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Atoms for Peace and Development

Ian Peter Swainson, Nuno Pessoa Barradas, Danas Ridikas

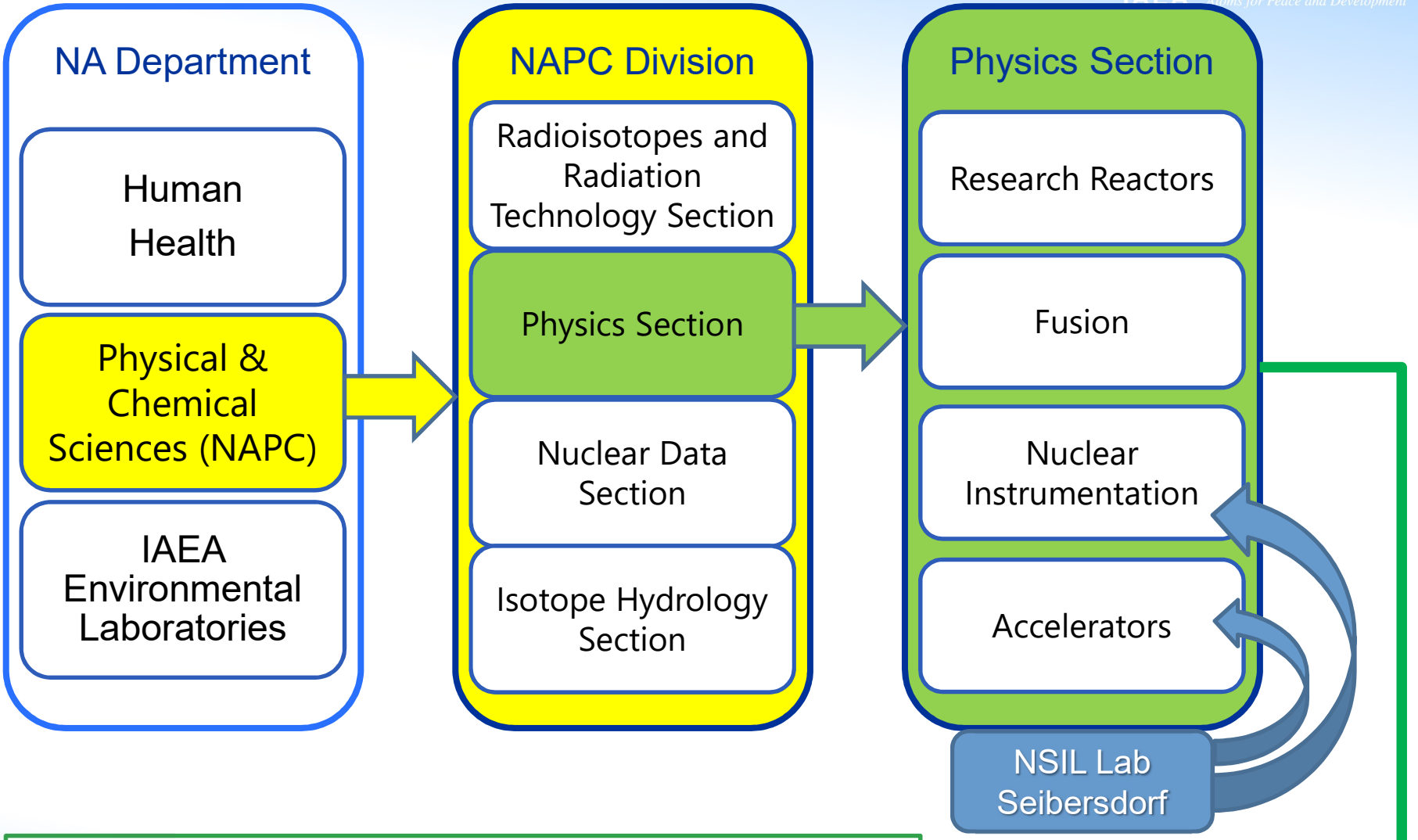
IAEA Activities Regarding Neutron Beam Instrumentation

IAEA
Division of Physical and Chemical Sciences
Physics Section
Vienna, Austria

Organization

- Director General's Office for Coordination (DGOC) includes the secretariat of the policy-making organs, legal affairs, internal oversight services and press and public information.
- Departments (6)

The Department of Nuclear Science and Applications (NA)



- **Staff:** 21 positions, 11@HQ & 10@Seibersdorf,
- plus consultants, interns, fellows; TOTAL: ~30-35
- **Budget:** ~4M Euros RB under 4 sub-programmes

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Activities in Support of Neutron Scattering

Coordinated Research Projects
Technical Meetings
Training Workshops
Round Robin standards exercises
Online training

Coordinated Research Project

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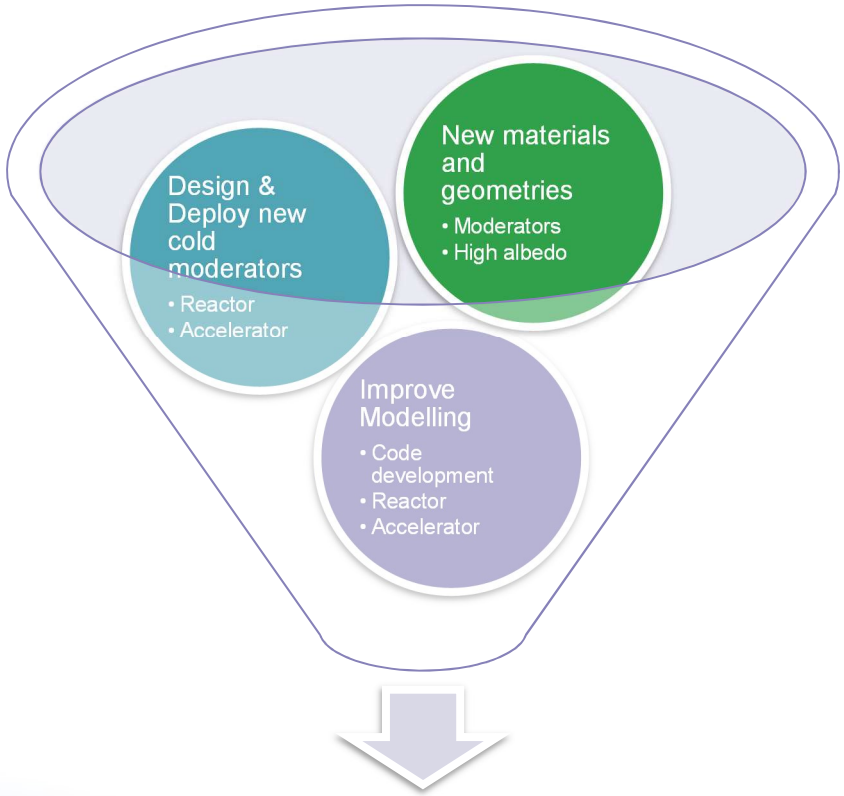
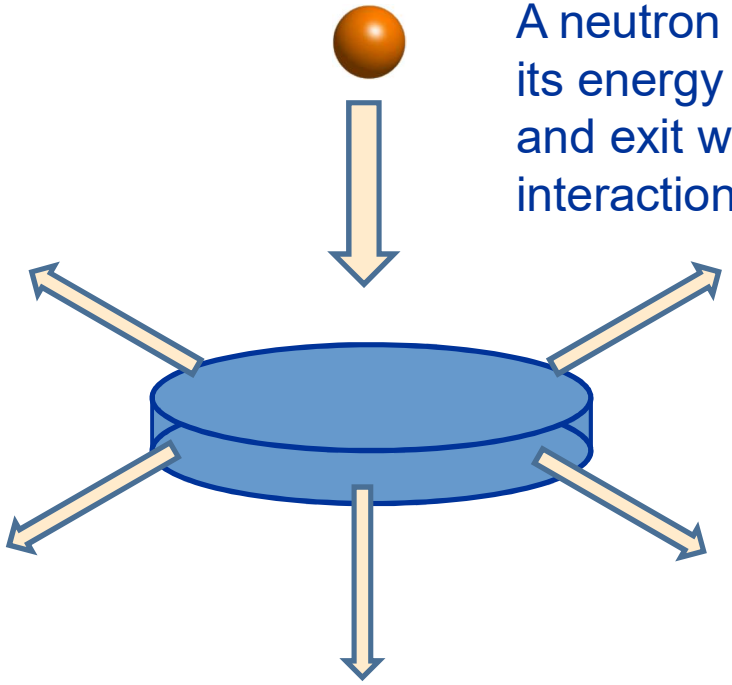
F12026: Advanced Moderators for Intense Cold Neutron Beams in Materials Research



