

Future R&D for HEP: Training

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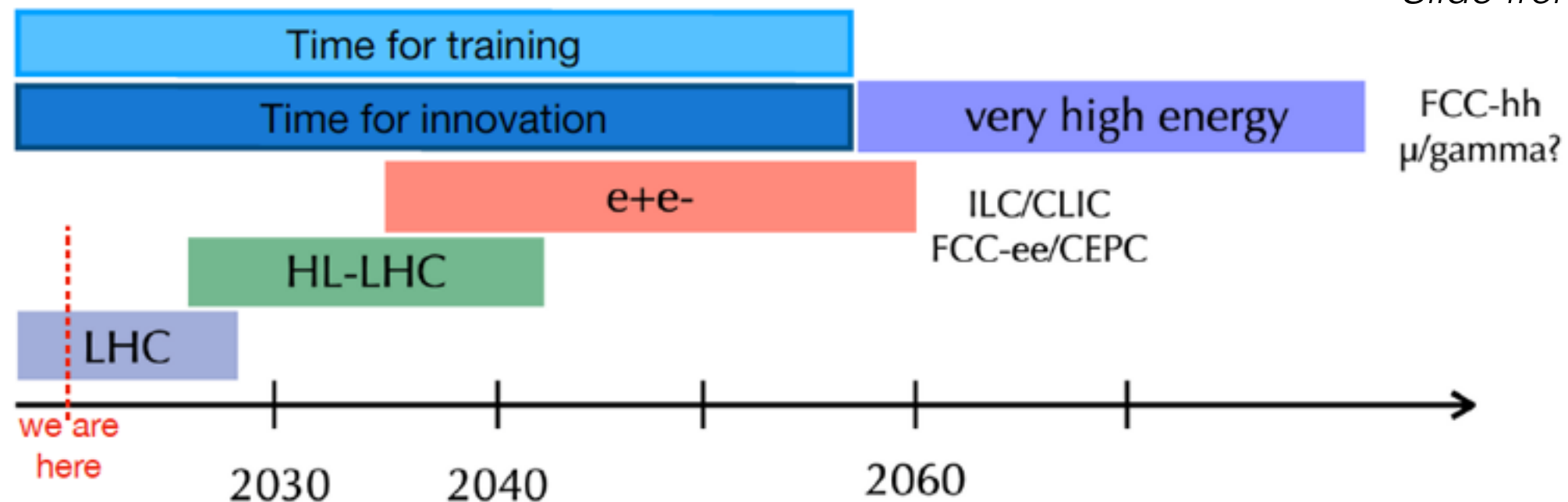


Outline

- Relevance of ECFA training symposium
- Current status of training in EU
- New ideas for future training
- Summary: What can TW learn from EU

ECFA Training Task Force

- Focus on instrumentation training



- Focus on the status/needs for EU
 - Can be a 'role model' for TW HEP

ECFA Training Task Force

- Stimulate and **recognise** the field of innovation
- **Attract** and train outstanding talents in physics and engineering
- Recognize the **diversity** of skills needed in the field: Detector science, electronics, mechanics, materials science, programming (FPGA, DAQ), accelerator science
- **Balance** between specialisation and breadth

Slide from E. Garutti

Establishing a successful long-term **training program in instrumentation** has

Benefit to particle physics: ensuring the continuity of highly qualified detector experts

Benefit to society: providing a talent pool for industry and other sectors

Current Status in EU

- Instrumentation training programs are offered mostly by universities and major labs.
- New ideas:
 - Virtual Reality (VR) labs
 - Training events organized with industry

Training at Universities in EU

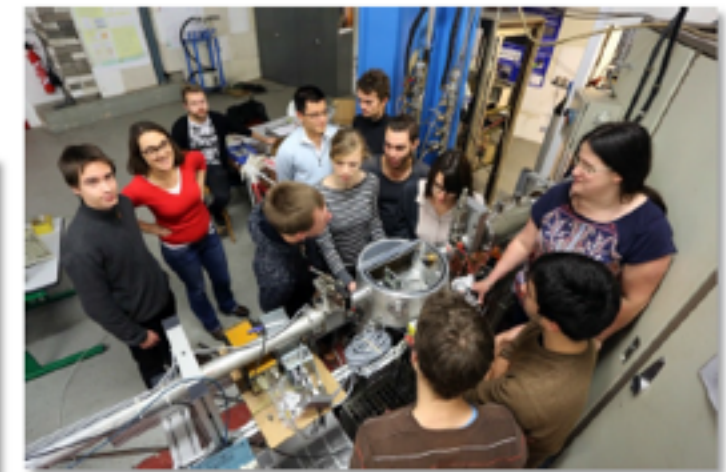
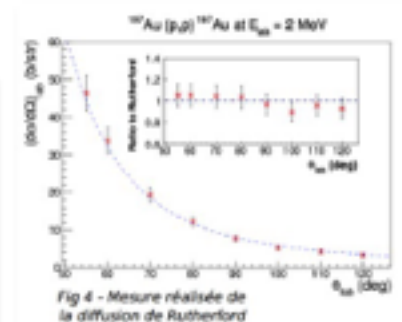
- Two main paths for HEP instrumentalists:
 - Bachelor/Master in **Physics** with tracks/specialization/elective courses in instrumentation
 - Bachelor/Master in **Engineering** (often proposed by Technical Universities) where one of the domains of application is HEP
- Student density is not large enough to have a master dedicated to HEP instrumentation.
 - Master programs composed of several close-by domains.

