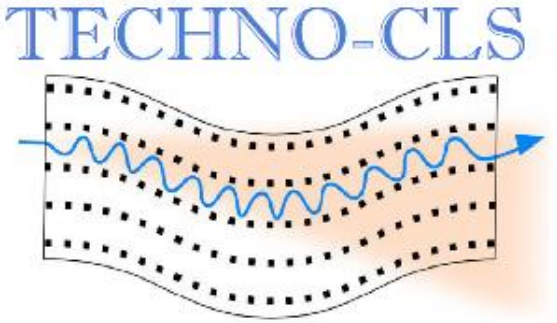
G.A. 101046458

EIC PATHFINDER OPEN TECHNO-CLS
"Emerging technologies for crystal-based gamma-ray light sources"



- The project started on 1 June 2022 and has a duration of 5 years.
- The TECHNO-CLS project, born from previous EU projects (CUTE, PEARL and N-LIGHT, still ongoing), has the main goal to realise the **science-towards-technology breakthrough** that will enable the practical **realization of the Crystal Light Sources (CLS).**

MBN Research Center

Coordinator: A. V. Solov'yov

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

INFN Istituto Nazionale di Fisica Nucleare

ESRF

HELLENIC MEDITERRANEAN UNIVERSITY

University of Kent

UNIVERSITÀ DEGLI STUDI DI PADOVA

Università degli Studi di Ferrara

Why a gamma-ray source?

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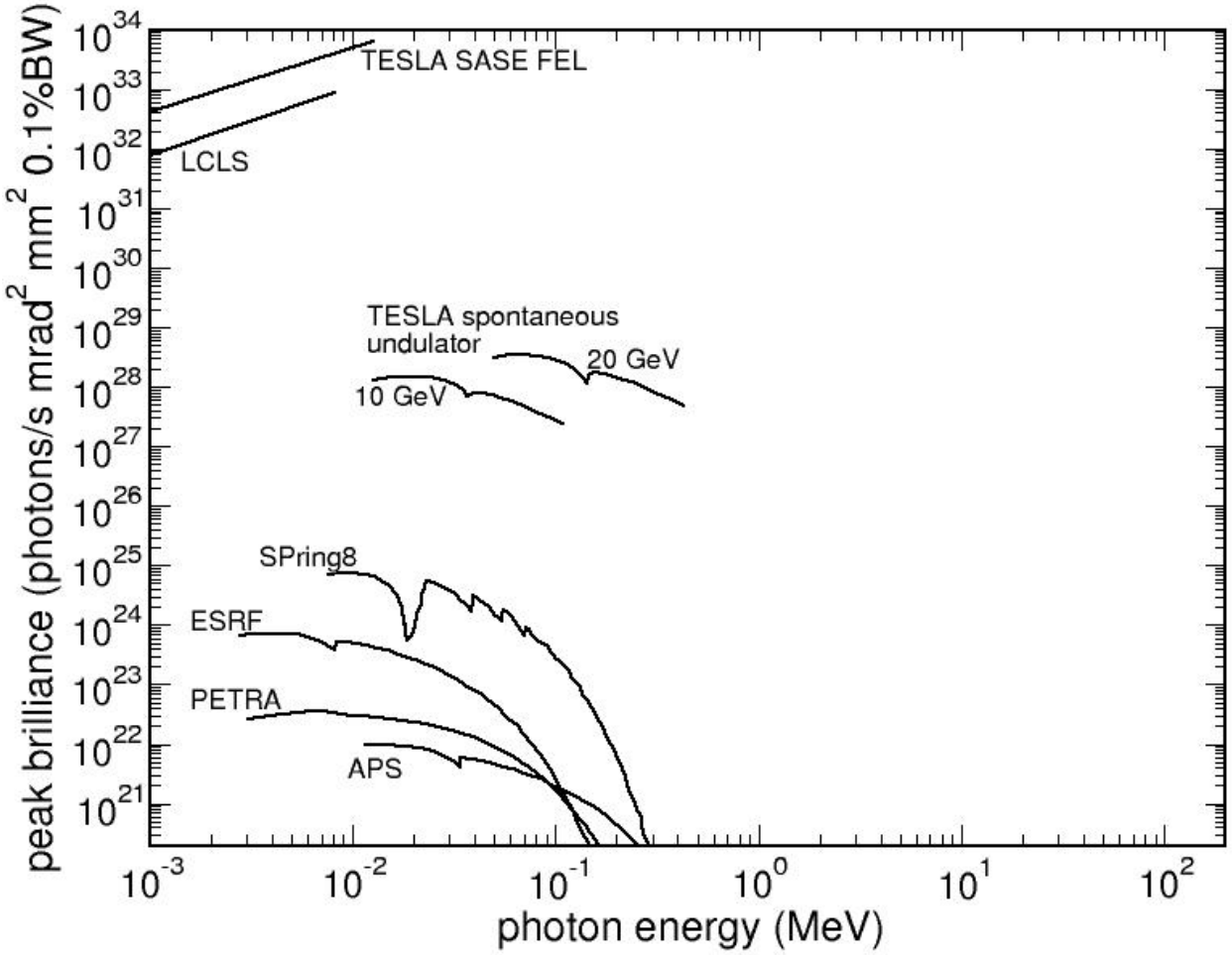
Current **X-ray Free-Electron-Laser (XFEL) sources** (European XFEL, FERMI, LCLS, SACLA, PAL-XFEL) or planned (SwissFEL) provide X-rays down to **λ∼1 Å.**

Synchrotron facilities, such as APS, SPring-8, PETRA III, ESRF2 can **provide shorter wave- length radiation but are orders of magnitude less intensive**.



Why a gamma-ray source?

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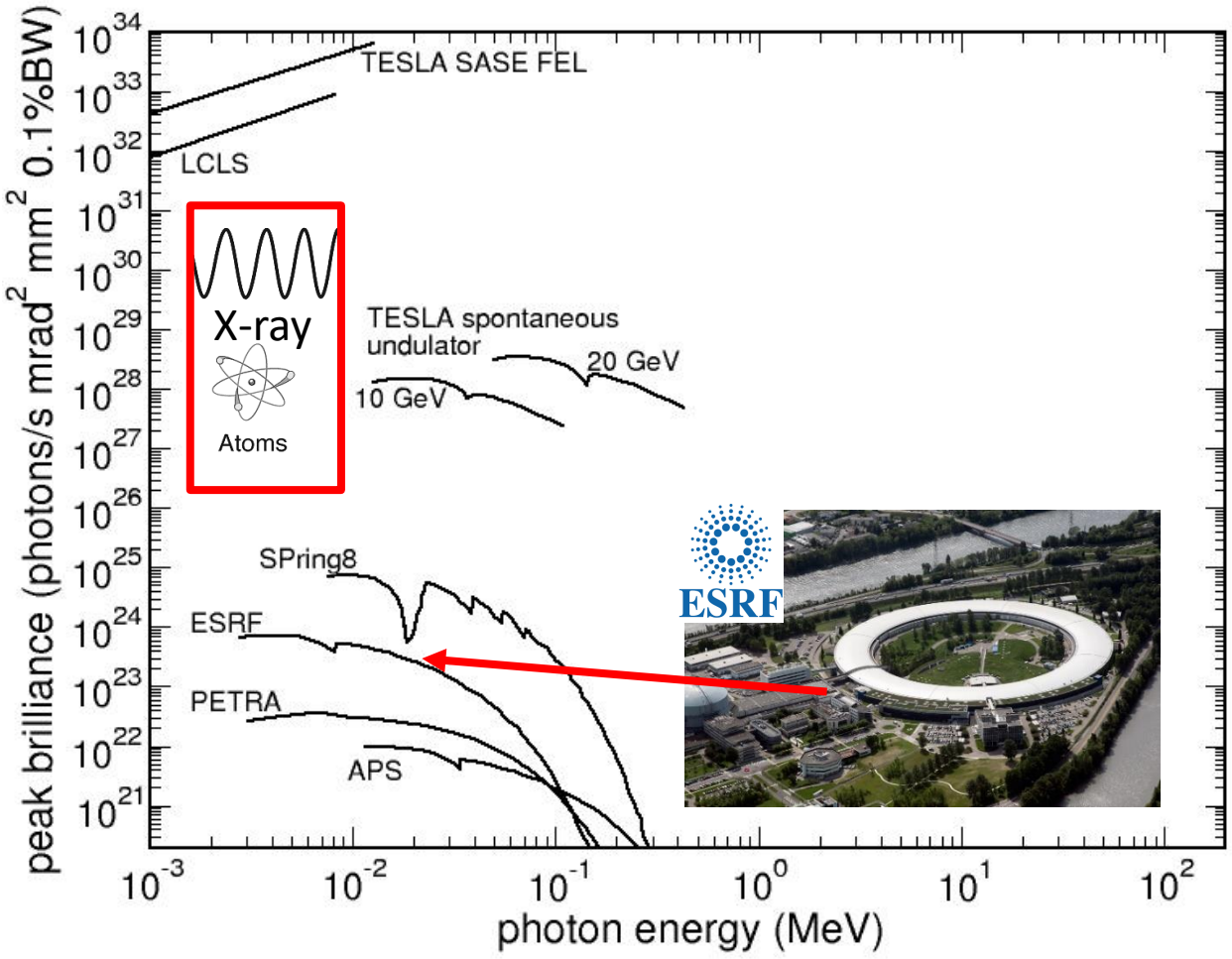

Why a gamma-ray source?

