

# Science Across Borders

*Many real and virtual borders*

Here I focus on, mainly:

- Geographic/Conceptual
- Fundamental/Applied – Useless/Useful
  - Academic /Corporate
- Interdisciplinary/Disciplinary
- Gender and Careers



After all, science is essentially international, and it is only through lack of the historical sense that national qualities have been attributed to it.

— *Marie Curie* —

AZ QUOTES

# Galileo Galilei: Sidereus nuncius, 1610



News of the observation of 4 moons of Jupiter and of mountains on the moon...

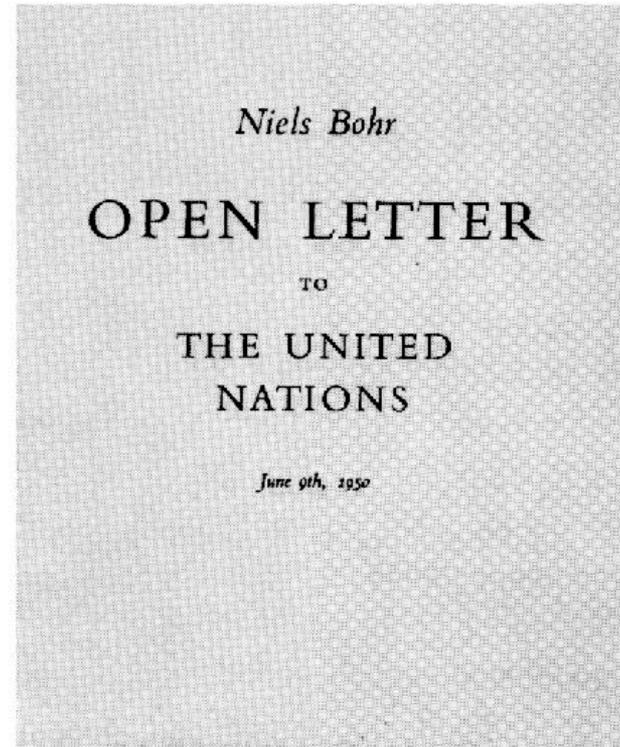
Circulation of the copies of *Sidereus nuncius*,  
from March 13 to April 30, 1610

All across Europe in 1.5 months !

Source: "Galileo's Telescope",  
M. Bucciattini et al.

# The open World ?

.....  
I turn to the United Nations with these considerations in the hope that they may contribute to the search for a realistic approach to the grave and urgent problems confronting humanity. The arguments presented suggest that every initiative from any side towards the removal of obstacles for free mutual information and intercourse would be of the greatest importance in breaking the present deadlock and encouraging others to take steps in the same direction. The efforts of all supporters of international co-operation, individuals as well as nations, will be needed to create in all countries an opinion to voice, with ever increasing clarity and strength, the demand for an open world.