Training at Universities: Example

Excellence by Experiment

Slide from E. Chabert

- Program proposed in **Strasbourg** (France) for bachelor/master students
- Now part of larger program [QMat](#) (international graduate school on Quantum science & nanomaterial)
- 8 experimental platforms in various domains (nuclear physics, particle physics, astroparticles, astrophysics, ...)
 - 3 of them uses local accelerators (4 MeV)
 - Available for internships or could replace “regular lab sessions”
 - Example: Rutherford’s experiment
 - Installation, DAQ, etc
 - Detector characterization (calibration, efficiency)
 - Geant4 simulation
 - Data analysis



Training at Universities: Example

Karsruhe Institute of Technology

Slide from E. Chabert

- Master in physics with a dedicated track
 - Graduate school: [KSETA](#): Karlsruhe School of Elementary Particle and Astroparticle Physics: Science and Technology
 - University of Excellence program “Research Infrastructure in Research-Oriented Teaching” (RIRO) [[ref](#), André Schöning]
- integration of the large KIT research infrastructures into teaching activities

Heidelberg

- Master in physics with dedicated courses
- Research Training Group: - High Resolution and High Rate Detectors in Nuclear and Particle Physics [[GRK 2058](#)]
- Graduate School of Fundamental Physics

Training at Universities: Example

Slide from E. Chabert

Master dedicated to instrumentation have a **broad range of applications**, one of them could be HEP.

- Telft University of Technology (Netherlands): Physics for instrumentation [[link](#)]
 - Applications: cosmology and particle physics, medical therapy, ...
 - Courses: elementary particles, nanotechnology, electronics for physicists, charged particle optics,
- University of Twente (Netherlands) : Master in applied physics in Energy, Materials and Systems [[link](#)]
 - Courses in HEP, nanophysics, surface and thin layers, electrical power & system integration, fluid mechanics, solid mechanics, ...
- Inter-university master in Paris: Large instruments, plasmas, laser, accelerators, tokamaks [[link](#)]

Training at lab/facilities in EU

- How big labs contribute to training in instrumentation?

Beam tests

Slide from C. Nellist

- Beam tests at CERN and DESY (and other facilities) are a great way to get on-the-job training and gain experience from experts.
 - Real-world instrumentation effects such as noise, grounding, shielding, solving problems on-the-fly and under pressure etc. take place in a very focused way with teams from different institutes.
 - In addition, preparation for test beams involves other facilities, such as additional clean-room studies, the irradiation facility and wire-bonding lab.

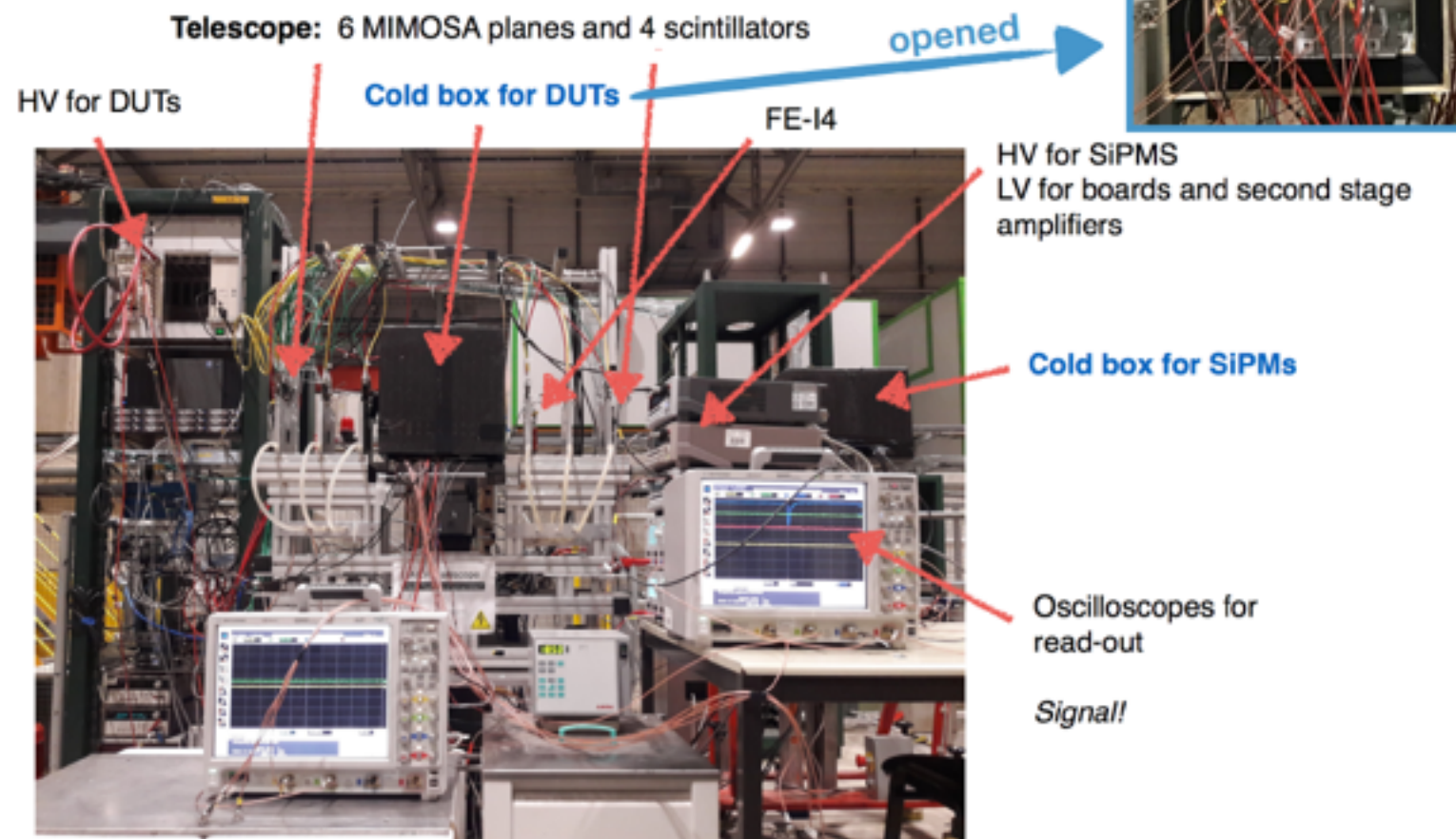
Training at lab/facilities in EU

- Example: NTHU participating in test beam shifts for a Phase-2 upgrade project

Beam Test Setup — Real Devices

Sept 2018 @CERN

- see: [Shifter Instructions by Stefan&Vagelis](#)