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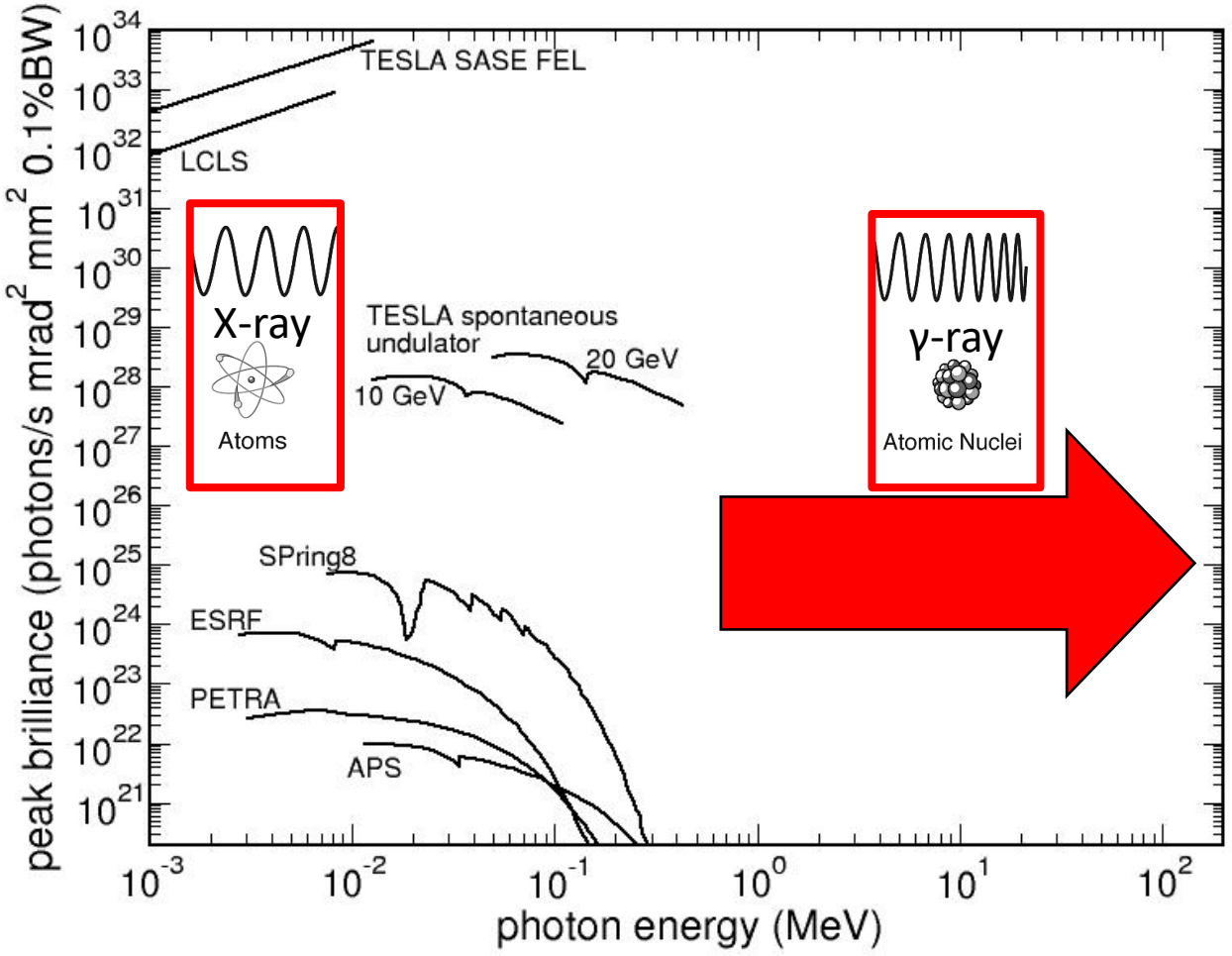
Sub-angstrom powerful spontaneous and, especially, coherent radiation are strongly needed for **application in basic sciences (from nuclear to solid state physics), life science, technology and medicine.**

To create a **powerful LS in the range λ<< 1Å,** new approaches and technologies are needed.



Standard Magnetic Undulator

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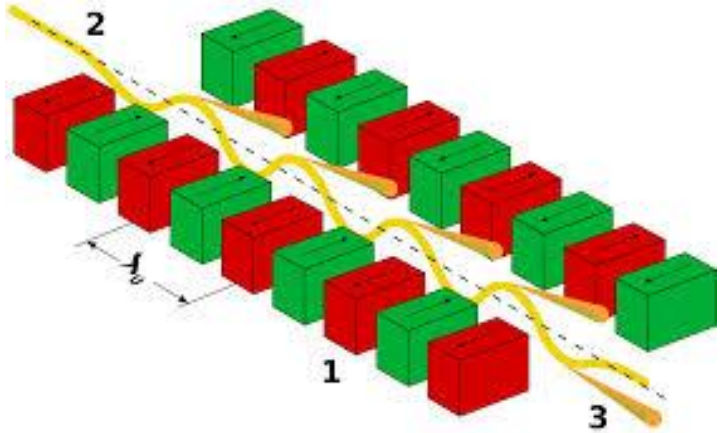
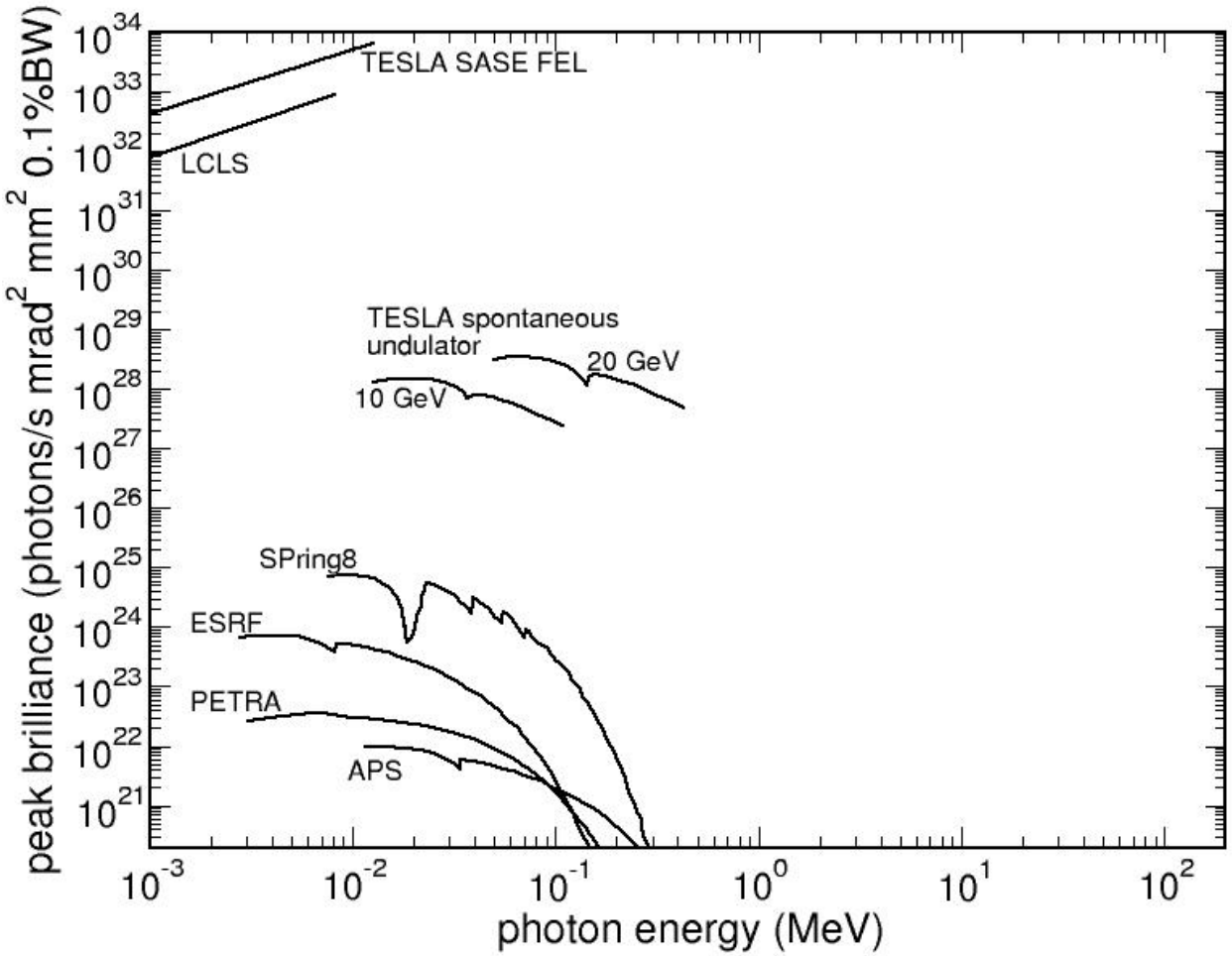
Classical scheme: magnetic undulator in a free electron laser

