The Role of International Collaborations for Large Research Facilities

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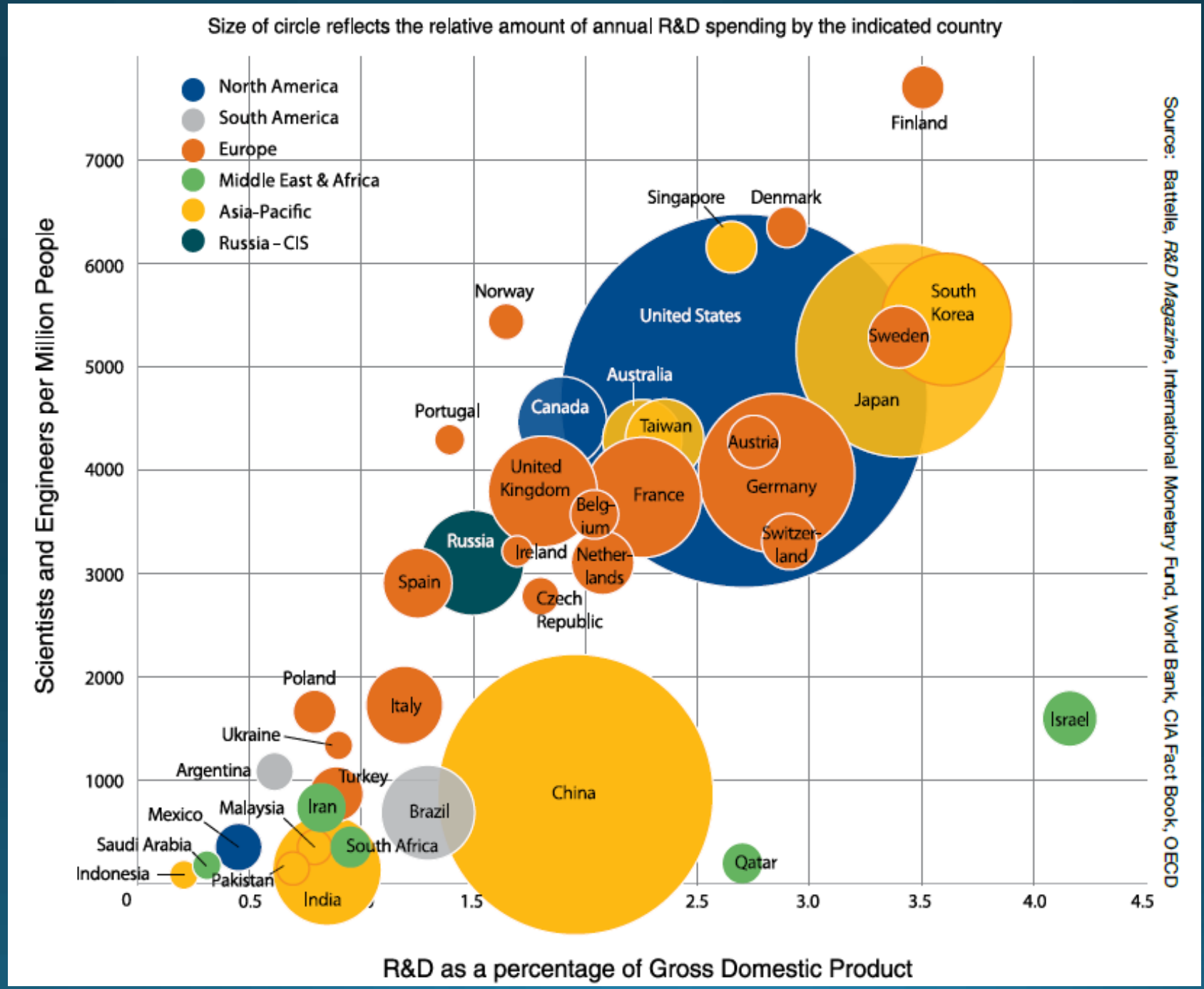
- **Session goals:**
  - Share common challenges and good practices to build effective international partnerships throughout lifetime of research facilities
  - Highlight good practices in international facilities management


