

Science Policy In Canada

The Role of Global Science in a "Flat World"

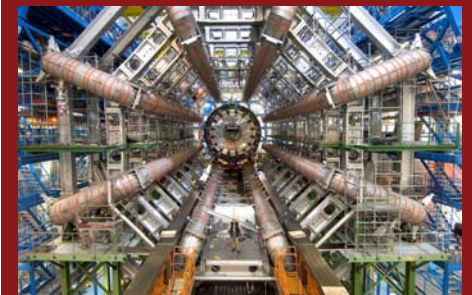
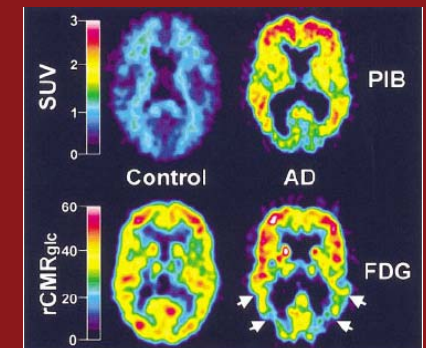
How Canada fits into the world of global science and
technology (A Personal View)



Frontiers In Science, Kolkata, India

Nigel S. Lockyer | Director | TRIUMF

Owned and operated as a joint venture by a consortium of Canadian universities via a contribution through the National Research Council Canada
Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada



Challenges to Canada

Global in Nature

- **Economy (maintain & improve standard of living)**
 - Economy is global
- **Health care (better) and costs (controlled)**
 - disease is global
 - benefits of discoveries international
 - big business
- **Environment**
 - Global climate change
- **Energy**
 - Global influence & global demand

Science & Challenges Interwoven

- In the eyes of the Canadian government,
 - Science and technology are connected
 - Science and economic growth are connected
 - Science and health are connected
 - Science and environment are connected
- In the eyes of the Canadian Government
 - Science seeds technical innovation
 - Universities do science and should pass on to industry so they create and exploit innovation
 - Struggling with how that really works..two different cultures....academic and private sector

Themes in Canadian Science Policy

- Focus in a few areas where there is excellence
 - Too small to do everything in science
- Connect to the world...flat world being accepted
 - Canada discussing associate membership in CERN
- Societal and economic impact important
- Brain gain: attract best to Canada
- Strong support for role of universities
- Emphasis on innovation & business collaborations with universities
- Training of highly qualified people (HQP) important
 - All NSERC (like NSF) proposals evaluated on HQP

Policy: Focus in Four Strong Areas

- Information & Computer Technology
 - Natural Resources
 - Health and Related Life Sciences & Technologies
 - Environmental S&T
-
- Reference: The State of S&T in Canada
 - Council of the Canadian Academies Sept. 2006

How is Policy Arrived at ?

- No science advisor to Prime Minister
 - Position eliminated...concerns raised
 - created a junior Minister for Science & Technology
 - viewed by government as recognizing increased importance of S&T
- Created a high level S&T & Innovation advisory committee (STIC)...university presidents, important business people, scientists..
 - No public disclosure of advice to government
- Council of Canadian Academies
- Community Long Range Plans

Who is responsible for Science?

- Ministry of Industry is responsible for Science in Canada
 - Funding councils support individual investigators
 - Natural Sciences & Engineering Research Council
 - Canadian Institutes of Health Research
 - Social Sciences and Humanities Research
- Ministry of Foreign Affairs & International Trade outside Canada
- Canada-India S&T Agreement & small funding program for cooperative research
- S&T Counselor at High Commission (New Delhi)

Successful programs

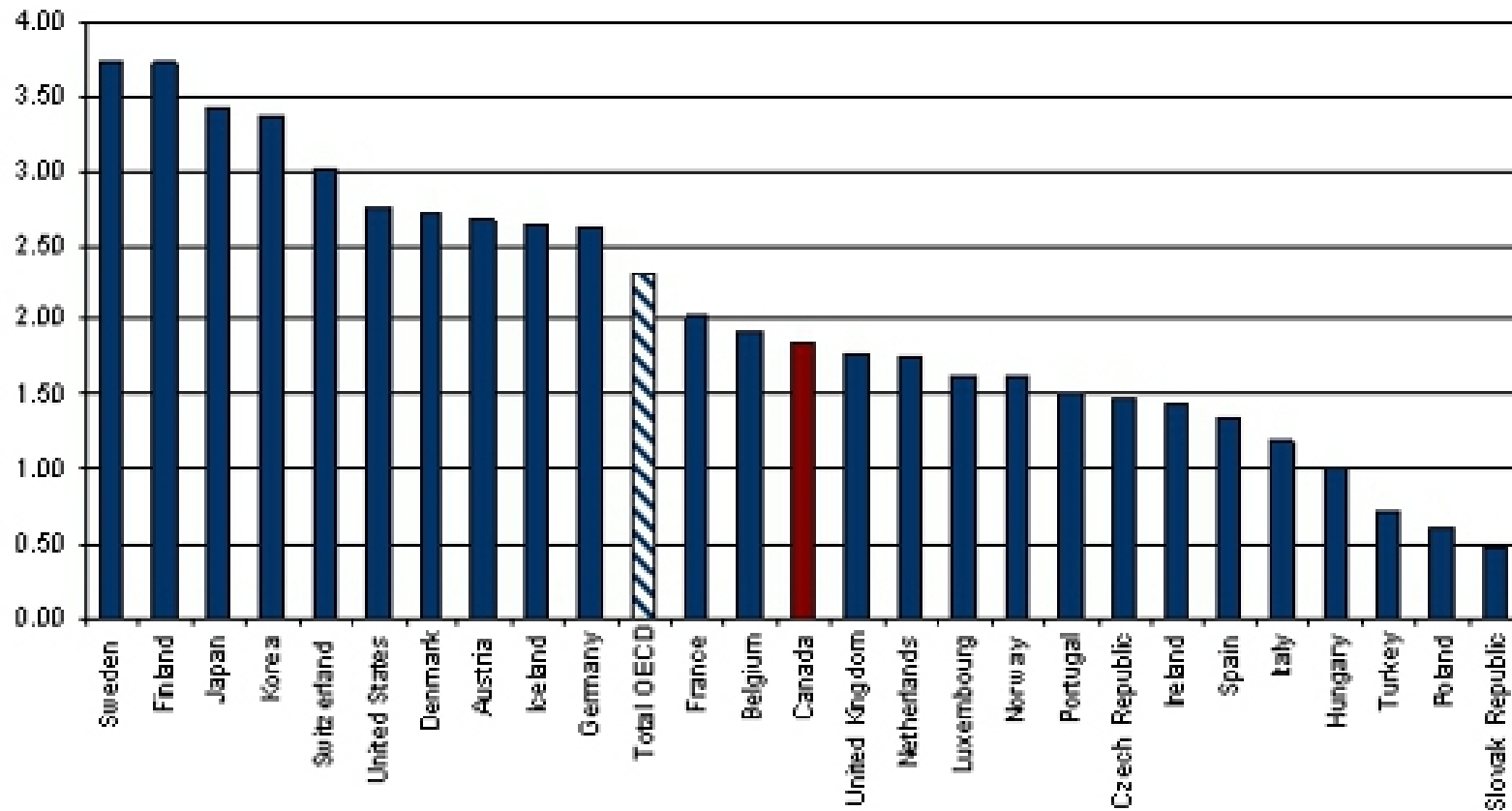
- Canadian Foundation for Innovation (CFI)
 - Source for funds for science infrastructure
 - Highly successful and popular
 - Multi-billion investment over decade
- Canada Research Chairs...Canada Excellence Chairs, bring in international stars & superstars
- National Fellowships for students (Vanier) & Postdocs (Banting)...again brings in the best internationally
- Stimulus package (KIP) \$2B aimed at university infrastructure...support Canada's strengths

