

Summary Report of the Fourth Joint Receiver Design Group (JRDG) Meeting

Held on 7 and 8 September 2000 at
Cavendish Laboratory, Cambridge, UK

Participants:

John Payne (NRAO), Wolfgang Wild (NOVA/SRON), Victor Belitsky (OSO), Charles Cunningham (HIA), Brian Ellison (RAL), James Lamb (OVRO), Bernard Lazareff (IRAM), Dick Plambeck (BIMA), John Webber (NRAO), Matt Carter (IRAM), Dave John (IRAM), Mark Harman (RAL), Anna Orłowska (RAL), John Richer (MRAO), Stafford Withington (MRAO), Andrey Baryshev (NOVA/SRON), Enzo Natale (Arcetri), Richard Wade (RAL), Marc Rafal (NRAO), Yutaro Sekimoto (NRO), Takashi Noguchi (NRO), Gie Han Tan (ESO)

The "Joint Receiver Design Group" (JRDG) and members of different groups working on ALMA receivers met for two days to discuss and decide on several receiver issues. This report summarizes the main results and decisions.

1. How the JRDG wants to make decisions

The JRDG discussed how decisions should be reached within the group. There was general agreement that a decision by consensus is the preferred way. It was also agreed that the two group leaders will take a decision if a consensus cannot be reached.

2. Questions and issues for the meeting

The following questions were presented to the meeting participants. During the meeting answers to these questions were found (see below).

- Receiver specification:
 - Comments on draft version 1.4 ?
- Calibration:
 - Which calibration scheme is preferred ?
 - Is a cold load required ?
 - Calibration interval ?
- Optics:
 - Does the JRDG agree with the proposed optics scheme ?
 - If not, what additional information/action is needed ?
- Dewar and cryocooler:
 - Is the WVR inside the dewar or not ?
 - Does the JRDG agree with the dewar layout ?
 - Are the cartridges ok ?
 - Does the JRDG agree with the cryogenic system ?

3. Receiver specifications

The "Specifications for the ALMA Front End Assembly" (draft version 1.4) were discussed. No problem was seen in extending the lower end of band 3 down to 84 GHz if a somewhat lower sensitivity for the extension is acceptable. In general, the group was concerned that the specs and goals for the receiver noise temperatures (Table 2, p. 7) were too ambitious for some bands. In

particular, the specs and goals for band 1 to 3 were felt unrealistic for HFET amplifiers by John Webber. He proposed to revise these numbers and suggested the following HFET performance specs:

Band	over 80%	over 100%
1	18 K	25 K
2	45 K	60 K
3	60 K	75 K

It was pointed out that some of the specs may be reachable for a single receiver, but probably not for 64 (or more) receivers. Similarly, the group felt that that some of the noise specs can be reached (or actually have been reached) for the SIS mixer alone, but not necessarily for the complete receiver (including optics, IF amplifiers, dewar windows etc.). The question was asked what "specification" means, and a clarification seems necessary.

In the discussion on FE specifications it was also mentioned that the tuning range might initially not be achievable due to limitations in the multipliers. An interim solution where only a subband is covered seems acceptable. The proper choice of the sub bands will be done in consultation with the ASAC.

It was suggested to include more specs, such as receiver linearity, max LO noise contribution, cool down time, window loss, and acceptance criteria.

4. Ongoing work in Japan

Yutaro Sekimoto presented the plans for ASTE and corresponding receivers. The 10m ASTE antenna will be taken to Pampa la Bola in Chile in December 2001, and it is planned to equip it with a receiver which provides space for three ALMA compatible cartridges and a holography receiver. A Japanese group is designing a 12 m antenna and its receiver cabin and intends to meet the corresponding ALMA ICDs. The cryocooler consists of a 3 stage Sumitomo GM cooler with He pot temperature stabilization. The cooling capacity of the 3 stage cryocooler is 0.78W/4.2K, 10W/12.5K, and 40W/78K.

