G8 Exascale Projects Workshop

G8 Research Council's Initiative on Multilateral Research Funding: "*Interdisciplinary Program on Application Software towards Exascale Computing for Global Scale Issues*"

PANEL DISCUSSION: G8 Exascale Project PI's & International Agency Representatives

Chair: William Tang, Princeton University

Salt Lake City, Utah, USA

3:30 – 5:00 PM, Monday, November, 2012

G8 Exascale Project PI's

- "Enabling Climate Simulation @ Extreme Scale" (ECS) – US, Japan, France, Canada, Spain

  Panel Representative: ***Franck Capello, lead PI***
- "Climate Analytics on Distributed Exascale Data Archives" (ExArch) UK, US, France, Germany, Canada, Italy

  Panel Representative: ***Paul Kushner, U. Toronto, Canada***
- "Icosahedral-Grid Models for Exascale Earth System Simulations" (ICOMEX) – Japan, UK, France, Germany, Russia

  Panel Representative: ***Thomas Ludwig, U. Hamburg, Germany***
- "Nuclear Fusion Simulations @ Exascale" (NuFuSE) – UK, US, Germany, Japan, France, Russia

  Panel Representative: ***Adrian Jackson, U. Ediburgh, UK***
- "Modeling Earthquakes and Earth's Interior based on Exascale Simulations of Seismic Wave Propagation" (Seismic Imaging) – US, Canada, France

  Panel Representative: ***Jeroen Tromp, lead PI***
- "Using Next-Generation Computers & Algorithms for Modeling Dynamics of Large Bio-molecular Systems" (INGENIOUS) -- Japan, UK, Germany, Russia

  Panel Representative: ***Makoto Taiji, lead PI***

Focus for G8 Exascale Project PI's in Panel Discussions

➔Observations on appropriate ***funding process/approach*** to enable effective international collaborative research with the following focus:

1. Added Value enabled by G8 Resources: How did each project leverage ***impact of G8-funding by:*** (i) *access to international computing facilities*; (ii) *sharing of hardware experiences*; and (iii) *collaborative software advances* motivated by science targets ?;

2. Mutually beneficial cooperation with specific ***added value from the international research collaboration***;

3. Opportunities for Early Career Researchers: What did each G8 project accomplish with respect to ***recruitment/training/assimilation of talented young scientists*** -- especially since nearly all of G8 funding was dedicated to supporting *Early Career Researchers/ Post-docs*; and

4. What funding mechanisms seem most appropriate to pursue in going forward to *improve and enlarge existing research efforts* in providing the needed resources for ***effective multi-national projects on the "path to exascale"*** ?

Response from J. Tromp, PI for G8 Seismic Imaging Project

1. How did each project **leverage** ***impact of G8-funding?***

(i) Thanks in part to the G8 grant, we recently *won a 2-year 200M Titan core hour INCITE allocation at ORNL*. I believe the G8 grant also helped us make a *successful case to NSF for a small GPU cluster at Princeton.*

(ii) All our software is open source, so, for example, the recently developed production GPU version of our software is already freely available via the Computational Infrastructure for Geodynamics svn server.

(iii) Besides the team from Princeton, Marseille and Toronto, we *collaborate with ETH Zurich and NVIDIA, and we plan to start collaborations with IBM and Intel. With IBM we plan to focus on "big data" and workflows, and with Intel on the new MIC architecture for seismic imaging and inversion.*

2. Members of the team have *spent significant amounts of time at partner institutions*. In addition, we have had visitors from Grenada Spain, INGV Rome, and INGV Bologna.