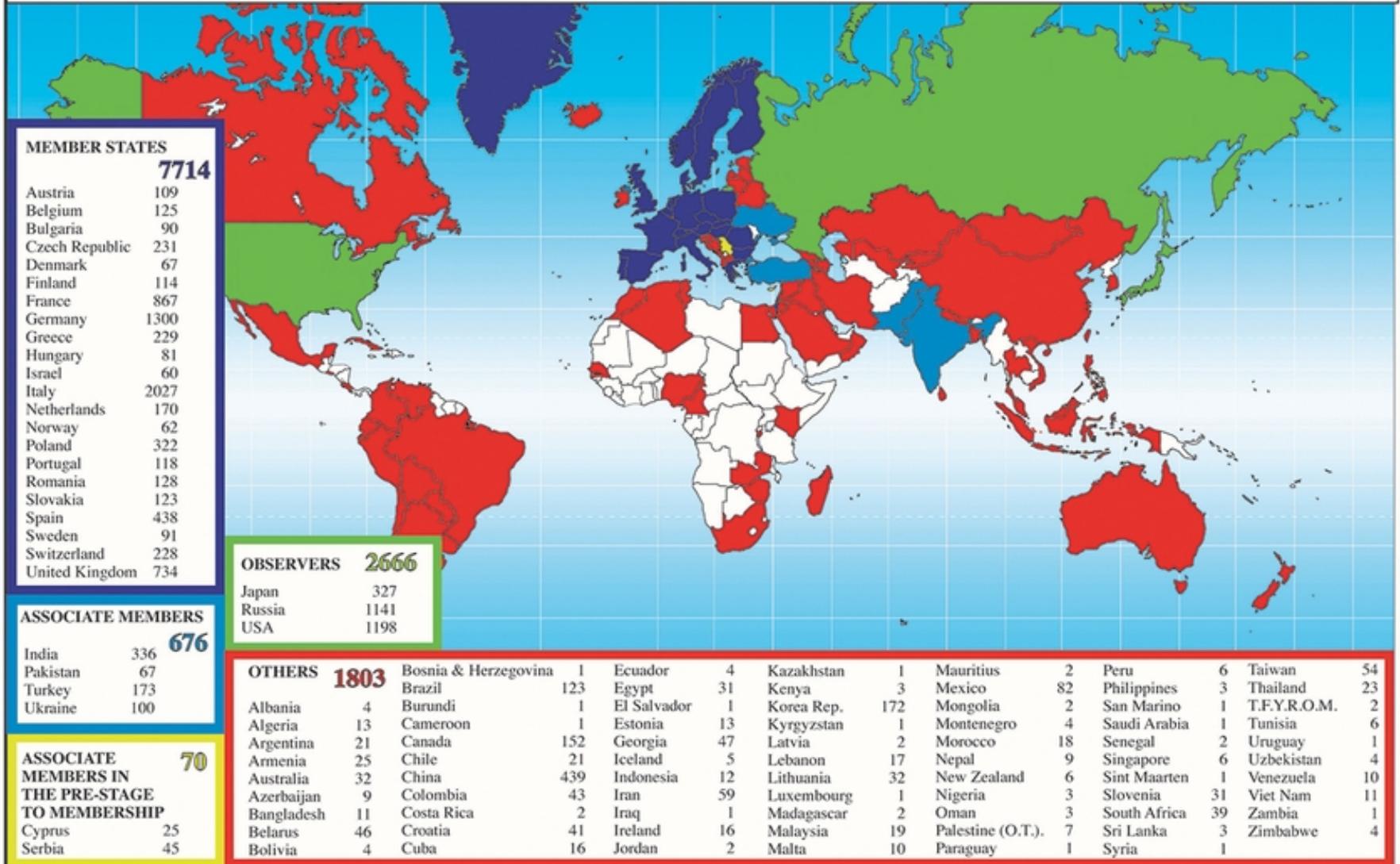


Naive perhaps, but visionary, and perhaps vindicated ...



# MegaScience is becoming GLOBAL

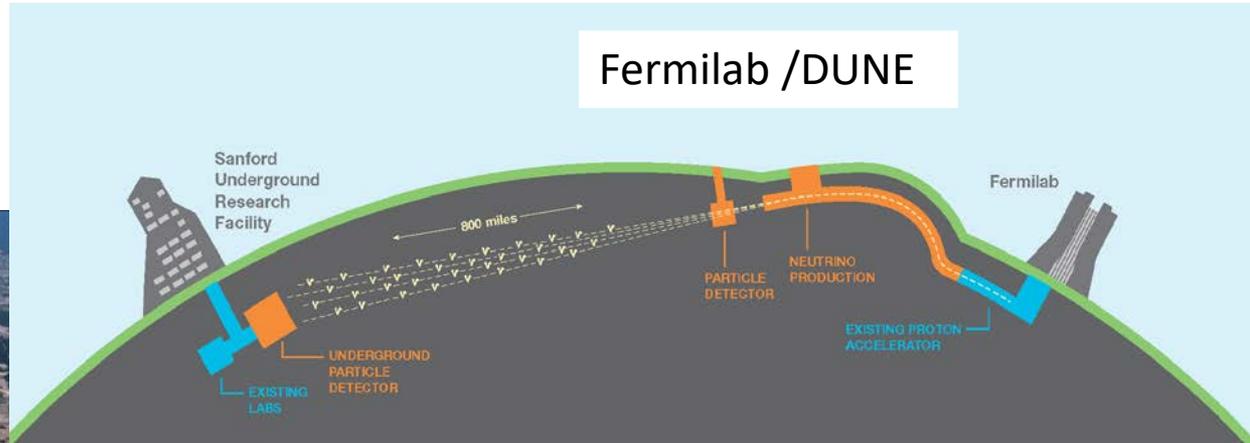
## Distribution of All CERN Users by Nationality on 20 January 2017



# Division of labor in Mega science? A new paradigm?



CERN /LHC



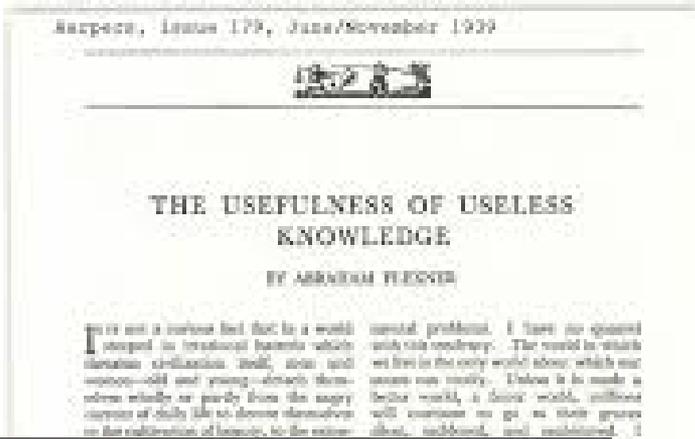
US ambassador and CERN DG sign inter-continental cooperation agreement in HEP

Europe/CERN: The **Energy Frontier**/beyond the Standard Model

USA/FNAL: The **Intensity Frontier**/neutrino physics

- Science has its own **universal language** that can transcend national divides
- **Openness** in Science has potentially a peace keeping mission and boosts development – although not always politically so palatable
- **MegaScience** projects are becoming increasingly **global** and **complementary** rather than mindlessly competitive -> towards a global division of labor?
- A **role-model** for smaller scale projects?

# The Usefulness of Useless Knowledge



Abraham Flexner, Institute for Advanced Studies (IAS), Princeton, founder and director.

Is it not a curious fact that in a world steeped in irrational hatreds which threaten civilization itself, men and women—old and young—detach themselves wholly or partly from the angry current of daily life to devote themselves to the cultivation of beauty, to the extension of knowledge, to the cure of disease, to the amelioration of suffering, just as though fanatics were not simultaneously engaged in spreading pain, ugliness, and suffering? The world has always been a sorry and confused sort of place—yet poets and artists and scientists have ignored the factors that would, if attended to, paralyze them. From a practical

# Curiosity driven research

Universe is powered by  $E=mc^2$   
=>  
Cosmic Understanding

GPS would not work without General Relativity  
=>  
50% of Danish agriculture is GPS assisted



Quantum Mechanics estimated to be behind 10-20% of GDP of developed countries)

Source: Stanford, Forbes, ...

