epX- centaurus

Four is our magic number. Each of our projects has four components.

Mathematical Physics
Advanced Computation

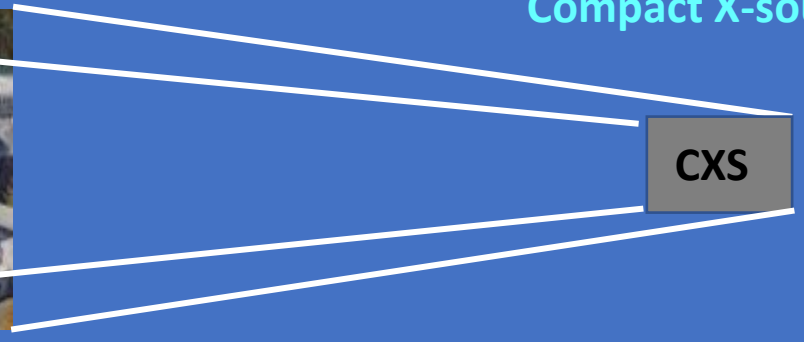
Mathematical Physics applied to Engeneering

Advanced solutions for small accelerators

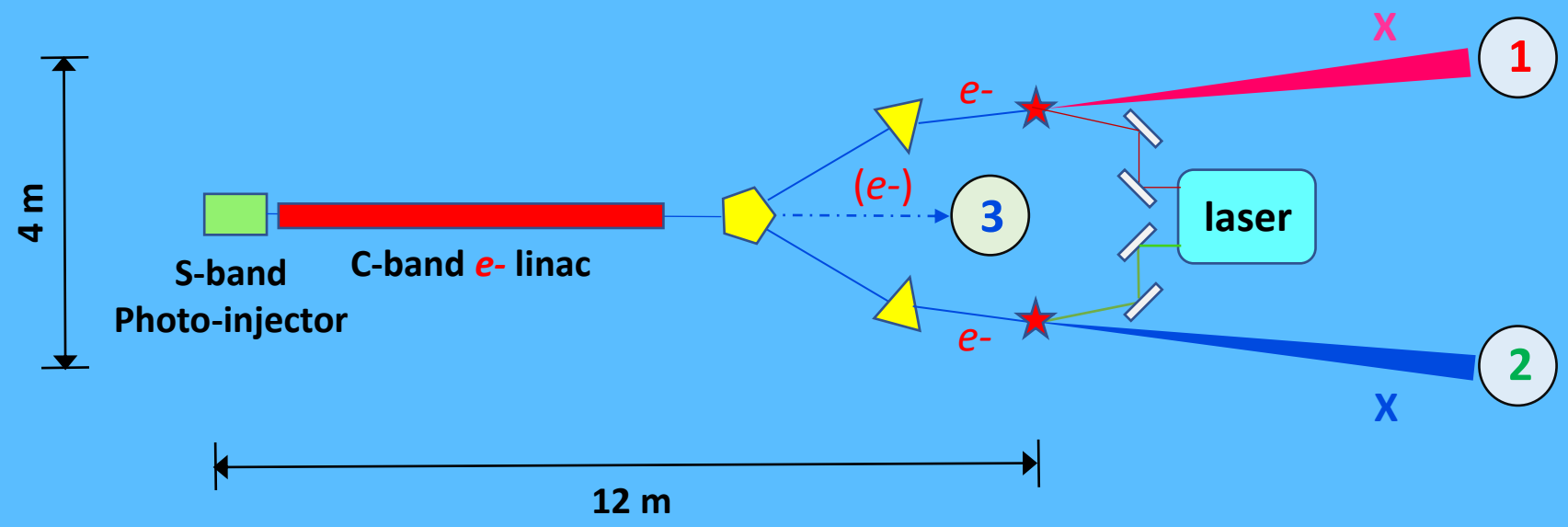
Climate and Complex systems modeling

Synchrotron X-source

Compact X-source



CXS: two (three) beam lines



APPLICATIONS
Medical Imaging
Industrial Non-destructive tests
Cultural Heritage Science
Research

