The STAR Project at UniCal: status, local competences, industrial collaborations and equipments

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PON MaTeRiA Project

Materials and Technologies for Advanced Research

RAdiazione per l'INnovazione 2015 , 12-13 Ottobre 2015, Laboratori Nazionali INFN e Centro Ricerca ENEA di Frascati

MaTeRiA

materiali, tecnologie e ricerca avanzata

EU/National Funding

PON "Ricerca e Competititvità" 2007 – 2013

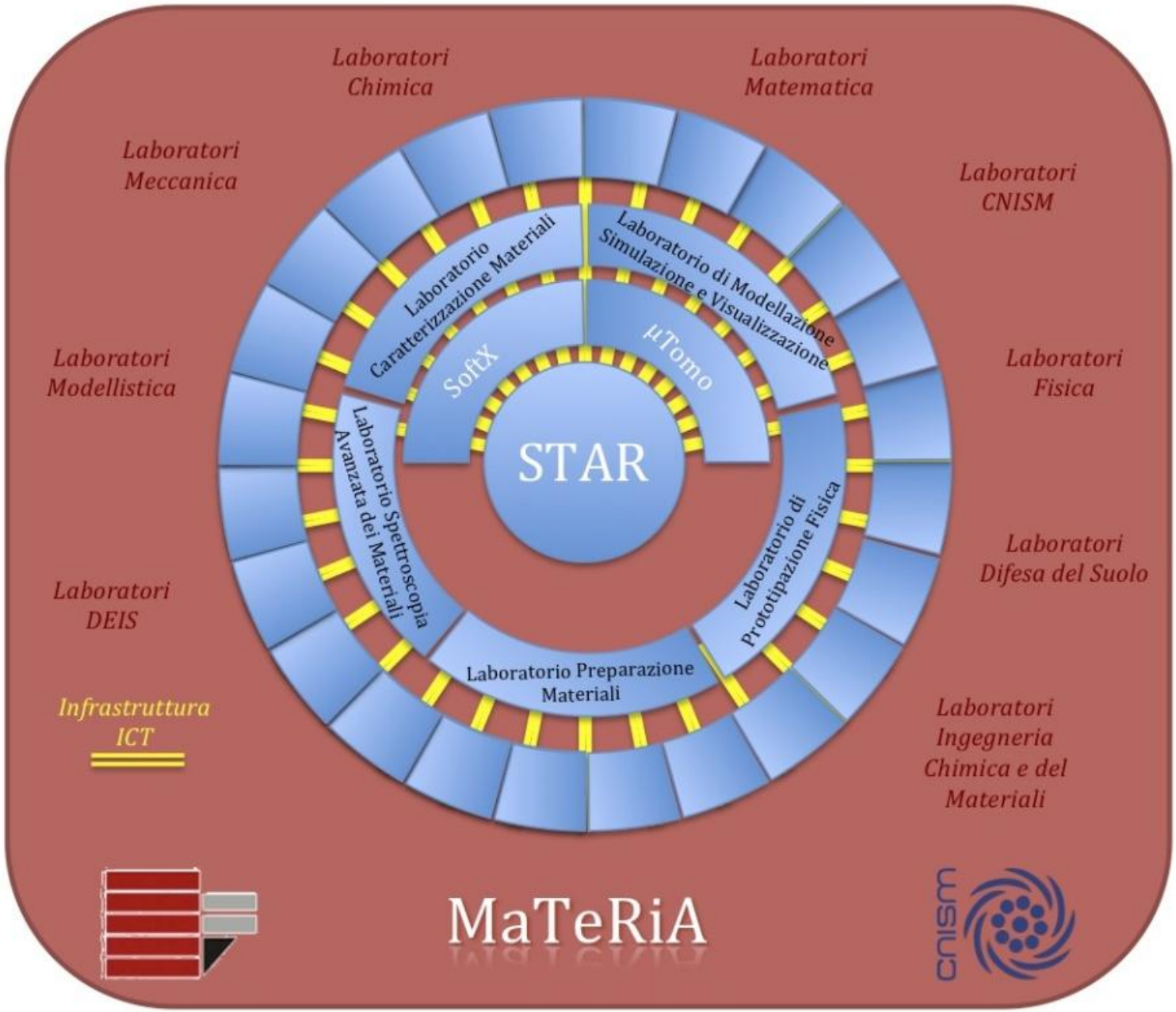
Scientific responsible: Prof. Mauro Ghedini