5. Calibration

The group considered the goal of an intensity measurement accuracy of 1% for a source above the atmosphere. The general consensus was that such a goal would be extremely difficult to realize. Dick Plambeck presented various options for calibration schemes and suggested that a cold load was not worth the added complexity. There was unanimous agreement within the group with this point of view and strong feelings were expressed that the inclusion of a cold load would increase the complexity and cost of the receiver and would be ineffective in aiding the calibration procedure. The group recommended further evaluation of the different schemes outlined by Dick. It was pointed out that the calibration interval is not a design driver and may be decided at a later date.

Richard Wade mentioned the plan of Bob Brown to organize a meeting about calibration issues. The group thought that this was a good idea and a necessary next step towards discussing more general problems of calibration. Such a meeting would involve scientists, receiver engineers and systems engineers and the calibration issues would be explored in depth

In spite of further discussion of the calibration issues it was the very strong feeling of the group that the decision not to include a cold load in the receiver design be absolutely firm and many members of the group expressed concern that this issue had been allowed to delay development in the design of the receiver for many months.

6. Optics

Matt Carter presented several alternative optics designs, both with a cold load and without. John Payne showed design ideas which have been worked on in Tucson. The definite exclusion of a cold load allowed to present a combination of various design ideas which seems to incorporate the best features of alternate designs. This design concept (the so-called "2 am solution") will be further elaborated in a one week working session of the optics group (25 to 30 September in Tucson). The receiver group asked the optics group to take the following guidelines for the ALMA optics design into account:

- All optical elements on or in the dewar – everything testable in the lab
- If possible, all cold optics should be part of the cartridge – cartridge fully testable in lab
- Preference for no adjustment at the telescope

7. Water vapor radiometer

Based on a technical proposal by MRAO and Chalmers for a water vapor monitoring system, the group agreed to keep the possibility to provide the WVR with a cold load in the main dewar. The group could see a number of advantages if the WVR were a complete stand-alone system with its own cold load (e.g. using a Peltier cooler, as suggested by Marc Rafal). This possibility should be further evaluated.

The same technical proposal concludes that cooling of the WVR is not required. The receiver group agreed to this as the baseline design. Cooling of the WVR will not be foreseen in the main dewar.

8. Dewar and cryocooler

Mark Harman and Anna Orłowska presented the current status of the dewar and cryogenic design. The group agreed with the main features of both designs. The pump and cooldown time is estimated to be on the order of five days for a receiver which is intended for long operation. Much shorter times may be feasible for testing purposes. Anna Orłowska will look into this issue.

The cartridge conceptual design was generally accepted, and it was decided to review the cartridge diameter once the optics design is finalized. A critical part of the dewar design is the thermal link to the cartridges, and first tests with a prototype thermal link have begun at RAL.

9. Distribution of information within the receiver group

Several weeks ago, different mailing lists for the ALMA receiver group were created (e.g. alma-dewar@eso.org, alma-optics@eso.org, alma-cryo@eso.org etc.). Many people joined many of the lists which led to an almost complete overlap between the lists. It was now decided to replace the different lists with one mailing list (called alma-receiver@eso.org) comprising all those who work on ALMA receivers. In addition, as before there is a list alma-jrdg@eso.org comprising the members of the JRDG and the AEC.

10. Next steps, schedule, next meeting

The optics group will get together for a working meeting from 25 to 29 September in Tucson with the aim to produce a detailed optics design. A report will be available shortly after the meeting.

The dewar design will be adapted once the optics design is known.

A preliminary design review (PDR) for the ALMA receiver is planned for 5 and 6 February 2001 in Tucson. The overall receiver design has suffered several months of delay due to persistent uncertainty about receiver calibration requirements. There was some discussion if this could be compensated for by rescheduling the tasks after the PDR but no conclusion was reached.

29 September 2000, W. Wild and J. Payne