

Optical and Infrared Astronomy Committee (OIRAC) Report to the CASCA Board, May, 2009

Our last report to the board was submitted Nov 2009 and is available on our web page at <http://astro.uwaterloo.ca/OIRAC>. Following is a summary of OIRAC activities from Dec 2008–May 2009.

1 Large Optical Telescope Considerations

As detailed in our previous report, OIRAC has been closely following the development of the next generation of large ($> 20m$) optical telescopes (LOTs), as it is a top priority for Canada to be at the forefront of such a project. Canada is currently a major partner in the Thirty-Metre Telescope (TMT), and we expect that project to begin moving ahead rapidly following the selection of a construction site, in July 2009. At the same time, it has become apparent that the European Extremely Large Telescope (E-ELT) project may be a viable alternative, as they are looking for additional partners to enable construction. Although the E-ELT project is currently behind TMT in terms of design, it is a top ESO priority and there is a real possibility that they could overtake TMT if the latter experiences further delays. The invitation to join ESO as a full member (as opposed to just an E-ELT partnership) offers a particularly interesting opportunity. In addition to E-ELT access, ESO membership could offer a long-term stability that we do not currently enjoy, and would provide access to other ESO facilities, most notably the VLT and its impressive suite of instruments.

To prepare for these future developments, OIRAC has been gathering information about the status and progress of both TMT and E-ELT projects from various sources. Most of the information presented here is unofficial, and obtained from informal conversations with various people including Ray Carlberg, Luc Simard, Dave Crampton, Marijn Franx, and Greg Fahlman. These conversations were summarized and discussed by OIRAC during email exchanges (most notably March 10-12 and April 27-May 4), and during face-to-face meetings at astro-ski (Feb 17-20) and one at HIA (May 5). Both meetings were attended by Balogh, Hutchings, Venn, and Willott.

Executive summary:

The future of optical astronomy is in the next generation of LOTs. Whatever the other advantages of an organization such as ESO, it is OIRAC's opinion that Canada should make the decisions that provide us with the best access to an LOT.

The TMT project is in excellent shape in terms of design. The situation will become more clear following site-selection in July, but there appear to be routes (and alternatives) to establishing a stable partnership and beginning construction. Although the project has been delayed, it is still on track to see first light, in the worst case scenario, at the same time as the E-ELT. The main limitation at the moment appears to be lack of funding. The TMT should continue to be Canada's "plan A", and this project has OIRAC's full support.

However, we note that the situation has the possibility to change rapidly, depending on partnership and funding developments, and progress made by the E-ELT community. If

TMT hits an unforeseen roadblock, we must be prepared to make a decision which allows Canada to stay involved in a leading LOT project. Therefore, we must continue to cultivate ties with ESO, and understand the requirements, procedures and consequences of joining either as an E-ELT partner or full ESO member. OIRAC will continue to monitor both projects and update the Board on any developments.

Canada's current position: Our TMT agreement expired March 31, and has been renewed informally until year-end. There is currently no signed agreement for Canada to participate in the construction phase of this project.

TMT partnership: The current TMT partnership consists of Caltech/UC (now a single partner) and Canada. The Japanese are very interested in becoming a partner, and are involved in all relevant discussions. Caltech/UC hope to offset capital against operations, with NSF as a fourth partner covering operations. But NSF is awaiting the Decadal review, due next year, to make a decision between TMT and the Giant Magellan Telescope (GMT).

India and China are both known to be considering TMT involvement. This has a number of implications. First, it means that should NSF and/or Japan decide against membership, the project may still be able to proceed. Similarly, if Canada were to decide to participate in E-ELT instead, the TMT could still be present as competition. Finally, many if not all of these other potential partners share Canada's desire to be second-to-none in terms of participation level. Thus, if it is necessary to grow to a partnership of six or more in order to enable TMT, our share could drop from the anticipated 25% to $\sim 15\%$. Note that, if Canada were to become involved in E-ELT via either partnership or ESO membership, our likely share (based on GDP) would be around $\sim 10\%$. Thus, as the number of TMT partners increases, it weakens one of the advantages of our involvement in TMT over E-ELT.

Site selection: The TMT partnership (and hence funding situation) is likely to become much more clear following the site selection, expected July 2009. The Hawaii senate has passed the law that allows the site to be negotiated, and the native Hawaiian organization is on-side. Both the Moore foundation (whose involvement is required by Caltech/UC) and Japan have expressed preference for the Hawaiian site, but neither has completely ruled out the Chilean alternative. Thus, a decision to site TMT in Chile would not necessarily exclude any partners. Both appear to be outstanding astronomical sites, and there are advantages to Canadian astronomy wherever it ends up.