Universities..economic engines

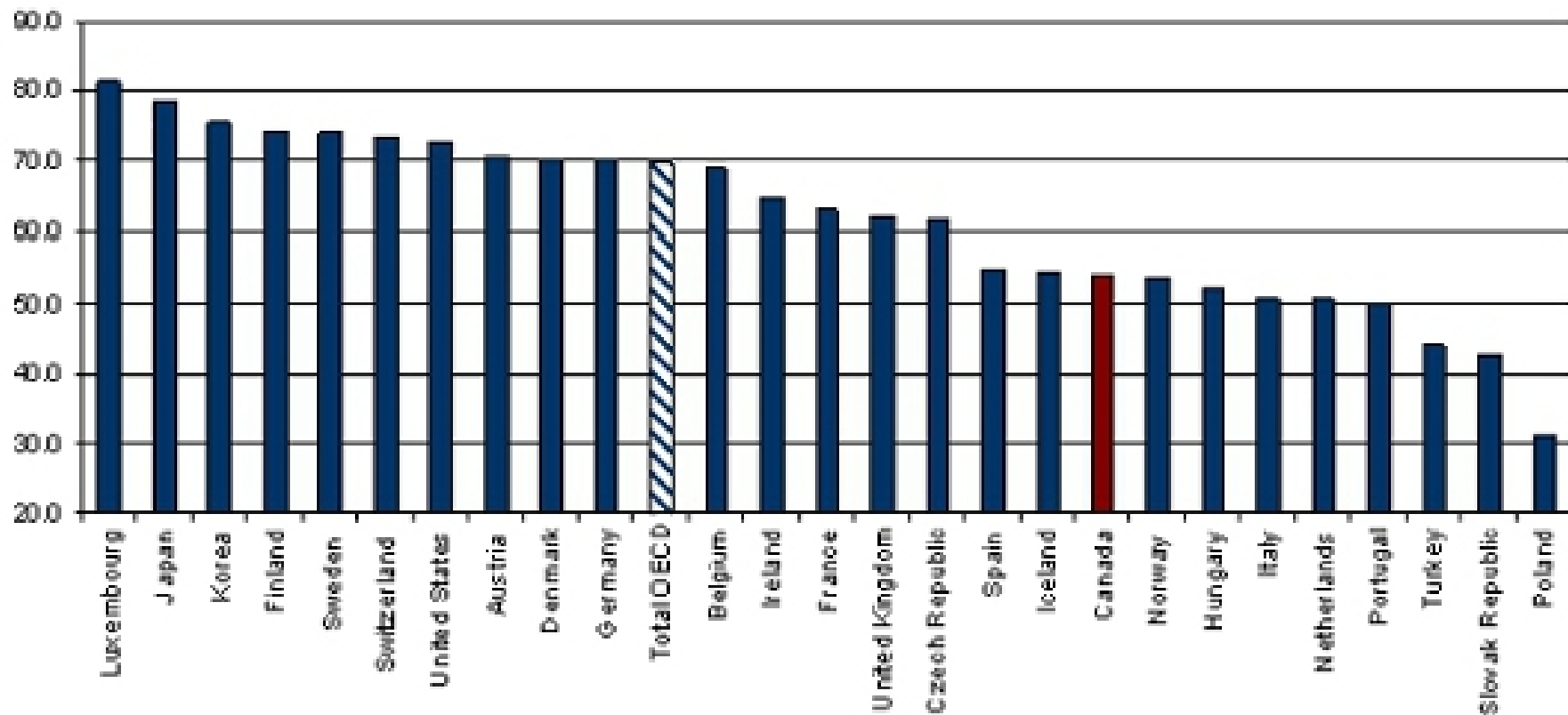
- General view that universities are incubators for economic innovation and growth
- Canada's National Research Council, a government owned laboratory system (\$0.8B per year operation) multiple labs across nation
 - Government looking to “transfer” labs to universities
 - View is universities are beehives of innovation
 - Not happening because universities see increased costs
 - TRIUMF is an icon for this model..university owned
 - Compare to US DOE National labs..good support
- Incubator companies setting up at universities
 - National Centres of Excellence