Training at lab/facilities in EU

- Major labs also provide great opportunities to attract students:
 - Beam lines for schools (BL4S): International competition for high school students around the world, organized by CERN since 2014. Winning teams can perform their proposed studies at CERN/DESY.
- Lab visits on-site/in media (virtual)



Image: CERN

Training at lab/facilities in EU

- Other formats of training: internships, (summer) schools, workshops, etc.
- Undergraduate and graduate:
 - Summer student programme offered by CERN and DESY.
 - CERN offers an internship program, open to any nationality, for up to 6 months
 - There is also the technical (TECH) and doctoral (DOCT) student programs at CERN.
 - CERN offers graduate engineer (mechanical, electronic, software) programs from Portugal (FCT), Spain (FTEC) and France (VI) for up to two years
- Postgraduate:
 - DESY and CERN both have fellowship programs.

Slide from C. Nellist

Training at lab/facilities in EU

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Slide from C. Nellist

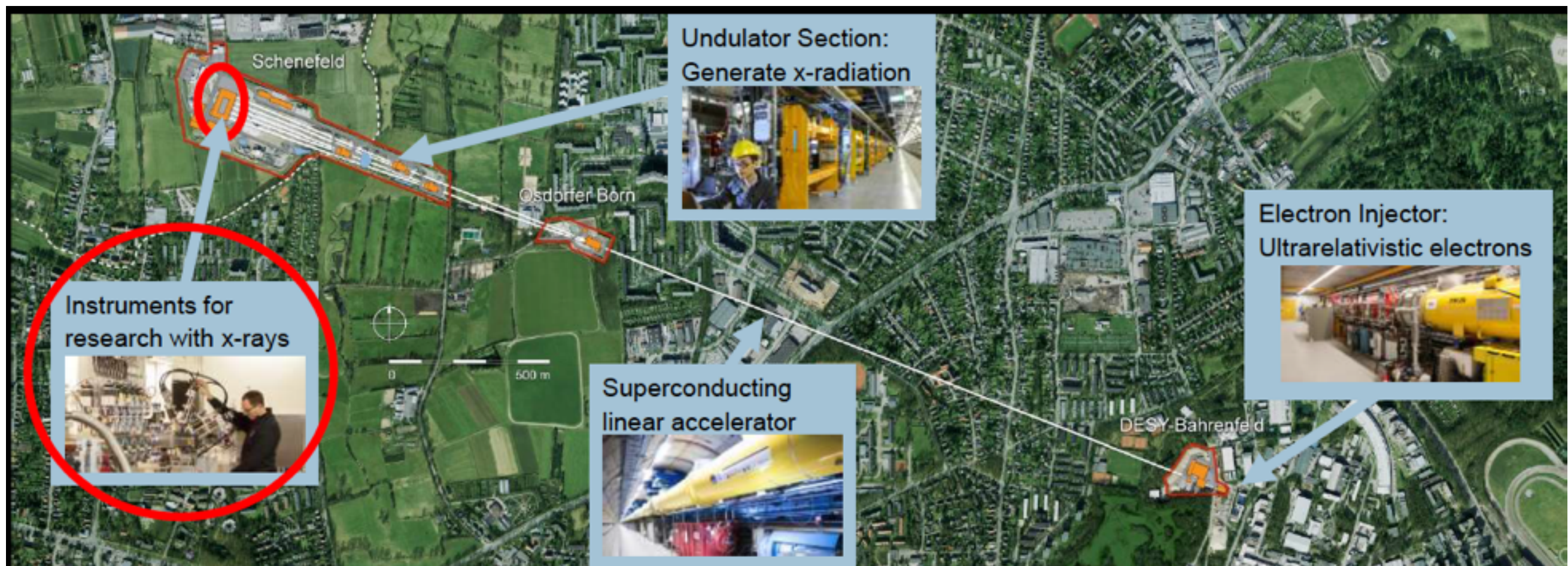
- **BTTB Workshop** (<https://indico.cern.ch/event/945675/>)
 - An annual workshop that originated at DESY.
 - It aims to cover a wide range of topics related to test beams for detector studies in tracking detectors, calorimetry and beyond, bringing together both experts and newcomers from various fields.
 - Includes hand-on tutorials on various topics, including soft-skills.
 - Can be access by people at all career levels.
- **Terascale Detector Workshop** (<https://indico.desy.de/event/24227/>)
 - An annual detector workshop in Germany , that includes 1-day courses on different topics every year.
 - This year's workshop took place at DESY.



