SFU Teaching Observatory and Science Outreach Centre

Background Document

(January 11, 2010)

Executive Summary

The Faculty of Science has significantly increased its involvement in outreach activities in recent years, with two important goals: to raise the profile of the Faculty in the community and to encourage more students to study science. Faculty and Department support has encouraged a strong group of dedicated faculty and staff to run a variety of programs including Starry Nights @ SFU (astronomy observing sessions open to the campus community and general public) and Science in Action (a science education and outreach program which provides a full day of science immersion to grade school students). Participation in these events has grown significantly. More than 3500 members of the public were hosted at a variety of astronomy outreach events in 2009. In particular, over 2150 grade-school age students were hosted at daytime astronomy workshops, accompanied by more than 300 teachers and parents, from over 70 groups. The Starry Nights email list has 850 contacts, half from off campus, and evening observing sessions typically draw over 100 participants. Total enrollment in Science in Action programs typically exceeds 3000 students per year.

These highly successful outreach programs require a dedicated facility to ensure long term viability. The Teaching Observatory will support astronomy courses for both science and non-science majors, and will be available in the evening for public viewing and special presentations. The Science Outreach Centre will provide space and support for both astronomy and general science workshops for elementary, middle and high school students visiting SFU during the daytime from nearby schools. With a focus on community involvement and outreach, it will become a destination of interest to the public and provide a vital link between the University and regional communities.

As conceptualized, the observatory and outreach centre will be located adjacent to the Diamond Alumni Centre on SFU's Burnaby Campus and will consist of a telescope and motorized dome, a flexible-use classroom, meeting and storage space, and outdoor setup space. Plans are for the primary telescope to be a 16-20-inch diameter reflector telescope. The telescope will provide digital feed to display screens in the adjoining classroom as well as off-site locations such as schools. It will be housed in a motorized dome with a diameter of 8 meters (26.5'). The single-storey classroom will provide

space for 70-100 students when set up in lecture format or 48 students when set up in laboratory format. Outdoor space will also be available to provide a place for the public to set up their own telescopes and will showcase a sundial and other displays.

Context

Since the teaching observatory project was first conceptualized in 2004, there have been several exciting developments.

- In 2006 the Department was approached by the Royal Astronomical Society of Canada's Vancouver Centre (RASCVC) with a proposal to work with the Department on outreach and teaching related to astronomy. This has developed into a very active and mutually beneficial relationship. We are currently providing some roof space for an all-sky telescope, some space for evening meetings and we have co-hosted special events for the public such as the recent lecture by Ray Villard, former media spokesperson for the Hubble Space Telescope. The RASCVC has been actively involved in many of our outreach activities, especially by providing volunteers, telescopes, and logistical support.

- Dr. Howard Trottier, a faculty member in the Department of Physics, has acted on his enthusiasm for amateur astronomy and started a program of observing events on campus. He leads a group of amateur astronomers and interested members of the public, Starry Nights @ SFU, who visit SFU on a regular basis to attend Star Parties. Star Parties are free and are open to everyone, whether from SFU or the greater community. Visitors are invited to look through telescopes provided by SFU Physics and RASC volunteers at a variety of celestial wonders, including star clusters, nebulae, galaxies, the Moon and the planets. This group hosted over 1000 visitors, mostly young families, at evening events during 2009.

Figure 1. Starry Night event at SFU. Image courtesy of Aaron Springford.

- SFU Science has increased its outreach activities significantly in recent years, mainly through a program called Science in Action at Simon Fraser University (SIA@SFU) developed by Dr. Sophie Lavieri, a faculty member in the Department of Chemistry. SIA@SFU is a unique science education and community outreach program providing children in Grades 3 through 12 with a full day of university science immersion at no cost to the participants. It fills a need that teachers and homeschoolers say is not available anywhere else in the province: a free, customized, university-based program that inspires a life-long passion for science by engaging children in hands-on science experiments while also expanding and enriching the curriculum. With over 50 SFU faculty and staff volunteers and hundreds of undergraduate, graduate, and postdoctoral student volunteers, this interdisciplinary program has been delivered to over 6,000 BC children to date. Most recently the year 2009 has seen a flurry of activity in the form of astronomy workshops designed by Howard Trottier to bring attention to the International Year of Astronomy (IYA), a celebration of the 400th anniversary of Galileo's invention of the telescope. The astronomy workshops alone were presented to more than 2150 grade-school age children, with total enrolment in Science in Action programs reaching more than 3000 during the 2009 calendar year.

