External Review of the David Dunlap Institute

January 10-11, 2005

Introduction: The Review Process and Overview.

The External Review Committee (ERC) was composed of Alyssa Goodman (Dept. of Astronomy, Harvard University), Lyman Page (Dept. of Physics, Princeton University), and A. Russell Taylor (Dept. of Physics and Astronomy, The University of Calgary). The ERC met January 10 and 11, 2005 at the University of Toronto Department of Astronomy and Astrophysics (DAA). We spoke with representatives of all elements of the department. Prior to the meeting we read the mission statement for the David Dunlap Institute (DDI) and we reviewed the DDI as part of the meeting.

The vision for the David Dunlap Institute is inspired. It is a wonderful way to make the already excellent program in astronomy and astrophysics at the University of Toronto even stronger. Increasingly, the physical sciences are finding direction from astrophysical observations. For example, we know from solar observations that the neutrino has mass, we know from galactic and cosmological observations that there is a new type of subatomic particle ("dark matter"), and we know from cosmological observations that there is a new substance in the universe ("dark energy") or that our fundamental notions of gravity are in need of revision. Behind the discovery of these new aspects of Nature lay new types of instruments. The DDI is aimed at fostering the development of experiments and instrumentation that will solidify and advance the picture we now have, keep the University of Toronto at the cutting edge of the next generation of discovery, and secure its leadership in the transformative research with the next generation of astronomical telescopes.

When it was built, the David Dunlap Observatory housed the world's second largest optical telescope. It vaulted Canadian astronomy to the forefront. The field has evolved significantly since then. There are now many larger telescopes and the city has encroached on the Observatory. We agree that it is a good time to revitalize the Dunlap family legacy and to align it with modern trends in astronomy. The DDI is a wonderful way to accomplish this.

Scientific Vision and Organization.

We understand the DDI to be an observational/instrumental version of CITA, albeit without CITA's national mandate. It would be an independent entity with its own director and would be planned to complement and build on the considerable strengths at CITA and the DAA.

We cannot imagine a better way to carry on the Dunlap legacy than with the DDI. A number of institutes have embarked on similar ventures, for example the new Kavli and NSF Centers in the US, but none has the advantage of complementing as potent a theory center as CITA.

The scientific vision is built on three broad themes.

1) Coupling of Experimentalists/Instrumentalists to the Academic Faculty.

The interaction between experimentalists/instrumentalists and academic faculty is precisely what makes the DDI such a great concept. Industries, government laboratories and technical organizations can build instrumentation, but it takes a strong coupling of technical and scientific expertise to ensure that instrumentation is driven by forefront science and can successfully adapt to the march of scientific inquiry. The Canadian Long Range Plan for Astronomy notes the paucity of

instrumentation laboratories associated with strong research universities, and the resulting decoupling of university scientists and instrumentation development. The DDI will establish a University of Toronto lead in redressing this inbalance in Canada.

At both the DAA and CITA, there are world-class scientists with strong track records of working with engineers, technicians, and industry who could take immediate advantage of the DDI. There are also ample opportunities for building stronger ties to the Physics Department. The DDI would be a major selling point for attracting faculty, postdocs, and graduate students, and for retaining faculty. Easy access to highly trained technical help is a boon for any project.

2) Scientific Instrumentation.

Modern astronomical instrumentation is at the forefront of experimentation in physics. In complexity and scale astronomical cameras, receivers, telescopes, and spectrographs rival instrumentation for particle physics. Yet, there are still many aspects of instrumentation that can be tackled and advanced by small groups. There is ample evidence of this in the DAA already.

The DDI would make opportunities for the University of Toronto where none now exist. When the capability to build instruments is established, the University of Toronto will be positioned to win more grants and contracts both nationally and internationally.

We endorse the concept that the DDI is involved in multiple projects and multiple levels, and not just one large project. With a variety of projects, one gains from a cross pollination of ideas, and a healthy ratio of scientist to more technical staff can be maintained.

Computational resources are necessary for any instrumental endeavor. For example, software will be as much a part of the next generation of detectors as will hardware. The size of the data sets that will derive from these facilities will present a computational challenge in simulations, data processing and data mining. The presence at CITA of one of Canada's most advanced computation facilities for astrophysics will complement the DDI to complete the triangle of observations-theory-computation, that will be needed to work at the forefront with the next generation. On a cautionary note, the director should ensure the DDI does not fall into the trap of becoming just a software center.

3) Public Education and Outreach.

It is natural for the DDI to have a significant component dedicated to outreach. Astronomy is a time honored vehicle for connecting science with the public. It is difficult to look at the sky and not dream about what might be out there! For years the DDO has been an emblem of the link between academia and the community. The ERC is pleased that outreach continues to be central to the DDI mission.

Implementation of the DDI.

The most challenging step in implementing the DDI will be in finding the right director. We believe that the director should be a scientist with both organizational experience and a keen eye for technical talent. If a top notch local candidate cannot be found, we suggest an international search. We imagine that the position will attract talented candidates.

The staffing plan is not yet complete, other than through the broad brush strokes mentioned above. We believe this is appropriate for this stage of planning.

The question of space for the DDI is important. The DDI should be physically as close to CITA and the DAA as possible. We emphasize that the interaction between the instrumentation programs

of the DDI and the scientific and computational expertise in the DAA and CITA will be the chief factor that sets the DDI appart from other instrumentation laboratories. Every effort should be made to ensure that this interaction is embedded in the day-to-day function of the institute.

The DDI will be an institute of international stature that will benefit both the University of Toronto and the national agenda for astronomy. The DDI will advance the legacy of the Dunlap family by ensuring the contribution of the family keeps the University of Toronto and Canada at the forefront of research. The Dunlap family can be proud of the mission and vision of the DDI. We hope the building sign conspicuously broadcasts the Dunlap name.

The combination of visitors, meetings, workshops, and colloquia will all enhance the visibility and vitality of the DDI. The Dunlap Medal is a great idea. It may be possible to get its recipient to give a public lecture as well!

In summary, the concept for the DDI complements and builds on the unique strengths already present at the DDA and CITA, and will launch the University of Toronto as a leader in experimental and instrumental astrophysics both nationally and internationally. The plan for bringing the DDI to fruition is clear, yet remains open and adaptable enough to take advantage of opportunities that arise along the way. The ERC was impressed with the vision and excited by the possibility of what the DDI could become. We look forward to welcoming the DDI into the astronomical community.