



Wir schaffen Wissen – heute für morgen

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Introduction to ESS - NIUS

Purpose of ESS-NIUS

Situation in Neutron Imaging TODAY

Program NIUS

ESS – status and development

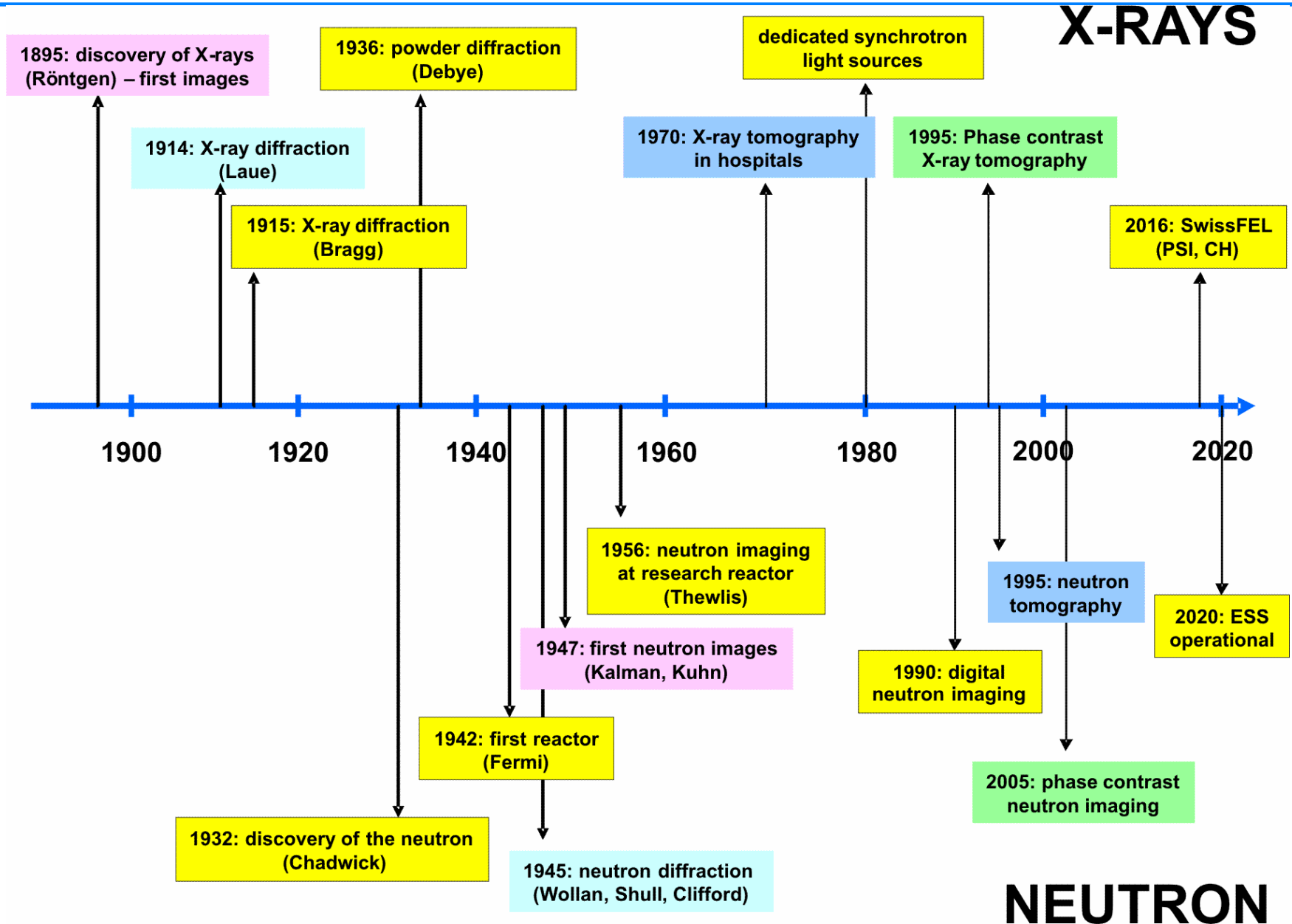
expected OUTCOME of NIUS: ... Questionnaire, ...