(Einstein had an H index of 20 in 1955 !)

# Serendipity and the unexpected

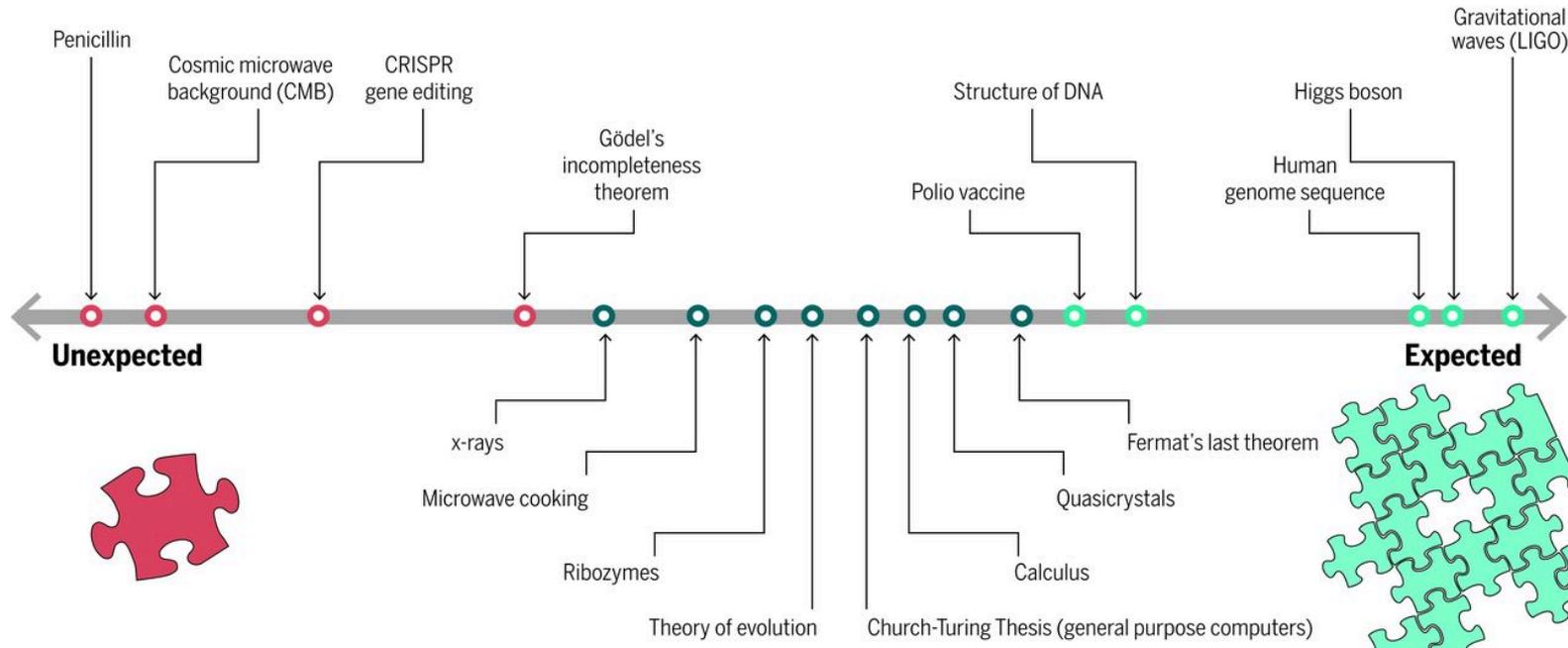


Internet  
`https:\\`  
`www`  
URL

(Without enforcing property rights), WWW estimated to be about 5-6% of US GDP in 2014  
(Source: Internet Association)

# Order a discovery ?

Source:  
Science, 355,  
2017



Probably not, but we can create the necessary conditions...

*See also the Science Europe SAC work on impact of science (case studies)*

# Impact of science

- **Impact of science** much in current focus- often discussed in terms of **'value' – a complex quantity**
- The great breakthroughs are often **unexpected and/or curiosity driven**
- The **payoff of 'useless science'** has proven to often be very significant on the long term
- **Strategic development and innovation may payback faster, but also decline faster.**
- There is a danger of – in the name of mindless competition- to downplay/ignore **the long term perspective.**

# Public vs. Corporate

**Microsoft Corporation** is investing substantially in creating the **Quantum Computer**, using Qbits instead of bits .

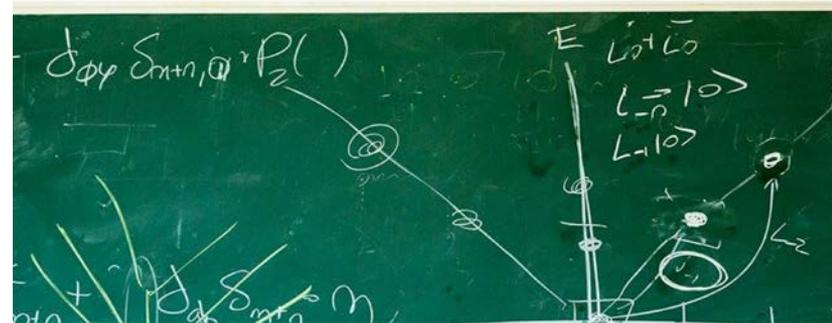
**Several Stations Q now** established in the world:

Redmond/USA, St.Barbara/USA,  
Copenhagen/DK, Delft/NL,  
Sydney/AUS,..