Soft X-rays (10 keV)

λ_u ~ cm





Standard Magnetic Undulator vs Crystal Light Source

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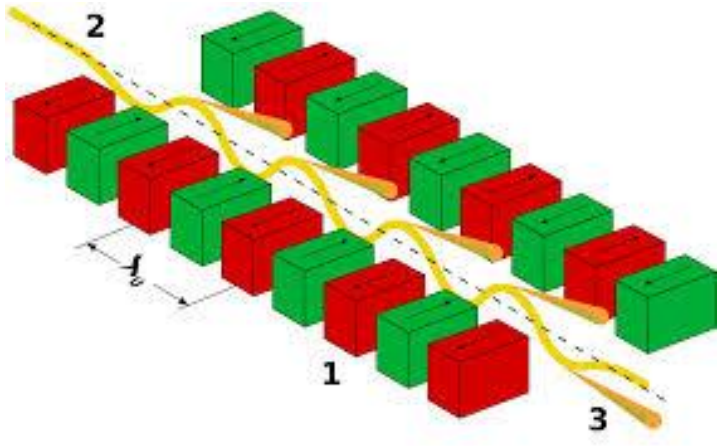
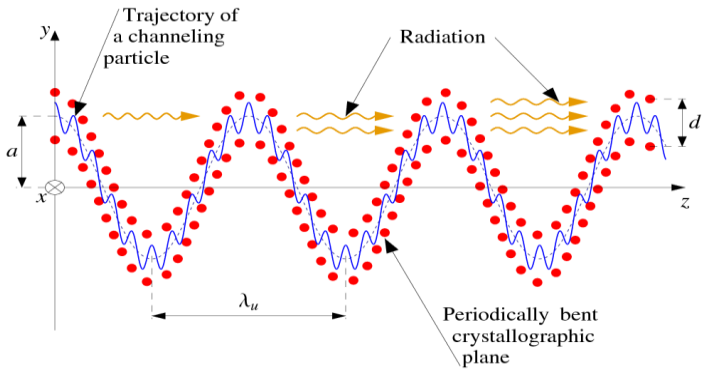
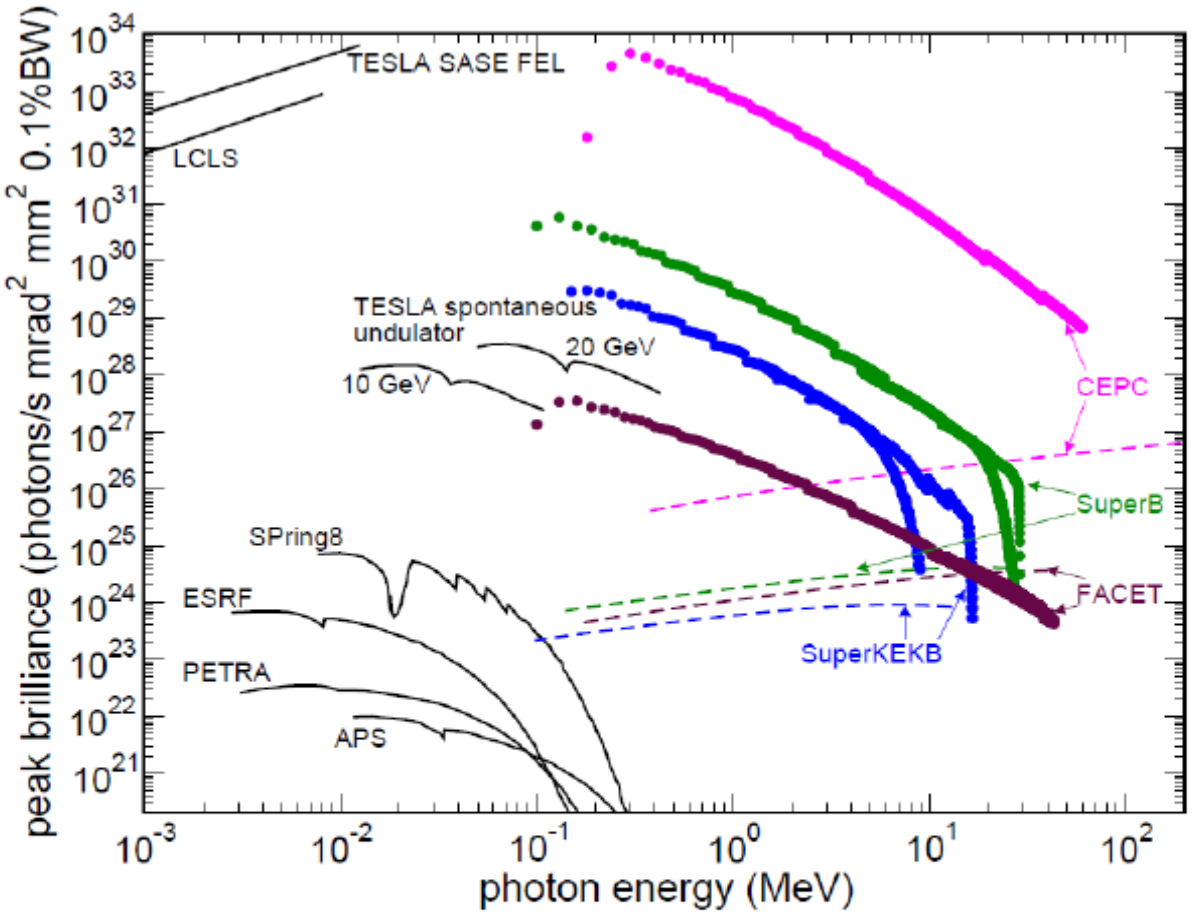
Classical scheme: magnetic undulator in a free electron laser
Soft X-rays (10 keV)
λ_u ~ cm



Innovative scheme: Crystalline undulator->
Hard X-rays and gamma rays (100 keV - 10 MeV)
λ_u << mm





Korol, A.V., Solov'yov, A.V. Eur. Phys. J. D 74, 201 (2020).

TECHNO-CLS idea

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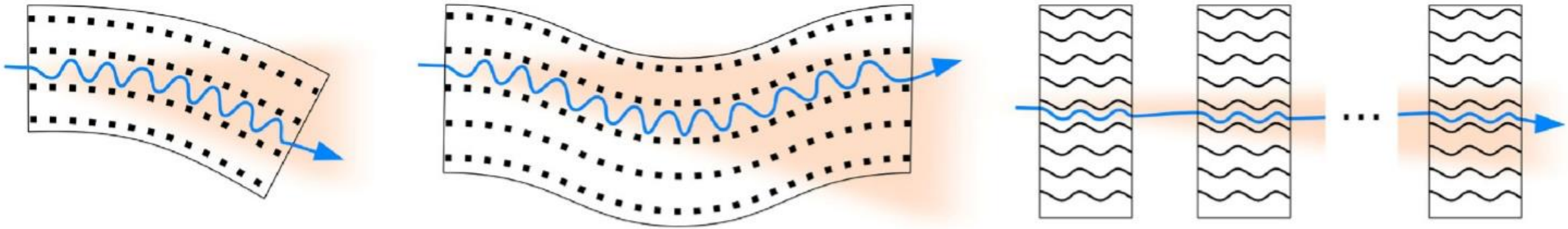

Korol, A.V., Solov'yov, A.V. Eur. Phys. J. D 74, 201 (2020).