R&D Facts for Canada

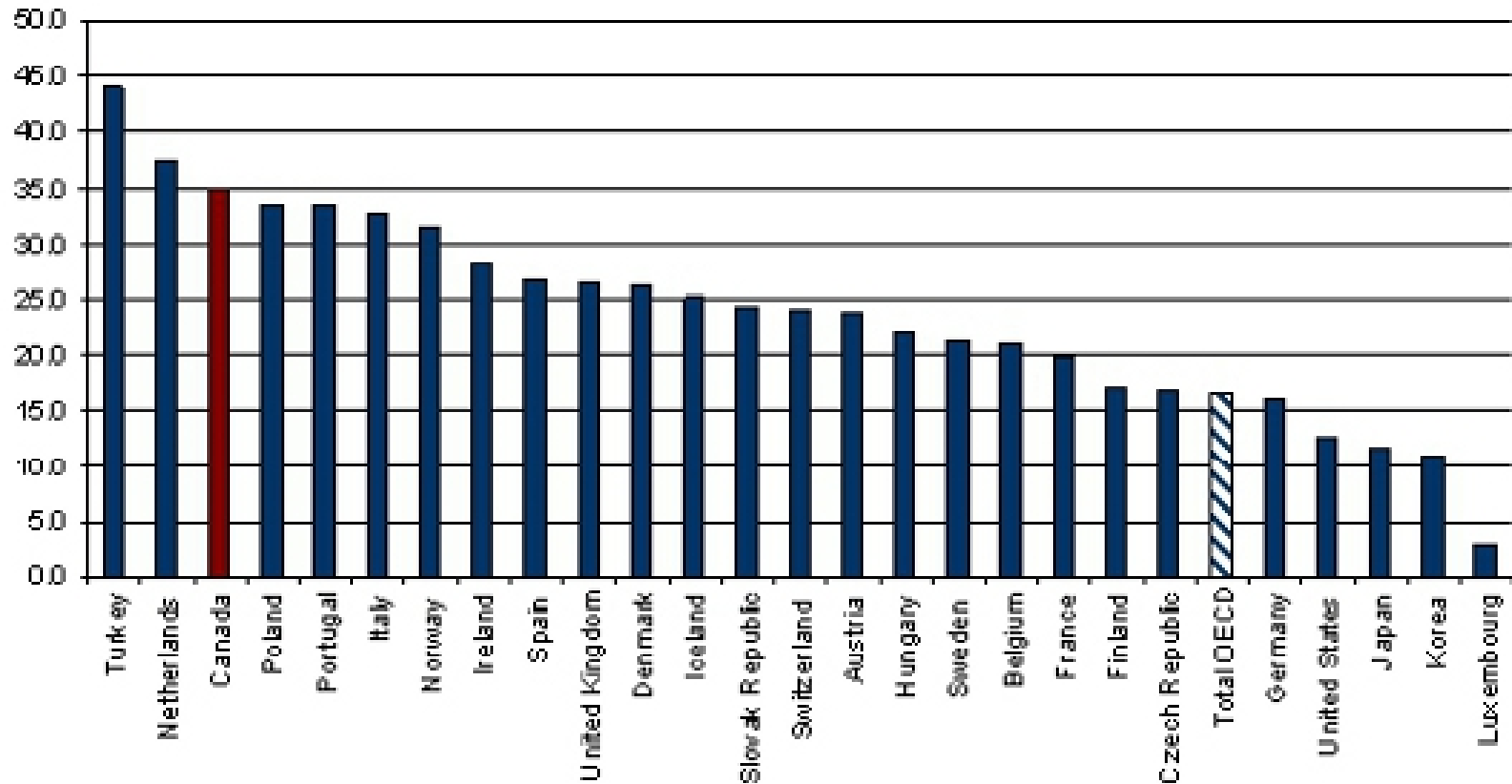
In relative terms, overall investment in R&D (public and private) in Canada is below the OECD average. The graph depicts gross expenditures on R&D (GERD) as a percentage of GDP in OECD countries. (OECD 2008)



Canada's business sector performs a smaller proportion of GERD than that of roughly two-thirds of other OECD economies. The below graph depicts the percentage of GERD performed by the business sectors of OECD countries.(08)



Canada's higher education sector performs a higher proportion of GERD than that of the majority of other OECD economies. The below graph depicts the percentage of GERD performed by the higher education sectors of OECD countries.