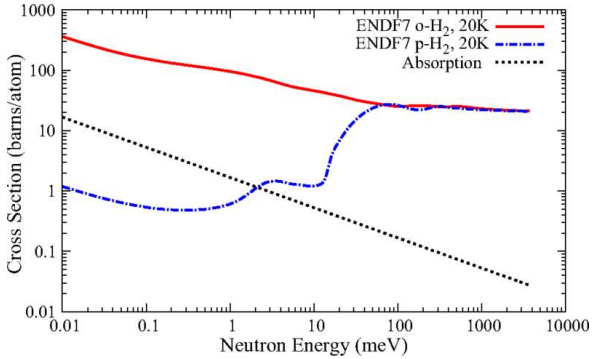
Advanced Cold Moderators

Rods, pancakes, butterflies



A neutron can lose almost all of its energy in a single collision and exit without further interaction.

There is “no chance” of “up-scattering”

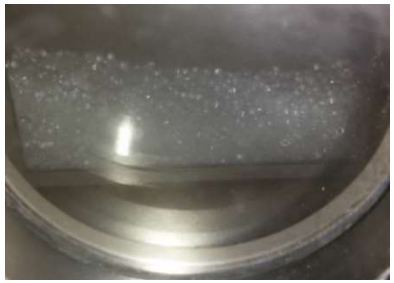


Instruments can be packed efficiently around the pancake

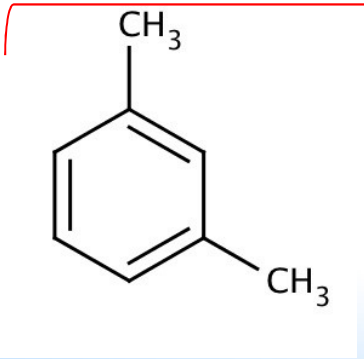
- ESS/STS liquid hydrogen moderators are low-dimensional: >99 % *p*-H_2
- Promise up to 5× better brightness

Pelletized cold moderators

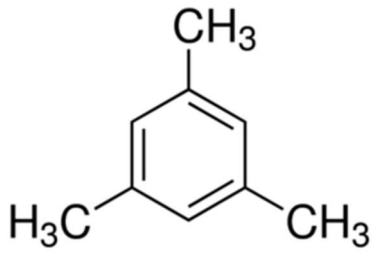
- Phenyl rings provide resistance to free radical induced radiolysis.
- Molecules with high-H concentration and low-frequency external modes and internal degrees of freedom are required.



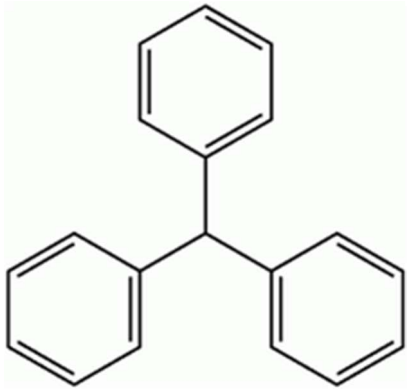
Mixture currently used at JINR, Dubna



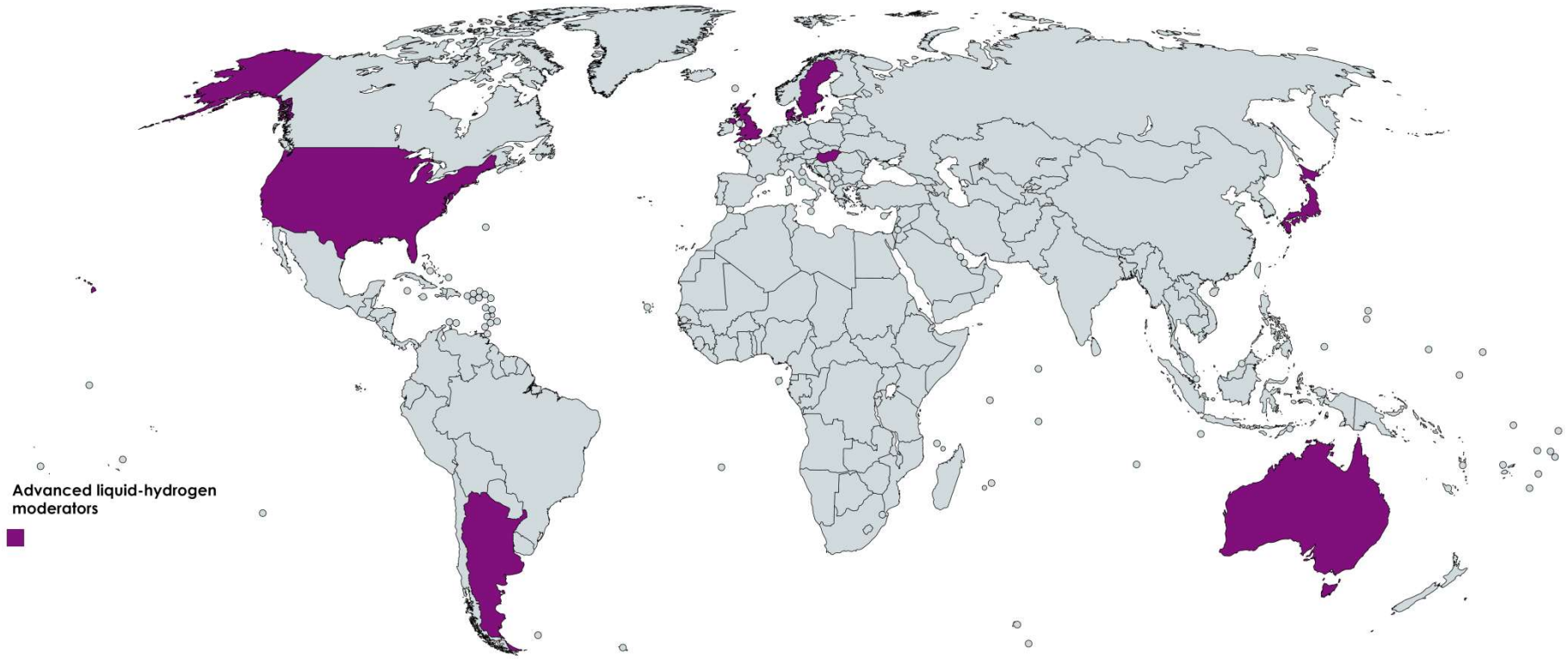
m-xylene
(1,3-dimethylbenzene)