MaTeRiA is a joint project aimed at developing a **new Research Infrastructure** inside the **University of Calabria campus area**

Partners: **UniCal**, The University of Calabria & **CNISM**, Italian Consortium on Physical Sciences of Matter (1300 reasercher from 39 universities)

Funding €15.700.000 | 8.4 M€ STAR source - CNISM
| 6.6 M€ Laboratories and building – UniCal
| 0.7 M€ Master program – UniCal

Start Date: January 1st, 2012 **End Date**: July 31st, 2015


Laboratori Chimica
Laboratori Matematica
Laboratori Meccanica
Laboratori CNISM
Laboratori Modellistica
Laboratori Fisica
Laboratori DEIS
Laboratori Difesa del Suolo
Infrastruttura ICT
Laboratori Ingegneria Chimica e del Materiali
Laboratorio Caratterizzazione Materiali
Laboratorio di Modellazione Simulazione e Visualizzazione
SoftX
μTomo
STAR
Laboratorio Spettroscopia Avanzata dei Materiali
Laboratorio di Prototipazione Fisica
Laboratorio Preparazione Materiali
MaTeRiA

MaTeRiA Labs organized in three progressive levels

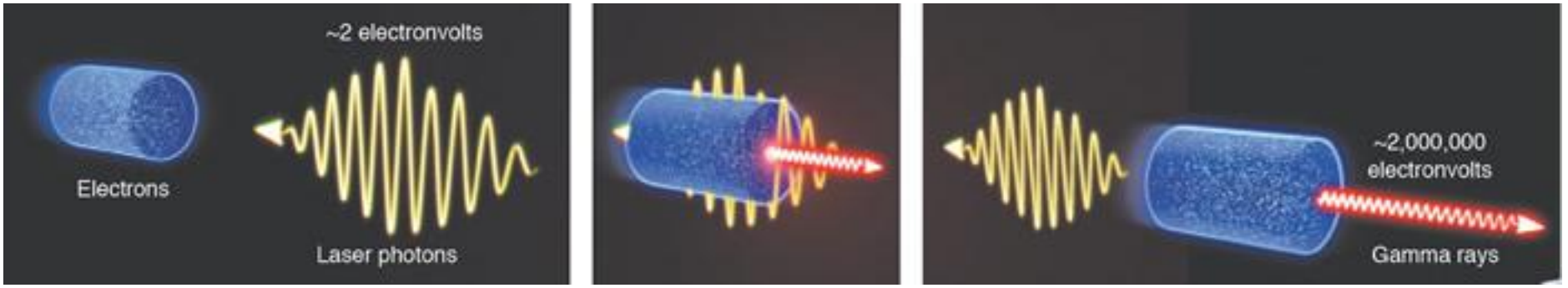
First level. **STAR** (**S**outhern Europe **T**homson Back-Scattering Source for **A**pplied **R**esearch) equipped with the beam-line **µTomo**.

Second level laboratories:

1. **Preparation and characterization**
2. **Characterization of the mechanical and physical properties**
3. **Modeling and simulation**
4. **Prototyping**
5. **Advanced spectroscopy**

Third level. Network of existent UniCal departmental laboratories

If the Physics of Compton/Thomson back-scattering is well known….



the Challenge of making a Compton Source running as an electron-photon Collider with maximum Luminosity, to achieve the requested Spectral Density, Brilliance, narrow Bandwidth of the generated *X*/ ɡay beam, is a completely different issue !