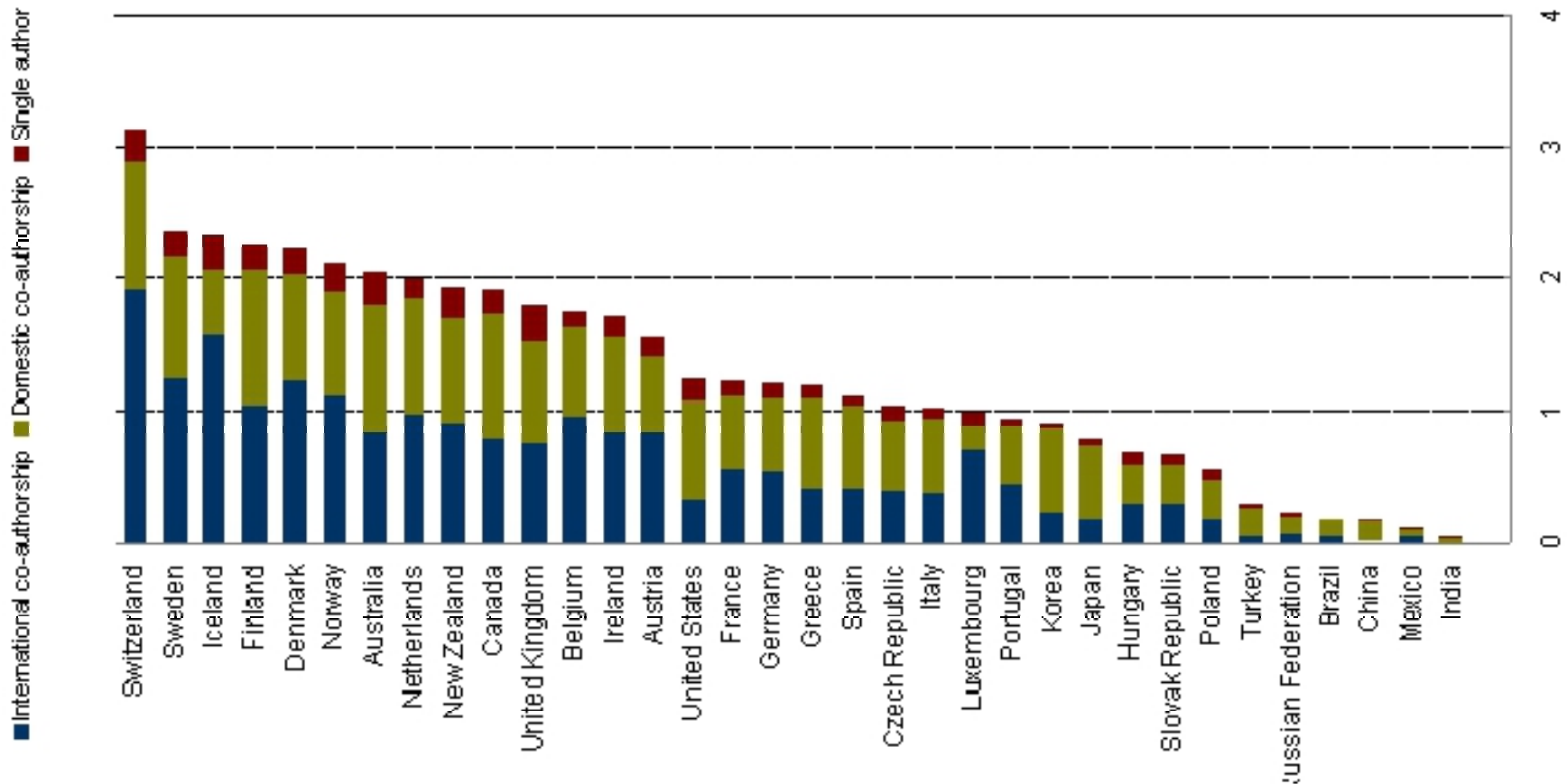


OECD Summary

- GERD is 2%, low end of OECD
- Canada's higher education R&D investment per GDP is second in OECD, behind only Sweden, and accounts for 35% of R&D in Canada
- **Low business R&D investment impacts Canadian science policy....**

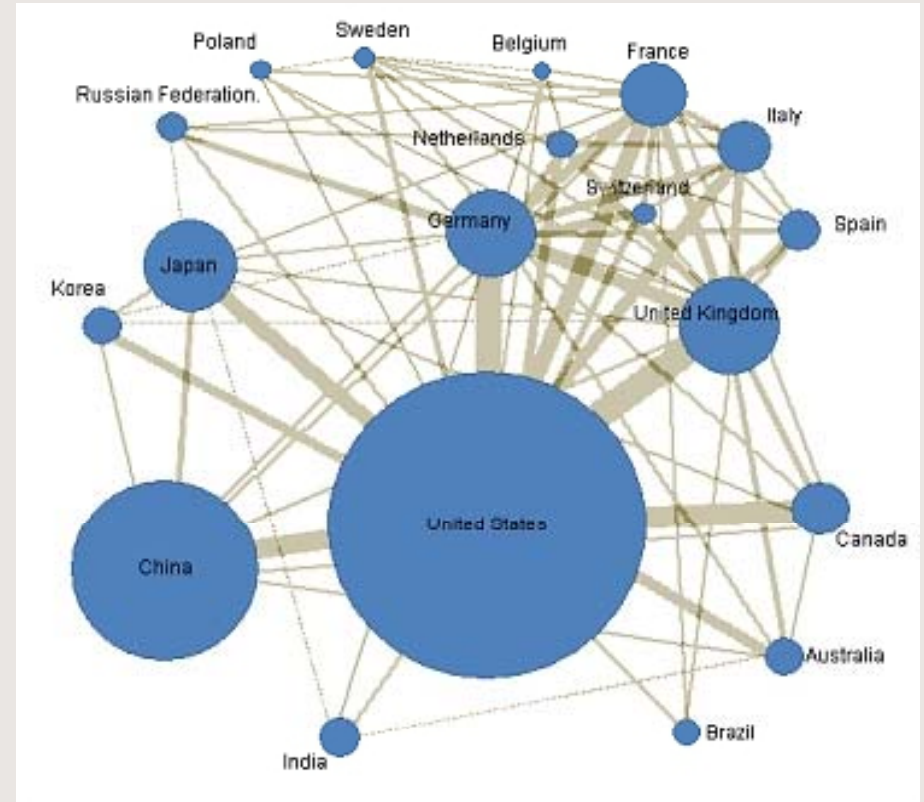
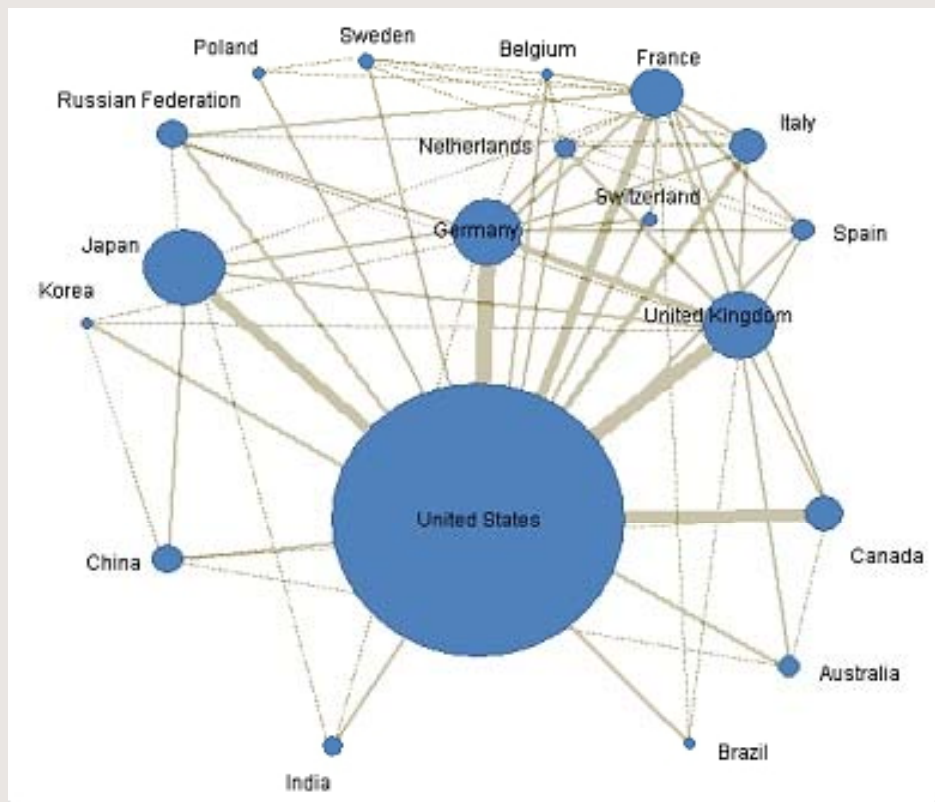
Scientific Publications

Canada ranks first in the G7 for the number of scientific articles it produces, relative to the size of its population. It also places first in the G-7 for the number of articles resulting from both domestic and international collaboration (as measured through co-authorship) on a per capita basis. The graph below depicts scientific articles per capita by type of collaboration. (Source OECD 2010)