New ideas for Training: VR Labs

- Example: The European X-Ray Free-Electron Laser Facility (European XFEL)

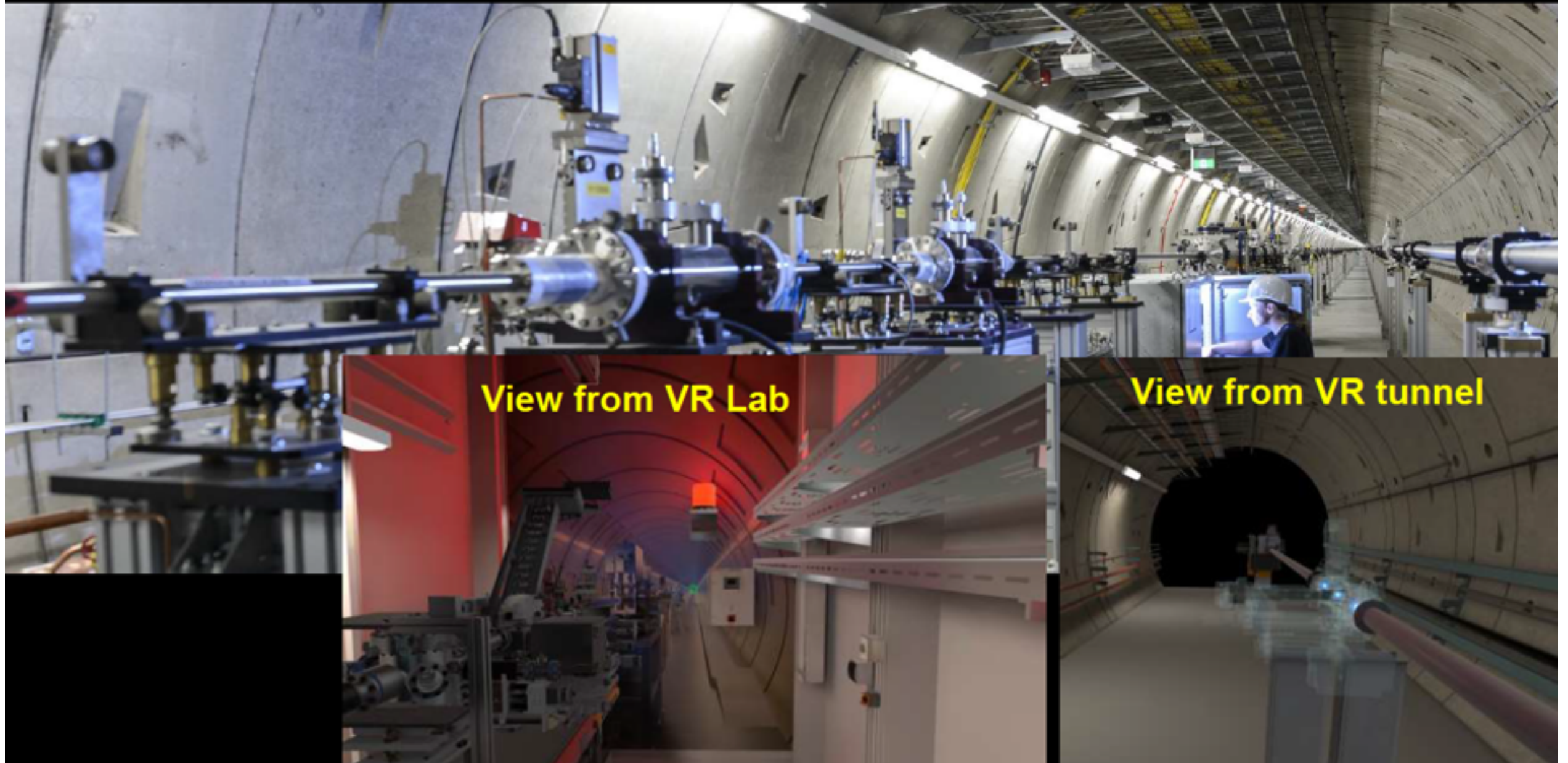
Slide from C. Bressler



New ideas for Training: VR Labs

Slide from C. Bressler

The Long Photon Beam Transport Tunnel