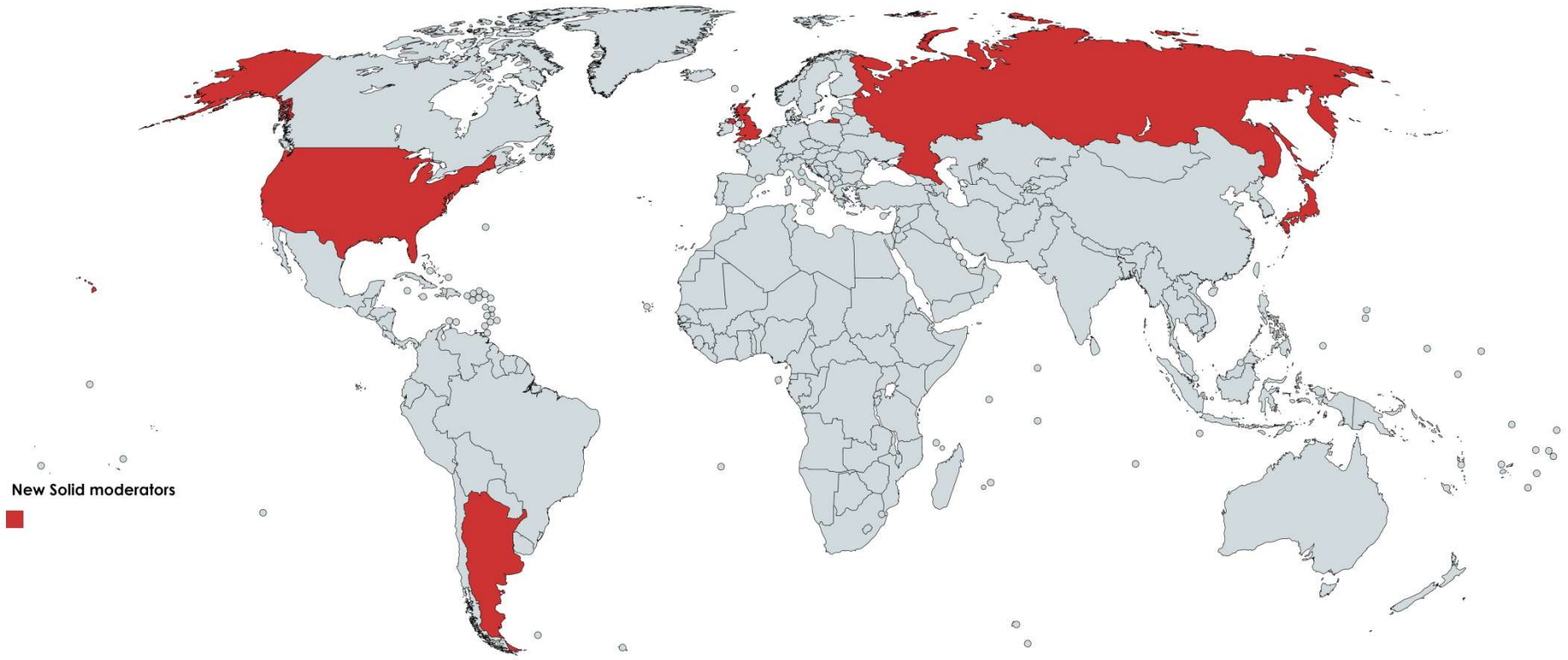
Mesitylene
(1,3,5-trimethylbenzene)



triphenylmethane



Argentina (CNEA): cross-sections and scattering kernels
Australia (ANSTO): design of optimized *l*-H_2/D_2 composite moderator for OPAL
Denmark (ESS) Measurements of flat moderators at JSNS
Hungary (BNR): Design, construction, testing of *p*-H_2 moderator at reactor, pinhole camera for flux distribution measurement
UK (ISIS) Historical data to determine *o/p* ratios in operating moderator
USA (ORNL-SNS):modelling of moderators; Raman spectra for *o/p* ratio
Japan (JAEA): transmission measurements; measurement of brightness distribution in operating moderator
Sweden (ESS) modelling of moderator/target performance of p-H2. Raman setup



Argentina (CNEA): cross-section measurements and scattering kernels for TPM, mesitlyene/xylene mixtures
Japan (J-PARC): Transmission measurements of TPM
UK (ISIS): cross-section measurements of TPM
USA (Indiana): cross-section measurements TPM
Russian Fed'n (JINR-Dubna): Pelletized moderator design, construction, testing TPM, mesitlyene/xylene mixtures

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TECHNICAL MEETINGS

Can be one-off or series of meetings on a topic of current interest.

Technical Meeting on Guidelines on Establishment and Optimization of Cold Neutron Sources in Research Reactor and Accelerator Facilities

1-4 October 2018 in Vienna, Austria.