Potential End Users

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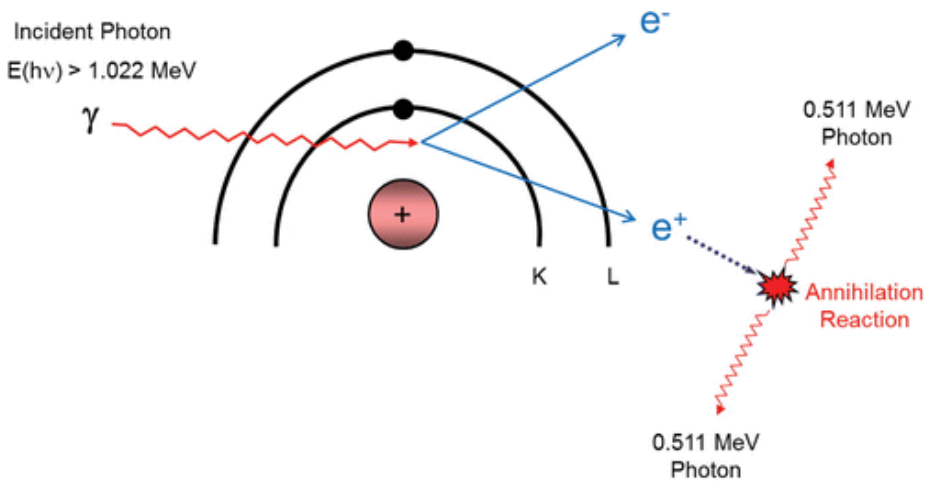
In **nuclear** and **solid state physics**, in **life sciences, in technology and medicine.**

- **Disposal of radioactive waste**
- **Radioisotopes for nuclear medicine** by photo-transmutation (e.g., for cancer therapy)
- **Photo-nuclear synthesis**
- Imaging for **biology and material science**
- **Space Science and Technologies**



Korol, A.V., Solov'yov, A.V. Eur. Phys. J. D 74, 201 (2020).

EIC Pathfinder is the beginning

Get funding & investment

EIC Pathfinder

Support to research teams to research or develop an emerging breakthrough technology

EIC Transition

Building on promising research results to demonstrate and mature the technology and develop business plans for specific applications

EIC Accelerator

Funding and investments through the EIC Fund for individual start-ups and small companies to develop and scale up game changing innovations

Important steps:

- ❑Involvement of **companies, external partners and investors**
- ❑Identify potential **users**

Business Acceleration Services

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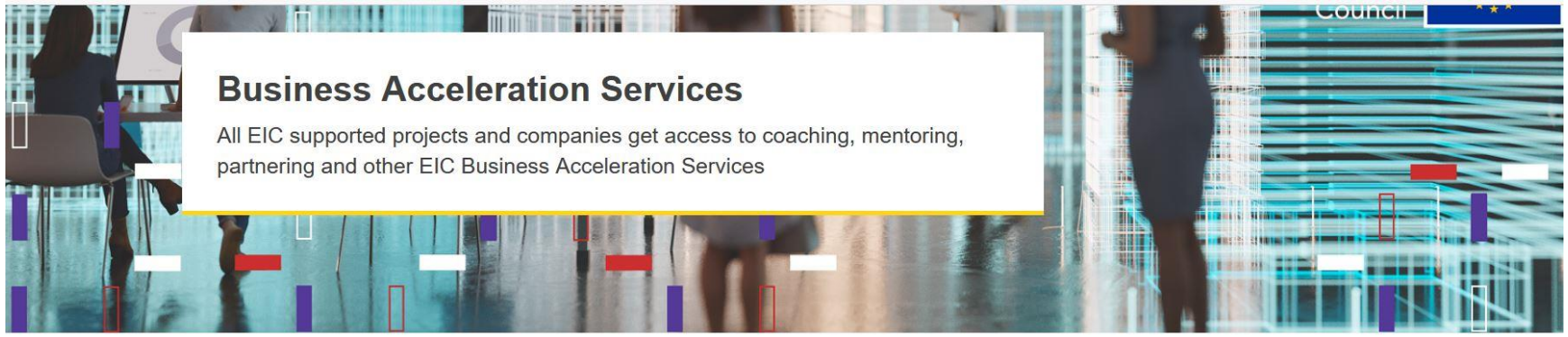


PAGE CONTENTS

- Business Acceleration Services
- Tech to Market
- Who can benefit and what services are offered?
- EIC Community platform
- Access to coaches, mentors, expertise and training

Related pages

EIC Community Platform | EIC overseas Trade Fairs Programme 2.0 | EIC Women Leadership Programme | Tech to Market Services (T2M BAS) | Coaching under the EIC | EIC Greenhouse Gas Programme | Ecosystem Partnerships and Co-Investment Support | EIC Scale Up 100

Business Acceleration Services

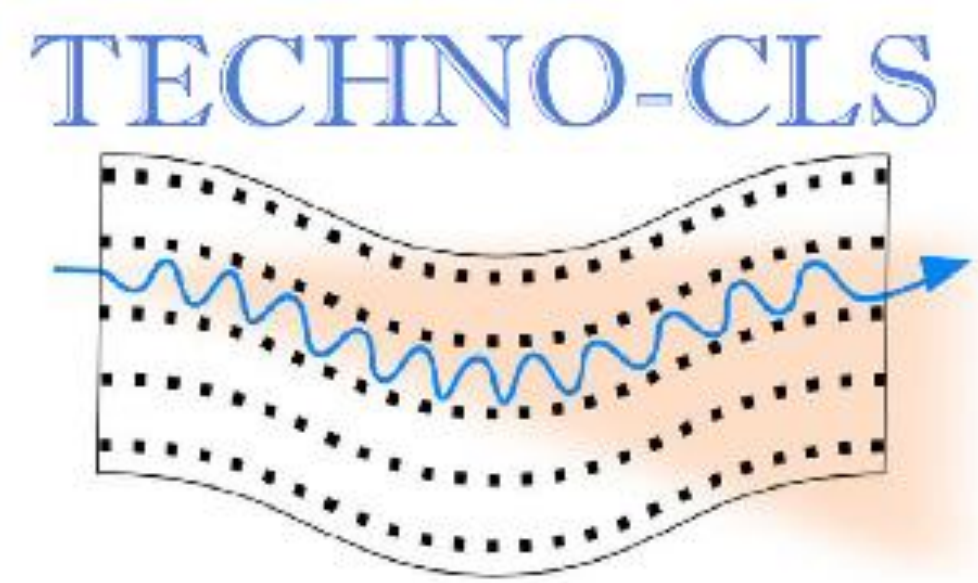
Under Horizon Europe, the EIC support goes far beyond funding and it aims at accelerating EIC innovations and growth of top deep tech companies. In order to further leverage the EIC investments, as EIC funded researcher, innovator or entrepreneur you will be provided with access to a range of tailor-made **EIC Business Acceleration Services (BAS)** at any stage of development

Tech to Market to help researchers and innovators from projects funded under EIC Pathfinder and Transition funding schemes in transition from lab to market

EIC Community platform

access to coaches, mentors, expertise and training

access to global partners (leading corporates, investors, procurers, distributors, clients)



R&D ACTIVITIES AND TECHNOLOGY POTENTIAL

Prototypes of CLSs

TECHNO-CLS
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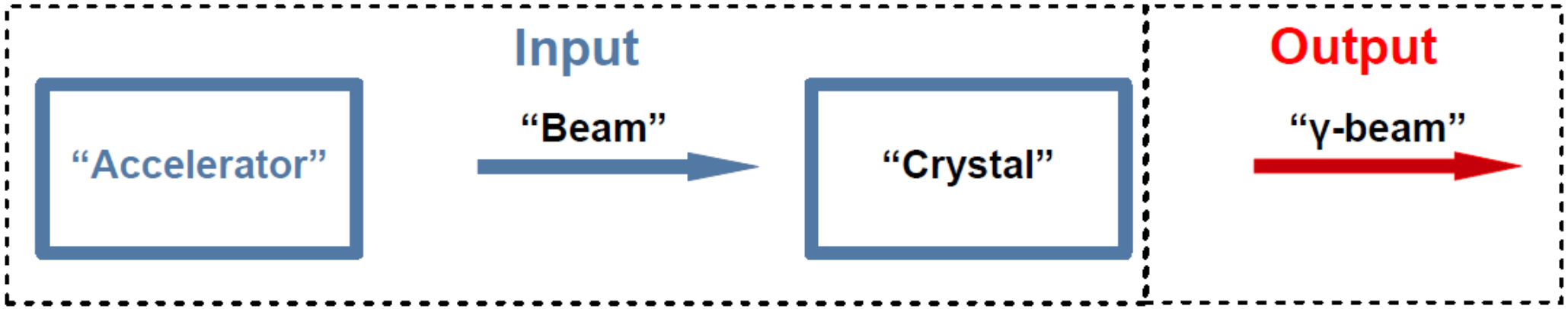