→ Science & Scientists Meeting Berlin, 19./20.4.2012

Purpose of ESS-NIUS

- Users from TUM, HZB and PSI will share their experience with all the participants
- The future „flagship of neutron science“ – ESS – will be presented, including the NI capabilities
- Feedback from the users to the facilities‘ operators for the future demands in their research
- Reply by the facilities‘ operators about feasibility and future plans

Historical overview



- free neutrons were discovered **37 years** after the X-rays were found
- neutron imaging started **50 years** after first X-ray images were made
- neutron diffraction comes **30 years** later than X-ray diffraction
- neutron tomography comes **25 years** later than X-ray tomography in hospitals
- phase contrast imaging with neutrons comes **10 years** later than with X-rays
- neutron imaging is **now** a competitive and complementary method compared to the X-ray techniques

- Dedicated beam line at a (most) powerful neutron source → intensity
- Well defined thermal or cold spectrum
- Best possible beam collimation ($L/D > 100$)
- Reasonable large field-of-view (diameter > 10 cm) - homogenous
- DIGITAL IMAGING DETECTION SYSTEM
- Experimental infrastructure (remote control of processes, radiation protection, access control, ...)
- Prepared for user access

Country	Location	Institution	Facility	Neutron Source	thermal/cold flux [cm ⁻² s ⁻¹]	L/D - ratio	Field of View
Austria	Vienna	Atominstitut	imaging beam line	TRIGA Mark-II, 250 kW	1.00E+05	125	90 mm diam.
Brazil	Sao Paulo	IPEN	imaging beam line	IEA-R1M 5 MW	1.00E+06	110	25 cm diam.
Germany	Garching	TU Munich	ANTARES	FRM-II 25 MW	9.40E+07	400	32 cm diam.
Germany	Garching	TU Munich	NECTAR	FRM-II 25 MW	3.00E+07	150	20 cm diam.
Germany	Berlin	HZB	CONRAD	BER-II 10 MW	6.00E+06	500	10 cm * 10 cm
Hungary	Budapest	KFKI	imaging beam line	WRS-M 10 MW	6.00E+05	100	25 cm diam.
Japan	Osaka	Kyoto University	imaging beam line	MTR 5 MW	1.20E+06	100	16 cm diam.
Japan	Tokai	JAEA	imaging beam line	JRRM-3M 20 MW MTR	2.60E+08	125	25 cm * 30 cm
Korea	Daejon	KAERI	imaging beam line	HANARO 30 MW	1.00E+07	190	25 cm * 30 cm
Switzerland	Villigen	PSI	NEUTRA	SINQ spallation source	5.00E+06	550	40 cm diam.
Switzerland	Villigen	PSI	ICON	SINQ spallation source	1.00E+07	350	15 cm diam.
USA	PennState Uni.	University	imaging beam line	TRIGA 2 MW	2.00E+06	100	23 cm diam.
USA	Gaithersburg	NIST	CNR	NBSR 20 MW	2.00E+07	500	25 cm diam.
USA	Sacramento	McClellan RC	imaging beam line	TRIGA 2 MW	2.00E+07	100	23 cm diam.
South Africa	Pelindaba	NECSA	SANRAD	SAFARI-1 20 MW	1.60E+06	150	36 cm dia.

- the given numbers are raw estimates due to permanent improvements
- some facilities provide multiple options in respect to beam collimation and intensity / FOV