- To produce a guide on how a country considering the installation of such a facility for the first time would go about structuring such a project, e.g.; the choice of moderator material, resources required (human, financial); design (including neutronics, mechanical; thermohydraulics; planning for replacement) safety and licensing; and processes involved in installation, commissioning and operation.
- **PURPOSE OF THE MEETING:** The intent of this meeting is to gather the operational experience and lessons learned from established sites and personnel to lead towards the production of an IAEA report.
- **TARGET AUDIENCES OF THE REPORT:** Managers with interest in establishing such a facility; project managers in the process of planning or executing such a project, reactor engineers and neutron scientists, as well as regulators.
- **REPORT STRUCTURE:** The report is intended to be a high-level overview with references to detailed technical reports. The intent is to include an updated world-directory of expertise to as an aid in project development.

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Technical Meeting on Modern Neutron Detection
4-8 September 2017
More than 40 participants from 20 countries

Session A: Detector Materials and Special Detection Techniques
Chair: Kanai Shah
Session B: Neutron Metrology and Calibration
Chair David Thomas
Session C: Spectral Unfolding
Chair: Harry Ing
Session D: Rem meters and Monitors
Chair: Thomas McLean
Session E: Detection of Thermal and Subthermal Neutrons
Chair: Eberhard Lehmann
Session F1: High-Resolution Spectroscopy
Chair: Vincent Gressier
Session F2: Low-Resolution Spectroscopy
Chair: Nolan Hertel
Session G: Fusion
Chair: Lee Packer

- The purpose of the meeting is to bring together experts from various fields in which neutron detection is used, and to initiate the development of an IAEA report that will cover the current state of the art in neutron detection and provide a 5–10 year outlook on technologies in this field.
- The meeting outputs will include individual papers from the contributors, which will be incorporated into an IAEA report covering the topics discussed.

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DATABASES

Attempt to summarize facilities of interest

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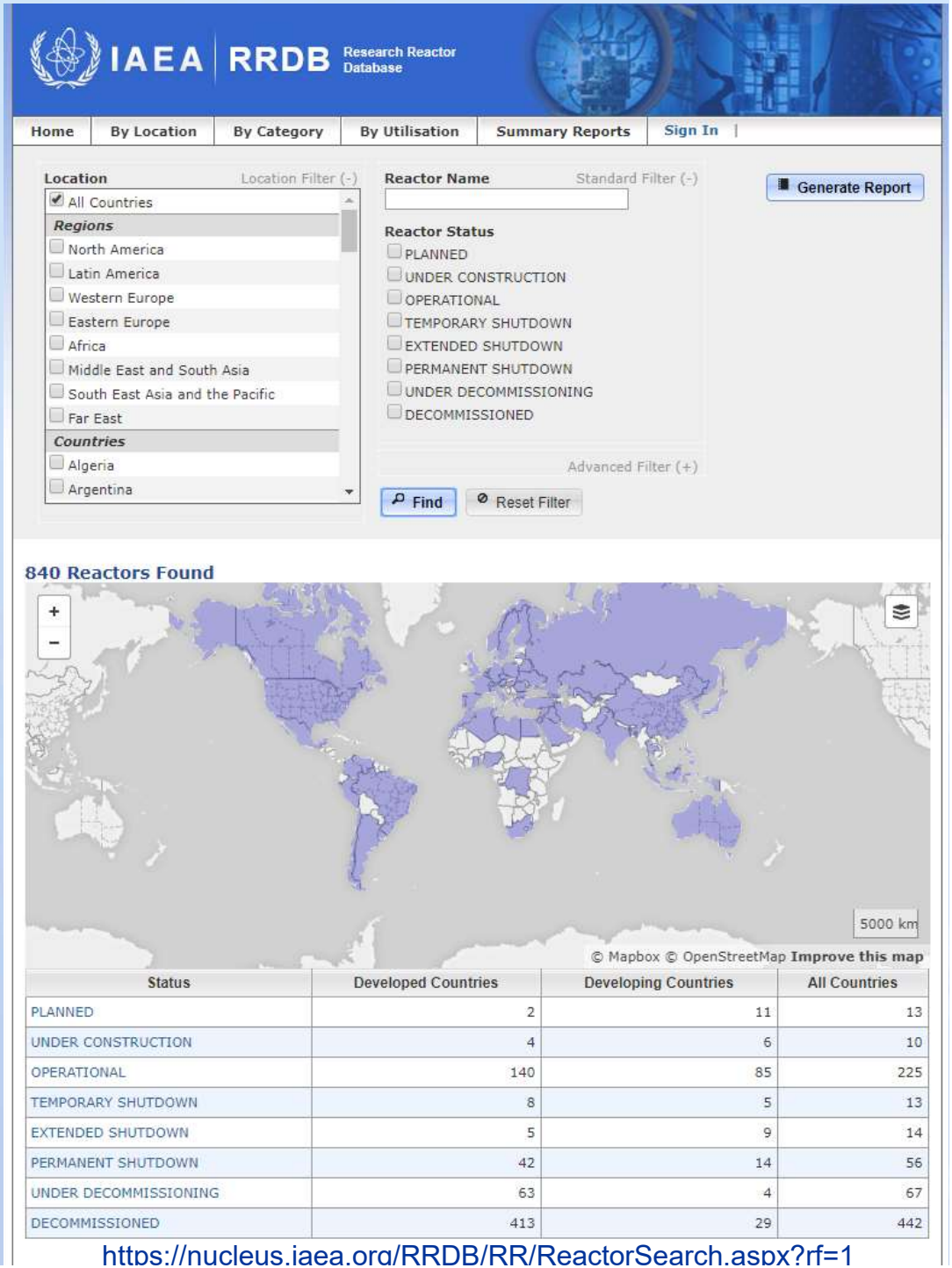
Research Reactor Database (RRDB)

Clickable map

Info on fuel, utilization, status, etc



Status	Developed Countries	Developing Countries	All Countries
PLANNED	2	11	13
UNDER CONSTRUCTION	4	6	10
OPERATIONAL	140	85	225
TEMPORARY SHUTDOWN	8	5	13
EXTENDED SHUTDOWN	5	9	14
PERMANENT SHUTDOWN	42	14	56
UNDER DECOMMISSIONING	63	4	67
DECOMMISSIONED	413	29	442