Figure 2. Visit by Sperling Elementary, 2009.

These events have encouraged us to update this proposal to include a center for science outreach as part of our plans for the observatory.

Advantages of an SFU Burnaby location for Astronomy and Outreach

Observing conditions on Burnaby Mountain are better than many in the surrounding area. With an elevation of more than 300 m (1000') above sea level, the Burnaby campus of Simon Fraser University offers superior viewing possibilities of the sky as

compared to the City of Vancouver, as haze and stray light from human activity are greatly diminished compared to lower altitudes.

Locating science outreach activities on campus has several advantages:

- It brings children and teachers into an environment where science is part of everyday life
- It provides proximity to experienced volunteers with a passion and in-depth knowledge of science
- It encourages interaction between the University and the surrounding community.

Finally, the University is within easy reach of most communities in the Vancouver region and has very frequent bus service to the nearby Skytrain line.

Users

The primary university users of the observatory will be members of the Physics Department, both students and faculty. More generally we expect the observatory and outreach center to be accessed by many community users including outreach groups such as Science Alive, regional elementary and highschool students, and amateur astronomy clubs such as the Royal Astronomical Society of Canada.

Activities

The primary activities associated with the observatory and outreach centre will be teaching and outreach, rather than research.

The Department of Physics currently offers two courses, PHYS 190, an introductory astronomy course designed as a science breadth course for non-science students, and PHYS 390, an advanced undergraduate astrophysics course that includes topics such as planet formation and stellar evolution. PHYS 190 is expected to be offered several times annually to enable more students to meet the SFU curriculum requirements for breadth implemented in 2006. Within the next few years, the Department plans to add a second introductory course designed for students who have taken first year science courses. Observation of the night sky is an important part of both PHYS 190 and PHYS 390 and could be a component of undergraduate research projects for honours theses or advanced physics/chemistry laboratories. Suitable projects would include measuring planetary motion or stellar spectra and intensities.

In addition, there are many possibilities for outreach activities, including:

- Visits by school groups. Based on recent experience with SIA@SFU, we have learned that teachers and home-school families are very enthusiastic about bringing their grade-school age children to science outreach events on campus. Current demand for these programs far exceeds the space available. A dedicated

Observatory and Science Outreach Centre will allow for expanded programming. We envision these visits will occur as part of SIA@SFU.

- Workshops for teachers. In the long run it is more efficient to offer teachers the support they need to provide engaging and stimulating science content in their classrooms. This space would be ideal for professional development workshops and programs such as the proposed M.Sc. in Science Teaching.
- Continuing education classes. Both the University and local school boards offer continuing education classes. For example, a number of school boards across the Lower Mainland offer 8-session introductory astronomy courses, often staffed by experienced amateur astronomers or high school teachers. These courses are given in generic classroom space and could benefit from a dedicated teaching environment like the SFU Observatory and Science Outreach Centre.
- Public viewing using the Observatory's telescope. All solar system planets, and numerous visually stunning objects such as star clusters, gas clouds, and galaxies can be resolved with a telescope such as the one proposed. In addition, unusual events such as lunar eclipses, comets and meteor showers, will be of interest to the public. Such occasions could form the basis of special events at the Observatory, designed to capitalize on media coverage which in recent years has increasingly generated significant public awareness of celestial events.
- Digital image capture. Public viewing of astronomical objects through the telescope will be combined with near-real time digital image capture. Modern digital cameras are used to take breathtaking full-colour images of a wide variety of astronomical objects in near-real time. Visitors to the SFU Observatory could take away an image of an object which is captured after it has been seen through the telescope by eye, as a keepsake of the visit.
- Web distribution of astronomical images. Digital images taken at the Observatory could be made available to school groups and the public to download from the web themselves. These images will have high aesthetic and pedagogical value, including as keepsakes of visits to the Observatory. School projects could also be facilitated through the Observatory, including time-lapse series such as the motion of the moons of Jupiter, lunar eclipses, and the apparent rotation of stars about the north celestial pole.
- Access for remote schools. Videoconferencing equipment, digital image capture, and web distribution of astronomical images will make it possible for students in remote communities to participate in these programs.
- Observing sessions for the public. The site will include space for the public to set up their own portable telescopes adjacent to the dome. This will become the permanent location of the Starry Nights program.
- Participation by local astronomy clubs. The Centre will provide meeting space for local astronomy clubs such as RASCVC.
- Access to remote telescopes. The Centre will provide an access point for controlling or receiving data from remote telescopes.
- General science outreach. Other science outreach programs such as Science Alive summer camps could make use of this space.

