

The 3-way ALMA project: Budget Boundary Constraints

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The baseline ALMA project is foreseen for a total construction cost of 552 M\$, to be funded by North America (NSF-NRC) and Europe (ALMA consortium). The possible addition of Japan to this project modifies the financial possibilities and may allow a more ambitious ALMA project.

The ALMA Coordinating Committee indicated to the ALMA partners that the addition of Japan as an equal partner should result in a reduction of the financial contribution of the original partners of at least 10 %. In terms of budget, this corresponds to a total ALMA value of \$745M. This budget will not go to a central organisation, but should be equally shared in terms of value by the in-kind contributions from the 3 partners.

This is a potential addition of 190 M\$ in value (above the baseline US-European project). However, all this funding will not be available for enhancing the ALMA scientific capabilities, since the addition of another partner has some implications on the baseline project itself. Even if the ALMA scope is not changed, a new partner will induce extra cost in management, because of the need for coordination between more parties. Also, it should be realized that Japan can only participate in ALMA if it contributes in-kind to the major constituents of ALMA, specially the antennas. This has some cost implications, since smaller series of antennas will be made, possibly increasing the unit costs. Tooling sets and maintenance equipment would need to be duplicated.

The evaluation of the cost increase due to these additional constraints is difficult. This was discussed at the ALG meeting in Tokyo (Jan 15-16), and the ALG members concluded that, although the uncertainties are large, realizing the baseline ALMA with 3 partners instead of 2 would result in an estimated overhead of 70 M\$, shared between management, site development, antennas, receivers, LO system, backend, correlator, computing, science and system at various levels. We caution ASAC that this estimate would need to be re-evaluated by a detailed Work Breakdown Structure and remains very uncertain.

This leaves about 120 M\$ of "new" funds for enhancing ALMA capabilities. In fact, considering that part of the overheads will be distributed into new capabilities, the ALG estimate that 140 M\$ (out of the 190 M\$ increase) could possibly be assigned to new ALMA capabilities, and only 50 M\$ being used for the basic overheads.

Using the ALMA detailed costs, the ALG also evaluated the potential costs of the possible ALMA enhancements:

- 1) Adding 4 bands to all 64 antennas: 48 M\$
- 2) Adding 6 bands to all 64 antennas: 68 M\$
- 3) Adding an "ALMA Compact Array" of 12 antennas (of size 8-m or smaller)
 - with 4 bands: 64 M\$
 - with 8 bands: 73 M\$
 - with 10 bands: 76 M\$
- 4) Adding an enhanced correlator
(Japan cost estimate 43 M\$)
(savings on baseline correlator 8 M\$)
net result: 35 M\$

In summary, with numbers rounded up to the nearest 5M\$,

+4 bands:	50 M\$
+6 bands:	70 M\$
ACA:	75 M\$
Correlator:	35 M\$

Total: \$160M (8 bands) or \$180M (10 bands)

This implies that all options cannot be funded under the projected budgetary constraints. The ASAC is thus asked to provide advice and scientific priorities among the possible enhancements. The ALG further stresses that the estimates are uncertain, and subject to a detailed costing analysis.