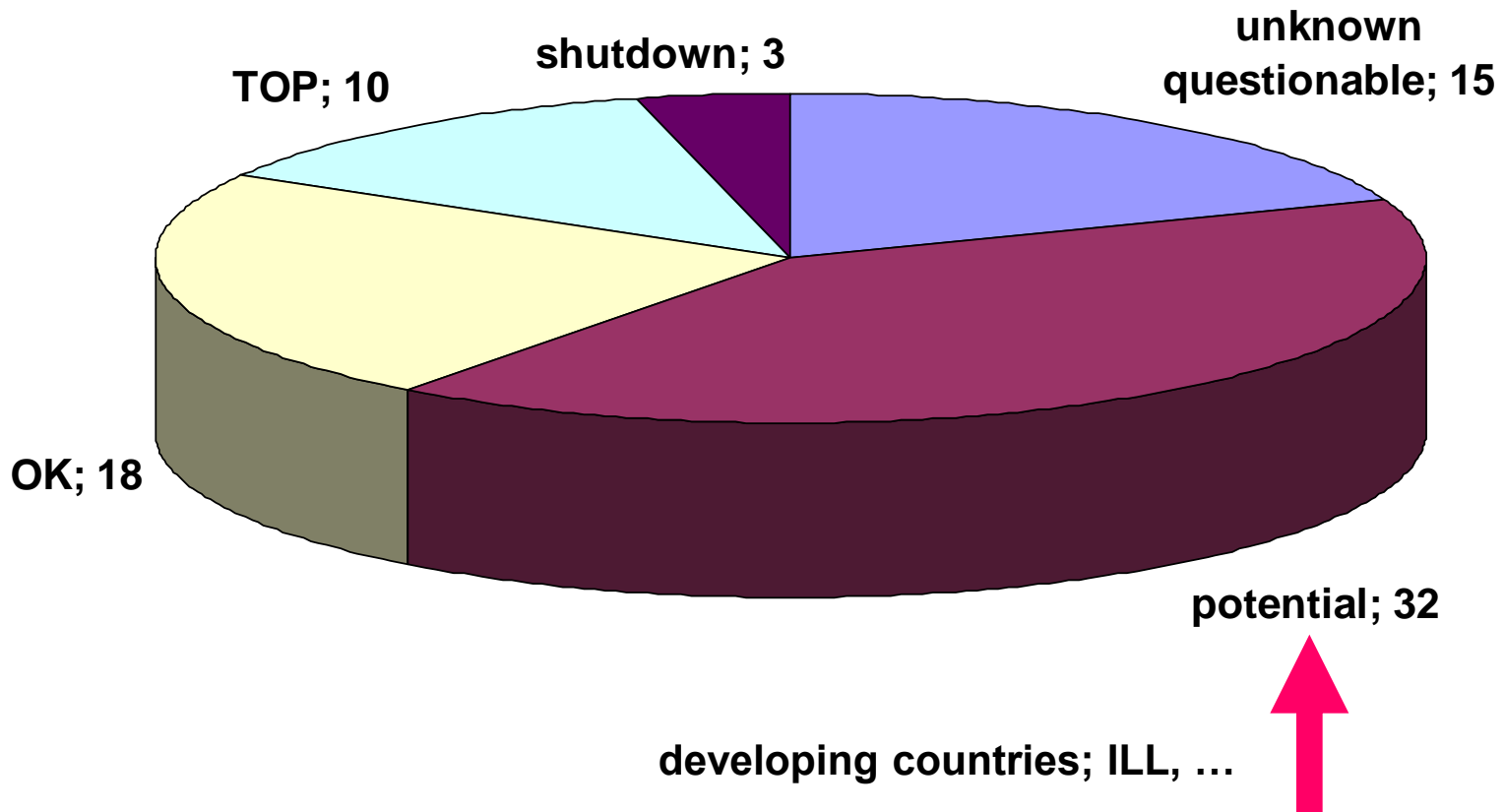
241 research reactors operational in **56** countries

188 with power > 1 kW; **110** with power > 1 MW

51 facilities claim to perform **neutron scattering**

77 facilities claim to perform **neutron radiography**

Neutron Imaging Facilities - worldwide (according to Research Reactor Data Base IAEA)