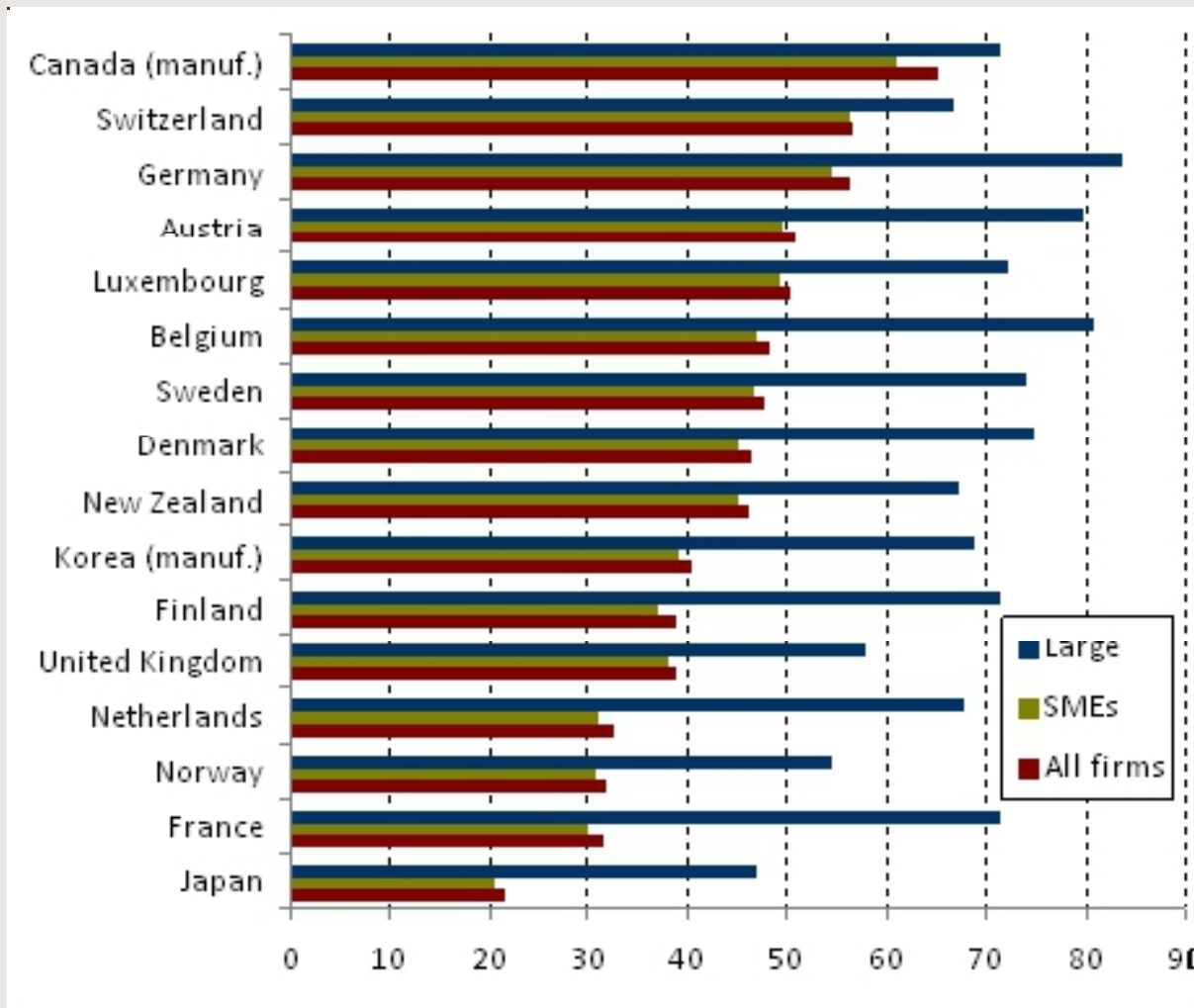
New Players are Emerging

The size of bubbles reflects the number of scientific publications and the thickness of the link indicates the intensity of co-authorship, a measure of collaboration. (Source:OECD1998, 08)