New ideas for Training: VR Labs

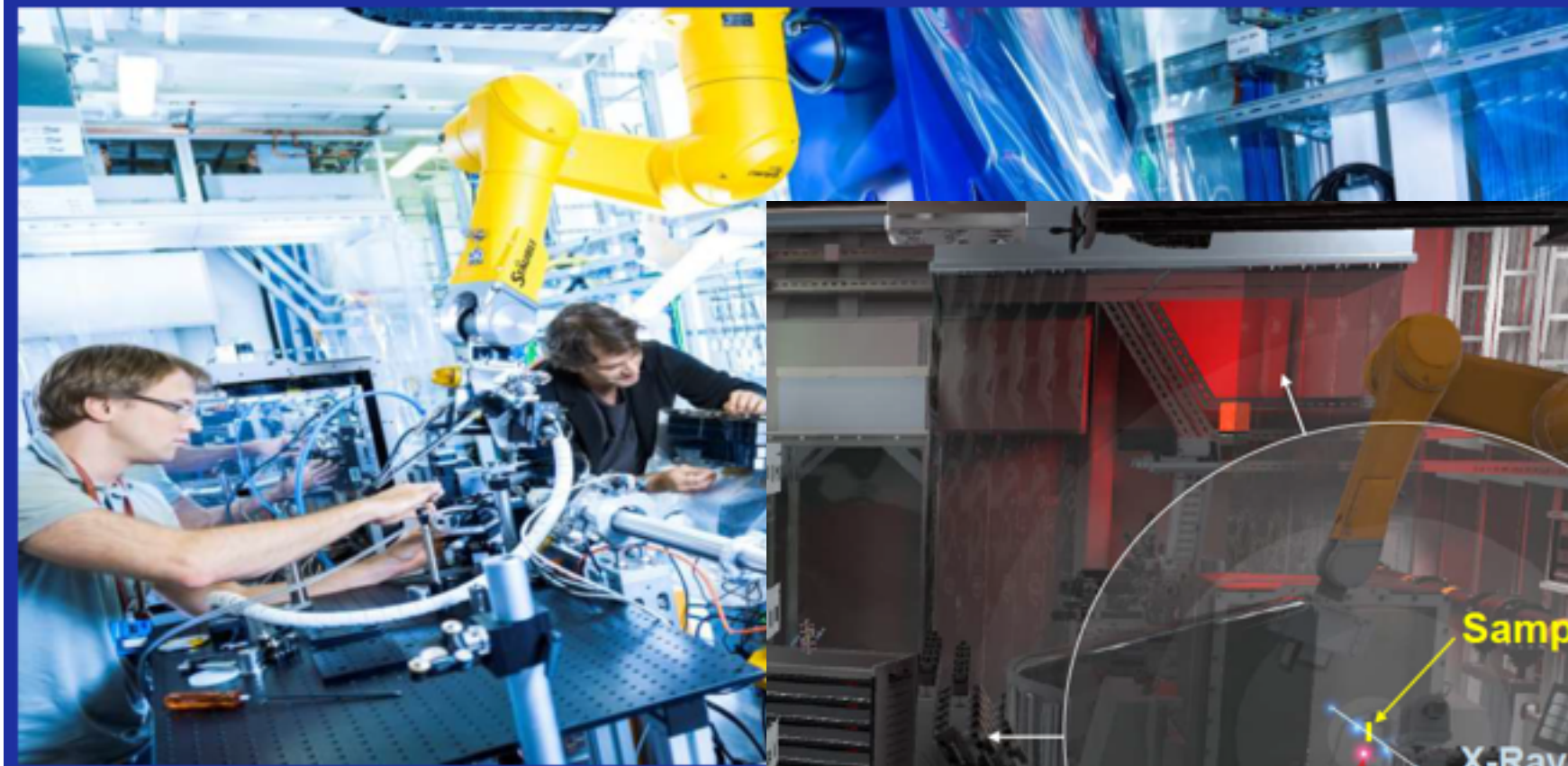
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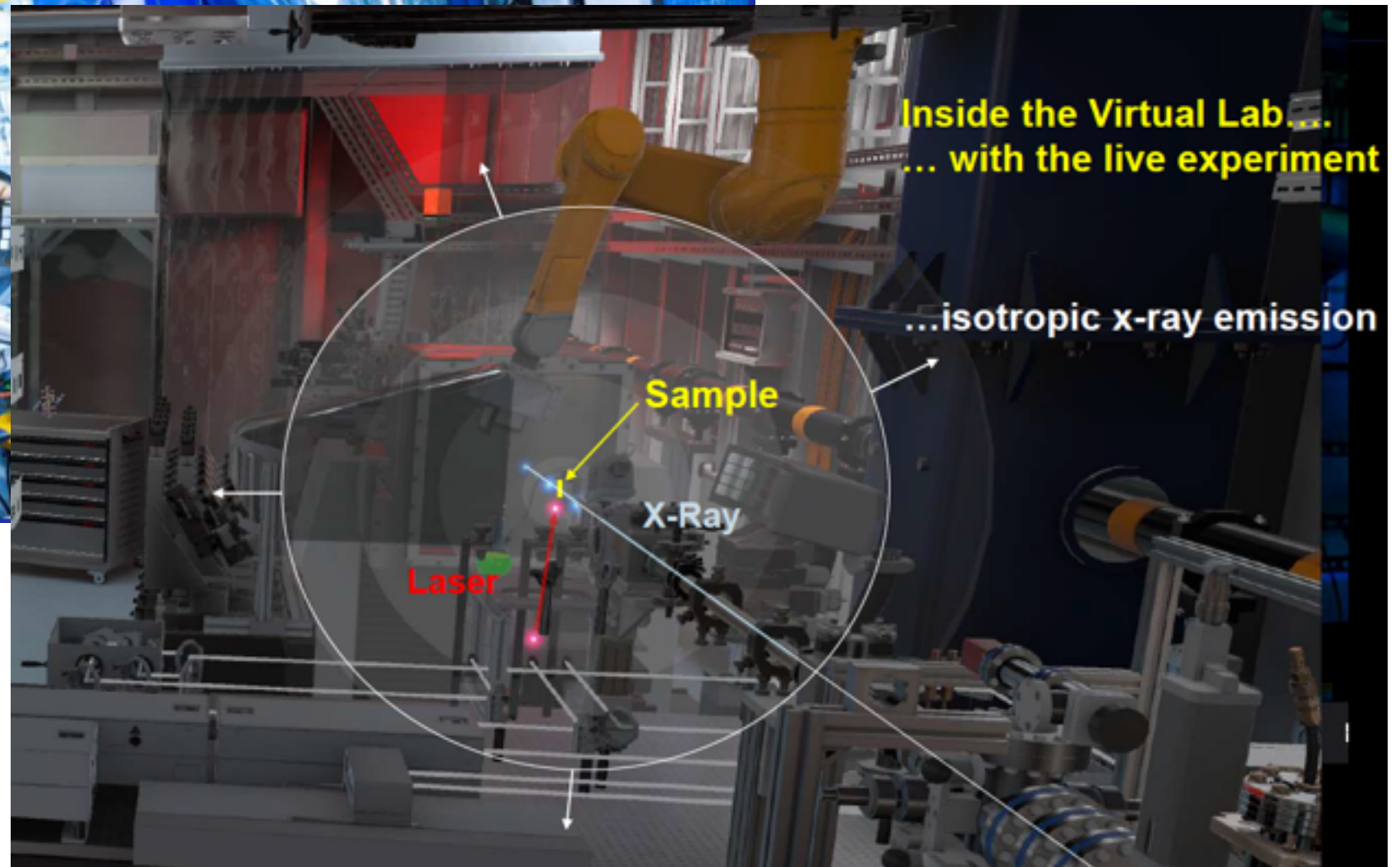
New ideas for Training: VR Labs

Slide from C. Bressler

Inside the Real Lab....