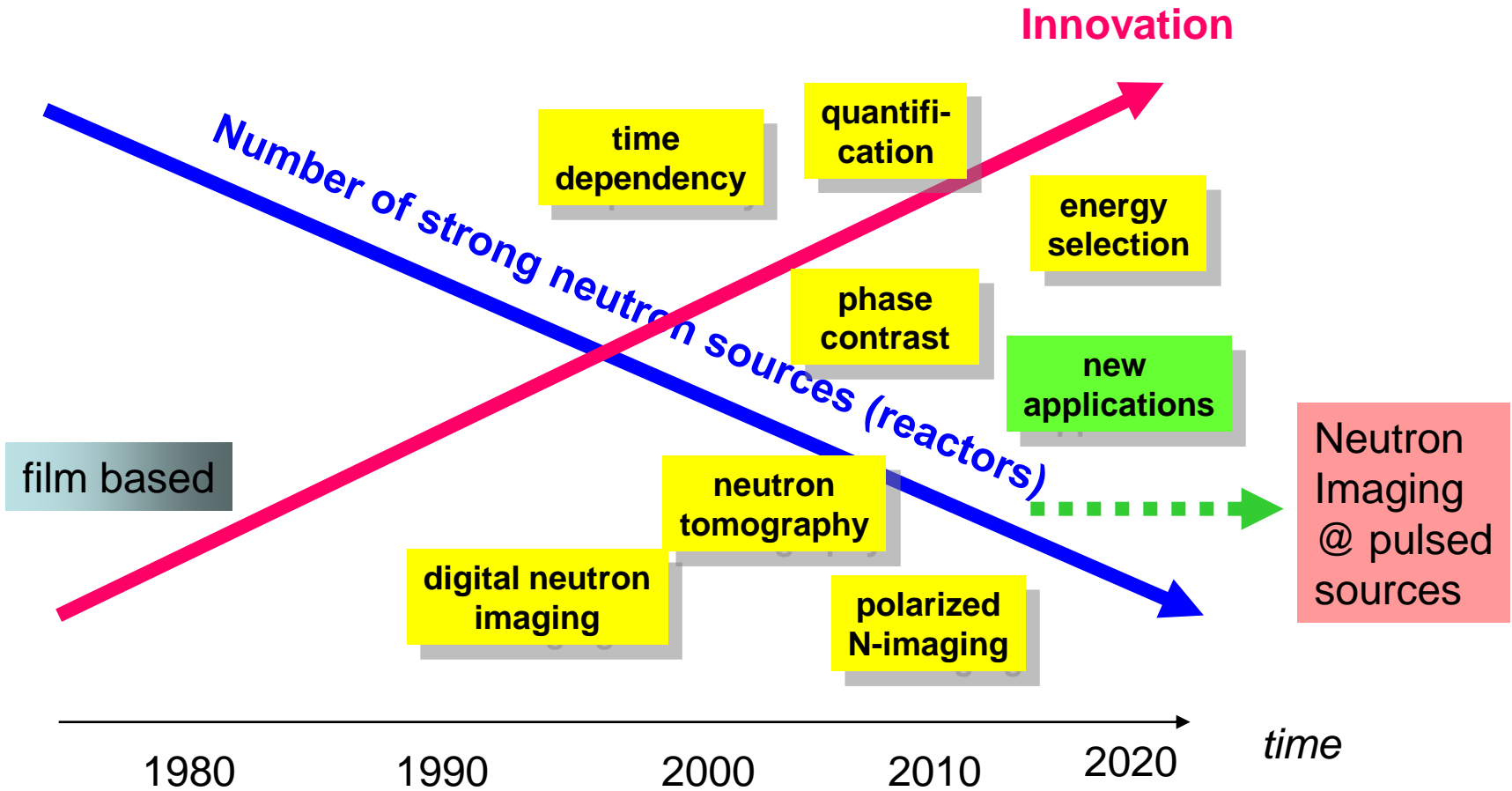
- The investment for a neutron imaging beam line is not done (0.1 to 0.5 Mio. US \$)
- Competition to other user groups (neutron scattering, irradiation technology)
- Missing user program and applications
- Limited know how and technical infrastructure in the particular country
- Missing experienced staff and education

It is possible to use the potential at other sources for neutron imaging with a suitable investment

- Considerations at prominent places to build a neutron imaging facility (ILL, LLB, Marokko, IBR-2, Kjeller, ...)
- Projects at pulsed sources (ISIS: IMAT; JPARC: ERNIS; SNS: VENUS; ESS: xxx)
- Construction started in some countries (OPAL - Australia, CARR – China)
- Upgrade decided or completed (SANRAD – South Africa, CONRAD, PONTO – Germany, ANTARES – Germany)
- IAEA strongly supports neutron imaging by a new CRP (neutron tomography in cultural heritage)
- and wants to finance 5 facilities in developing countries

- 33 Oral presentations in 10 sessions
- Participants from 13 countries
- Poster session: 15 contributions (short talks)
- excursion to PSI
- discussion & interaction
- summary each day
- global summary → report to the main sponsor