3. The G8 grant has *partially supported ~4 graduate students and ~4 postdocs at team institutions.*

4. I would be very happy with a similar level and duration of funding for future projects. The one component that is missing is a hardware component; i.e., hardware that is necessary to develop the target exascale software

➔ but in practice ***the G8 grant has helped in gaining access to needed hardware resources.***

G8 International Agency Representatives

- **France**: French National Research Agency (ANR) – *ECS, ExArch, NuFuSE, ICOMEX, Seismic Imaging*

  Panel Representative: ***Jean-Yves Berthou***
- **US**: National Science Foundation (NSF) – *ECS, ExArch, NuFuSE, Seismic Imaging*

  Panel Representative: ***Irene Qualters***
- **Germany**: Deutsche Forschungsgemeinschaft (DFG) – *ExArch, NuFuSE, ICOMEX, INGENIOUS*

  Panel Representative: ***Marcus Wilms***
- **Japan:** Japan Society for Promotion of Science (JSPS) – *ECS, ICOMEX, NuFuSE, INGENIOUS*

  Panel Representative: ***Kyoshi Saito***
- **United Kingdom**: Engineering & Physical Sciences Research Council (EPSRC) – *ExArch, NuFuSE, ICOMEX, INGENIOUS*

  Panel Representative: ***Daniel Emmerson***
- **Canada**: National Sciences & Engineering Research Council of Canada (NSERC) – *ECS, ExArch, Seismic Imaging*

  Panel Representative: ***Irene Qualters (on behalf of Eniko Megyeri-Lawless, NSERC)***
- **Russia**: Russian Foundation for Basic Research (RFBR) – *NuFuSE, ICOMEX, INGENIOUS*

  Panel Representative: ***Statement from Academician Boris Chetverushkin, RFBR Board Member***

Focus for International Agency Representatives in Panel Discussions

➔Observations on ***funding mechanisms*** associated with scientific objectives/goals of G8 Exascale research projects with the following specifics:

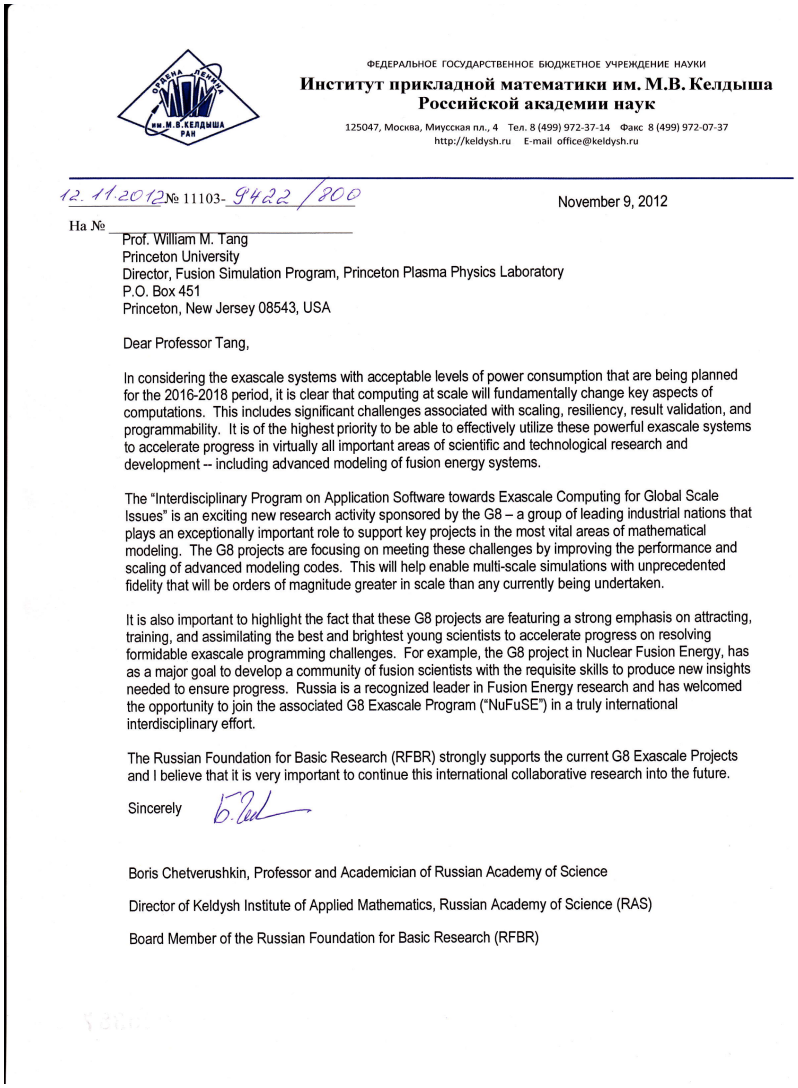
1. What are *national funding mechanisms* that currently exist and/or are planned at the national level to *support "Path to Exascale" R&D for next 5 years* ? ➔ including thoughts on (i) mutually-beneficial *connections between "Path to Exascale" topics and broader needs of scientific community @ national level;* and (ii) ***international funding mechanisms***;