https://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx?rf=1

Accelerator Knowledge Portal

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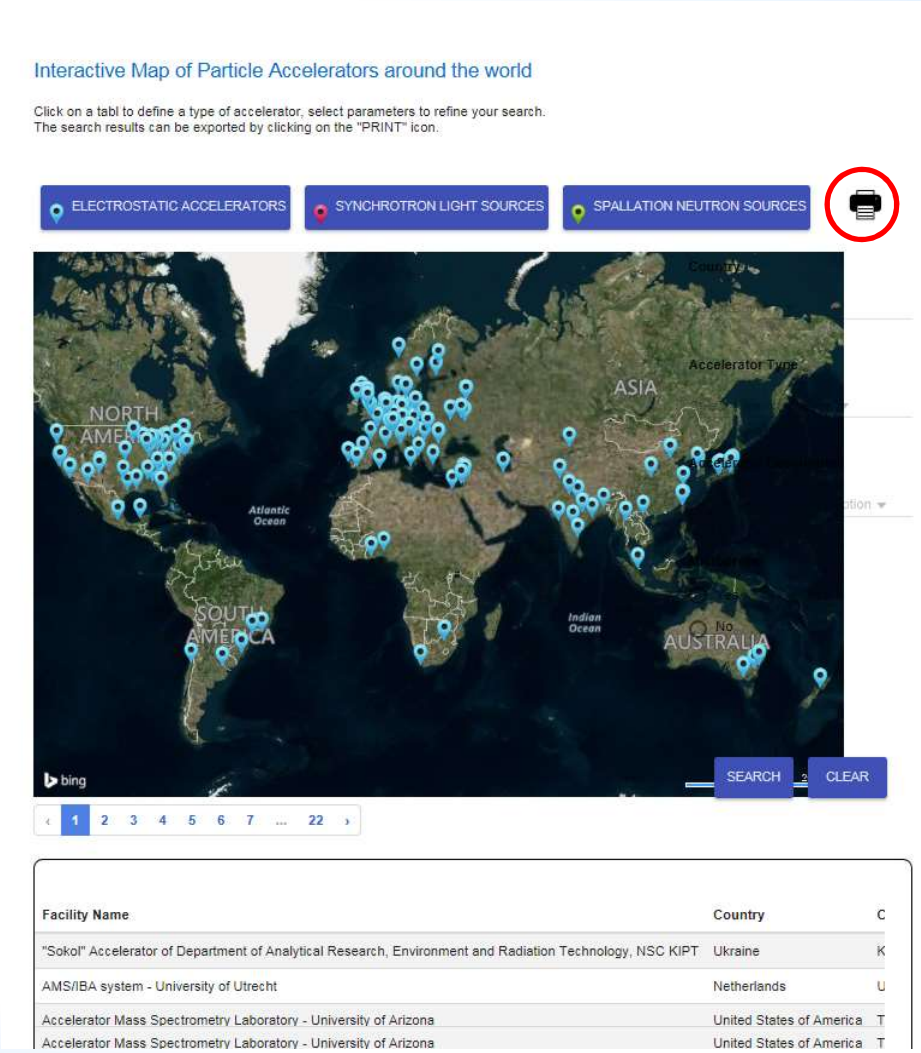
Search by

- Region
- Country
- Accelerator type

Save results in pdf

(map & list)



ELECTROSTATIC ACCELERATORS | SYNCHROTRON LIGHT SOURCES | SPALLATION NEUTRON SOURCES | NEUTRON SCATTERING INSTRUMENTS

‹ 1 2 3 4 5 6 7 ... 22 ›

Country

Select Country

Accelerator Type

Select Accelerator Type

Accelerator Description

Select Accelerator Description

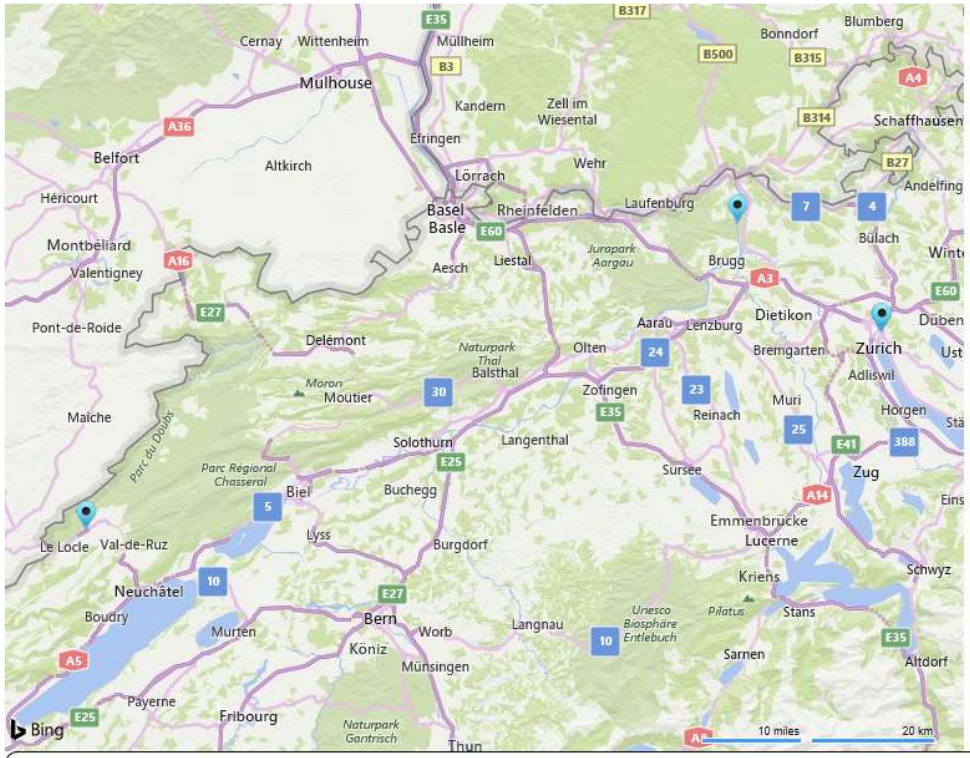
Microprobe

- Yes
- No

SEARCH CLEAR

Country	Facility Name	City	Accelerator Details	Microprobe	Email
Algeria	Centre de Recherche Nucleaire d'Alger	Algers	4MV Single-ended Van de Graaff	No	
Argentina	Comisión Nacional de Energía Atómica	Buenos Aires	20MV Single-ended EN-FN-MP-UD	Yes	
Australia	Australian National University	Canberra	1,7MV Tandem Van de Graaff	No	
Australia	CSIRO Nuclear Microprobe	Melbourne	5MV Tandem Van de Graaff	Yes	

ELECTROSTATIC ACCELERATORS | SYNCHROTRON LIGHT SOURCES | SPALLATION NEUTRON SOURCES | NEUTRON SCATTERING INSTRUMENTS



Country

Switzerland

Accelerator Type

Select Accelerator Type

Accelerator Description

Select Accelerator Description

Microprobe

- ○ Yes
- ○ No

SEARCH CLEAR

Country	Facility Name	City	Accelerator Details	Microprobe	Email
Switzerland	University of Applied Sciences of Western Switzerland, Haute Ecole Arc Ingénierie	La Chaux-de-Fonds	1,7MV Tandem Dynamitron	No	
Switzerland	PSI/ETH Compact Radiocarbon Dating Facility	Zurich	0,5MV Tandem Pelletron	No	
Switzerland	PSI/ETH Compact Radiocarbon Dating Faculty	Zurich	6MV Tandem EN	No	
Switzerland	INFN Pisa / Paul Scherrer Institute	Villigen	1MV Tandem Dynamitron	No	