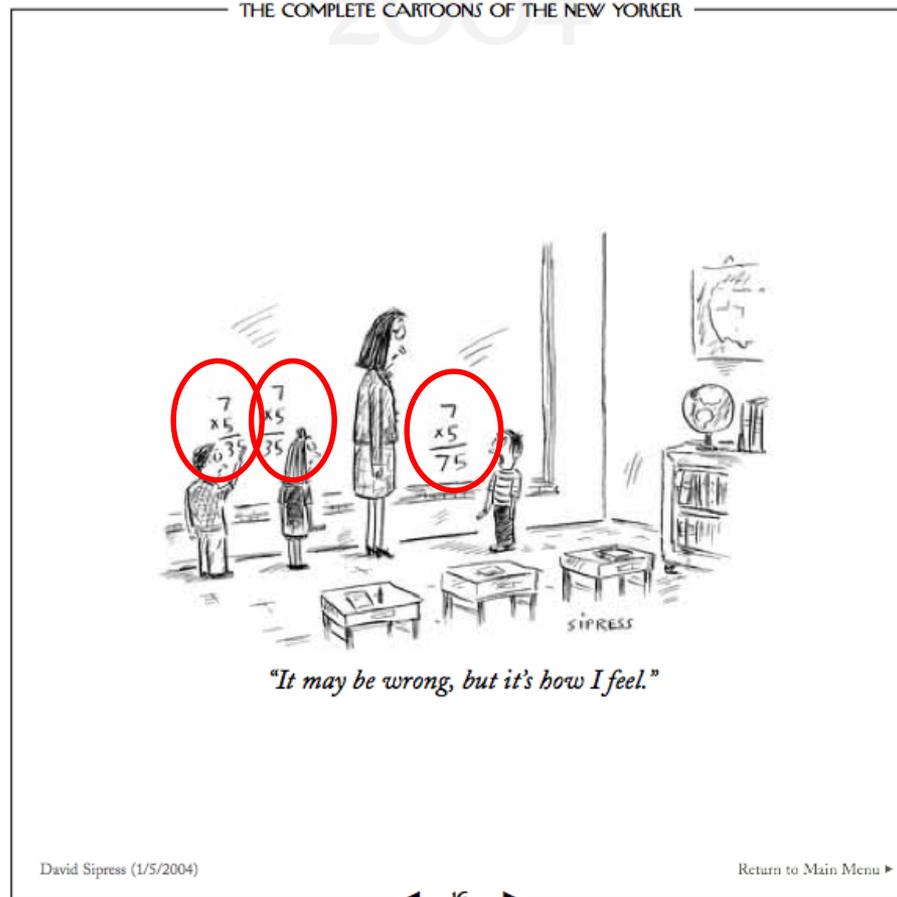
Why don't they do it on their own?  
What do they get out of it ?

STATION

Q



# A fundament – solid education



Source:  
The New Yorker,  
2001

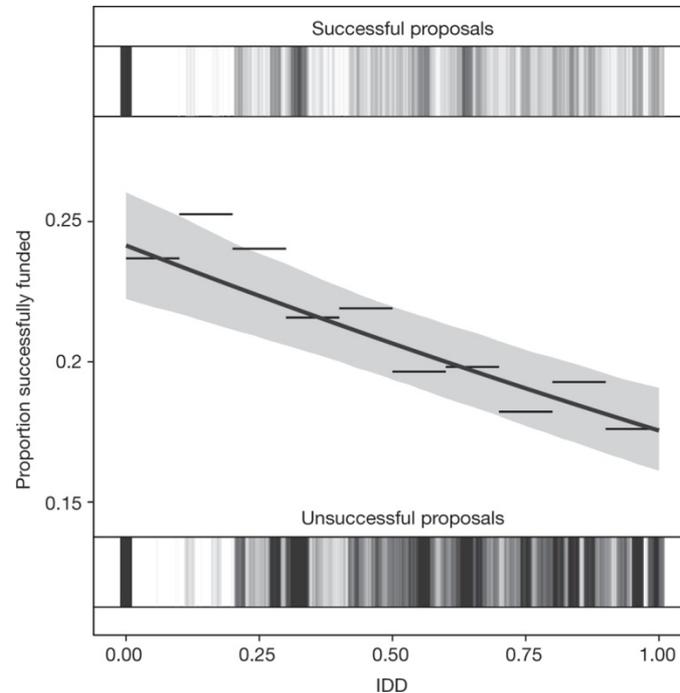
# How much innovation on the candle would ...



# Academic vs. corporate research

- The Microsoft Station Q story illustrates **the attractiveness of public academic research for high-level innovation**
- What does **academia** offer ?
  - openness to new ideas, fast turnaround, intellectual environment attractive to bright youngsters, professional stringency, ...
- What does the **corporate** sector offer ?
  - Substantial dedicated funding, rapid and professional development & support, organisation and purpose, personal rewards, ,...