Principal elements:	Characterisation of the beam:	Relevant issues:	Experimental and theoretical characterisation of the radiation:
• Type of accelerator • Apparatus • Beam line • Infrastructure	• Type of projectile • Energy and energy spread • Size • Emittance • Current	• Crystal manufacture; • Structure characterisation • Crystal manipulation • Channeling experiments • Advanced simulations	• Spectral-angular distribution • Number of photons • Brilliance • Power

Prototypes of CLSs: computer simulation MBN Explorer and MBN Studio 5.0

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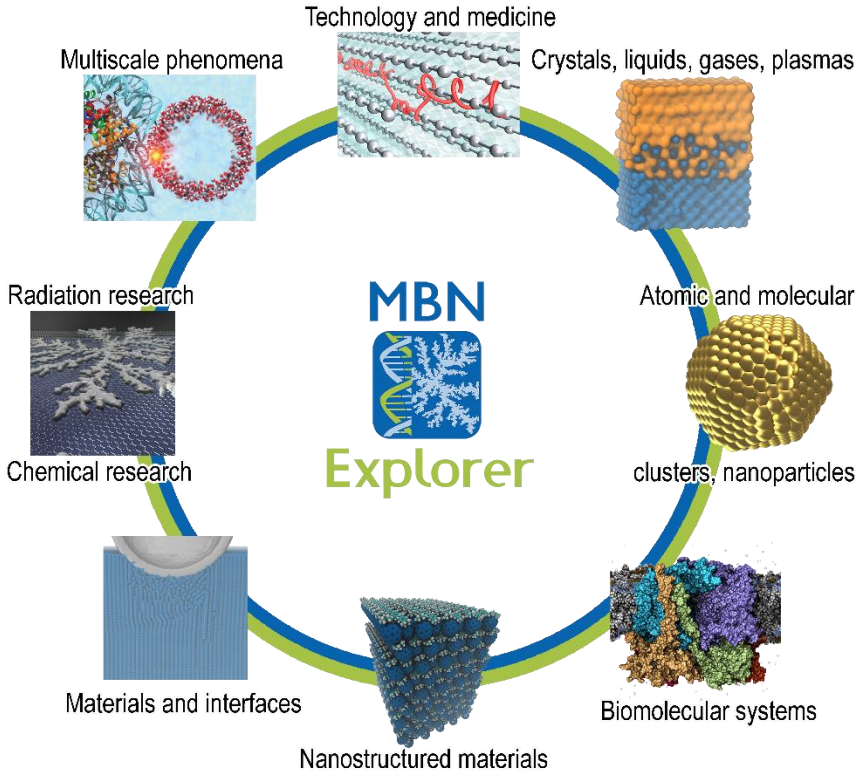
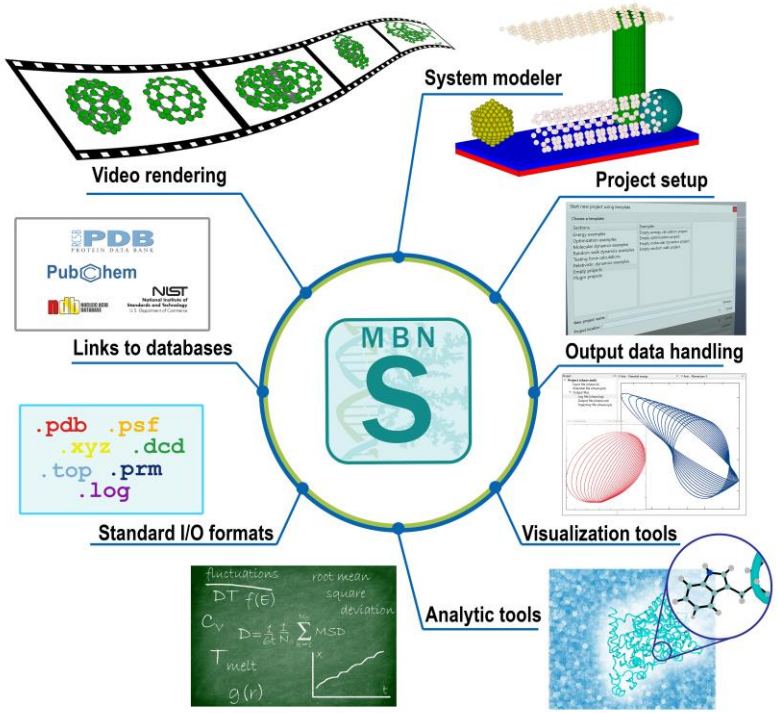
- MBN Explorer & Studio software 5.0 are the powerful instruments for advanced theoretical and computational research and multiscale modelling of structure and dynamics of complex Meso-Bio-Nano (MBN) systems.
- MBN Explorer & Studio software can be utilised in many discipline areas
- MBN Explorer & Studio are being developed by the MBN Research Center in Frankfurt.

You are welcome to contact us at www.mbnresearch.com !





Software developed by

MBN Research Center

is used by TECHNO-CLS partners

MBN

University of Kent

to simulate CLSs can be exploited for many other purposes in material, chemical and bio-science!

How to realize it… crystal manufacturing

TECHNO-CLS

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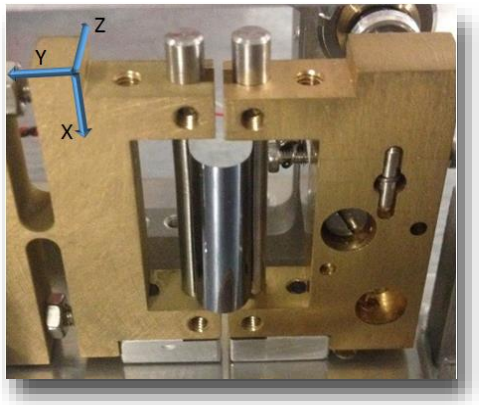
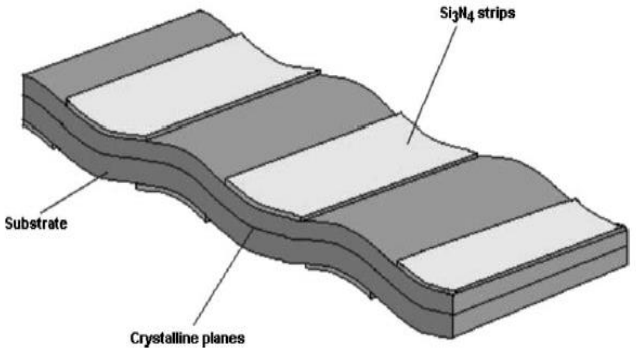
INFN Istituto Nazionale di Fisica Nucleare