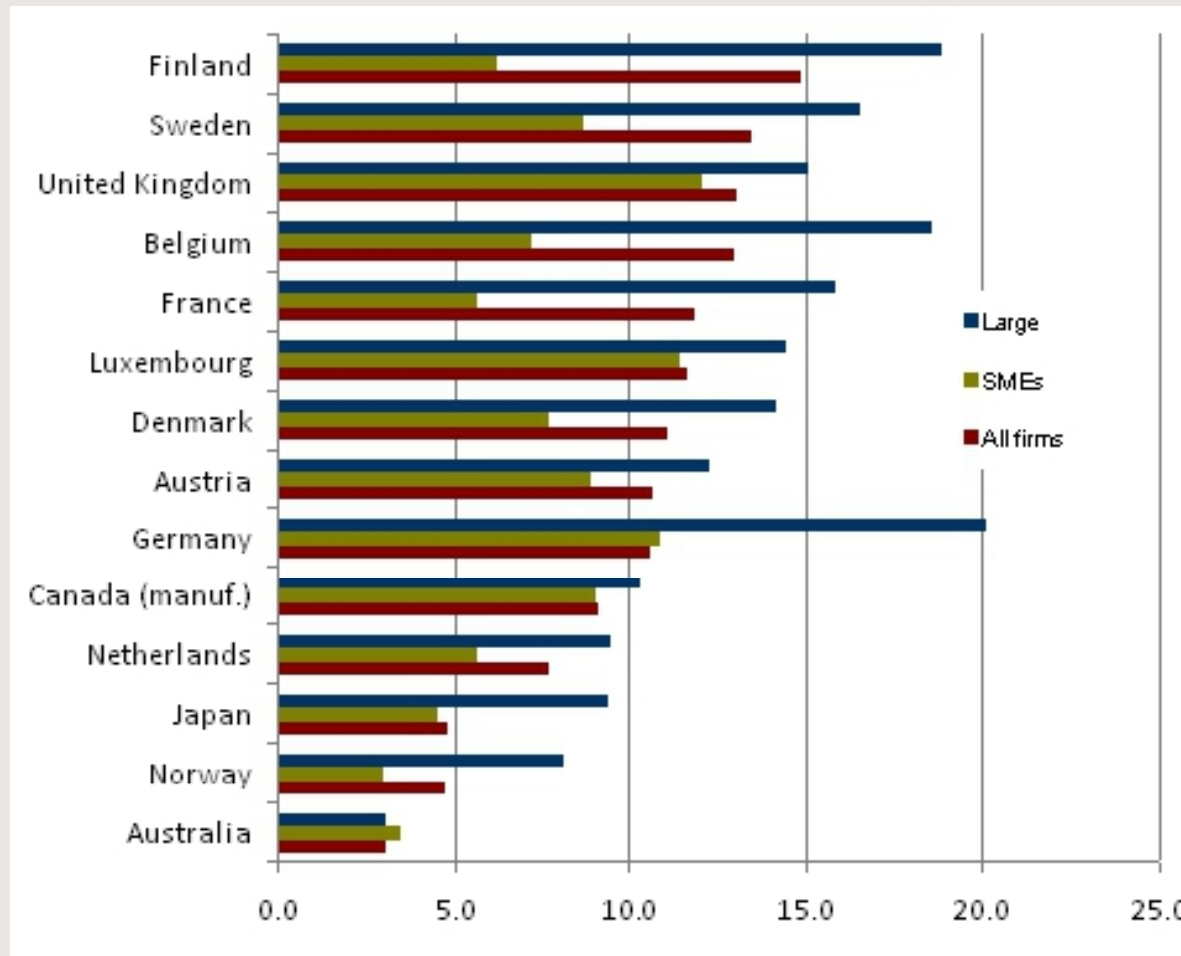
Good news: Innovation strong

A 2009 OECD report indicated that Canada's manufacturing sector led a comparison group of 16 countries in terms of the incidence of innovation.



Bad news..low value Innovation

The same 2009 OECD report indicated that Canada's manufacturing sector lags behind many other comparator countries for the value derived from product innovations. (2002-2004)



TRIUMF.....an example of Science Policy at Work

TRIUMF: A National Science Facility



Members

Carleton University
University of Guelph
Queen's University
Simon Fraser University
University of Alberta
University of BC
University of Manitoba
Université de Montréal
University of Toronto
University of Victoria
York University

Associate Members

University of Northern BC
University of Calgary
McMaster University
Saint Mary's University
University of Regina

TRIUMF is Owned and Operated by 16 Canadian Universities

A Vision for TRIUMF

- **Leverage University Research:** The Canadian university research community views TRIUMF as a way to strengthen and expand their research programs.
- **Connect to the World:** International subatomic physics laboratories look to TRIUMF when partnering with Canada and its research community.
- **Create Social and Economic Growth:** TRIUMF bridges academia and the private sector as a model for commercialization and social impact.

- In order to seed discoveries and maintain a high standard of living, Canada needs:
 - State-of-art scientific infrastructure
 - Best scientists in the world working here
 - Highly skilled technical work force
 - Scientists interconnected with the world's scientific & technical network
- A desire & a mechanism to bring these discoveries to the people of Canada

Where to Focus?

- Compelling questions define the scientific thrusts
- But Canada cannot be involved in *all* the key scientific questions pursued today
- So, through national planning groups and consultations, Canada has identified which questions to pursue
 - Council of Canadian Academies
 - STIC
 - Subatomic Physics “Long Range Plan”
- Challenge is to balance risk and reward

Questions Define TRIUMF's Science Framed in a Global Context

Identified by Long Range Plan

- 1) What new physics lies beyond the Standard Model of Particle Physics?
- 2) Does neutrino have a role in evolution of the universe?
- 3) What is dark matter and dark energy?
- 4) How & where are the heavy chemical elements produced?
- 5) How do simple underlying interactions lead to complex phenomena?
- 6) What are the underlying biochemical & biological mechanisms that contribute to onset of neurological disease and cancer?

Science is a Global Enterprise

Canada must participate—and lead in some areas

- **Particle physics is perhaps the most global**
 - Canadian leadership in accelerator design was the entre for LHC involvement
 - Robotic handling of highly radioactive materials & detector expertise was entre into Japan neutrino experiment
 - Global coordination: ICFA (Atsuto Suzuki, Japan); ILCSC (Enzo Iarocci, Italy); FALC (Pierre Coulombe, Canada)
- **Nuclear physics is next most global**
 - Global leader in rare-isotope beams (RIBs)
 - Precursor of medical isotopes

TRIUMF is Canada's connection to global excellence in subatomic physics



A Global Decision: Wise Cold People

International Technology Recommendation Panel

“This recommendation is made with the understanding that we are recommending a technology, not a design.” August 20, 2004

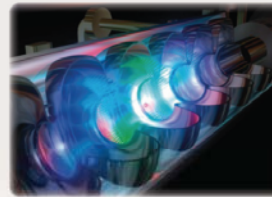


Superconducting RF is the accelerator technology to build International Linear Collider

Why Accelerators? Dual Role

- **Science:** Canadian subatomic physics community and universities see accelerator S&T as their vehicle for pursuing
 - The most compelling questions in particle & nuclear physics (global research program)
- **Commercialization opportunities:** accelerators have proven track record in the marketplace: medical isotopes, cancer therapy, X-rays, klystrons, ion implantation...

