

# THE ORIGINS OF STRUCTURE IN THE UNIVERSE

CANADIAN ASTRONOMY AND ASTROPHYSICS IN THE 21ST CENTURY



**House of Commons  
Standing Committee on Finance  
2015 Pre-Budget Consultation**

**Submission of the Coalition for Canadian Astronomy**

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## **Executive Summary**

Astronomy is one of Canada's great scientific and industrial success stories, with the country ranked among the world leaders in the field and Canadian industry transferring the expertise gained from working on astronomy projects into lucrative commercial opportunities. Canada's astronomy stakeholders have a long-term plan to sustain this leadership, which includes participation in the new high-tech generation of astronomical facilities.

The plan's top priority is our partnership in the Thirty Meter Telescope (TMT), which our scientists and industry have played a leading role in designing. Initial TMT construction has begun, but unfortunately without Canada's participation in this exciting phase of the project. Without a financial commitment by April 2015, Canada will be sidelined from its role in the current project plan. This date of April 2015 is an accommodation by the TMT Board to allow the financial commitment of Canada to be made in the 2015 Budget. Other TMT partners made their financial commitments in 2014, as scheduled.

Canada's share of construction costs is \$293 million USD over ten years. The Coalition recommends the Government commit to this construction in Budget 2015, either through allocation of existing resources, new money or both.

Canada allocating the required funding to the TMT project in Budget 2015 will ensure that:

- our industrial partners will build what Canada has already paid to design,
- our astronomers will have access to 20% of the available time on the skies to conduct their world-class research, and
- our universities will continue to work with industry to commercialize technologies that will be spawned from such a robust undertaking, as has been the historical reality of astronomy in Canada.

## **Introduction**

The Coalition for Canadian Astronomy is composed of:

- Academia: represented by the Association of Canadian Universities for Research in Astronomy (ACURA) and its 20 member universities;
- Professional astronomers: represented by the Canadian Astronomical Society (CASCA);
- Industry: Canadian companies involved in major astronomy projects.

It is critical that the 2015 Federal Budget include an allocation for TMT to maintain Canada's international leadership in Astronomy and Astrophysics, along with the associated industrial and technical expertise. The TMT is the flagship project of Canadian astronomy and the top priority of the Long Range Plan for Astronomy and Astrophysics, the community's roadmap to sustaining excellence. A funding commitment must be made by April 2015 if Canada is to preserve its current stake, along with all the scientific and industrial jobs that flow from it and investments made over the past decade.

## **Thirty Meter Telescope: Project Overview**

The TMT will be the world's most powerful optical-infrared telescope. With an aperture of 30 meters and the world's most sophisticated instrumentation, it will be capable of ground breaking discoveries, from exploring the beginnings of the universe to discovering earth-like planets and probing them for the existence of life. The TMT and its instruments are fully designed and the first phase of construction has begun.

Construction costs will be \$1.5 billion USD and will be shared among the project partners: Canada, China, India, Japan and two major U.S. universities, with a later contribution expected from the U.S. National Science Foundation.

## **Canada's Role**

As a founding member of the TMT, Canada has played a major role in its design, thanks to an initial investment of \$30 million. Canadian engineers and scientists continue to lead the system engineering and instrumentation programs for the observatory and have chaired the international scientific advisory panel for several years.

Canada's proposed share of the construction cost is \$293 million USD. This will provide some 20% of the observing time and project control. Funds would be mostly spent in Canada and would enhance our industrial capability and competitive edge for future contracts. Canada's largest contribution will be the enclosure (see cover image), a precision steel structure to be built by Empire Industries in Port Coquitlam at a cost of about \$150 million. Another \$70 million is earmarked for Canadian instrumentation work, including the sophisticated adaptive optics system that will give TMT the ability to peer at fainter objects and farther into the universe than was previously possible, and with much greater clarity.

## **Scientific Benefits**

TMT partnership is the highest scientific priority in CASCA's Long Range Plan for Astronomy and Astrophysics (LRP). All Canadian astronomy stakeholders – universities, professional astronomers and Canadian companies involved in astronomy instrumentation – are united behind the LRP. The LRP process has been vital to Canada's achievements in Astronomy, a field in which Canada is recognized to be among the best in the world in the 2012 report to the Government by the Council of Canadian Academies. Participation in a large optical facility is a necessity for those countries that want to be leaders in this field. Japan, India, and China have already recognized the importance of joining the TMT project.

## **Economic Benefits**

The TMT is an ideal example of how investments in science can deliver new commercialization opportunities to Canadian industry.

The Coalition for Canadian Astronomy has projected 1,050 person-years of work from Canada's contribution of the telescope enclosure and instrumentation, plus an equal number of indirect jobs. Canadian export-oriented companies like Empire Industries and COM DEV will be heavily involved in TMT work. The Coalition recently received letters from more than 20 other companies across Canada that will be project suppliers. The enclosure and instrumentation contracts aggregate 75% of the Canadian Government's financial commitment being requested (\$222 million of \$293 million).