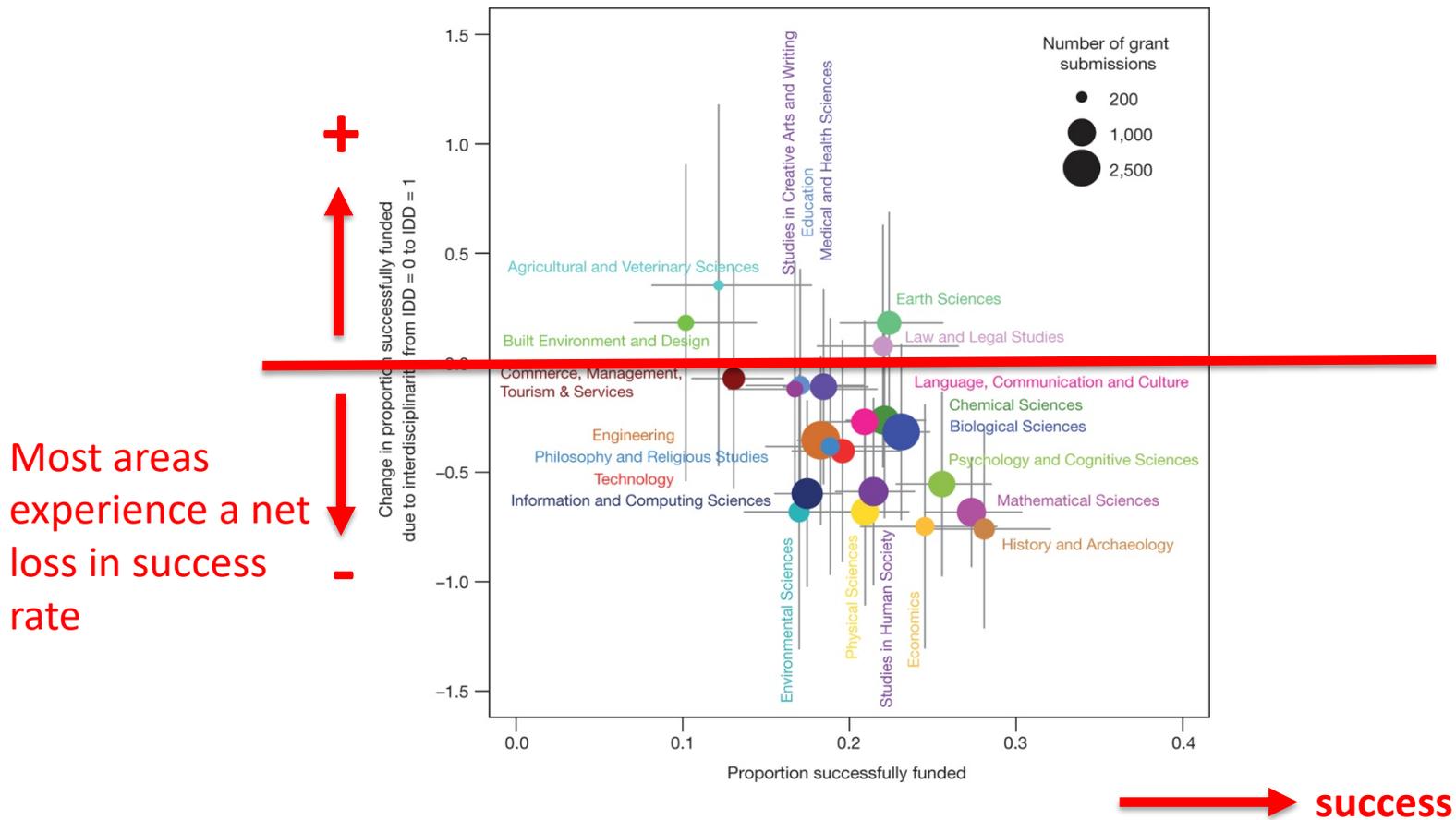
# Interdisciplinary research



Relationship between funding success and IDD score:  
Study reveals that **success ratio decreases with increasing interdisciplinarity**

L Bromham *et al.* *Nature* **534**, 684–687 (2016) doi:10.1038/nature18315

# Relationship between interdisciplinarity and funding success by research division



L Bromham *et al.* *Nature* **534**, 684–687 (2016) doi:10.1038/nature18315

# Interdisciplinarity

- Most will agree that great advances may **potentially be reaped** from interdisciplinary research
- But, in spite of encouragement, **interdisciplinary projects score lower in quality and funding** through most evaluation committees
- **Need new schemes** to ensure true trans-disciplinary collaboration.
- Will probably require **long term effort** and stimulus programs.