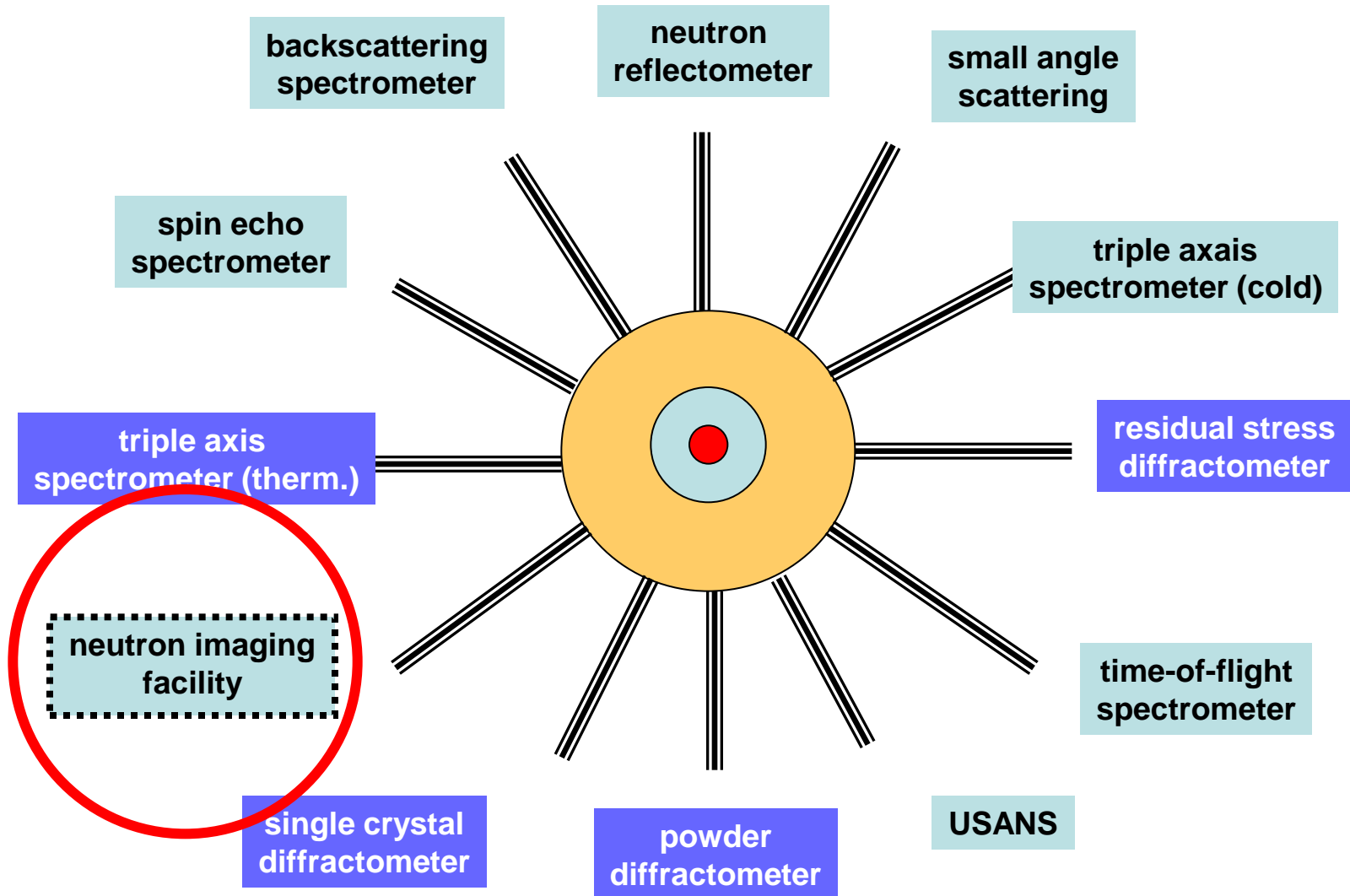
Global trends in neutron imaging



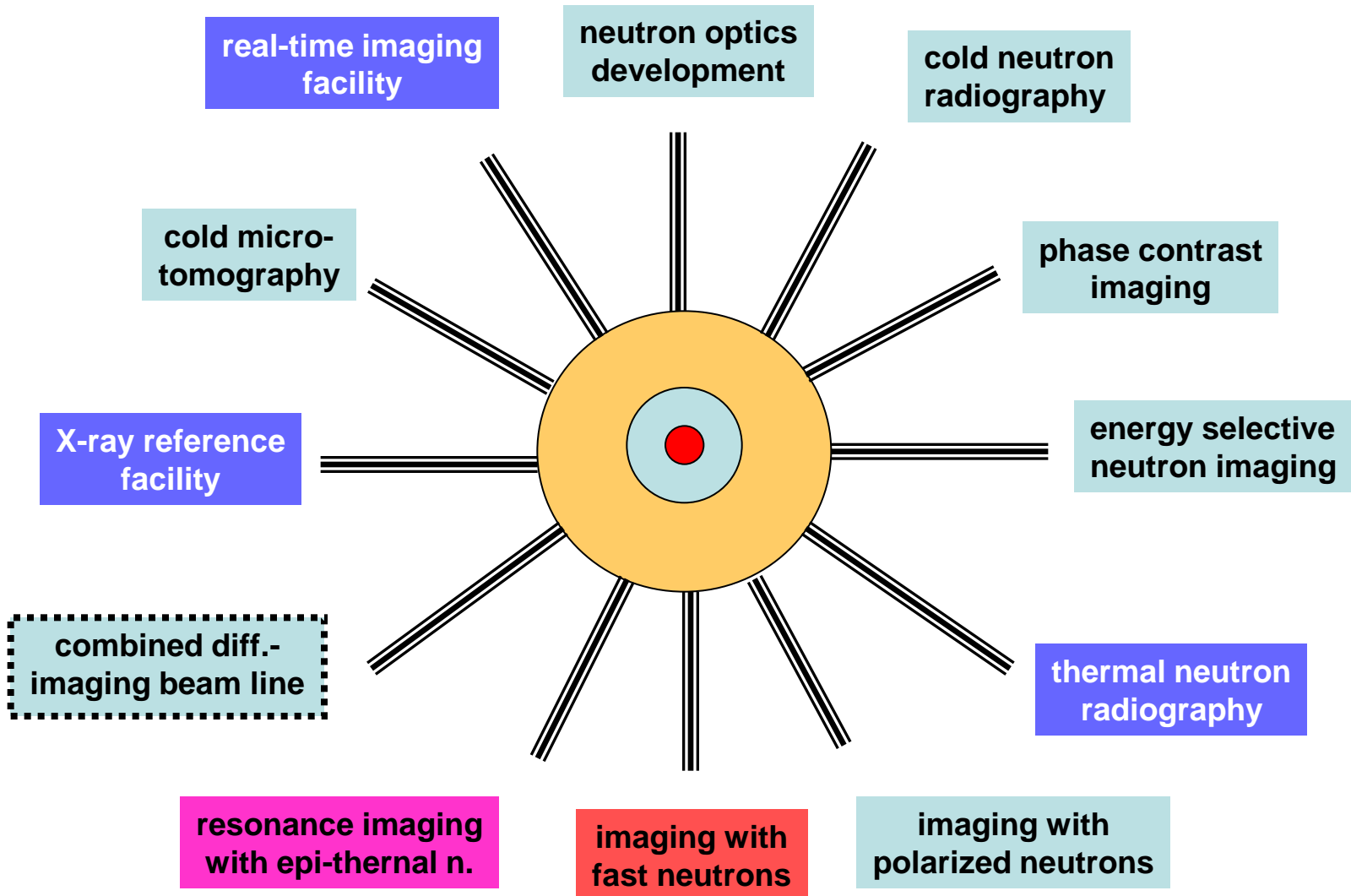
ESS

- **Questionnaire**
- **Discussions (after talks, daily summary, general summary)**
- **Collection of presentations to the INDICO-homepage of NIUS2012 (for internal use first)**