(and in Calabria even harder!)

e-beam bunch and laser pulse characteristics

Table 2: Electron beam parameters

	Phase-1	Phase 2
Bunch charge (nC)	0.5	0.5
Energy (MeV)	20-60	20-85
Rms length (ps)	1-5	1-5
$\varepsilon_{n\_x,y}$ (mm-mrad)	1-3	<1.5
Energy spread (%)	0.1-2	0.05-0.5
Focal rms spot size (μm)	15-40	10-40

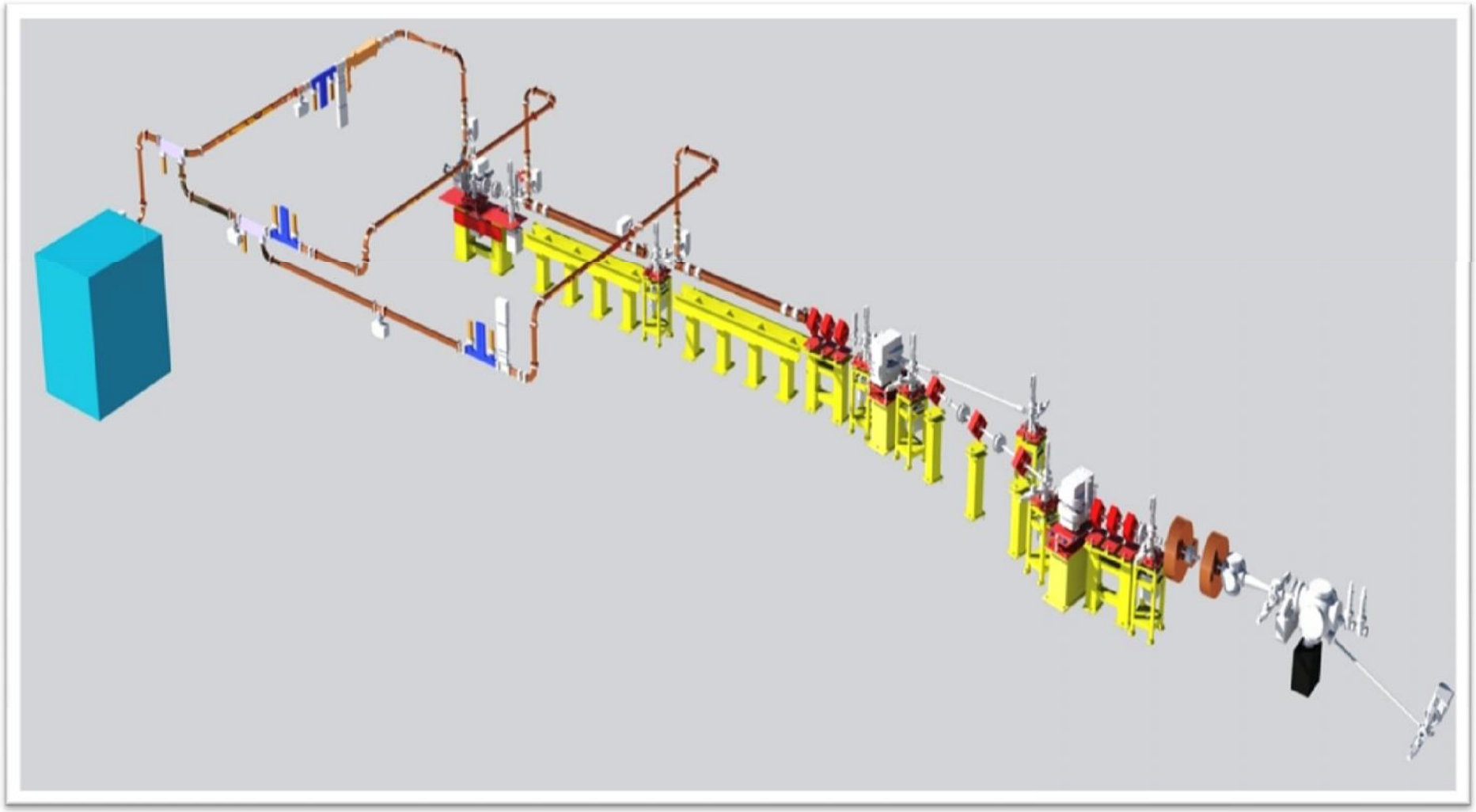
Table 3: Laser beam parameters

	Phase 1	Phase 2
Pulse energy (J)	0.8	0.8
Wavelength (eV)	1.2-2.4	1.2-2.4
FWHM pulse length (ps)	10-20	10-20
M^2	< 1.5	<1.5
Focal spot size w_0 (μm)	20-50	10-40