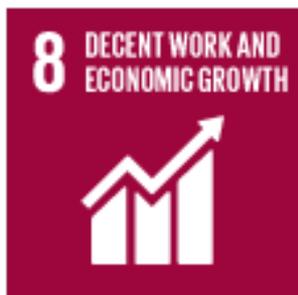


# SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD



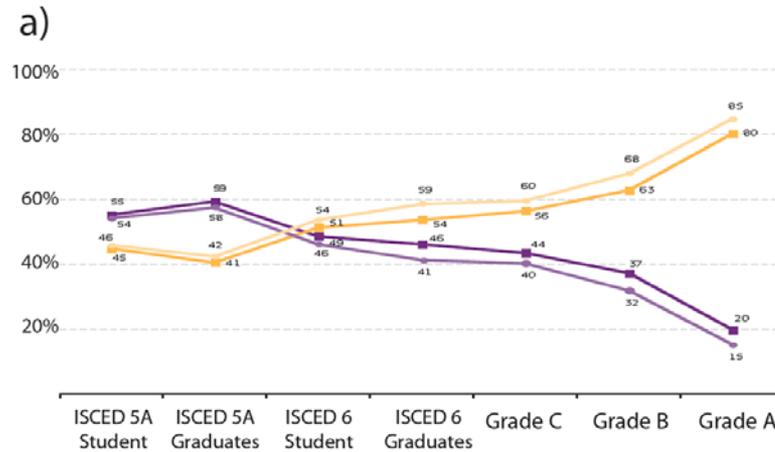
EU average



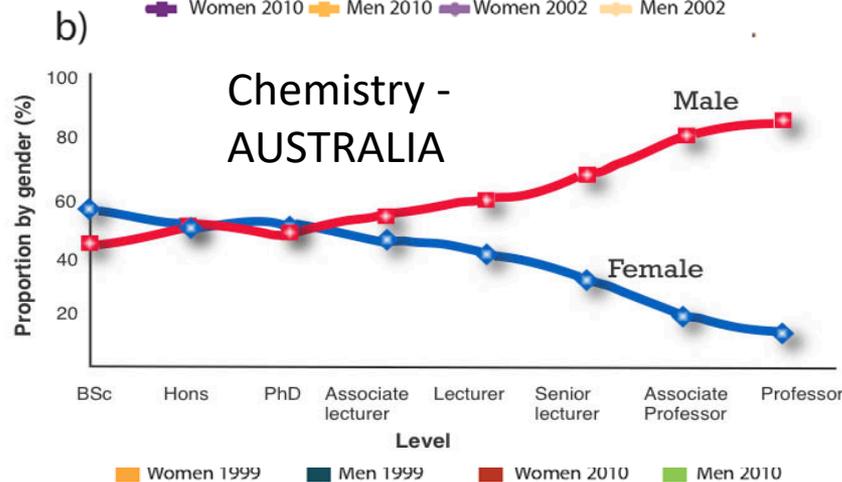
# (Poor) Use of talent ?

Gender inequality in Academia is shockingly identical across the world !

The X-factor.

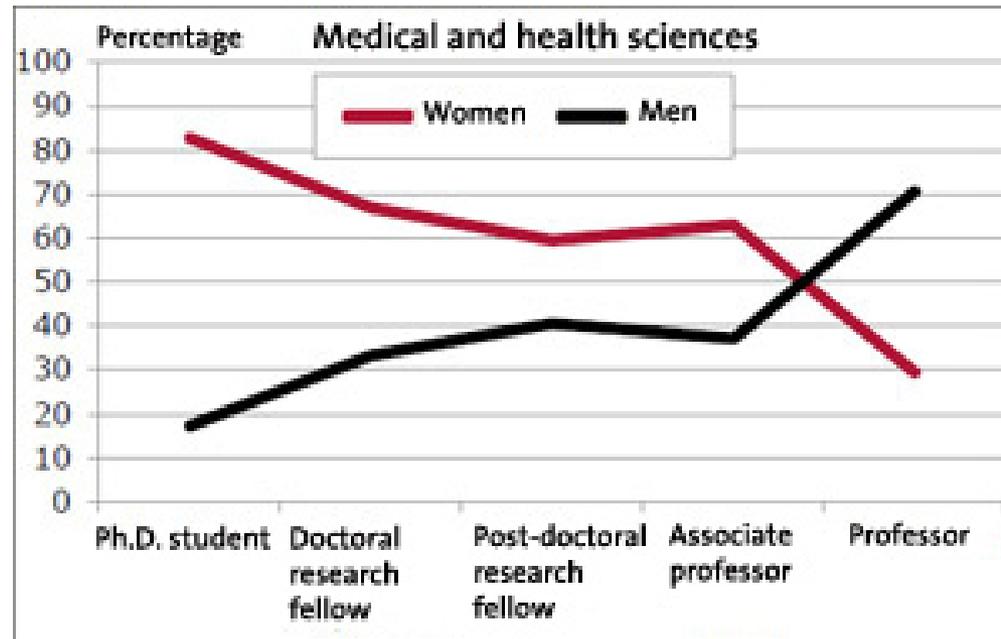


EU average



DK average

In Norway, in the medical sector,  
the bias occurs only at the end/top of the career.



Traditional explanations focus on (male) discriminatory effects (conscious or unconscious)  
– but is this the entire picture, now, in developed countries?



JORGE CHAM ©THE STANFORD DAILY

# How Stereotypes about Genius Affect Women and Minorities in Academia

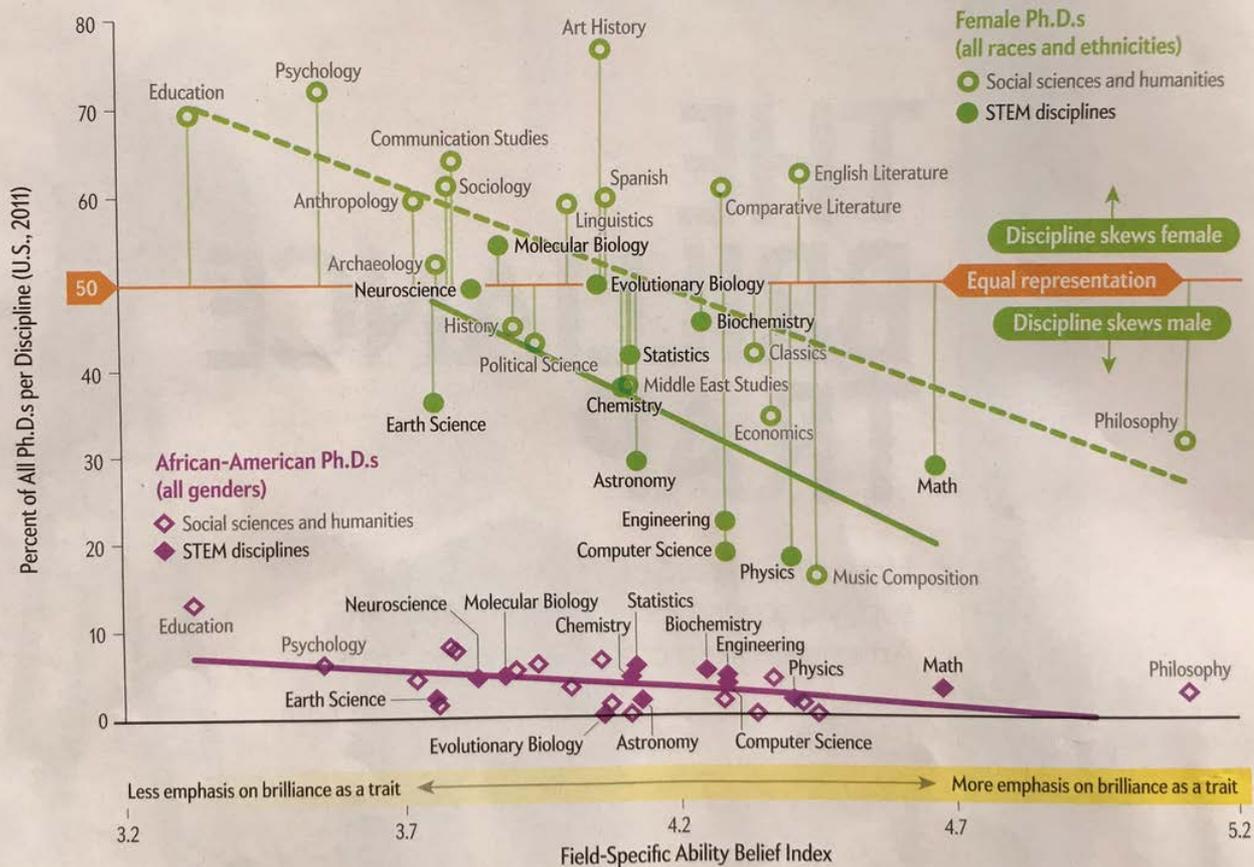
A survey of almost 2,000 professionals in 30 academic fields determined how strongly they believed that the trait of brilliance, as measured by a so-called field-specific ability belief index, mattered for success in their discipline. Fields with higher scores, such as