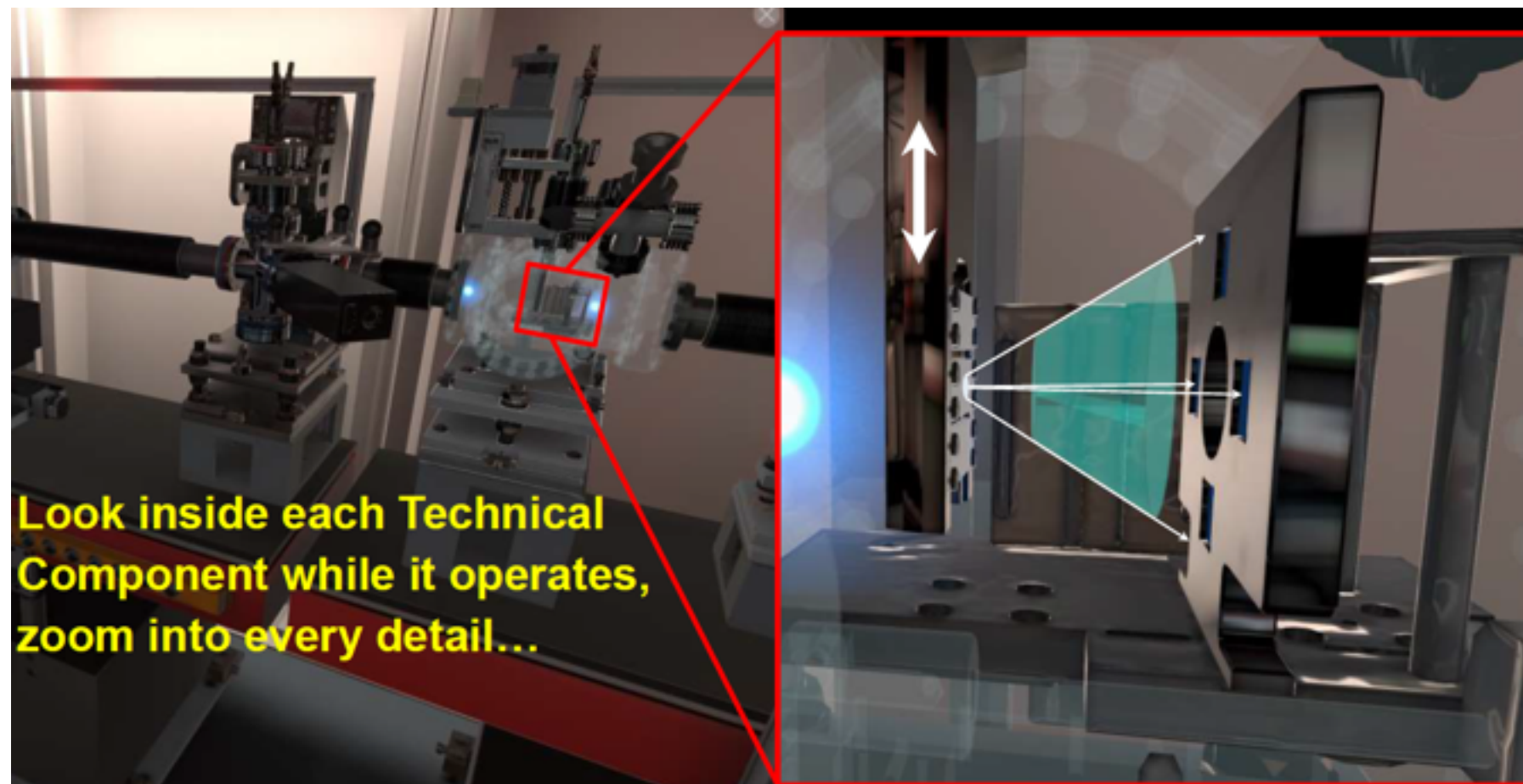
Inside the Virtual Lab....
... with the live experiment



New ideas for Training: VR Labs

Slide from C. Bressler

- “Flight simulators for physicists”



New ideas for Training: Industry

- Example: IdeaSquare at CERN
 - A dedicated test facility at CERN that hosts detector R&D projects
 - Facilitates MSc student programs and hosts special innovation-related events.
 - “..bring together researchers, engineers, people from industry and young students and encourage them to come up with new ideas that are useful for society.”