ARIEL..a Unique facility in world

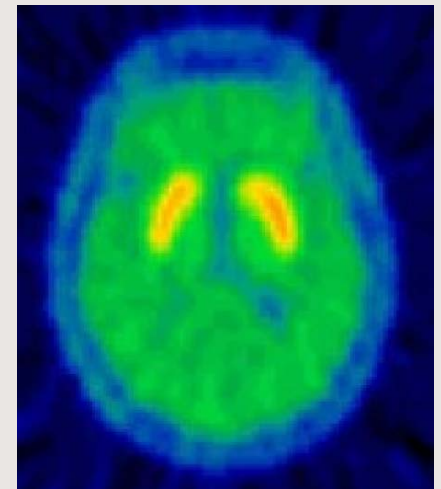
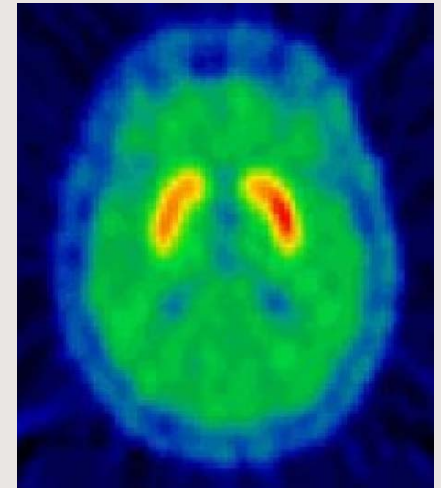
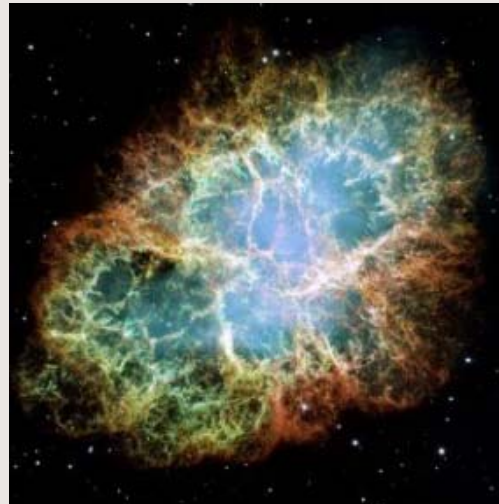
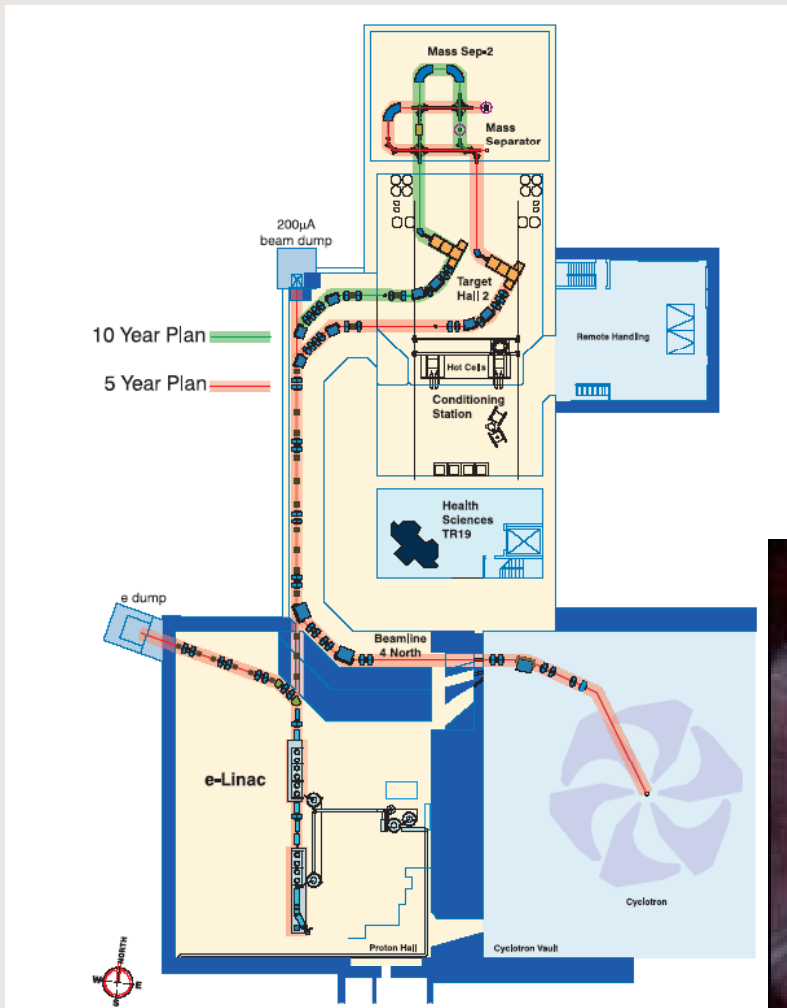


ARIEL is a new underground beam tunnel surrounding a next-generation linear accelerator – an e-linac, led by the University of Victoria. The project will allow TRIUMF to develop technology to advance Canada's supply of critical medical isotopes, capitalize on existing investments, and broaden its research capabilities in particle physics, nuclear physics, nuclear medicine, and materials science.



SCHEME C:
TRIUMF ARIEL PROJECT
November 24, 2008

Isotopes for Science & Medicine



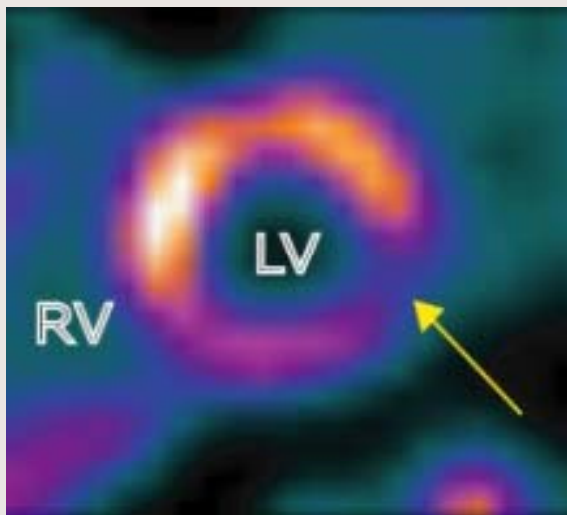
Heavy Ion Linac Operating



Post acceleration ISOL Facility...unique in world

Technetium-99m: Most Widely Used Isotope

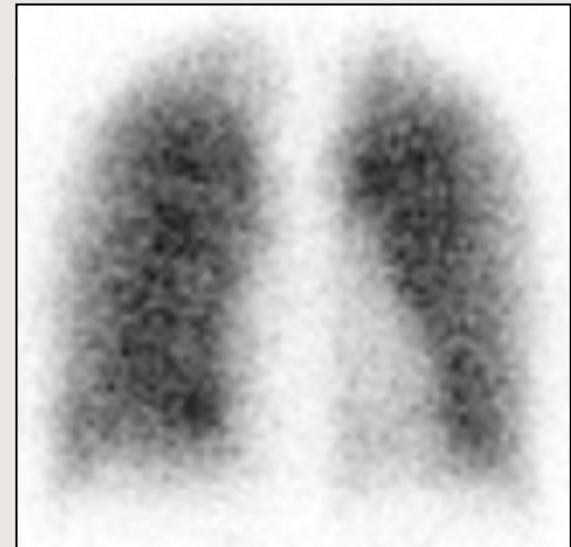
- Tc-99m most widely used radionuclide for nuclear medicine procedures in the world
- Accounts for 80% of all procedures ..40M/yr worldwide
- 76,000 scans/day (>1 scan/second)



Cardiac Function



Bone Metastases



Lung function

Global Isotope Crisis

- Failed isotope reactor: TRIUMF takes lead in formulating a solution to a national problem with international ramifications
- Use “existing” small medical cyclotrons
 - Benefit: grows business in cyclotron sales
- Make Tc-99m as well as PET isotopes
 - Propels health imaging forward

Accelerators: Benefits to Canada

“TRIUMF has designed and built what has been internationally recognized as the best cyclotrons in the world.”