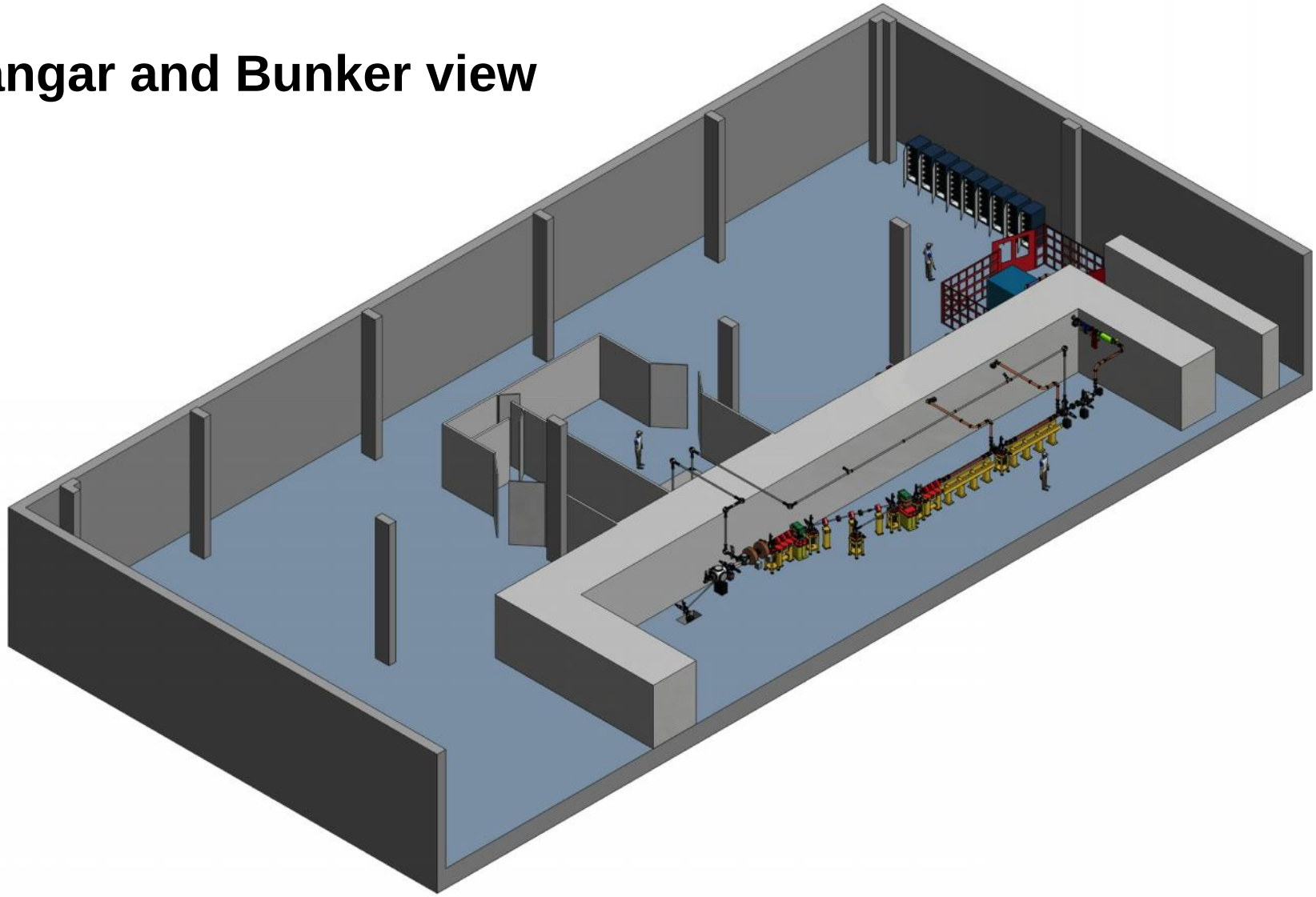
Examples of various X-ray beams in Phase 1