The E-ELT site has also not been decided upon. Spain has voiced a strong desire to site the facility in La Palma, and this could happen if they put up enough money. However, ESO currently favours a site in Chile for synergy with ALMA. They are of course paying close attention to the TMT site decision. It seems likely that a decision to locate TMT in Hawaii would strengthen ESO's desire to locate in the southern hemisphere.

Timeline: TMT is aiming to begin construction in 2011, and to begin operations in 2018. This represents a delay of four years from the original plan. ESO is now pushing for a start to E-ELT construction in Dec 2010, also with a goal of starting operations in 2018. Assuming that the E-ELT project is not delayed, TMT cannot afford any further delays on its side, or it will risk coming second. This means that construction funds will need to be available

soon after the site decision is made.

The TMT design, which is essentially finished, is still considerably ahead of the E-ELT. The E-ELT design is “fixed”, and has been sent out to various companies for price quotes, expected by May 2010. Once accepted, these quotes will be binding. However, design and cost changes could still occur following more detailed engineering work by the industrial sector, and there are reasons to believe this could be the case, causing project delays. In particular, the current design loses 70% of light through a 6 mirror train, which negates much of the aperture advantage it holds over TMT. Furthermore, the 1000 segment mirror presents serious logistics issues (e.g. computer control) that aren’t present for the 500 segments of TMT.

Despite these design challenges, E-ELT is a top ESO priority, as they want to maintain the position of excellence they have established through VLT. They have assembled an excellent team of people and are proceeding with design at a rapid pace, with an impressive prototyping and testing programme at VLT.

Cost and funding plans: The total cost of TMT, including first instruments, is now estimated at \$1.3 billion (Canadian), with operating costs estimated at \$25 million per year. If Canada is to participate in the construction phase, our share would be \$170 million. Involvement in the E-ELT would require \$160 million, and this would enable construction. This amount could be lowered when in-kind contributions (ALMA, CFHT) are considered. Canada’s share of operations would depend on whether we joined ESO as a full member (\$20 million annually) or only joined the E-ELT project as a partner (\$6 million).

There is no Canadian infrastructure or corporation for capital funds, and no clear funding plan. Both the Minister for Industry, and opposition MP Keith Martin, have shown support for TMT, and are been pushing for \$170 million of stimulus money for the dome and telescope structure (i.e., not covering operations or instrumentation). Clearly, funding at this level would represent a very big step forward. However, a coherent plan for operations and instrumentation money is still required.

Although the ESO long-term stability is one of its major attractions, it is not clear how viable their funding model is in practice. The fact that they need to seek additional members to fund new projects suggests that this model is not well-suited to growth. Under the current plan, E-ELT would be partly funded (by up to 50%) by regular ESO contributions once ALMA is completed. However, this would require about a 35% increase from all partners’ subscriptions, and it is not clear that all partners would agree to this.

Looking ahead to operations: TMT instrument design is advanced, and instrument building should start as soon as possible. Canada is already heavily involved in this process, and well-positioned to contribute significantly. In contrast, it is unclear what scope there is for hardware contributions or construction contracts within E-ELT. The instrumentation plan is not well-developed, and there are many European institutes that want to be involved.

Serious consideration must be given to the mode of operation that best suits Canadians, as this is also being negotiated at present. We must use our experience with Gemini to strike the right balance between queue and classical mode observing, and for a mode of governance that leads to competitive instrumentation development.

It is also time to develop a coherent plan for data management and distribution, which is

linked with the observation mode. There is clearly an opportunity for CADC to be involved, though this has not happened as yet.

Finally, it is critical that Canada be well-positioned to exploit the advantages of an LOT, and this requires funding of postdoctoral fellows and graduate students. A comprehensive and well-funded fellowship programme would be desirable.

Summary:

- We need a clear project organization and funding plan for any LOT option. This includes not only construction costs, but also instrumentation development, operations, and scientific use (i.e. fellowships).
- We must establish a set of criteria that determine when the TMT is no longer our best option. Such criteria might be a) if funding for Canadian participation cannot be secured; b) insufficient partners are found to enable construction, even with Canadian funding; c) the joining of additional partners, meaning that Canada's share becomes less than 15%; d) a delay which puts TMT more than one year behind E-ELT. We should have a clear plan of alternatives in place, should one or more of these scenarios arise.
- In the meantime, we should continue to learn more about the details of how any collaboration with ESO would proceed; in particular, the mechanisms for joining (membership or partnership) and an accurate cost estimate. Should the need for an alternative to TMT arise, we may need to make decisions quickly.
- We need to be sure that the LOT plan for instrumentation and operation mode is suitable for the Canadian community. Now is the time to be thinking about this, as well as data management issues and the funding of young astronomers who will use these facilities.