Neutron scattering instruments

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Title	Name of the Facility	City	Country	Instrument Name	Instrument type	Facility Status	Neutron Energy	Comment	Power (MW)
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	KWS	uSANS	Available	Thermal		0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Radiographie	Imaging	Available	Thermal		0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Interferometer	Interferometer	Available	Thermal		0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Polarimeter	Physics	Available	Thermal	polarised	0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Pneumatic Transfer System	AA/Irrad	Available	Thermal	NAA	0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Test beamline	Other	Available	Thermal	polarised/unpolarised test beam	0.250
TU Wien Atominstitut	TRIGA-MARK II Reactor	Vienna	Austria	Weisser Strahl	Other	Under Construction	Thermal	white beam	0.250
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK4 SPN-100	Strain scanner	Available	Thermal	Multipurpose 2-axis	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK6 MEREDITH	Powder diffractometer	Available	Thermal	Medium resolution	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK9 TKSN-400	Strain scanner	Available	Thermal	High resolution 2-axis	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK8 MAUD	SANS	Available	Thermal	High resolution	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK3-a	Depth profiler	Available	Thermal		10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK3-b	PGAA	Available	Thermal	PGAA	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	HK3-c	Other	Available	Thermal	Two-germanium detector system employed to study gamma-gamma coincidences of (n,g) reactions.	10
Nuclear Physics Institute, ASCR	Research Reactor LVR-15	Řež	Czech Republic	NOD	Test	Not open to users	Thermal	Diffraction optics experiment (e.g. focusing Si crystals.)	10
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D2B	Powder diffractometer	Available	Thermal	Very high resolution.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D20	Powder diffractometer	Available	Thermal	2-axis diffractometer equipped with large microstrip detector. For real-time studies of very small samples.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D1B	Powder diffractometer	Available	Thermal	High intensity with 128 degree PSD.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D4	Powder diffractometer	Available	Hot	Large Q-range to allow characterization of local order of non-crystalline materials.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	SALSA	Strain scanner	Available	Thermal	Dedicated to studies of residual stress.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D3	Single-crystal diffractometer	Available	Hot	Polarized instrument used to study magnetic structures.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D9	Single-crystal diffractometer	Available	Hot	Four-circle, high Q-range.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D10	Single-crystal diffractometer	Available	Thermal/Cold	Four-circle diffractometer with 3-axis energy analysis option.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D16	Diffractometer;#SANS	Available	Cold	Variable vertical focusing for the study of partially ordered structures such as intercalated layers.	58.3
Institut Laue-Langevin	HFR Reactor	Grenoble	France	D19	Single-crystal diffractometer	Available	Thermal	A large structure diffractometer.	58.3

Neutron Scattering Instruments DB

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- Data originated from a survey conducted by NIST in 2017 from Peter Gehring/Dan Neuman.
- Attempting to preserve to see if there is interest
- Some sites are missing
- Does ISNIE find this useful? What information is missing in the current entries?
- Databases always require updates: if you find mistakes please tell us.

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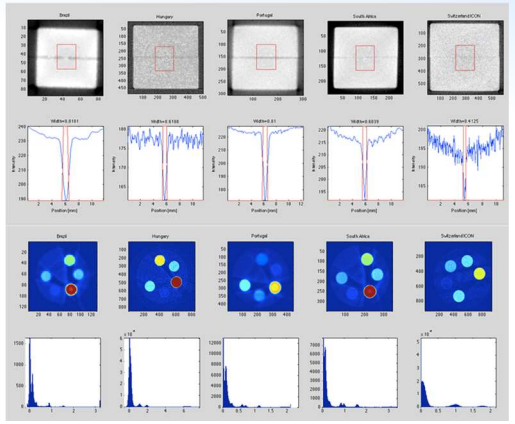
Research Reactor Section

Physics Section implements the utilization aspects of this program

Neutron Imaging: Round robin

2012-13, in cooperation with Paul Scherrer Institute (PSI), Switzerland

- Objective:
  - Test **2D contrast and resolution**
- Means
  - Samples from PSI, guidelines and deadlines
  - Advice and evaluation
  - Results analysis
- Results:
  - **Participation from 14 facilities world-wide**
  - Good results achieved by 5-6 facilities
  - Deficiencies identified for 2-3 facilities



- **New exercise initiated August 2018**
  - In cooperation with PSI
  - Use improved samples/methodology
  - Test **3D contrast and resolution**
  - **16 facilities to participate world-wide**

21

Neutron Imaging: E-learning course

- Second most common analytical technique at RRs, after NAA
- Currently in development, release in CLP4NET in 2019

Dr Eberhard Lehmann

Dr Nikolai Kardjilov

Activity	Completion date
Phase 1: Define course structure	31 October 2017
Phase 2: Develop training materials	9 April 2018
Phase 3: Review of training materials	16-18 April 2018
Phase 4: Develop revised training materials	30 November 2018
Phase 5: Test e-learning course	10-14 December 2018
Phase 6: Implementation	2019