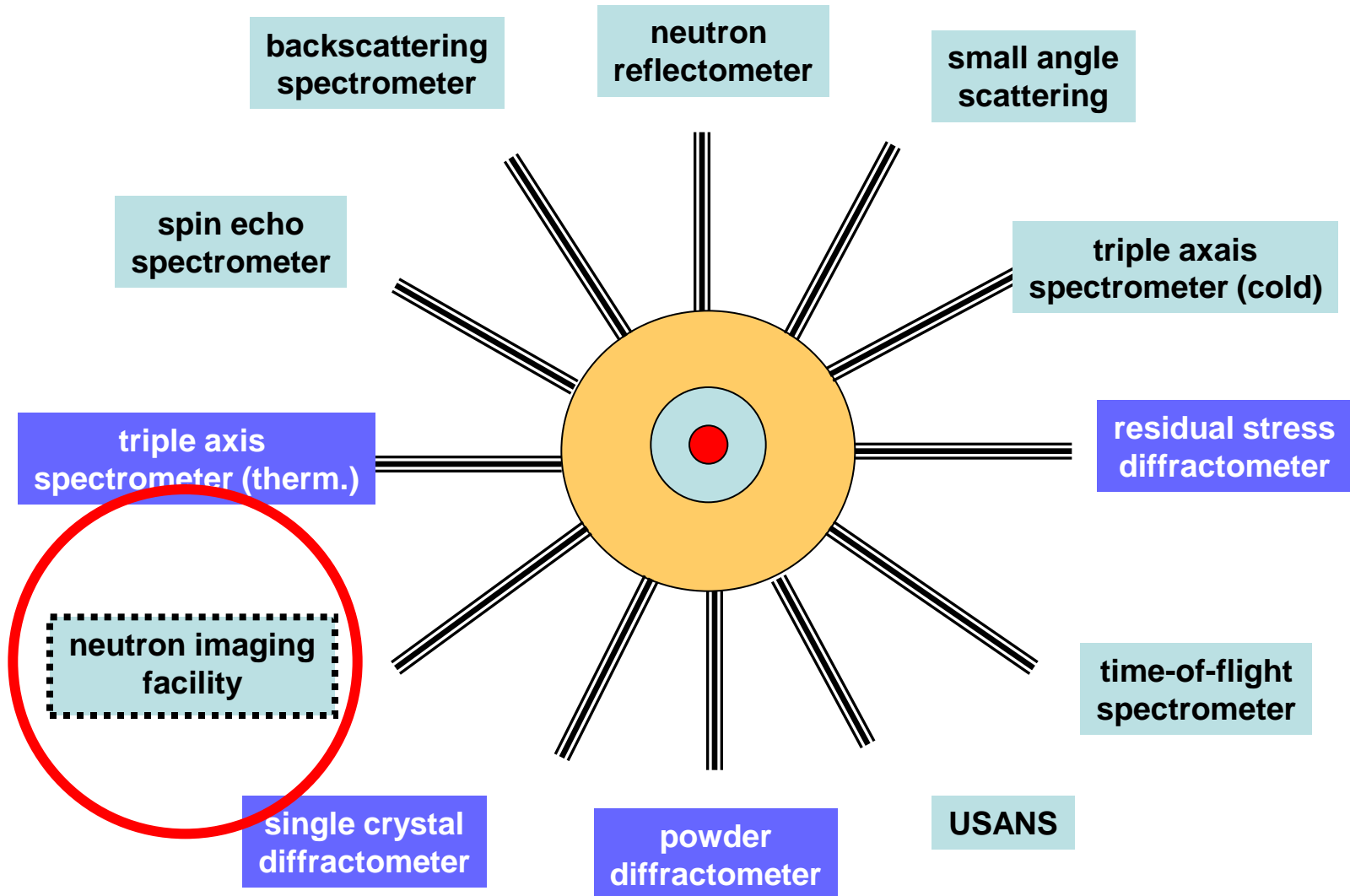
New source for neutron scattering



New source for neutron imaging



New source for neutron scattering





<http://www.isnr.de>

11th PSI Summer School on Condensed Matter Research (11-20 August 2012) - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

Microsoft Outlook Web Access x 11th PSI Summer School on Condensed ... x NIUS2012 - ESS Neutron Imaging User S... x +

indico.psi.ch/conferenceDisplay.py?confId=1386

Google Europe/Zurich English Login

11th PSI Summer School on Condensed Matter Research

11-20 August 2012 *Institut Montana Zugerberg in Zug, Paul Scherrer Institut in Villigen - Switzerland*
Europe/Zurich timezone


- Scope
- Program overview
- Timetable
- Registration
 - Registration Form
- Speakers
- Committees
- Venue
- General information
- Practical training
- Deadlines
- Sponsors / Grants
- School poster

2012 PSI Summer School on Condensed Matter Research

Imaging Life and Matter - using photons, neutrons and muons

August 11-17, 2012 (lectures)

Institut Montana, Zugerberg/Zug, Switzerland



The PSI summer school 2012 is dedicated to the fascinating and growing field of **imaging experiments** at large scale facilities. International experts and PSI staff members will introduce and deepen your knowledge about real space imaging from life to

Start Wireless Network Co... 11th PSI Summer Sch... DE 19:09

Mein Dank geht an

All members of the NIUS preparation team – let's hope for a successful meeting!