	high flux	smal bdw	short pulse
Photon energy (KeV)	7-120	7-120	20-120
Photons/sec (@ 100 Hz)	10^{10}	10^{9}	10^{7}
Bandwidth (rms)	10%	1%	1%
Rms Pulse length (psec)	1-5	1-5	<0.2

STAR – The Electron Machine
(65 MeV, upgrade to 100 MeV)



Hangar and Bunker view



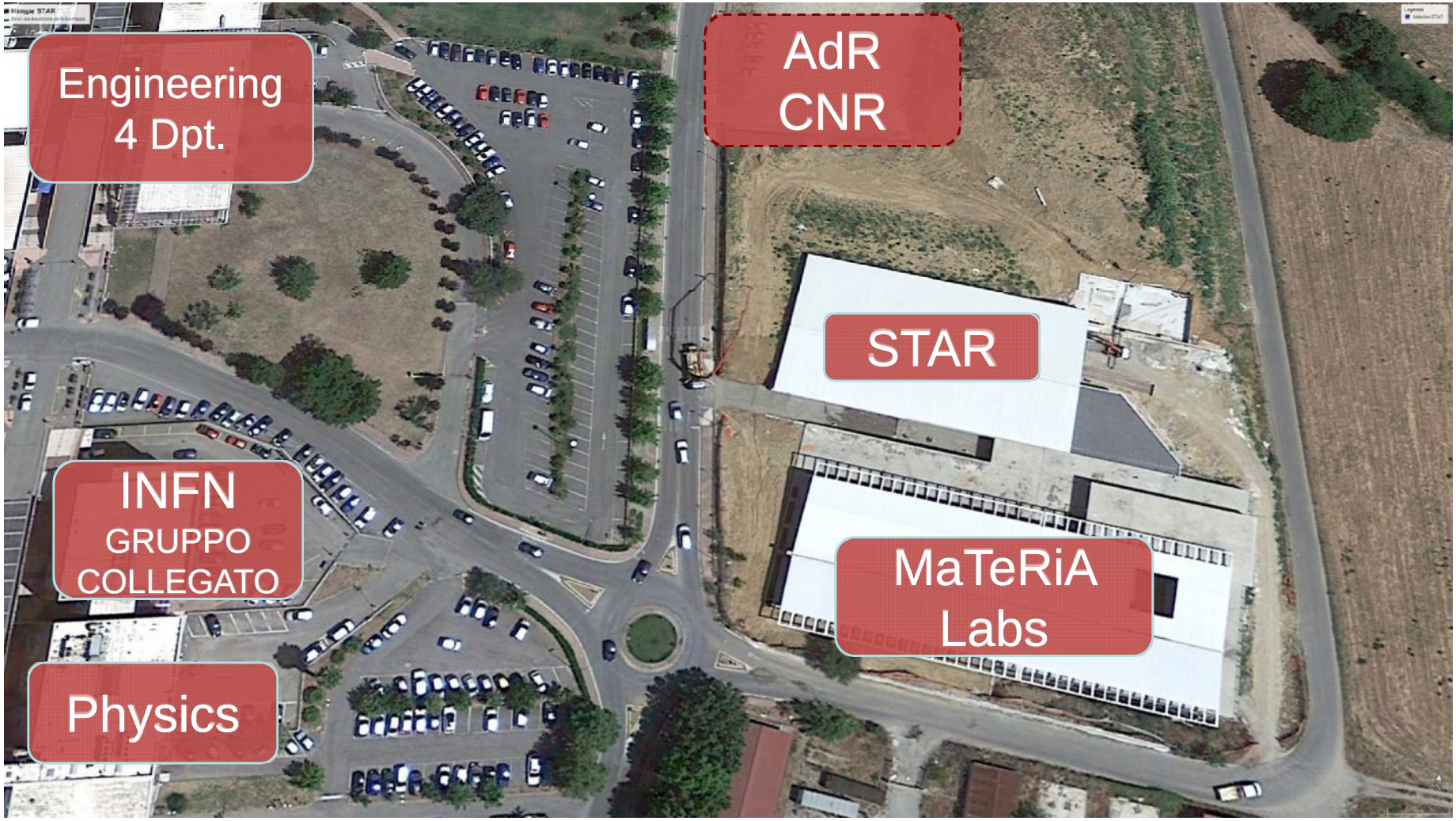
Campus di Arcavacata
UNIVERSITÀ DELLA CALABRIA

