Annex 1 to the Agreement between ESO and IRAM concerning Windows and Infrared Filters

1. Scope

To select and test suitable materials and designs for the vacuum windows and IR-blocking filters for the ALMA frontend. To supply windows and filters for the engineering model and prototype ALMA receivers.

2. List of activities

1. Literature survey and enquiry in the community on existing experience.

2. Select materials to be tested.

3. Obtain samples of materials to be tested.

4. Prepare materials (flat surfaces, grooves).

5. Measure absorption at 230GHz; for each sample test various thicknesses to separate surface reflection from volume absorption. Perform a first selection on the basis of absorption at 230GHz.

6. Measure absorption at 650 or 850GHz using heterodyne receiver (will require access for ~2days to such a receiver in another collaborating ALMA institute); *and/or* perform wideband absorption measurement using an FTS.

7. (Windows only) Perform tests of bursting strength with tbd safety factor, using custom built burst chamber.

8. (Windows only) Measure leak rate using standard leak rate meter (if adequate), or collaborate with vacuum experts at, e.g. RAL.

9. (IR filters only) Measure IR leakage using a "macrobolometer" in a He/N2 dewar: absorber linked to He bath by a calibrated thermal resistance.

10. Write report.

11. Following approval of proposed design, supply windows and filters for engineering model and prototype ALMA receivers.

Two-step approach. In view of the fact that the level of IR blockage that can be achieved (with acceptable RF loss) is an important parameter for the cryogenics design, a two-step approach will ba adopted.

- Select one or two configurations of windows and IR filters, based on already implemented solutions, and perform measurements to etablish a baseline performance, that will be used as a worst-case hypothesis in cryogenic design. This phase should be finished by end 2000.

- Continue the investigation to find an optimum solution; fabricate windows and filters for the engineering model receiver.

3. Criteria

The work done in this WP and its output must be guide by, and judged against, definite criteria. Because there are at present no mention of windows and IR filters in the *Specifications for the ALMA Front End Assembly*, we list here what we propose as relevant criteria for windows/filters that will be investigated, proposed, and supplied.

3.1 Windows

- Mechanical resistance against atmospheric pressure
- Low leakage : air, water, He (may not be applicable)
- Good transmission over nominal RF bandwidth
- Can be reproduced in series production

3.2 Filters

- Blockage of IR radiation (in concert with window)
- Good transmission over nominal RF bandwidth

Notes:

a. Decrease of IR radiation load can also be achieved in part with grating surfaces on mirrors inside dewar; this needs to be coordinated with the common optics task.

b. Radiative IR load must be assessed for each of the 70K, 15K, and 4K stages.

4. Interface(s)

To Dewar design group, Optics group, Team Manager.

5. Deliverables.

Progress reports will be supplied quarterly to the Project Office:

Q4/2000: Baseline solution used as worst-case hypothesis for cryogenic analysis

Q1/2001, Q2/2001: Interim progress reports

Q3/2001: Report containing measurement methods, measurement results, and recommendations for the selection of windows and IR filters.

Q4/2001: Actual windows and filters for the engineering model receiver.