Size of circle reflects the relative amount of annual R&D spending by the indicated country
North America
South America
Europe
Middle East & Africa
Asia-Pacific
Russia – CIS
Scientists and Engineers per Million People
7000
6000
5000
4000
3000
2000
1000
0
0.5
1.5
2.5
3.0
3.5
4.0
4.5
R&D as a percentage of Gross Domestic Product
Finland
Singapore
Denmark
Norway
United States
South Korea
Sweden
Australia
Japan
Portugal
Canada
Taiwan
Austria
United Kingdom
France
Germany
Belg-ium
Switzer-land
Russia
Ireland
Nether-lands
Spain
Czech Republic
Poland
Italy
Israel
Ukraine
Argentina
Turkey
China
Brazil
Mexico
Malaysia
Iran
South Africa
Saudi Arabia
Indonesia
Pakistan
India
Qatar
Source: Battelle, R&D Magazine, International Monetary Fund, World Bank, CIA Fact Book, OECD

Why International Research Collaborations?

- **<u>Advance</u> the FRONTIERS of Science and Engineering**
  - ACCESS to unique expertise, facilities, and phenomena
  - LEVERAGE limited resources, share costs + risks
  - EXCHANGE insights and techniques, expand knowledge base
  - ADDRESS national, transnational and global challenges
- **<u>Prepare</u> a GLOBALLY-ENGAGED U.S. S&E workforce**
  - NURTURE capable young researchers with strong networks overseas
  - DEVELOP a global perspective
  - FACILITATE mobility and brain circulation

NSF International Activities

- NSF supports international collaboration (projects, facilities) when it enhances research and STEM education

  NSF funds the US-side of international collaborations

- Span all NSF Directorates and Offices - directorates provide most of funding
- Strengthen partnerships with, and leverage funding from, foreign counterpart funders
- Often involve cooperation with other U.S. government agencies, other governments, and private foundations