Ming Wu Fan, Former President, China Institute of Atomic Energy

Tc-99m Production with Cyclotron



ACSI Sales
Booming

Feeds into Nuclear Medicine Revolution

- Medical isotopes (unstable nuclei) connected to molecules that target processes in the body will allow doctors to image
 - Disease metabolism –watch tumor construction
 - Tag amino acid transporters or DNA or....
 - Track where the drug is going in your body
 - Is therapy working –chemo or radiation
 - Called personalized medicine (we are all different)
- Future medical isotopes will be used for therapy (use alpha particles)
 - Break both the DNA strands with alphas
 - Kills cell in two passes versus 20 passes for x-rays

Invest in Modern Infrastructure

- GMP upgrade



March 2, 2011

Photos by: Mindy Hapke

Govt's Believe In Science

Canada's Economic Action Plan:

“We are building a new knowledge-based economy...one where our scientists and entrepreneurs can find the support they need to get their ideas to market; and one where investors will find greater opportunity.”

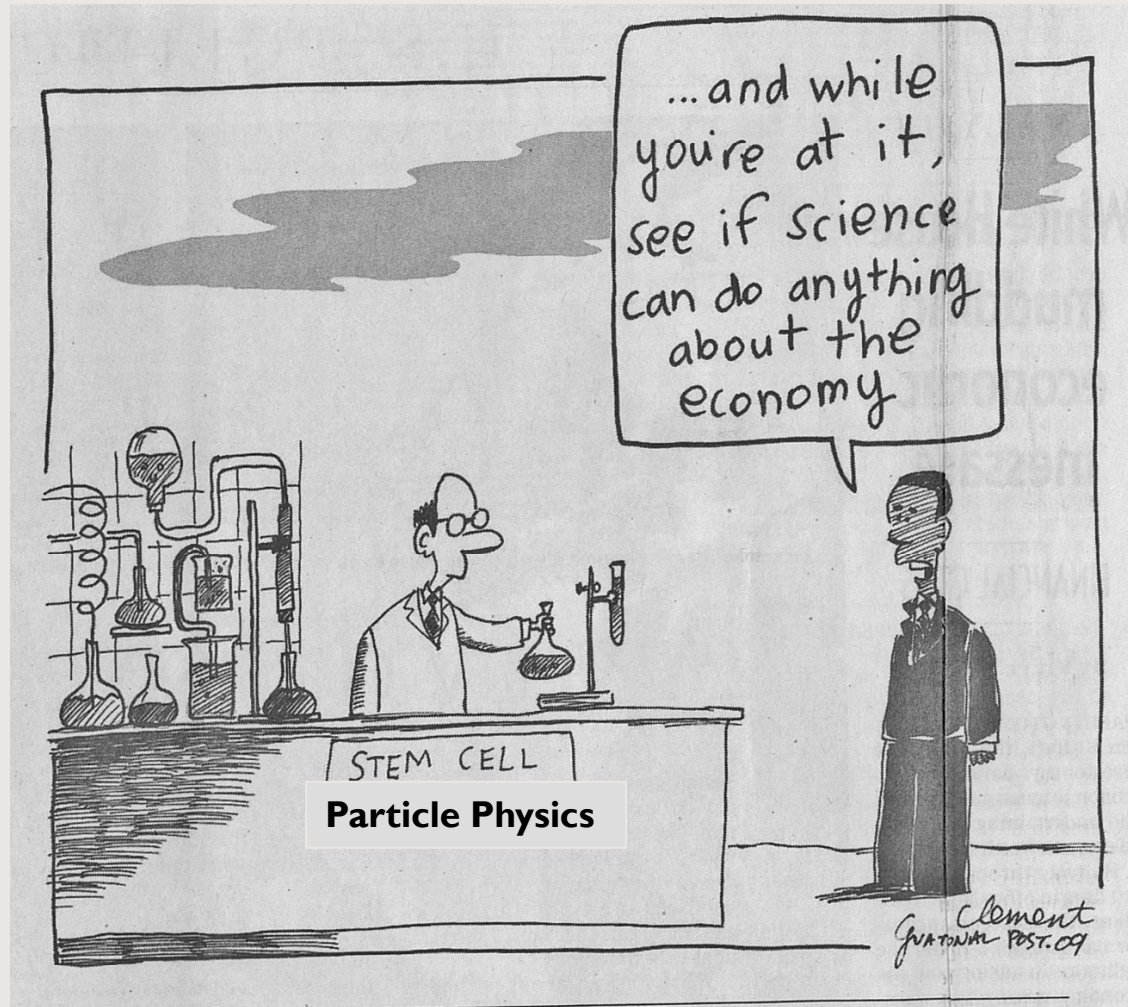
—*By Tony Clement, Minister of Industry*

“More than ever before, science holds the key to our survival as a planet and our security and prosperity as a nation. It is time we once again put science at the top of our agenda and worked to restore America's place as the world leader in science and technology.”

—*By Barack Obama, U.S. President*

U.S. Says Science Drives Economy

Huge Investment Just Made: \$20B



Concluding Comments

- Canada and India share a strong commitment to education, the environment, health and science. Both view technology as a means to solve problems and to advance economic development.
- The Year of India in Canada was designated for 2011 by the Prime Minister of India, Dr. Manmohan Singh, and Prime Minister Stephen Harper during the latter's visit to India in November 2009.



Thank you!

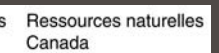
Merci!

Accelerating Science for Canada
 Un accélérateur de la démarche scientifique canadienne

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TRIUMF: Alberta | British Columbia |
 Calgary | Carleton | Guelph | Manitoba |
 McMaster | Montréal | Northern British
 Columbia | Queen's | Regina | Saint Mary's
 Simon Fraser | Toronto | Victoria | York



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- <http://rd-review.ca/eic/site/033.nsf/eng/00028.html>
- CCA Report on Canadian S&T
- S&T Strategy (guiding policy document for Gov't)
- STIC: State of the Nation
- S&T Progress Report
- Compete to Win
- Why Canada Falls Short