The Location

Figure 3. The location currently under consideration is just to the east of the Diamond Alumni Centre, represented by the dashed square in the photo shown above.

Construction

As conceptualized, the Teaching Observatory and Science Outreach Centre consists of two components: a classroom component and an observatory component. Entry would be from a plaza, where visitors could set up their own telescopes and which would feature a sundial. The dome would sit at or slightly above street level, with the classroom and storage space below street level. Phil McCloy, Campus Planning and Development, has provided a couple of sketches of possible configurations. Configuration A is shown in Figure 2; Configuration B in Figure 3. Configuration B is slightly larger, which will lead to greater flexibility for programming and for working with the widest possible variety of partners.

The classroom component should include approximately 140 m^2 of floor space. The goal is to accommodate 70-100 students in loose seating or a smaller number at tables. To improve flexibility, it would be convenient if this space could be partitioned into two smaller classrooms. The space should be designed to accommodate:

- both lectures and active learning environments,
- screen and projection equipment,
- video conferencing equipment for remote schools,
- storage space for small telescopes and laboratory equipment,
- space for computers for access and control of remote telescopes,
- sink and counter top for preparing demonstrations and/or snacks for visitors,
- public washrooms, and
- access to ground level and to the observatory in the form of stairs and elevators.

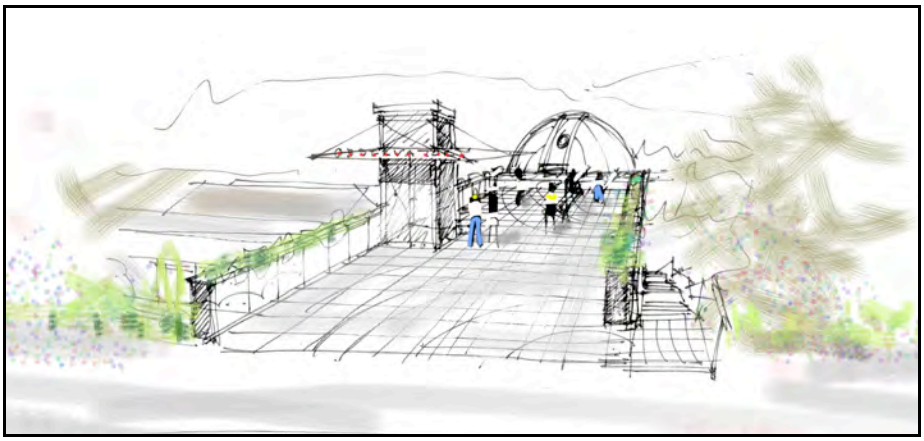

Figure 4. Conceptual drawing of entry plaza and observatory dome for the new Teaching Observatory and Outreach Centre (Configuration A).

