Proposal for TRIUMF Commitment (5YP 2015-2020)

Date:
September 13, 2012

PROJECT/COMMITMENT TITLE: Expansion of the Theory Cluster Computer

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PROJECT DESCRIPTION:

The Theory Group (TG) at TRIUMF acquired a dedicated High Performance Computing facility, the TRIUMF Theory Cluster, in 2009. Two upgrades were made after that: one in 2010 and one in 2011. At present, this facility is still of modest size, 24 compute nodes (with 12 cores each) and 64 GB of memory per node. The Theory Cluster proved to be indispensable for the nuclear physics staff members and all the postdoctoral research associates for developing and debugging new codes and running the less demanding jobs for production. The large memory per node and the unlimited wall time access are key features that make the Theory Cluster an important tool to advance the research.

The Theory Group proposes to expand the Theory Cluster to 96 compatible nodes with the possibility to modernize them.

SCIENTIFIC JUSTIFICATION:

One of the primary goals of the TRIUMF Theory Group is to develop an ab initio description of bound and scattering properties of nuclei and hadrons. This is achieved via a numerical solution of the quantum many-body problem, which is a CPU time demanding and memory intensive task. The Theory Group also studies physics at the Large Hadron Collider (LHC) where the simulation of particle collisions is needed to compare new theoretical predictions with experimental results. It is essential for efficient and productive theory research to have access to a parallel computer such as the Theory Cluster with immediate availability, unrestricted wall time and a large memory per node configuration. Overall, the satisfaction of the Theory Group members with the Theory Cluster is high, the cluster runs mostly smoothly, and the utilization of the cluster is very high. It is maintained and administrated by Kelvin Raywood from the CCN group.

With the expected increase of the Theory Group members on the one hand, and, on the other hand, with the increasing computational demand due to advances of our ab initio calculations pushed to heavier masses and the expected wealth of new LHC data, it is essential to expand the computing power of the Theory Cluster. Even after increasing the size four times as requested, the Theory Cluster will be of modest size by today's standards. With this proposed upgrade of the Theory Cluster, the TG expects to need more help for the management and the maintenance of it, but given the size we propose, this should take less than a 0.5 FTE.

RELATIONSHIP TO BROADER CANADIAN RESEARCH COMMUNITY:

The TG is on a forefront of Canadian theoretical nuclear and particle physics research with frequent publications in the most prestigious physics journals such as Physical Review Letters. The TG is aligned with the TRIUMF experimental programs more closely than other Canadian theory groups. A local high-performance computation capability is essential to maintain the alignment and the leadership position in the nuclear and particle theory. As mentioned before the numerical applications developed in the TG are very memory intensive and highly parallel, so that a large memory/node and a high speed interconnect are indispensable. Top high performance computers, that meet these requirements and are accessible externally (e.g. Jaguar etc.), cannot be easily used for code development and debugging, due to CPU time restriction,

waiting time for interactive queue, etc. Our experience shows that having a local dedicated compute cluster with large memory/node and fast interconnect is beneficial for productivity.

BROADER IMPACTS:

Nuclear physics has entered an exciting era with advances in ab initio methods for light nuclei and in the development of a universal density functional theory for heavy nuclei. This progress is the fruit of a combination of new theoretical ideas and the availability of large-scale computing resources. Testing theoretical proposals against LHC data also requires significant computing power. **As such, scientific computing is key for the success of the theory program at TRIUMF.** Having a local compute cluster of modest size is not unusual in a physics lab with a focus on nuclear physics (e.g., GSI) and is necessary to maintain, on the theory side, the international leadership position of TRIUMF in nuclear and particle physics.

MAJOR MILESTONES:

Description	Date
Expansion by 24 nodes	2016
Expansion by 24 nodes	2017
Expansion by 24 nodes	2018
Modernization of the oldest 24 nodes	2019
Modernization of the oldest 24 nodes	2020

RESOURCE REQUIRMENTS:

CASH FLOW REQUIREMENTS						
\YEAR SOURCE \	ONE	TWO	THREE	FOUR	FIVE	TOTAL
TRIUMF	100k	100k	100k	50k	50k	400k
EXTERNAL						
TOTAL	100k	100k	100k	50k	50k	400k
TRIUMF NON-CASH RESOURCES						
\YEAR RESOURCE\	ONE	TWO	THREE	FOUR	FIVE	TOTAL
Information Technology – System Administration	0.5 FTE	0.5 FTE	0.5 FTE	0.5 FTE	0.5 FTE	2.5 FTE

EXTERNAL FUNDING INFORMATION:

ONGOING OPERATIONAL REQUIREMENTS:
Space in a cooled computer room

DECOMMISSIONING REQUIREMENT:

Accepted: Date: