From cold war to climate change: the role of ICTP in addressing global challenges

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Why Basic Science for Development?

Today's *global* challenges have a strong basic-science component

- Climate change
- Spreading of diseases
- Earthquakes and tsunamis
- Nuclear safety
- Renewable energies





Why Basic Science for Development? (II)

Solutions to global challenges may differ West-vs-East, North-vs-South

Ability to focus on **regional** technological priorities

Need to add value to local natural resources (e.g minerals in Africa & LA)

=> Basic science must be **geographically** diverse and inclusive







Basic Science: a priority everywhere?

Goma, Eastern Congo

CERN, Geneva, Switzerland



If I were given 1,000,000 Euros to help a poor area, how would I use them?

(A) I would give one meal to 1,000,000 people

(B) I would build a hospital

(C) I would build a school

(D) I would build a research institute





Multiplicative effect

1 university professor
 10 university students
 10 high-school teachers
 200 high-school students
 200 primary-school teachers
 4000 primary school students

Generates precious skills: Engineers, doctors, managers, teachers, politicians,...

In the long run, it frees countries from dependency on foreign aid

Why should "elevated thought" be a prerogative of the rich?







Article 27 - Human Rights:

"Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in **scientific advancement** and its benefits."

"Scientific thought is the common heritage of humankind" Abdus Salam 1926-1996

(Weak)-

DONO

fission

Nuclear

GACAN

(Maxwell) M

1111



(CTP)

ICTP and post-cultural revolution China





Abdus Salam with Zhou En Lai in Beijing, 1972

First visit of Chinese scientists to ICTP, 1979



The Physics divide



Data from: Scimago, WoS



What is your country's h-index?

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index
1 💻 Ur	nited States	8.626.193	7.876.234	177.434.935	83.777.658	23,36	1.648
2 🔠 Ur	nited Kingdom	2.397.817	2.103.145	44.011.201	10.321.539	21,03	1.015
3 🔳 Ge	ermany	2.176.860	2.045.433	35.721.869	9.141.181	18,50	<mark>88</mark> 7
4 🚺 Fr	ance	1.555.629	1.468.286	24.700.140	5.516.943	17,95	811
5 💽 Ca	anada	1.227.380	1.134.588	22.152.666	4.136.384	21,40	<mark>7</mark> 94
6 💌 Ja	pan	2.074.872	2.008.410	27.040.067	7.619.559	13,79	<mark>7</mark> 45
7 🚺 Ita	aly	1.200.448	1.117.013	18.019.464	4.186.908	17,52	<mark>7</mark> 13
8 🔜 Ne	etherlands	681.804	628.678	14.278.721	2.321.446	24,56	<mark>6</mark> 94
9 🚺 Sv	vitzerland	493.857	460.824	10.872.269	1.458.098	26,10	<mark>6</mark> 86
10 🚟 Au	Istralia	890.458	809.027	13.772.961	2.947.945	19,49	644
11 🔚 Sv	veden	460.607	433.674	9.417.604	1.448.940	23,21	614
12 💶 Sp	ain	952.099	884.670	12.628.097	3.068.362	16,14	591
13 🚺 Be	elgium	372.093	348.017	6.691.791	948.874	21,01	547
14 💶 De	enmark	263.026	245.115	5.494.671	779.833	24,94	518
15 💌 İsi	rael	272.352	255.036	5.079.652	694.959	20,56	496
16 🔛 Cł	nina	3.617.355	3.569.652	19.110.353	10.462.121	7,44	495
17 🔚 Au	istria	268.472	250.181	4.334.382	583.299	19,24	449
18 🛨 Fi	nland	234.846	223.366	4.295.721	666.893	21,20	443
19 📧 So	outh Korea	739.229	719.338	7.063.429	1.528.443	12,38	424
20 🔚 No	orway	206.965	190.800	3.354.827	530,420	20.17	402



African publications & citations in Physics (1996-2014)