cnism

INFN

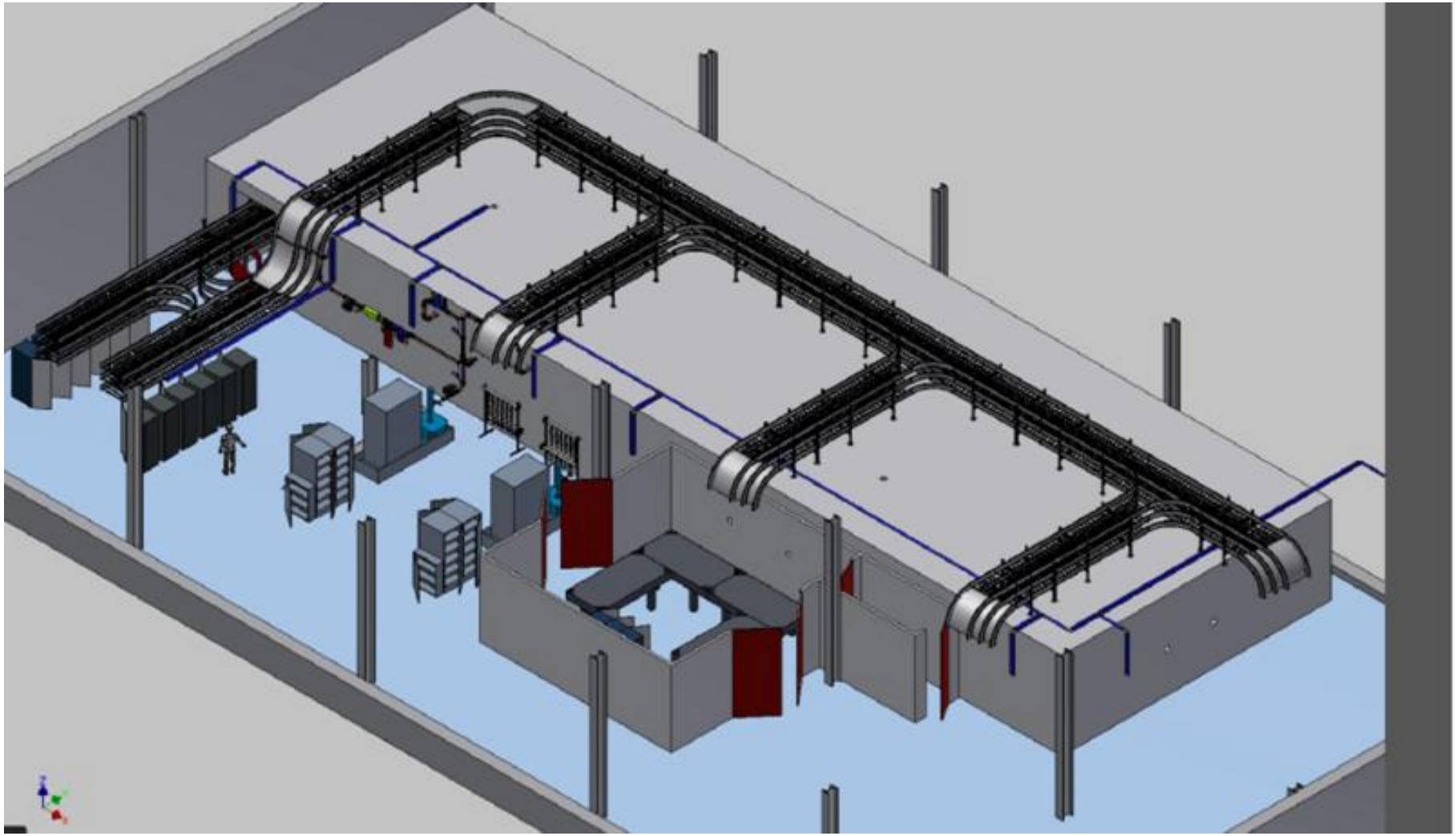
elettra Sincrotrone Trieste
Elettra and FERMI lightsources