2 Gemini

Canada's agreement with Gemini, which expires in 2012, needs to be renewed in 2010. This is currently Canada's flagship optical facility, and the oversubscription for Bands 1 and 2 (which are the programmes most likely to get completed) is still very healthy at > 3 for both Gemini-N and Gemini-S. Although the instrumentation has not been perfectly suited to Canadian interests (Canadians make little use of Michelle or T-RECs, for example), this is set to improve with the arrival of FLAMINGOS-2, MCAO, and the upgraded GMOS CCDs. Flamingos-2 recently passed acceptance testing, and will soon be shipped to Gemini South. This will almost certainly improve the oversubscription for Gemini South time, which has lagged behind the North in most semesters. Therefore negotiations of the next agreement should be focused on the *future* capabilities of Gemini, rather than on the past.

Through the ALTAIR report, the US community has expressed dissatisfaction with the Gemini model, and is seeking an increased share and an instrumentation suite that puts more emphasis on relatively cheap, workhorse capabilities. Canada clearly needs to pay

attention to this, as it is likely to lead to important changes at Gemini. Although some of the concerns voiced in the ALTAIR report (e.g. the instrumentation plan) may resonate with the Canadian community, it is not clear that Canada is as dissatisfied with the overall operation. In particular, a survey of Gemini users in Canada by the Canadian Gemini Science Committee found general satisfaction with the operational model, in particular with strong support for queue observing.

The future success of Gemini will depend heavily on the available instrumentation. It was recently announced that the Aspen instrument program has been terminated, with GPI the only instrument being supported. GPI is a revolutionary instrument, and is likely to be heavily used by Canadians, so this is an important success. However, the cancellation of WFMOS and GLAO is a setback, and means the longer term future instrumentation is unknown. This is a particular concern for the northern telescope, as FLAMINGOS-2, MCAO and GPI are all destined (initially, at least) for the South. Gemini must submit its five-year funding proposal to NSF by September 2009, and this will outline a new instrumentation plan. This is a crucial step, and likely to be influenced by the ALTAIR report.

The other important recommendation made in the ALTAIR report was that the US increase its share of Gemini, to something like 75%. This is partly enabled by the expected withdrawal of the UK, but given that other partners may also be interested in increasing their share, Canada may find it difficult to retain a 15% involvement. We must also consider carefully how our role in Gemini might change with such an overwhelmingly large partner.

The decision to enter a new agreement with Gemini clearly impacts our potential involvement with ESO, and probably limits us to E-ELT partnership rather than full ESO membership. However, for the moment, maintaining the status quo with Gemini is the only viable option. Therefore, OIRAC recommends that Canada either maintain *or increase* its share of Gemini in the contract negotiations.

3 CFHT

The lease on the CFHT site is valid until 2033, and we currently pay \$3.14 million per year in operations. Despite its age, CFHT is still consistently oversubscribed by a factor of at least 2, and new, exciting instrumentation is in the works (Imaka, Spirou). There is room for further expansion or development; for example, it is well-documented that a 12-m telescope could fit in the existing dome. Given the cost, site quality and room for future developments, it is OIRAC's opinion that our involvement in CFHT must continue. This would remain true even if we were to consider ESO membership.

4 OIRAC, the RAC, and a proposal for a CGBA:

OIRAC continues to believe that Canadian interests will be best served by a committee that oversees all ground-based facilities, regardless of wavelength. The common funding sources and science goals of these facilities makes it sensible to consider the interplay between them, and makes them distinct from our space-based initiatives. Our arguments have been presented in some detail, in all previous reports dating back to November 2006.

On Jan 19 OIRAC was informed that the Board is producing recommendations on this issue, complete with official terms of reference, for the Board meeting prior to the 2009 AGM. We look forward to hearing the results of this meeting. It is important that we have the most effective committee structure in place for the next LRP exercise which we understand is imminent.

5 Recommendations:

- The OIRAC recommends that the TMT be considered as the prime path for Canadian LOT involvement, but that ties to ESO continue to be cultivated in the event that the TMT hits a roadblock
- The OIRAC recommends that Canada either *increase*, or at least maintain the status quo, in its share of Gemini.

6 Membership

The current OIRAC membership is as follows:

Name	Membership expires
Michael Balogh (Chair)	May 2009
Pierre Bergeron	May 2009
John Hutchings	May 2010
Chris Willott	May 2010
Tim Davidge	May 2011
Kim Venn	May 2011

The terms of Balogh and Bergeron have thus come to an end, and replacements must be found.

It will also be necessary to choose a new chair.