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index	
1	🔚 South Africa	14.802	14.575	168.541	29.078	14,11	114	
2	💽 Algeria	8.712	8.634	46.274	11.599	7,23	59	
3	Morocco	6.219	6.166	48.617	10.050	8,53	68	
4	Tunisia	<mark>6</mark> .209	6.147	37.373	11.010	7,77	54	
5	Nigeria	1.802	1.783	9.160	2.540	7,25	36	
6	Cameroon	848	843	4.739	1.506	7,54	27	
7	Senegal	349	346	1.903	434	7,84	21	
8	🔤 Ethiopia	304	301	2.397	353	11,49	23	
9	🛌 Sudan	301	300	1.401	247	7,29	16	
10	📕 Libyan Arab Jamahiriya	261	260	1.223	85	5,88	19	
11	🚝 Kenya	254	252	1.912	145	9,71	24	
12	💶 Ghana	252	248	1.117	166	5,36	17	
13	📕 Benin	197	194	1.213	225	7,05	16	
14	💋 Namibia	167	163	6.825	498	38,22	45	
15	📻 Botswana	155	153	891	123	5,72	15	
16	Côte d'Ivoire	149	149	677	66	4,52	15	
17	Burkina Faso	125	122	653	92	6,75	14	
18	💋 Tanzania	106	103	761	68	8,52	14	
19	Madagascar	93	92	118	17	4,65	5	
20	💳 Mauritius	92	92	342	76	5,15	10	
total: 45,000						Source: www.scimagojr.com		
France: 300,000			4,500,000			(Scopus)		

Citations -vs- R&D spending



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The human factor

65% of children starting primary school now will be employed in jobs that don't exist yet

It takes 1 year to build a hospital but 15 years to educate a medical doctor

Critical thinking more important than knowledge

Education is a looooong term investment





The PhD divideUSA: 1762 PhDs in Physics (2012)



APS survey, in partnership w/IoP, EPS, ICTP, and African partners



The Abdus Salam International Centre for Theoretical Physics

African Schools in Physics



+ African School on Fundamental Physics and Applications + African School on Electronic Structure Methods and Applications

Locations: Ghana, Rwanda, Senegal, Ethiopia, South Africa, Kenya, Namibia, Sudan, DR Congo

Focus on: Mentorship Community building International networking

Support from: ICSU, ICTP, CERN, APS, IOP, EPS, CNRS, NSF,...



Women in Science in Developing Countries



A Global Approach to the Gender Gap in Mathematical and Natural Sciences: How to Measure $\ensuremath{\mathsf{It}},\ensuremath{\mathsf{It}}$ It?

Home

Project (+) A Global Approach to the Gender Gap in Mathematical and Natural Sciences

GENDER GAP IN SCIENCE

Work packages
 Organization
 Description of the three tasks
 for the project

https://icsugendergapinscience.org/ ICTP, 4-8 November 2019



4th Career Development Workshop for Women in Physics (ICTP, 14-18 October 2019)



Organization for Women in Science for the Developing World

Main activities:

- Fellowships
- Networking (~4000 members)
- Awards (w/ Elsevier Foundation)





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The role of international collaborations



How do we foster international collaboration?



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2016: ~ **50** Synchrotrons in the world, mostly in "developed" countries

adapted from "AfLS Roadmap", C. Biscari, 2016



"Utilisation of Light Source and Crystallographic Sciences to Facilitate the Enhancement of Knowledge and Improve the Economic and Social Conditions in Targeted Regions of the World"

- 1. Regional Committees develop Strategic Plans for each Region
- 2. Establish an AdLS/Crystallography Colloquium Programme in each Region
- 3. Publish and Disseminate an AdLS/Crystallography Information Brochure

4. Promote and Facilitate Researcher and Student **Short- & Long-Term Visits/Study** at International AdLS and Crystallography Facilities and Schools (*including IUCr-UNESCO OpenLabs*)

5. Convene a **Meeting at UNESCO** Headquarters in Paris to Present the *Strategic Plans* for the Regions and Launch the *Business Plans*



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ICTP: World-class Research, Education, and a Successful Model of International Collaboration

What is ICTP?