2. View on relevance of "Path to Exascale" research within broader context of ***computational and data science needs and opportunities*** for *cost-effective joint funding to support shared computational and data cyber-infrastructure, applications research, and associated education and training*;

3. What *funding mechanisms* could be put in place to support ***continuation of productive/ successful multi-national R&D projects on "Path to Exascale"*** ? ➔ consider examples of existing funding models that could be leveraged or enhanced for such exascale research topics?

4. What ***mechanisms for organization of agencies*** should be put in place to ***enable sustained funding for multi-national computational science collaborations***? → e.g., consider those in other disciplines such as physics and astronomy?

Letter of Support: Academician B. Chetvureshkin, Board Member of *Russian Foundation for Basic Research (RFBR)*



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На №

Prof. William M. Tang
Princeton University
Director, Fusion Simulation Program, Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, New Jersey 08543, USA

Dear Professor Tang,

In considering the exascale systems with acceptable levels of power consumption that are being planned for the 2016-2018 period, it is clear that computing at scale will fundamentally change key aspects of computations. This includes significant challenges associated with scaling, resiliency, result validation, and programmability. It is of the highest priority to be able to effectively utilize these powerful exascale systems to accelerate progress in virtually all important areas of scientific and technological research and development -- including advanced modeling of fusion energy systems.

The "Interdisciplinary Program on Application Software towards Exascale Computing for Global Scale Issues" is an exciting new research activity sponsored by the G8 – a group of leading industrial nations that plays an exceptionally important role to support key projects in the most vital areas of mathematical modeling. The G8 projects are focusing on meeting these challenges by improving the performance and scaling of advanced modeling codes. This will help enable multi-scale simulations with unprecedented fidelity that will be orders of magnitude greater in scale than any currently being undertaken.

It is also important to highlight the fact that these G8 projects are featuring a strong emphasis on attracting, training, and assimilating the best and brightest young scientists to accelerate progress on resolving formidable exascale programming challenges. For example, the G8 project in Nuclear Fusion Energy, has as a major goal to develop a community of fusion scientists with the requisite skills to produce new insights needed to ensure progress. Russia is a recognized leader in Fusion Energy research and has welcomed the opportunity to join the associated G8 Exascale Program ("NuFuSE") in a truly international interdisciplinary effort.

The Russian Foundation for Basic Research (RFBR) strongly supports the current G8 Exascale Projects and I believe that it is very important to continue this international collaborative research into the future.

Sincerely

Boris Chetverushkin, Professor and Academician of Russian Academy of Science

Director of Keldysh Institute of Applied Mathematics, Russian Academy of Science (RAS)

Board Member of the Russian Foundation for Basic Research (RFBR)

Key Excerpts from Letter:

- " It is of the highest priority to be able to effectively *utilize these powerful exascale systems to accelerate progress in virtually all Important areas of scientific and technological research and development* -- including advanced modeling of fusion energy systems."

- "The G8 projects are focusing on meeting these challenges by improving the performance and scaling of advanced modeling codes. This will help *enable multi-scale simulations with unprecedented fidelity that will be orders of magnitude greater in scale than any currently being undertaken*.

- " It is also important to highlight the fact that these G8 projects are featuring a *strong emphasis on attracting, training, and assimilating the best and brightest young scientists to accelerate progress on resolving formidable exascale programming challenges*."

- "The Russian Foundation for Basic Research (RFBR) strongly Supports the current G8 Exascale Project, and I believe that it is *very important to continue this international collaborative research into the future*,"