physics, math and philosophy, awarded fewer advanced degrees to women and African-Americans, compared with neuroscience and psychology, which scored lower. The results suggest that many fields implicitly equate brilliance with white males.

Expectation of 'brilliance' of discipline and attractiveness to women.

Loner vs. Collaborative?

Source: Scientific American 2017

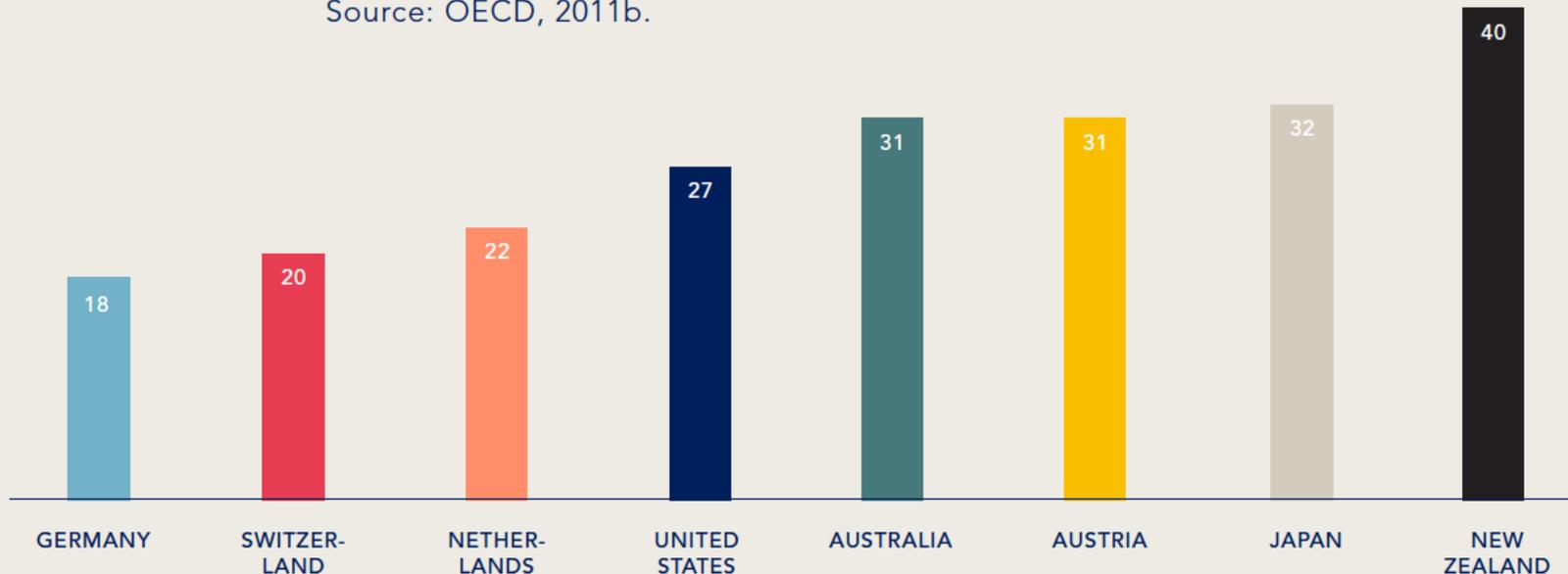


# Family patterns are changing drastically

**FIGURE 24:**

**Single-parent households.**

Projected share as a % of all households with children (2025-2023)\*.  
Source: OECD, 2011b.