Synergy with the research institution of the UniCal Campus



View of the STAR source location

STAR hangar layout



Status of STAR Infrastructure as of today

First X-ray photon beam
expected by 2017

µTomo beamline

•µTomo fully exploits the diffraction limited, monochromatic and tunable STAR X-rays:

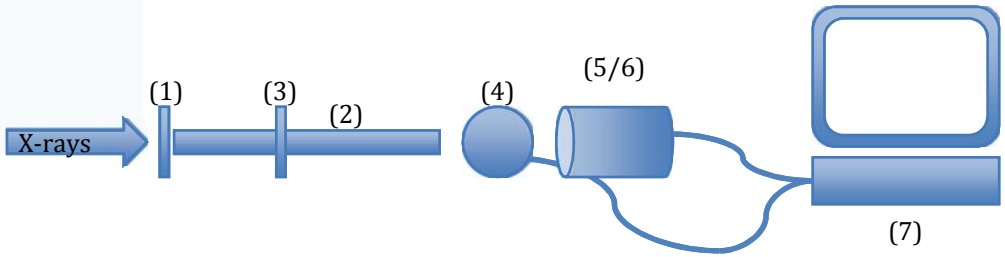
- Phase contrast images are obtained by using the X-ray beam
- Chemically resolved radiography for an efficient quantitative analysis by means of the X-ray tunability
- Hard X-ray are used for high Z elements mapping

•Experimental techniques:

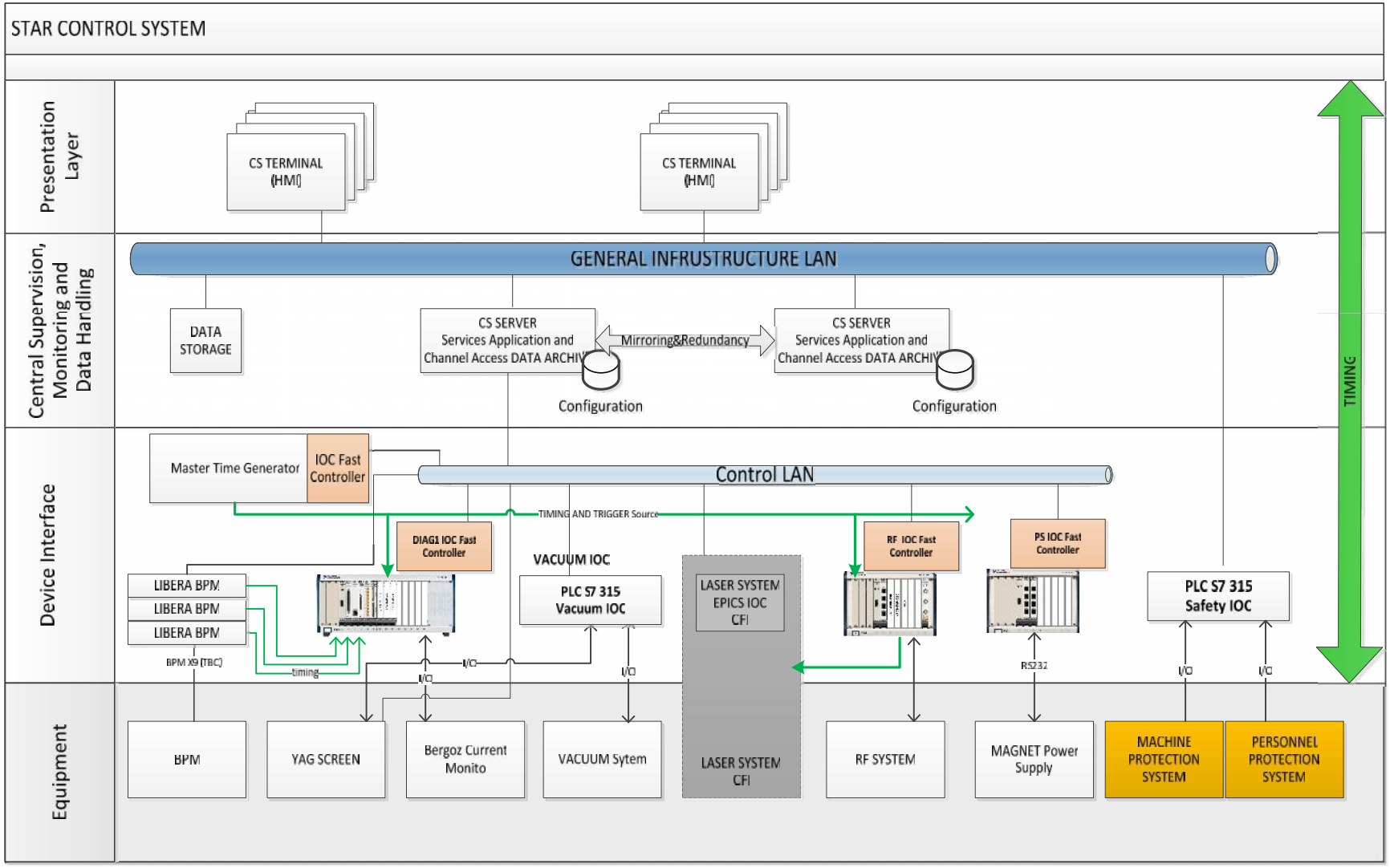
- PHase Contrast (PHC) radiography
- Chemically resolved radiographic images
- Micro-tomography and holotomography

Elettra Sincrotrone Trieste

- **Front end**
- **X-ray transfer line**
- **Slits**
- **Sample-holder (2 translations + 3 rotations)**
- **Detectors pair for high/low energy X-rays**
- **Detector stage (3 translations + 2 rotations)**
- **Data acquisition system**



EPICS-based Control System architecture



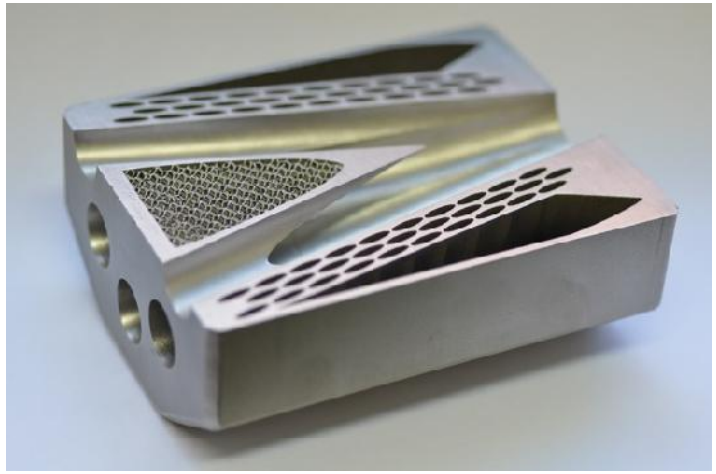
Synergy with the Lazio region

Commissioning:

Control System:

We plan to become partners in the future of the STAR Lab

An Example of 2nd-level Laboratory advanced equipment



Stainless Steel 3D Printer

All STAR laboratories are looking for research and industrial partnerships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Thank you