New ideas for Training: Industry

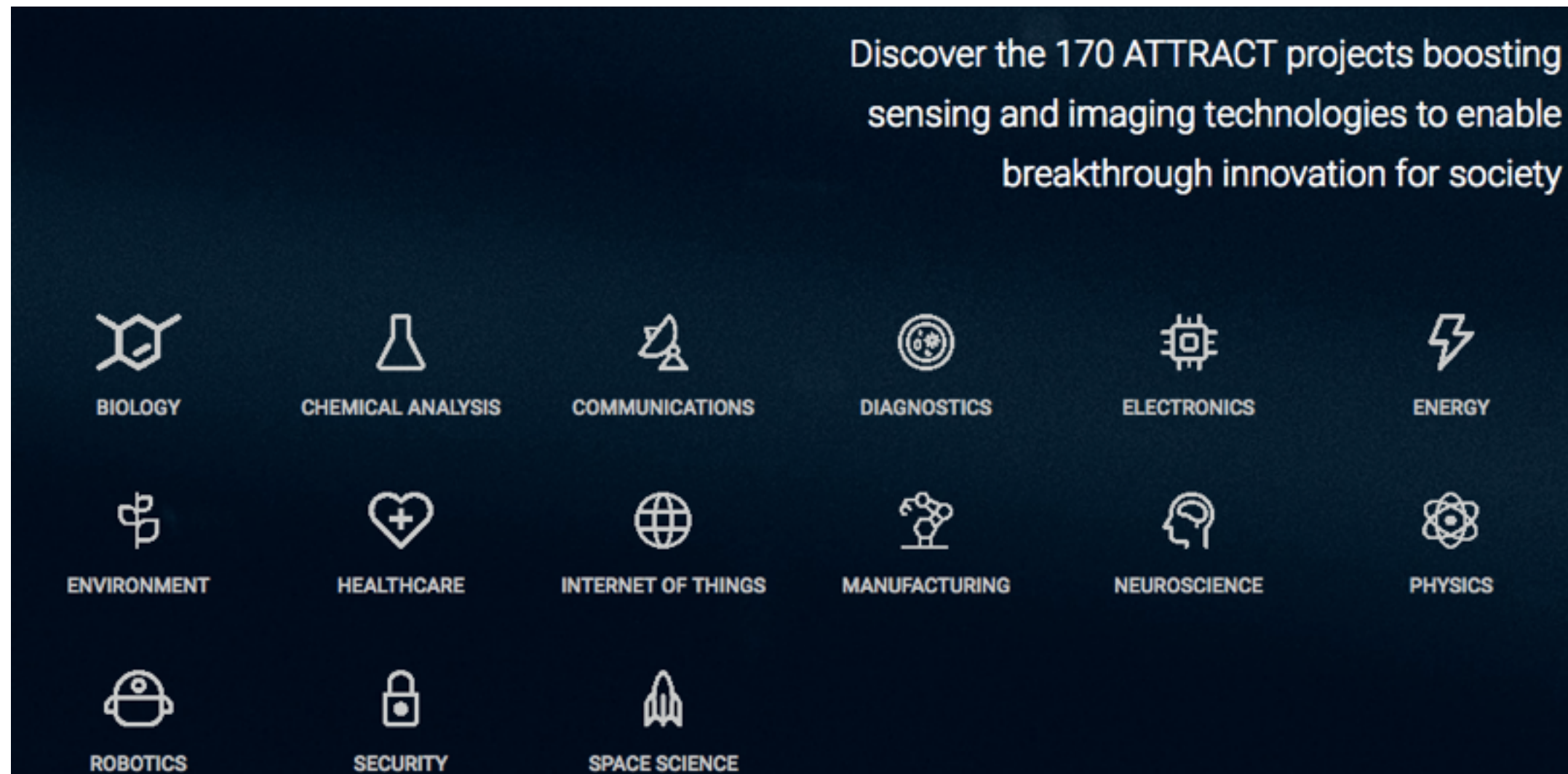
- ATTRACT: Initiative from IdeaSquare at CERN <https://attract-eu.com/>



New ideas for Training: Industry

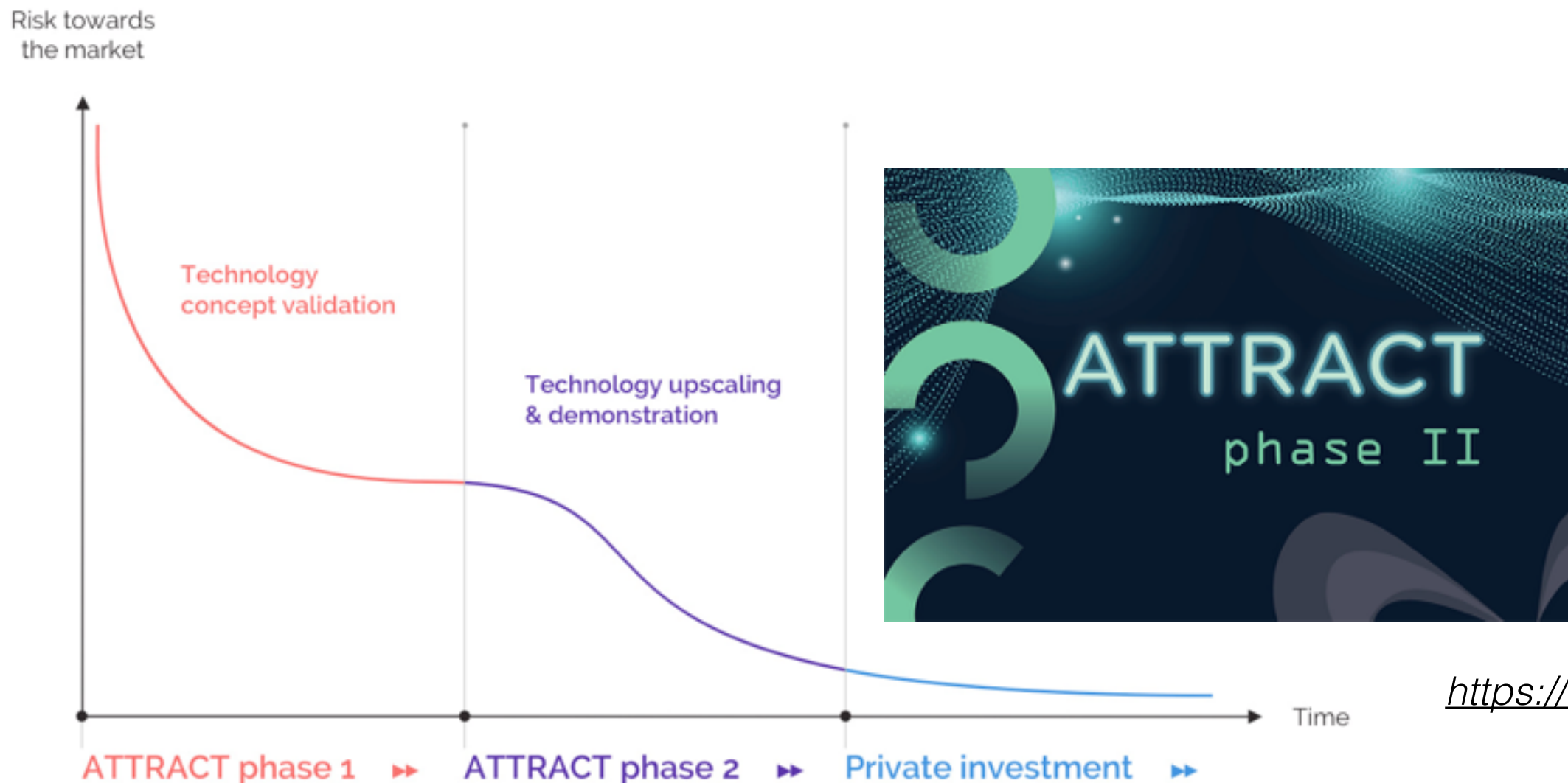
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New ideas for Training: Industry