\* The period over which changes are predicted are as follows: Australia (2006-2026), Austria (2007-2030), Germany (2007-2025), Japan (2005-2030), Netherlands (2009-2030), New Zealand (2006-2031), Switzerland (2005-2030) and United States (2000-2025)

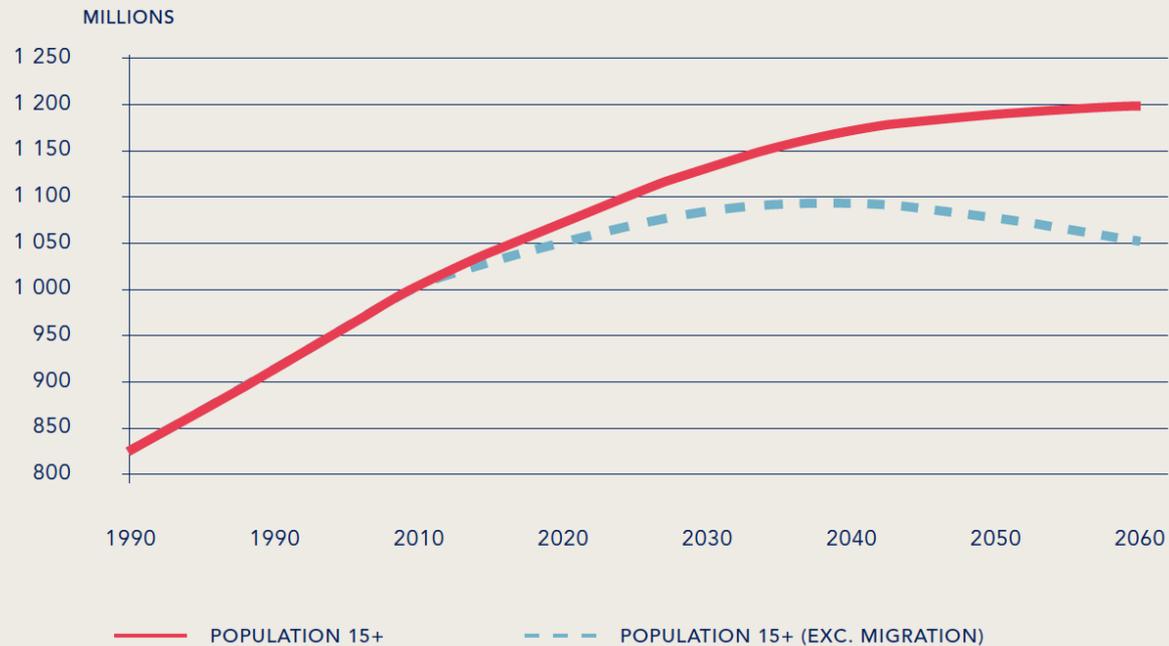
Source:  
OECD, 2011

# Careers

- Gender divide reflects, perhaps, also the gap between expectations and reality.
- Social mores are changing fast – will the traditional career requirements in academia survive?
- Mobility is declining in the affluent countries, why?
- Migration issues are increasing. Are we ready to integrate the highly skilled/trained?

# EU population will only be sustained via migration (says OECD)

**FIGURE 5:** Population and migration 2010-2060 in OECD countries.  
Source: Westmore, 2014.



With migration

Without migration

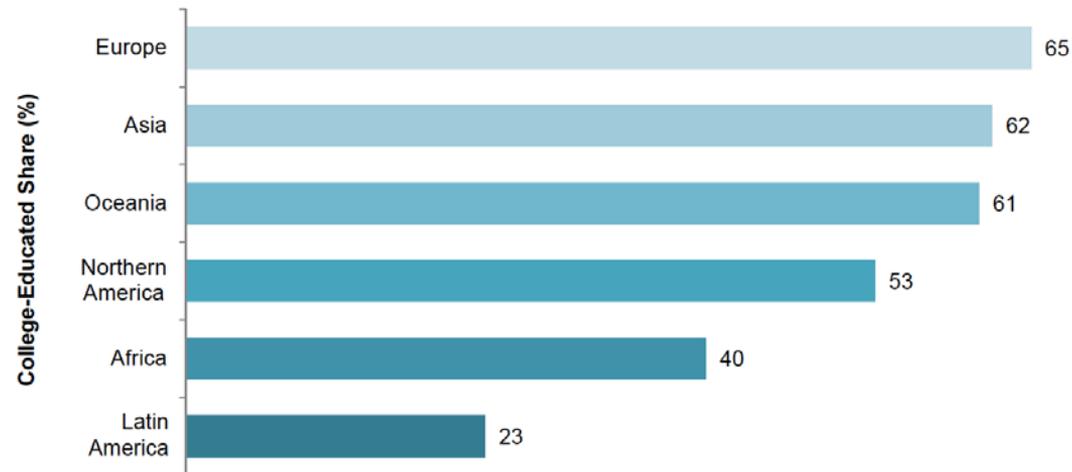
# Summary

- Science has much to bring to society – as the incredible developments since Galileo witnesses (in just 400 years), in terms of prosperity, health, security and outlook.
- To maintain this drive, society (and political leaders) must also appreciate what the nature of the scientific endeavor is, and trust, protect and nurture it.

# Extra's

# US benefits from highly skilled brain-gain

Figure 2. Share of College Graduates among Recently Arrived Immigrants (ages 25 and older), by Region of Birth, (%), 2015\*



\* Recently arrived describes immigrants entering the United States between 2011-15.

Notes: *Northern America* includes Canada, Bermuda, and Cape Verde; *Latin America* includes Mexico, Central America, the Caribbean, and South America; *Oceania* includes Australia, New Zealand, Fiji, Tonga, Micronesia, the Marshall Islands, and Northern Mariana Islands.

Source: MPI tabulation of data from the U.S. Census Bureau 2015 ACS.

## Are we doing enough in Europe to utilize the influx?