All work slated for Canada is in highly-skilled sectors, and previous investments in astronomy research have a proven track record of delivering long-term economic spin-offs. Empire Industries has parlayed its unique expertise gained from building more than half of the world's largest optical and radio-astronomical facilities into being a world-leading designer and builder of media-based attractions for the entertainment industry. The TMT enclosure would be built in Canada, exported and installed in Hawaii and become the most visible icon of the whole TMT project. It would represent a high-profile symbol of Canada's technological prowess.

In addition, the optical technology developed at the National Research Council and Canadian universities for TMT instrumentation will be further refined and built by Canadian optical industries such as COM DEV, opening new commercial opportunities in space technology.

COM DEV has detailed its interest in the design, building and testing of TMT, stating that it "will help support and extend our technology base for both future space instrumentation projects and our main business in space communications components and systems." The commercialization potential is clear, as noted in a letter to the Minister of Industry which states "working with the technologies embodied in the proposed TMT instrumentation will allow COM DEV to enhance our skills, leading to new applications in the area of space instrumentation, and to enhance our technology base, allowing us to tackle new products in optical communications and to continue to successfully compete globally."

The TMT elements slated to be built in Canada are in those industries that the Government identifies as a priority: high-tech advanced manufacturing with enormous export potential in developed and emerging markets. Canada's past astronomy investments have helped develop an internationally leading industry for sophisticated design, engineering and construction, as well as sophisticated instrumentation and optics work, all with vast and proven commercialization and high priority patent applications potential.

A list of companies that have the capabilities of contributing to TMT is given in the Canadian TMT Project Digest ([http://casca.ca/wp-content/uploads/2014/07/TMT\\_digest\\_2014.pdf](http://casca.ca/wp-content/uploads/2014/07/TMT_digest_2014.pdf)). In addition, the TMT will spawn, retain and attract highly-qualified experts to our country.

Finally, there are the benefits of building connections – scientific, academic and industrial – with the existing and emerging economic powers of Asia: China, India, Japan, all TMT partners. These connections will be very important to Canada in the years to come.

### **Project Status**

China, Japan, Caltech and the University of California formalized their financial commitment to TMT in early 2014 and have formed the TMT International Observatory (TIO) Corporation. Construction has begun and the ground-breaking ceremony is scheduled for October 7, 2014. India is expected to formalize its participation by fall 2014 and will join the TIO Board at that time.

Canada is not yet a participant in TMT construction, pending a funding decision by the Government expected to be provided before the April 2015 extended deadline given to Canada by TIO. Canada will need to formally join the TMT within the coming year to retain its negotiated share of the project and its right to the construction contracts.

There is considerable urgency since the enclosure is required early in the construction phase. In recognition of this, the TMT project office has been authorized by the TIO Board to prepare a contingency plan for an alternative supplier to mitigate the risk that Canada might not be able to join by April 2015. This has already occurred once on the TMT project, when Japan appointed Mitsubishi to replace Empire Industries, Canada's industrial partner, which was originally selected to build the \$125 million telescope because Canada was unable in 2010 to make a commitment to TMT.

### **Funding Requirements and Sources**

Canada's contribution to TMT construction under the current plan is \$293 million USD, including deliverables from work performed and controlled in Canada valued at 75% of Canada's total contribution (or \$222 million USD). This includes the provision of the telescope enclosure and adaptive optics system. The remaining funds are for centralized project management and infrastructure costs.

These funds would be distributed over the nine-year construction period, somewhat front-end weighted, driven by the enclosure which must be in place before the telescope is assembled inside it.

Past funding for TMT design work has come from the NRC, Canada Foundation for Innovation, and NSERC, with additional provincial and university contributions. The Coalition considers that it may again take a combination of such sources (including the new Canada First Research Excellence Fund) to contribute to funding Canada's share of TMT construction. However, such sources will not be sufficient to fully fund Canada's share and therefore the 2015 Budget will need to include a line item for the planned TMT construction costs.

Finally, it is important to note that TMT construction is a one-time cost for a project with a lifespan of 50 years or more. The long-term operating costs can be funded mostly from existing sources by winding down our engagement in existing telescopes.

### **2015 Budget Process**

The Coalition recognized the Federal Government's fiscal constraints following the economic downturn. Canada's representatives on the TMT Board at the time conveyed to the other partners that the Government needed time to restore fiscal balance before seeking a TMT construction commitment and were given a special accommodation to April 2015. With the Government's fiscal deficit poised to be eliminated, the Coalition is formalizing its request for \$293 million of funding for Canada's negotiated ownership share of the TMT.

### **Budget Recommendation**

The Coalition requests that the Federal Government solidify Canada's commitment to the Thirty Meter Telescope Project (TMT) and identify a means to fund Canada's \$293 million planned partnership stake.

### **Conclusion**

Opportunities to secure a leading role in a global project like TMT are rare. Thanks to Canada's leadership in this field, we have negotiated such an opportunity for Canadian astronomy. Canada is at the forefront of this project's design and much of the TMT can and should be built in this country. No partner is better qualified. Seizing this moment to secure Canada's partnership in TMT will pay scientific and economic dividends for decades to come.