Silicon and Germanium

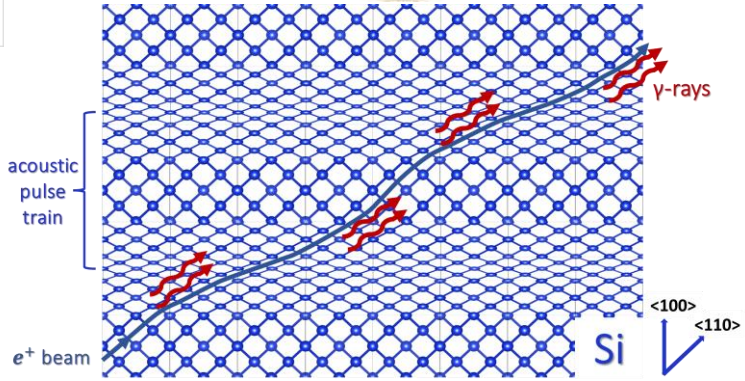
HELLENIC MEDITERRANEAN UNIVERSITY

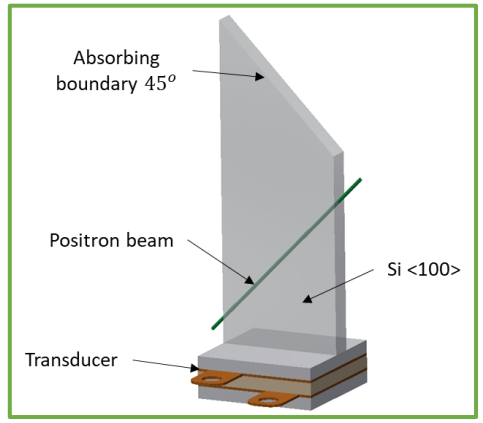


Mechanically bent crystal

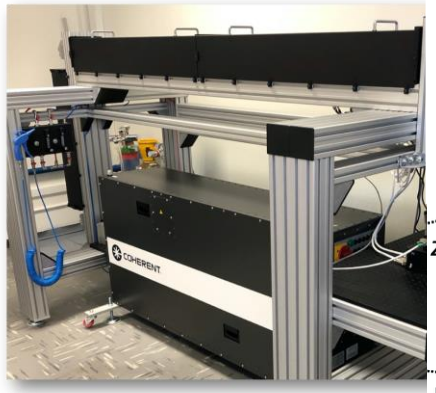


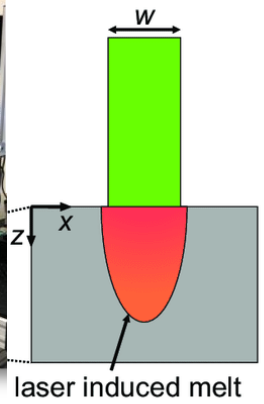
Undulator based on thin film deposition and pattering





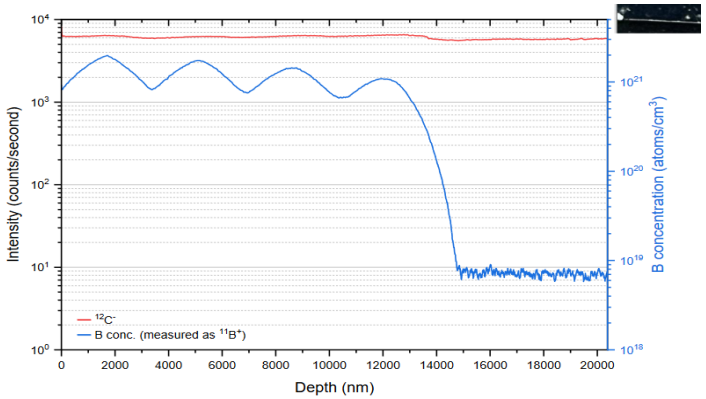
Acoustically-driven Crystalline Undulators





Undulator based on pulsed laser melting

Università degli Studi di Padova



Boron doped diamond based undulator

ESRF

How to realize it… crystal characterization in lab

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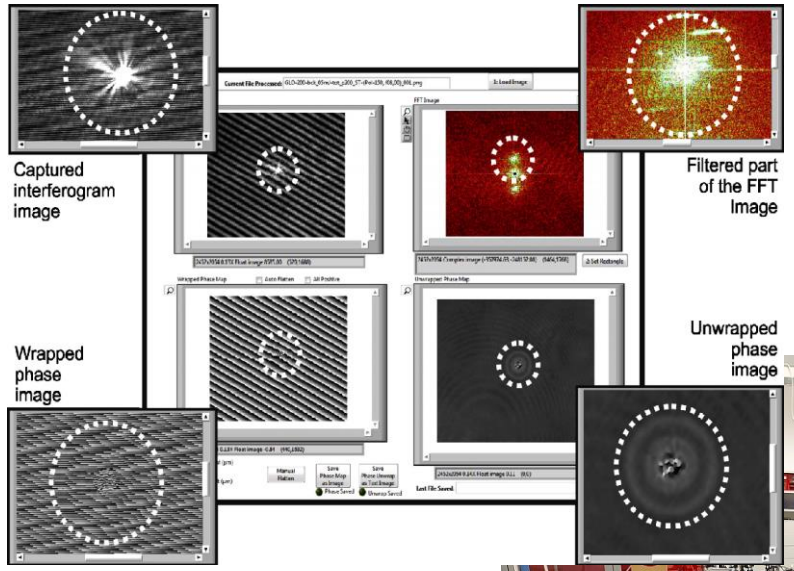
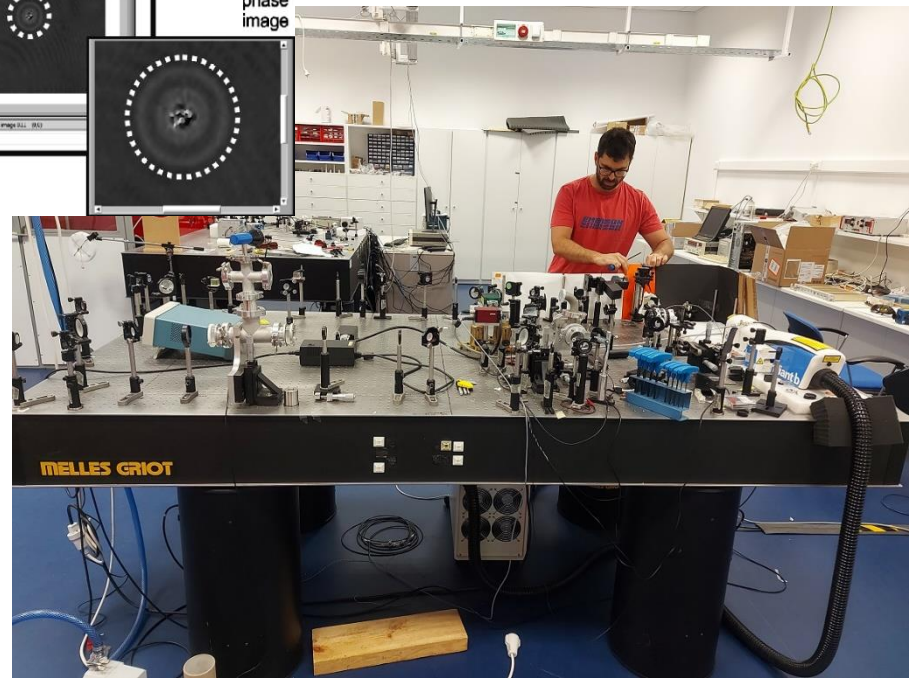
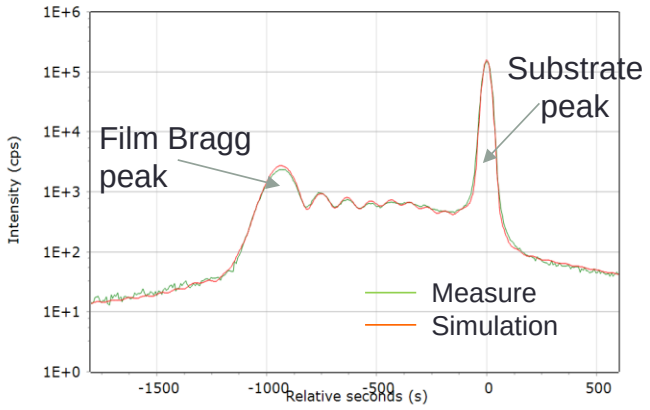
Optical Interferometry





High Resolution X-Ray Diffraction



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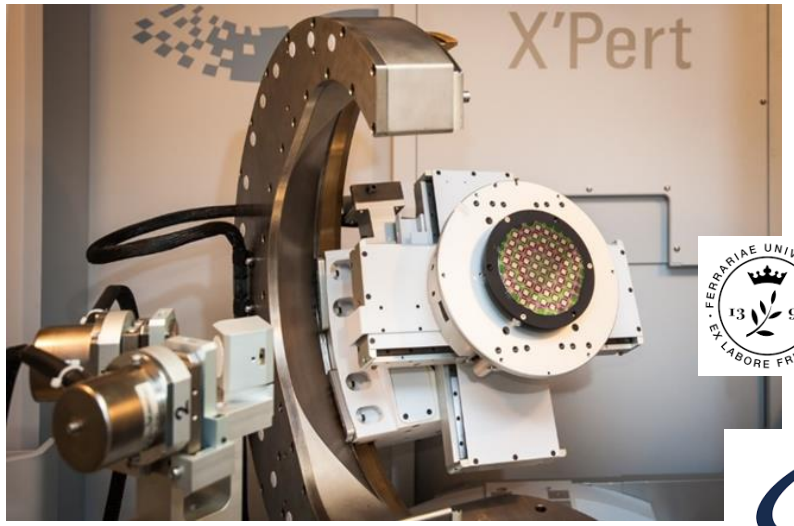

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How to realize it… characterization in accelerators