Large Facility Projects

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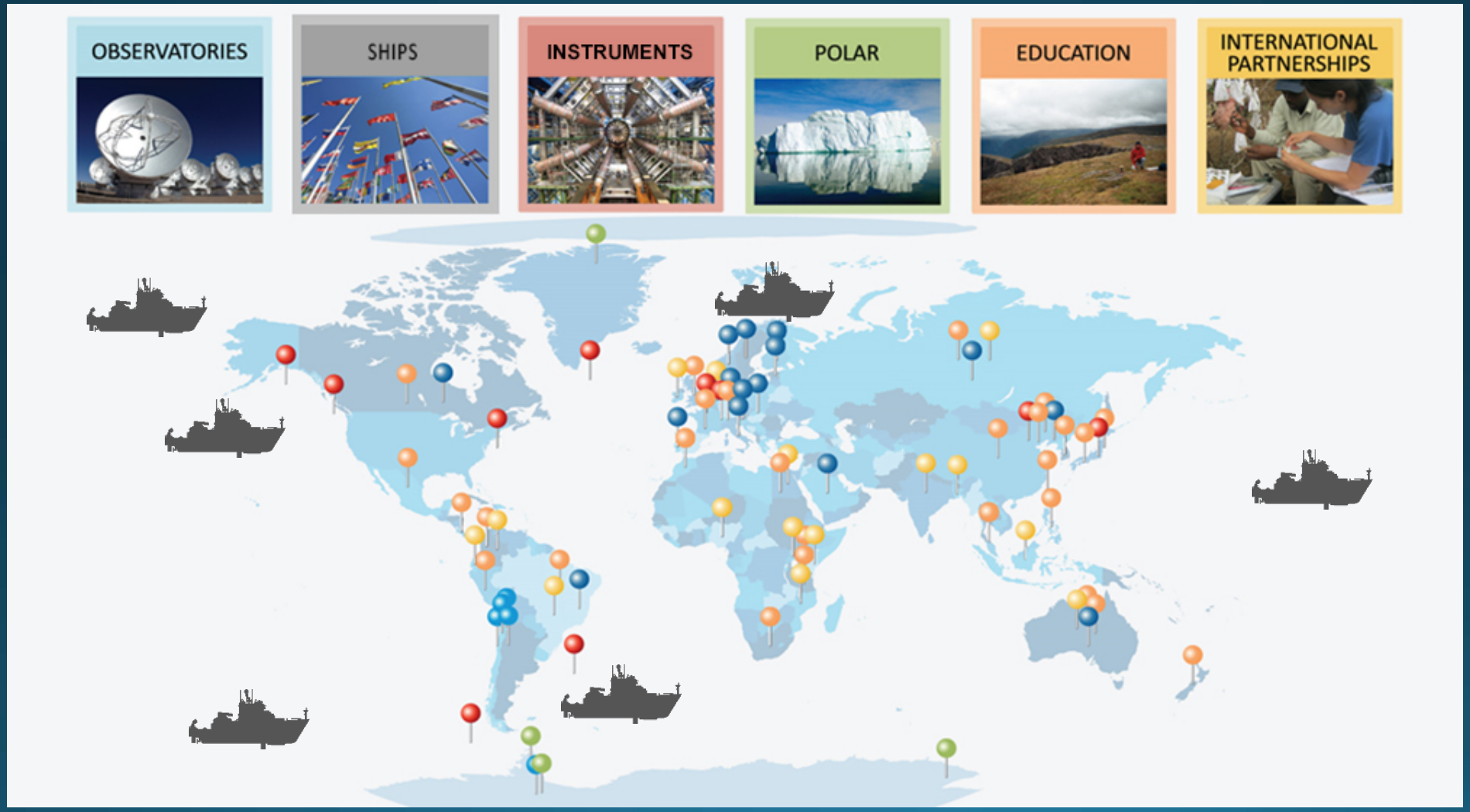
Facility	Acronym	Location	Stage	Recipient	DIR/DIV
United States Antarctic Program	USAP	Antarctica	Operations	Leidos	GEO/PLR
-- Antarctic Infrastructure Modernization for Science	AIMS	Antarctica	Design	Leidos	GEO/PLR
Arecibo Observatory	AO	Puerto Rico	Operations	SRI International	MPS/AST GEO/AGS
Academic Research Fleet	ARF	Distributed	Operations	Various (21 research vessels)	GEO/OCE
-- Regional Class Research Vessel	RCRV	Mobile	Design	Oregon State University	GEO/OCE
-- National Deep Submergence Facility	NDSF	Mobile	Operations	Woods Hole Oceanographic Institution	GEO/OCE
Cornell High Energy Synchrotron Source	CHESS	New York	Operations	Cornell University	MPS/DMR
Green Bank Observatory	GBO	West Virginia	Operations	Associated Universities Incorporated	MPS/AST
Gemini Observatory	Gemini	Chile & Hawaii	Operations	Association of Universities for Research in Astronomy	MPS/AST
IceCube Neutrino Observatory	ICNO	Antarctica	Operations	University of Wisconsin	GEO/PLR MPS/PHY
International Ocean Discovery Program (JOIDES Resolution)	IODP	Texas & Mobile	Operations	Texas A&M Research Foundation	GEO/OCE
International Ocean Discovery Program (Science Support Office)	IODP	California	Operations	University of California, San Diego Scripps Institution of Oceanography	GEO/OCE
Long Baseline Observatory	LBO	Distributed	Operations	Associated Universities Incorporated	MPS/AST
Large Hadron Collider	LHC	Switzerland	Operations / Design / Construction		MPS/PHY
-- A Toroidal LHC Apparatus (ATLAS) Detector Operations and High Luminosity Upgrade Design	ATLAS	Switzerland	Operations / Design	SUNY - StonyBrook	MPS/PHY
-- A Toroidal LHC Apparatus (ATLAS) Detector Phase I Upgrade	ATLAS	Switzerland	Construction	SUNY - StonyBrook	MPS/PHY