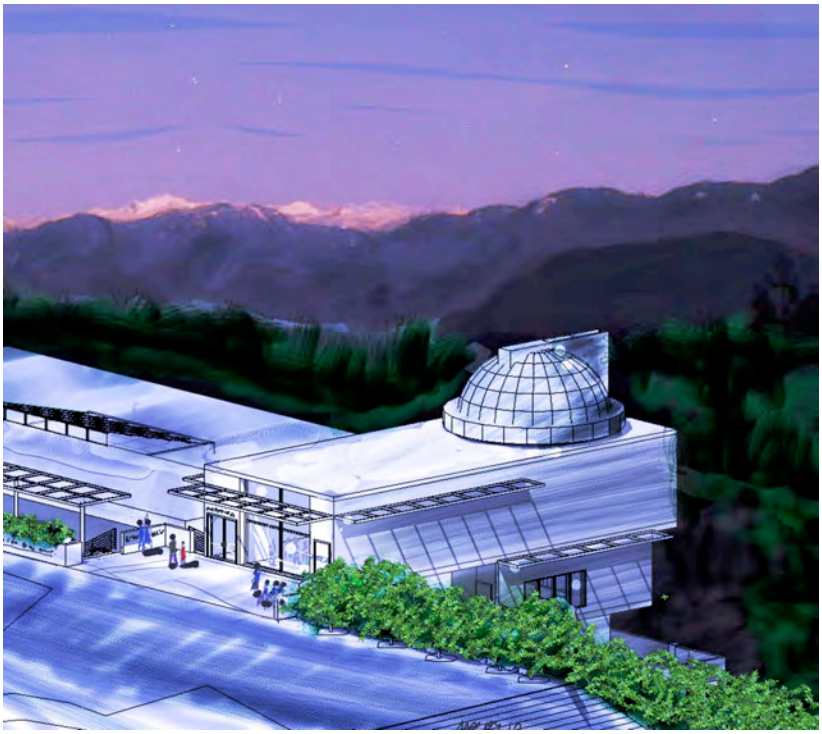

Figure 5. Conceptual drawing of entry plaza and observatory dome for the new Teaching Observatory and Outreach Centre (Configuration B).

The classroom roof should contain sufficient thermal insulation to reduce warm air escape in the winter, acknowledging that warm air turbulence from a hot roof on summer evenings may be unavoidable. Lighting around the observatory should be full cut-off, if possible, to reduce stray light glare. Lighting within the observatory should include a red light system to minimize dark adaptation for nighttime observers.

The observatory component consists of a dome and the support for the telescope. With a diameter of about 8 m, the dome sits on a track that is supported on a cylindrical

structure. It is made of aluminum and is lightweight - approximately 3000 kg for an 8 m (26 ') diameter dome. The dome has a small motor to rotate it and a motorized shutter. There should be a heating system within the dome itself so that temperature does not fall below the dew point. There is great risk of condensation forming on the interior of the dome due to temperature gradients. These can be alleviated by keeping the dome slightly warmer than the outside. Insulation of the dome should also be considered.

The dome is larger than what is needed for a single telescope, but this is essential as it will allow for access to the dome and will provide the space required to manage large groups of visitors.

The telescope must be mounted in such a way as to suppress mechanical vibrations. Thus, the mount is anchored by a concrete column 1 m in diameter and of sufficient depth (4 m) to be stable. A weight ratio of 20:1 of column to telescope should be sufficient to increase the harmonic frequency of the system and reduce damping problems.

Instrumentation budget

What is most important in a teaching observatory is the ability to observe a great variety of celestial objects directly through a telescope - a "hands-on" experience. As a tool for instruction or student projects, it is also important to capture images digitally so that they can be shown in nearby classrooms and distributed on the internet.

Instrumentation costs, while not insignificant, are a modest component of the overall budget. The following estimates are quoted in Canadian dollars:

4 m radius dome (installed)	$105,000
16-20-inch diameter reflector telescope, with CCD camera and robotically-controllable mount	$150,000
Computers, monitors, projectors	$15,000
TOTAL	$270,000

Long Term Plans

SFU	Maintenance, services, security
Physics	Technical support for telescope
Science in Action	Volunteers for workshops etc
Fund Raising	New equipment, supplies, programming support