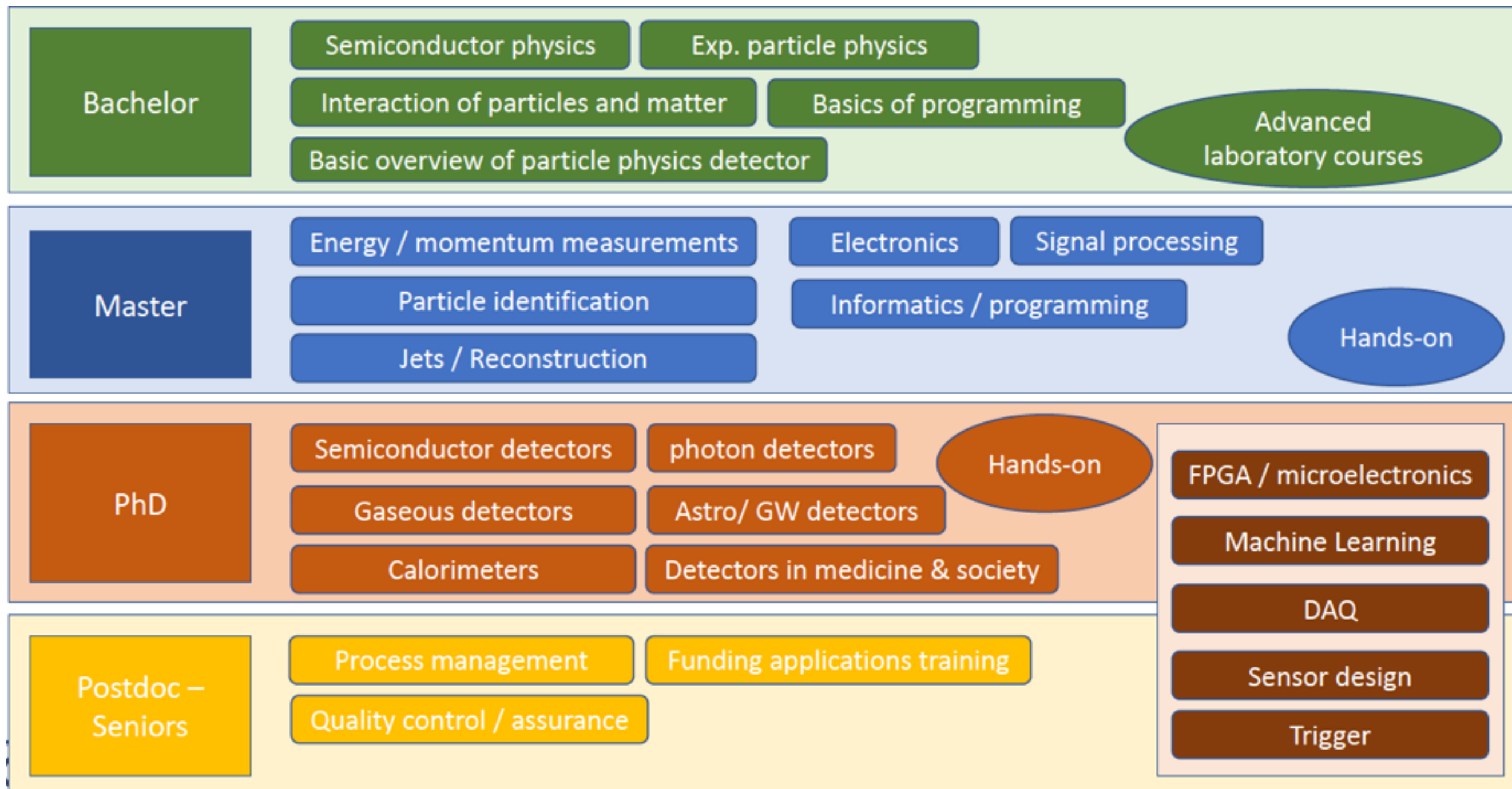
- ATTRACT: Current call of 'phase-2' proposals (deadline Sept. 20th)



<https://attract-eu.com/>

Training for all career levels

Slide from E. Chabert



Summary: What can TW learn from EU?

- Proposal from ECFA Symposium: Develop a coordinated EU project on Training (apply for EU funds)
 - TIDC is a perfect platform for such projects/programs in TW
- A Co-built academy-industry school?
 - (From TIDC workshop in January 2021) Great interactions with representatives from local TW (semiconductor) companies
- Enlarge the pool of future HEP physicists/instrumentalists: Make use of VR/media for outreach/attracting students from high schools