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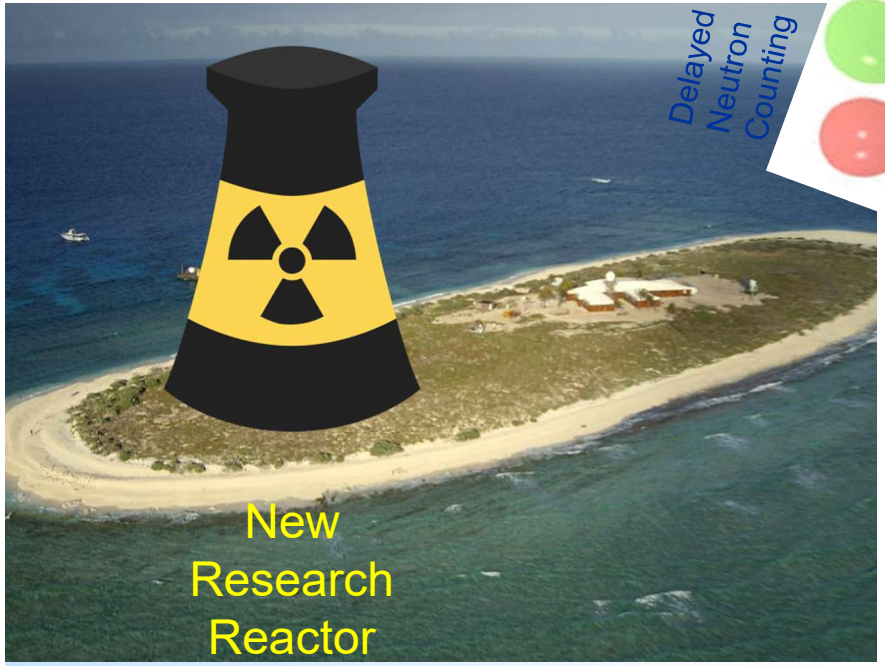
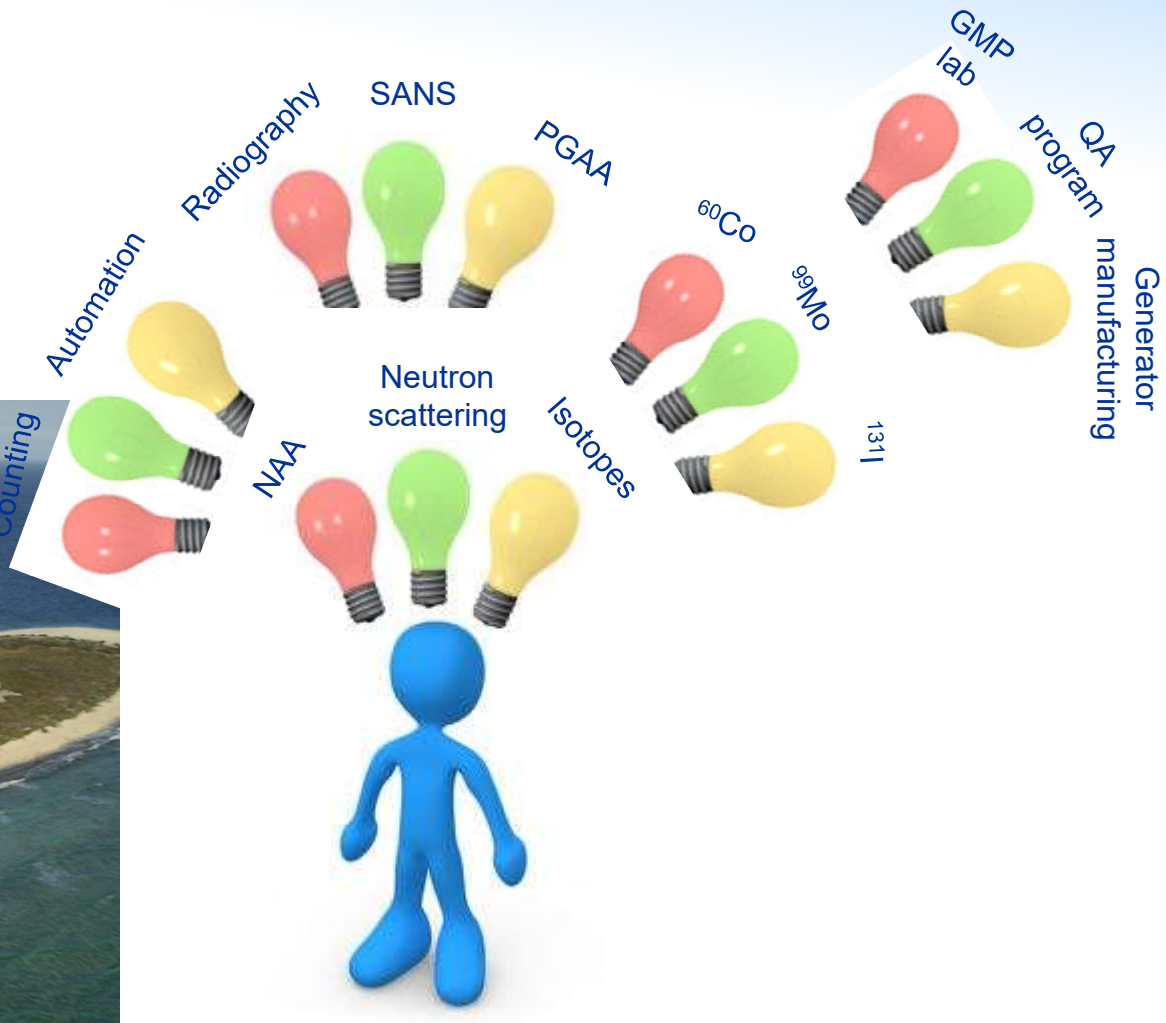
TECHNICAL COOPERATION PROJECTS

Where a society like ISNIE and its members could really be helpful

New Reactor in Country Y





Knowledge Transfer

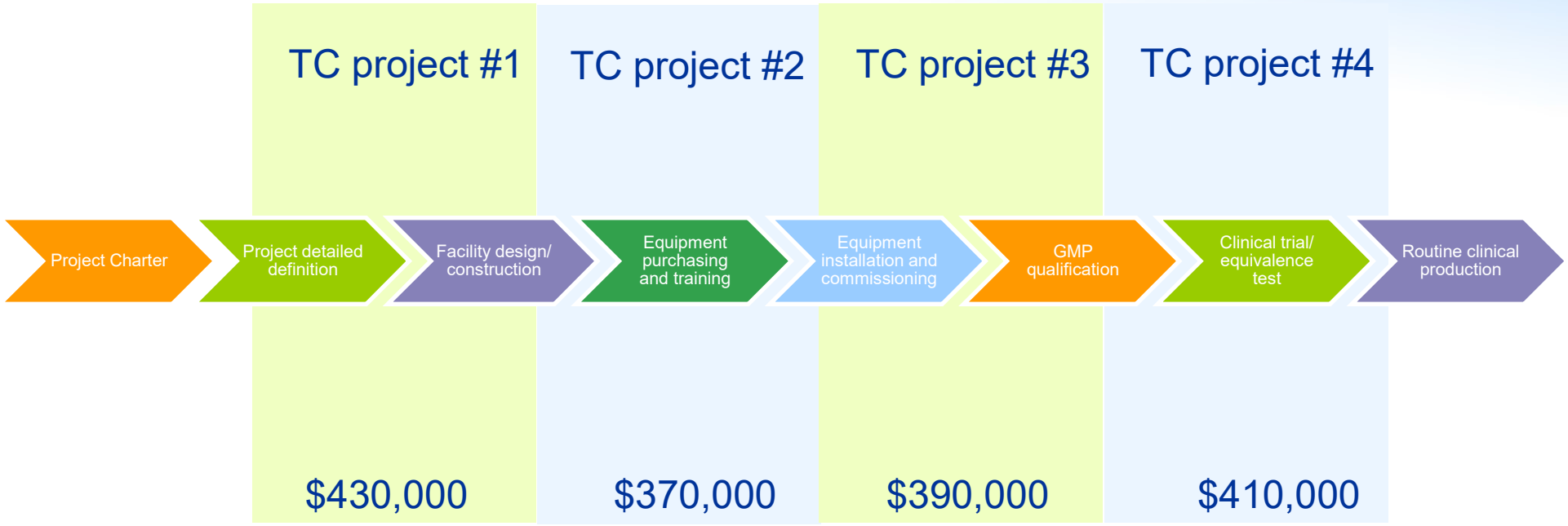
Scientific Visits (1-2 weeks)
Fellowship Visits (month-year)