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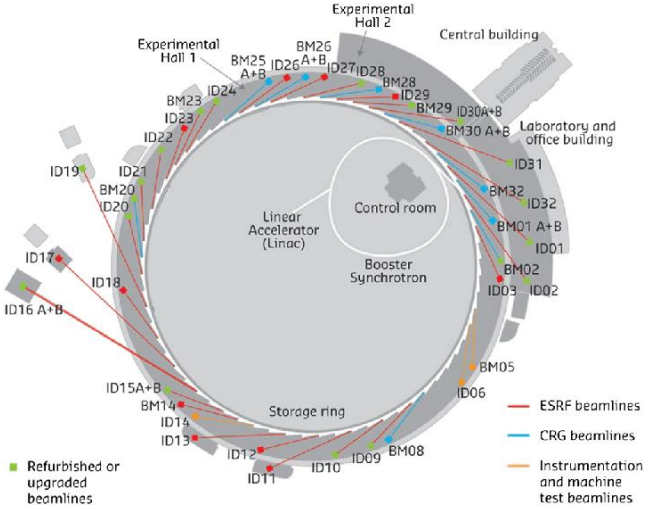
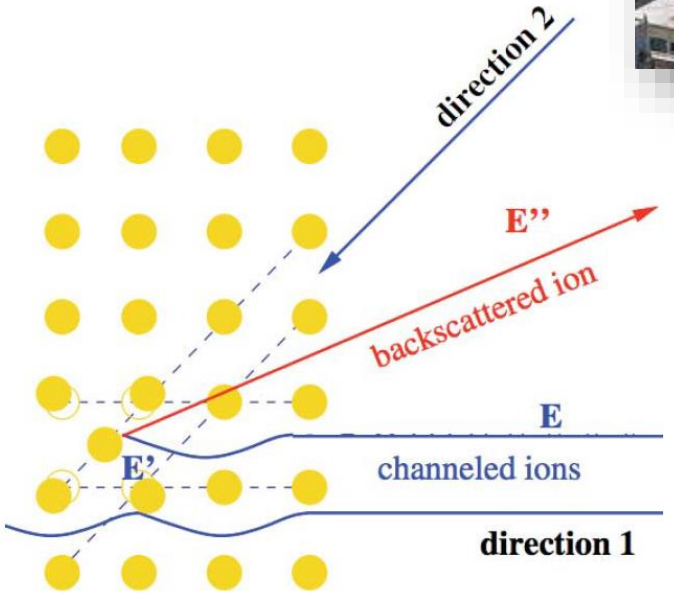




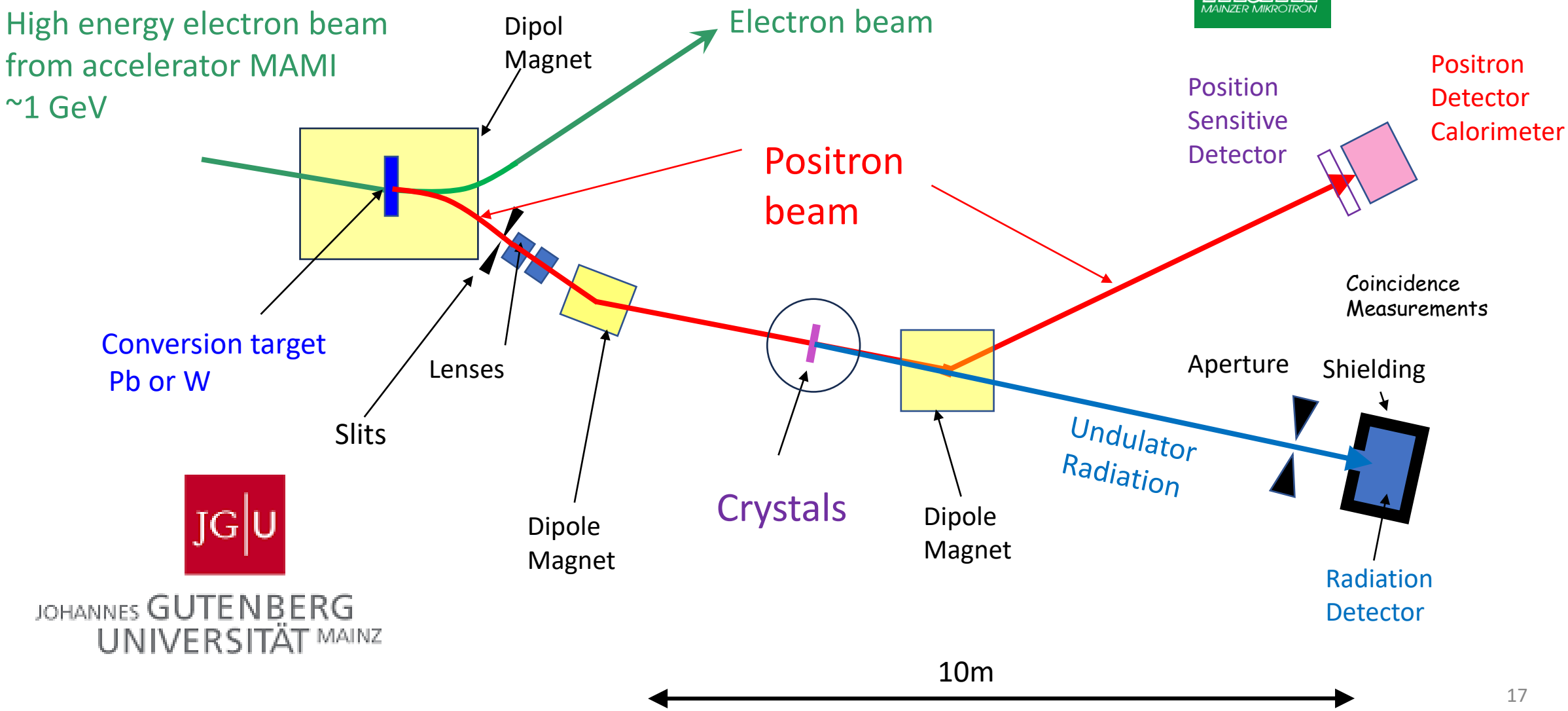
BM05 characterization:

use for Bragg X-ray diffraction Imaging: Rocking Curve Imaging and Topography
White beam and monochromator beam (Energy from 5 to 65keV)
Large parallel beam up to cm size and focused beam down to µm size

Rutherford BackScattering Channeling @ INFN LNL lab with 2 MeV alpha at AN2000 accelerator

How to test it….

Development of a positron beam @MAMI



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How to test it….

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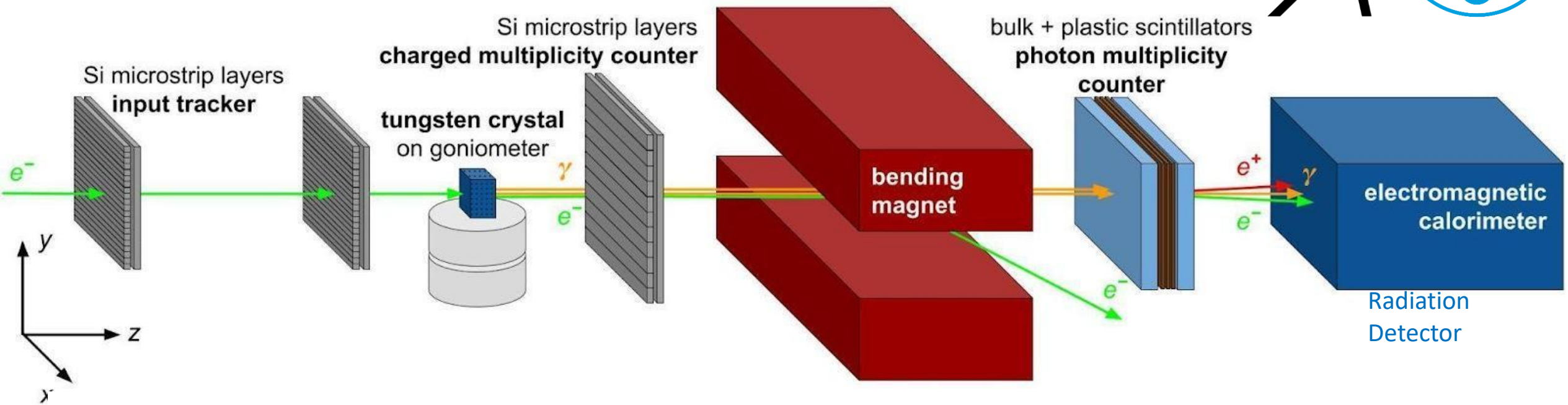
Experimental setup for CLS tests in big accelerators



We are PATHFINDERS…..