- Founded in 1964 by Nobel Laureate Abdus Salam to enhance international cooperation through science
- Combines world class research with a unique global mission of building science capacity in the developing world
- Governed by tripartite agreement between Italy, UNESCO and IAEA

Research at ICTP

Core Research Areas

- High Energy, Cosmology and Astroparticle Physics
- Condensed Matter and Statistical Physics
- Mathematics
- Earth System Physics (Climate & Seismology)
- Quantitative Life Science

Special initiatives

- ICT for Development (wireless, Internet of things)
- Materials for Renewable Energy
- Science for Cultural heritage (x-ray tomography)
- High Performance Computing
- Quantum computing









Research on Climate Change @ICTP





IPCC INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Climate Change 2021 The Physical Science Basis



ICTP's Earth System Physics Section



Topics:

- ✓ atmospheric and ocean circulations
- ✓ aerosols and atmospheric chemistry
- ✓ biogeochemical cycles
- \checkmark the cryosphere
- ✓ land surface processes
- ✓ impacts of climate variability and change
- ✓ regional climate model REGCM



ICTP's Postgraduate Diploma Programme: Preparing young scholars for PhD studies

Since 1991, 1000+ Diploma graduates; more than 75% earned or working toward PhDs



Education at ICTP

Postgraduate Education

- Post-Graduate Diploma
 - 40 students/year (with MSc from LDCs)
 - 75% admitted in good PhD schools
- STEP (Sandwich PhD)
 - 10 students/year, mostly from LDCs
- PhD in collaboration with
 - SISSA (Physics, Mathematics)
 - University of Trieste (Physics, Fluid Dynamics)
- Master in Medical Physics (Univ. Trieste, IAEA)
- Master in High-Performance Computing (SISSA)
- Master in Complex Systems (Paris, Torino, SISSA)
- Salam Lectures

Total n. students on campus: ~200









Fighting the "Brain Drain"

- Associates and Federation Scheme
- Conferences, workshops and schools at ICTP and in developing countries
- Training and Research in Italian Laboratories (TRIL)
- Office of External Activities

• Also, ICTP hosts the Academy of Sciences for the Developing World (TWAS), the Global Network of Science Academies (IAP) and the Organization for Women in Science for the Developing World (OWSD)

ICTP Conferences and Schools





- Schools, conferences, workshops year-round
- (~ 60 at ICTP, ~25 hosted activities, ~15 in developing countries)
- Half of them on subjects related to 4 core research areas
- The rest on many subjects: medical physics, optics, nano physics, plasma physics, electronics, high performance computing, biophysics, satellite navigation, science dissemination and e-learning, m-science, entrepreneurship, nuclear physics (IAEA), teacher training, etc.



ICTP visiting scientists: where do they come from?



A Worldwide Constellation of Physics Centres

- Four Institutes so far
- Activities modelled after ICTP
- UNESCO Category 2 Institutes



ICTP Success Stories





Freddy Cachazo, Postgraduate Diploma Graduate (1996-97)

- Recipient, 2014 New Horizons Prize
- Gribov Medallist 2009
- Dyson Chair, Perimeter
 Institute



Zohra Ben Lakhdar, ICTP Associate

- 2005 L'Oreal-UNESCO Award for Women in Science recipient
- founding member, Tunisian Physics
 Society and Tunisian
 Astronomy Society
- Professor of physics, Tunis El Manar University, Tunisia



Narayan Adhikari, Postgraduate Diploma Graduate (1997-98)

- ICTP Regular
 Associate 2008-15
- Senior Associate 2018-23
- Research group leader, Tribhuvan University, Nepal



"Over the years ICTP has left a deep legacy in performing and promoting outstanding fundamental scientific research. In particular, it has had a major impact supporting science in developing countries. Investing in science is the most efficient long-term way to address the major challenges facing humankind." Stephen Hawking (1942-2018)



Thanks!





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