Expert Missions

Home-Based Assignments

Small contracts; e.g. Write installation-specific documents; small custom design.
All major contracts done through tender process (usu. lowest price, technically compliant)

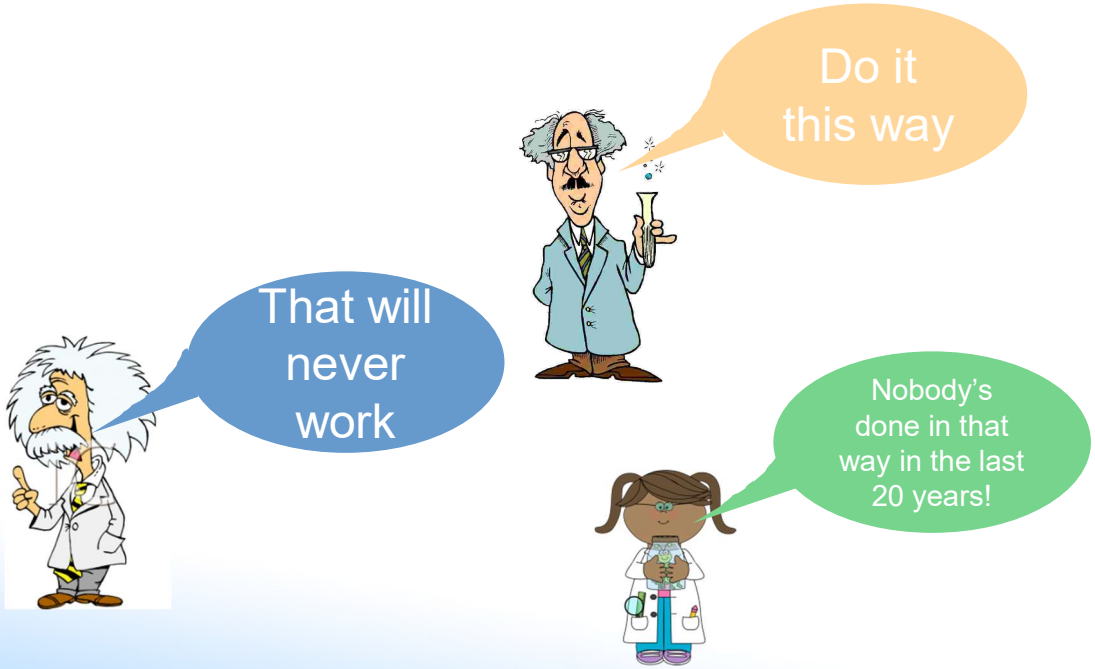
Limitations: Typical TC project lifetimes and overall project



- TC projects 2-3 years may not match the timescale of a “real” overall project: e.g. routine clinical production of ^{131}I-MIBG (targets, mgmt+regulatory approvals, hot cells + chemistry, GMP, clinical trial/bioequivalence tests, etc…)
- “Real” overall project is split into multiple TC “sub-projects”
- Cash flows may not always match overall project cash demands

Limitations: Knowledge Transfer

- Expert Missions cannot last years - weeks
- Possibly fractured or contradictory advice
- CP and team need to gain knowledge and confidence to run the overall project coordination in country



ISNIE

A source of contacts for:

- expert missions;
- hosts of scientific visits/fellowships;
- project management experience;
- PM documents: WBS, Gannt charts etc;
- specifications for equipment;
- budgetary guidance
- equipment suppliers and trouble shooting;
- approved procedures, documentation, safety assessments;
- safety/regulatory advice;
- long-term support network.

Symposium of North Eastern Accelerator Personnel (SNEAP)

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SNEAP is a community of personnel involved with electrostatic particle accelerators and their use. Founded in 1968, the organization gathers annually to discuss and exchange information to the benefit of all who attend. The topics covered include ion sources, electrostatic add rf accelerators, telemetry and control systems, cryogenic systems, safety issues and many other topics relevant to the operation of small to medium sized electrostatic accelerator laboratories.

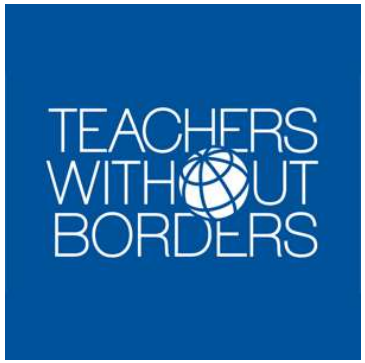
Hello Dear Sneapers,
Does anybody have experience related to the rescue/evacuation of people from the accelerator tank inside? Our NEC 20 MV accelerator, in Buenos Aires, Argentina, is inside a big vertical pressure tank (35 meter tall, 8 meter diameter). If a person doing maintenance on the annular platform or manlift (elevator moving within the column) has an accident or faints for whatever the reason, it could be a major problem to help him out of the tank. For this reason, all experience, procedure, standards or safety rules, list of necessary safety elements or related suggestions to share, will be very important for us.
Best Regards,
Eng. Carlos Miguez Tandar accelerator,
Buenos Aires,
Argentina

Dear Sir
I am looking for a host laboratory for training on the operation, devellopement and maintenance of particle accelerator type V.d. and Tendem. G This internship is funded entirely by IAEA and includes training costs for the host laboratory. If anyone can orient me I will be very grateful.
Best regards

SNEAPERs: For an upcoming project I need some more standard HVEC 9" OD tank flanges, preferably blanks, but I'll take whatever I can get. See attached pictures. I'll definitely pay for shipping if you have a few lying around and want to get rid of them. Thank you.
Cheers!!! ----(AMS)--------- Tom Miller

Dear Sir
El Instituto de Fisica of the Universidad Nacional Autonoma de Mexico are in operation 4 low energy accelerators: A 2 MV and 5.5 MV Van de Graaff (high voltage engenerring Co), a 3 MV tandem Pelletron (NEC) and one MV tándem (High voltage europe) AMS. The 5.5 MV vertical accelerator was donated from Rice University and I was responsible to move this accelerator and reinstalling in Mexico. This accelerator has been in operation since 1950 and I obtained a good experience is solving most of the problems to install and maintenance of the whole laboratory. I am available to host someone to be trained here. Please contact me if you are interested.
Sincerity yours
Dr. Eduardo Andrade Instituto de Fisica UNAM

ISNIE: Neutron Instrumentation Engineers without Borders?



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Thank you for your attention

I.Swainson@iaea.org