Facility	Acronym	Location	Stage	Recipient	DIR/DIV
-- Compact Muon Solenoid (CMS) Detector Operations and High Luminosity Upgrade Design	CMS	Switzerland	Operations / Design	Princeton University	MPS/PHY
-- Compact Muon Solenoid (CMS) Detector Phase I Upgrade	CMS	Switzerland	Construction	University of Nebraska - Lincoln	MPS/PHY
Laser Interferometer Gravitational-wave Observatory	LIGO	Louisiana	Operations / Construction	California Institute of Technology	MPS/PHY
Large Synoptic Survey Telescope	LSST	Chile	Construction	Association of Universities for Research in Astronomy	MPS/AST
National Center for Atmospheric Research (FFRDC)	NCAR	Colorado & Wyoming	Operations	University Corporation for Atmospheric Research	GEO/AGS
Natural Hazards Engineering Research Infrastructure	NHERI	Distributed	Operations	11 Individual Awards to Various Universities	ENG/CMMI
National Ecological Observatory Network	NEON	Distributed	Construction Operations	Battelle Memorial Institute	BIO/DBI
National Geophysical Observatory for Geoscience	NGEO	Distributed	Operations	--	GEO/EAR
-- Geodesy Advancing Geosciences and EarthScope	GAGE	Distributed	Operations	UNAVCO	GEO/EAR
-- Seismological Facilities for the Advancement of Geoscience and EarthScope	SAGE	Distributed	Operations	IRIS Consortium	GEO/EAR
National High Magnetic Field Laboratory	NHMFL	Florida & New Mexico	Operations	Florida State University	MPS/DMR
National Nanotechnology Coordinated Infrastructure	NNCI	Distributed	Operations	16 member university consortium	ENG/ECCS
National Optical Astronomy Observatory (FFRDC)	NOAO	Arizona & Chile	Operations	Association of Universities for Research in Astronomy	MPS/AST
National Radio Astronomy Observatory (FFRDC)	NRAO	Distributed	Operations	Associated Universities Incorporated	MPS/AST
-- Atacama Large Millimeter/Submillimeter Array	ALMA	Chile	Operations	Associated Universities Incorporated	MPS/AST
-- Very Large Array	VLA	New Mexico	Operations	Associated Universities Incorporated	MPS/AST

Facility	Acronym	Location	Stage	Recipient	DIR/DIV
National Superconducting Cyclotron Laboratory	NSCL	Michigan	Operations	Michigan State University	MPS/PHY
National Solar Observatory (FFRDC)	NSO	New Mexico & Arizona	Operations	Association of Universities for Research in Astronomy	MPS/AST
-- Daniel K. Inouye Solar Telescope	DKIST	Hawaii	Construction	Association of Universities for Research in Astronomy	MPS/AST
Ocean Observatories Initiative	OOI	Distributed	Operations	Consortium for Ocean Leadership	GEO/OCE

NSF's global presence



International Collaborations & Large Facilities

- **Facilities located outside U.S. and/or distributed networks**
- **Cooperative partnerships of multiple international groups**

NSF's Large Facilities Manual (LFM) provides guidance:

- incorporating international input into the review process
- negotiating and managing international partnerships
- compliance with international agreements and treaties

"International partnerships are generally the most complex."

"International partner agencies need to understand the funding processes in the different countries involved."

Discussion:

- What roles do various partners play - their contributions tangible and intangible?
- How did/do you identify potential partners?
- How did/do you negotiate and manage partnerships during various phases of facility construction and operation?
- How is your international collaboration structured and managed?
- What are the good practices for information sharing, conflict resolution within complex international collaborations?
- How do different cultures and approaches affect working together?

Take home message:
What helps reduce barriers and improve efficiencies for international partnerships in research facilities?