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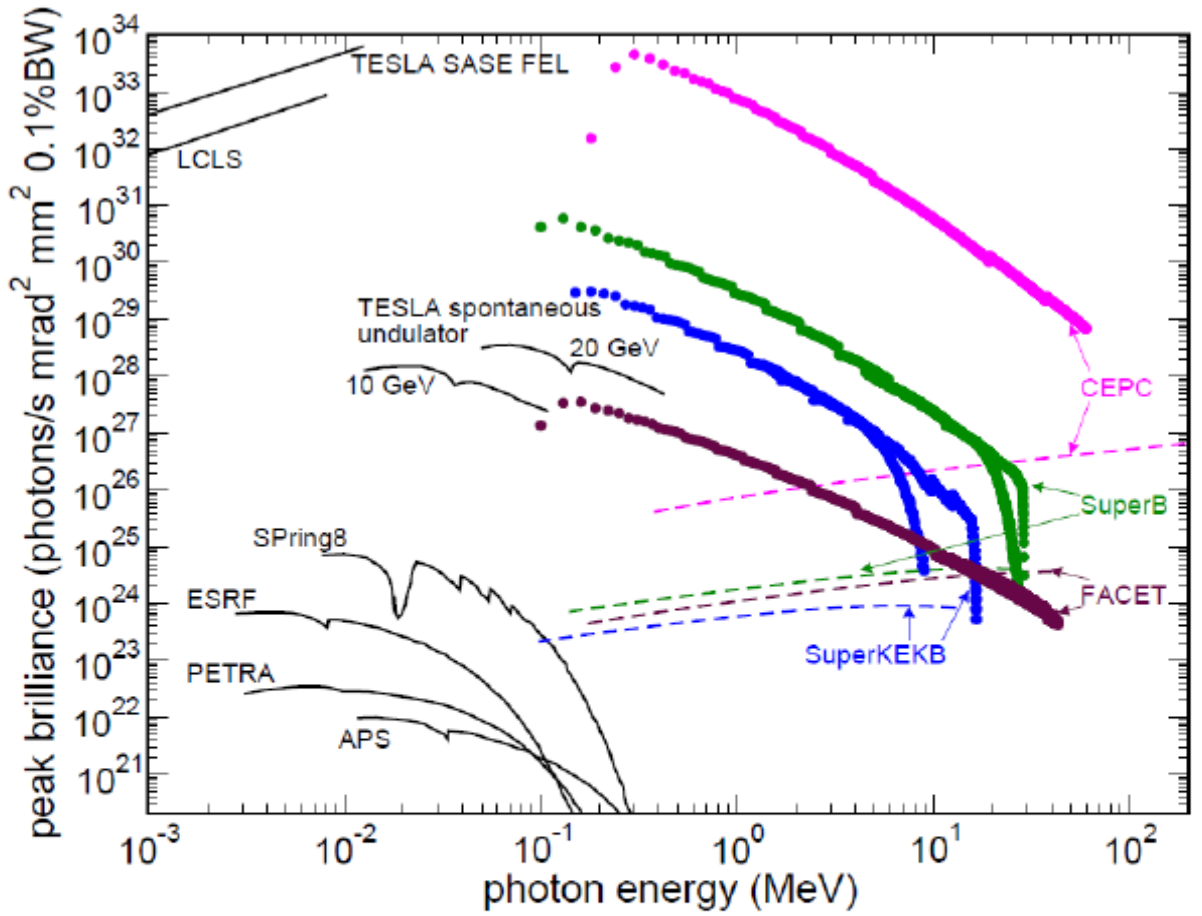
- Highly **innovative light source**;
- TECHNO-CLS will fall out **cutting-edge technologies**;
- TECHNO-CLS Consortium possess knowledge for CLS development;
- **Looking for** industrial **partners**, like investors, suppliers and end users.



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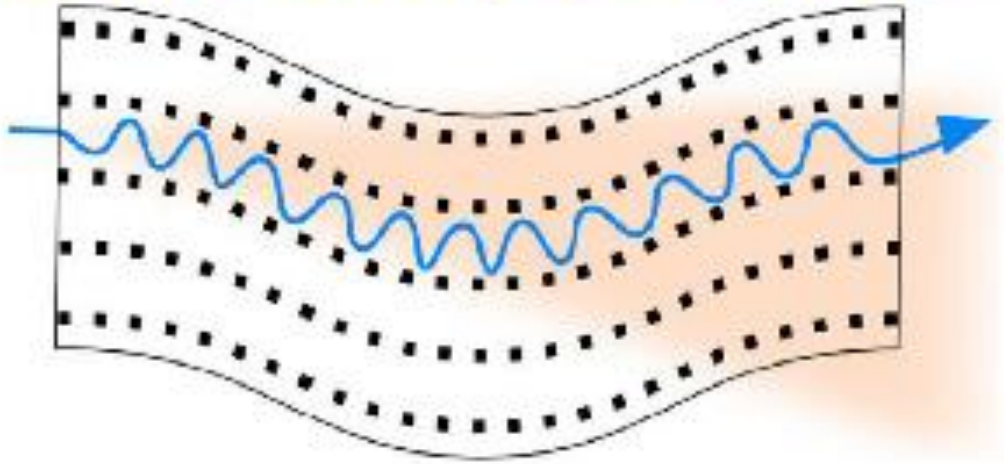
EIC PATHFINDER

European Commission

FROM IDEA TO INVESTMENT

TECHNO-CLS



THANK YOU FOR THE ATTENTION

BACK UP

CLSs experiment with particle beams : Possible collaboration with industrial/commercial partners

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Companies/Institutes providing…

- ❑**Electron and/or positron beams!!!**
- ❑**Detectors for position and energy determination of charged particles** (positrons and electrons)
- ❑**Gamma ray detection systems**
- ❑Beamline devices for high energy electron and positron beams (**magnets, vacuum components, beam monitoring systems, control devices**)
- ❑**high precision mechanics and devices positioning**

Companies/Institutes **may want to exploit the developed technologies** for:

- ❑Investigation of the structure of crystals (bent and flat)
- ❑**Development of new positron sources** for high energy accelerators

CLSs characterization: Possible collaboration with industrial/cc partners and other institutes

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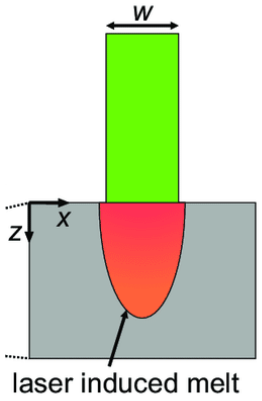
- Companies/partners capable to **check crystalline quality of CLS**s with the high-resolution needed by TECHNO-CLS

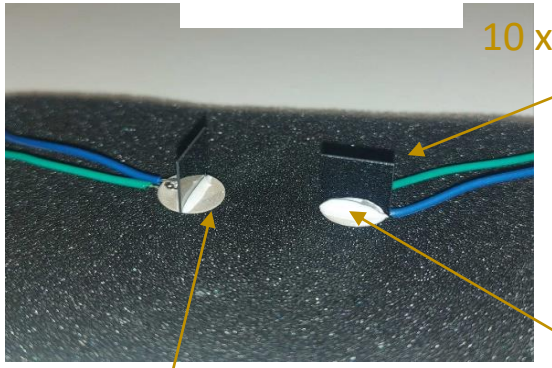
- **HRXR and interferometry producers**, with whom develop special tools for CLSs characterization

- To **work with other synchrotron/Institutes** for measurement of CLSs

CLSs manufacturing: Possible collaboration with industrial/commercial partners and other institutes

- **Semiconductor (Si and Ge) and Diamond producers** that furnish **the high-quality (low dislocation and high-homogeneity)** base material
- **Laser technologies** for material transformations
- Industries working of thin film deposition
- **Acousto-Optic Modulator (AOM) producers: to develop a novel AOM** with ultrafast and homogeneous acoustic excitation (≥ 100 MHz), small dimensions, tunability and vacuum compatibility
- **The TECHNO-CLS challenge involves cutting edge technologies in Si and Ge micromaching, in diamond doping and ultrafast AOM that can be patented!**





EIC PATHFINDER OPEN

- The **European Innovation Council (EIC)** supports game changing innovations throughout the lifecycle from early stage research, to proof of concept, technology transfer, and the financing and scale up of start-ups and SMEs.

- **EIC Pathfinder program supports research teams to research or develop an emerging breakthrough technology.**

- EIC Pathfinder Open provides funding for projects in any field of science or technology, based on high-risk/high-gain science-towards-technology breakthrough interdisciplinary research.