential effect, and demonstrating a satisfactory mitigation plan for each risk

This memo represents the comments and recommendations of the reviewers.

General:

The group is excited at the prospect of a new spectrometer for the GBT possessing the capabilities presented at the review. In particular, the nearly order-of-magnitude increase in the number of spectral windows will be very welcomed by GBT users. The reviewers feel that the overall improvement over the existing spectrometer speed, reliability, and capabilities, while substantial, is less than might have been anticipated given the period of time since the commissioning of the existing spectrometer. While this is probably the next appropriate, achievable technical step beyond the existing spectrometer and reflects the available time and funding provided by the NSF ATI grant, and the need for the spectrometer to work within the limits of existing receivers and IF systems, the reviewers feel it is important to note that this

will be an additional challenge to the NRAO staff as they announce the instrument to the general observing community and provide guidance on the various new modes and set-up parameters.

One suggestion universally noted by the reviewers is a need for a high-level, easy to understand graphic that illustrates the conceptual architecture and sets the stage for more detailed description of capabilities. This top-down approach to describing the spectrometer should illustrate the similarities, differences, and improvements over the existing spectrometer in a concise way, as a comparison is inevitable when introducing a replacement instrument.

And finally, the reviewers strongly recommend a defined activity focused on the preparation of user materials along with systems development. The efficiency of observers using the new spectrometer and ultimately their satisfaction with the new spectrometer will be as dependent on the ease of use, transition, and support as it is on the instrument's capabilities.

Specific Questions, Concerns, and Recommendations:

1) Satisfying the science case

- The specifications as presented meet the science requirements.
- This spectrometer is well matched to the capabilities of the KFPA, but will need significant expansion to accommodate larger multi-pixel receivers.
- Bandwidth for Ka observations is still slightly less than existing Zspectrometer. This will need to be explained well in the user documentation.
- Doppler tracking seems to be adding complexity - perhaps the team should consider moving it out of the spectrometer into data processing and the associated firmware design effort traded for other science modes

2) Addressing all of the specifications

- The specifications are well matched to the science goals
- There may be still too many modes to complete all of the work on time and on budget. The project might benefit from a review of the prioritization of lower-priority modes by a broader discussion of relative importance; there is good agreement on the highest-priority modes.

3) Meeting the requirements of the ATI grant description

- Insufficient information was available to the reviewers for them to assess compliance with the grant description.

4) Appearing to be technically and financially viable

- While the Berkeley/Casper track record for projects is good, there is some concern about the transfer of knowledge to NRAO for maintenance, future enhancements, etc. The reviewers recommend time for documentation should be integrated into the project plan, specifically in-process documentation tasks throughout the design and construction phases. (If it waits until the end of the project, it may never get done.)

- The total number of FTEs assigned between NRAO and Berkeley is likely to be sufficient to do the work, but there is concern about the fact that these FTEs are spread across so many staff members in each organization. This dilutes the project information over a large base and increase communications overhead. High quality documentation will be required to mitigate this risk.
- Berkeley is new to using GPUs for spectroscopy - NRAO did that work for GUPPI. How are the throughput numbers being validated? The reviewers felt that this was a risk that should be added into the project's risk profile and tracked throughout the development to expose any problems as early as possible. How will the GPU programming expertise get handed back to NRAO ?
- Will data read/write speeds be a bottleneck to observer efficiency? Will there be extended periods waiting for the data to be available after a scan? The reviewers encourage the team to begin work on the data stream-related issues in the project as soon as is practical as these may represent a significant portion of the software work – possibly illustrating insufficient resources have been assigned to the project for this work.

5) Being able to be completed in accordance with the grant and project schedules

- The scope of the project matches the funding secured pretty well
- The reviewers feel the project needs to establish a firm date for a decision on Roach 2 so that any duplication of effort caused by joint Roach 1&2 development or any other dependencies can be resolved.
- The project plan is lacking sufficient detail to assure that the M&C software is available when hardware and additional modes are delivered. It was difficult for the reviewers to assess this risk with the information presented.

6) Identifying the risks of the project, their potential effect, and demonstrating a satisfactory mitigation plan for each risk

- The reviewers share the project team's concern with the pressures of observers and its effects on the project schedule. They encourage NRAO management to establish policies around shared use or any early science before any such use is advertised to the community
- The Risks section of the presentation lacks the software risks that were presented during the software presentation. It is important that these risks be tracked along with firmware and hardware risks.
- An additional risk should be added as how to disseminate data to the users. The mitigation described during the review was that users will expect to reduce their data by SSH/VNCing into GB. However, these data will eventually need to be distributed to the public and copying data from disk in GB may be very time intensive and the document does not make a clear description on how the data will be provided to an archive and searched on. While it is not relevant to the design of the spectrometer specifically, the design does lead to a large amount of data and that data needs to be pushed out to the user community.

Members of the Review Panel:

Jay Lockman (Chair)

Toney Minter

Ron Maddalena

Rick Fisher

Roger Norrod

Tony Remijan

Dave Frayer

Glen Langston

Karen O'Neil

Chris Clark