1 *X-ray* energy $E_X \leq 500\ keV$

2 *X-ray* energy $E_X \leq 1\ MeV$

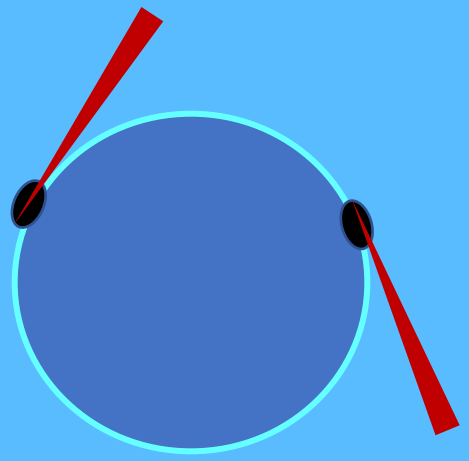
3 *e-* energy $E_e \leq 165\ MeV$

Pulse duration $1 \div 5\ ps$

The physical principle

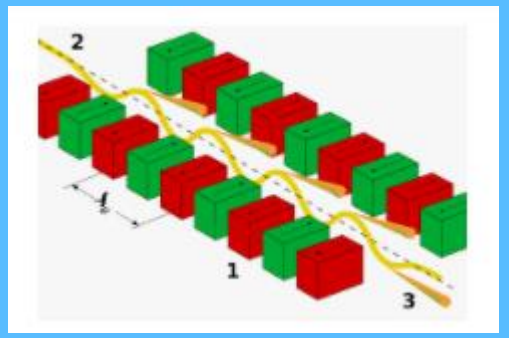
Energy of photons emitted by relativistic electrons in Accelerator Dipoles and Undulators have the same expression as those produced via the Inverse Compton Scattering (ICS) process

Accelerator Dipoles



Undulator

$$E_X \propto hc\frac{\gamma^2}{\lambda_u}$$

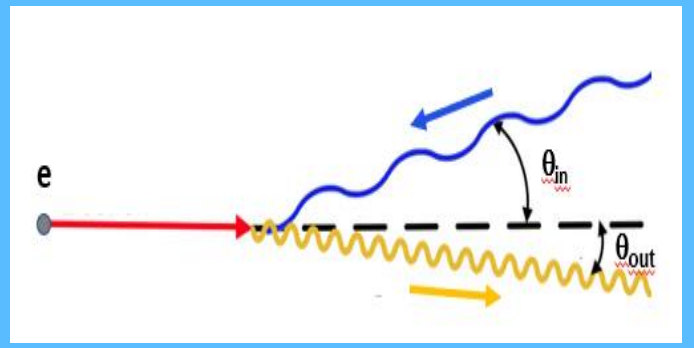


$\lambda_u \sim 15\ mm$

$$\gamma = \frac{E_e}{m_e c^2}$$

ICS

$$E_X \propto hc\frac{\gamma^2}{\lambda_{ph}}$$

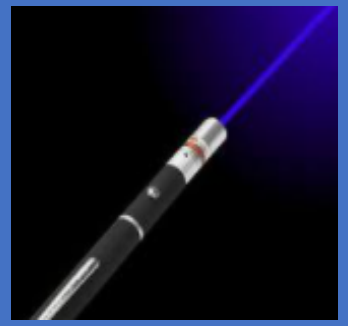


$\lambda_{ph} \sim 1\ \mu m$

Imaging with tunable monochromatic partially coherent ICS X-rays

Conventional and ICS X-rays are similar to the light of a bulb and of a laser pointer.
The energy of ICS X rays can be tuned the color of a laser pointer is fixed

light bulb



laser pointer

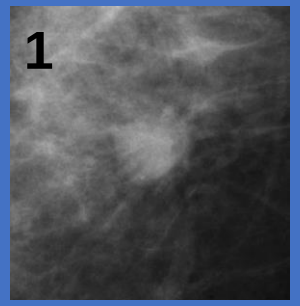
Light

X-rays

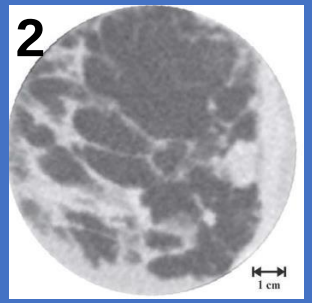
X-ray tube

ICS source https://lynceantech.com

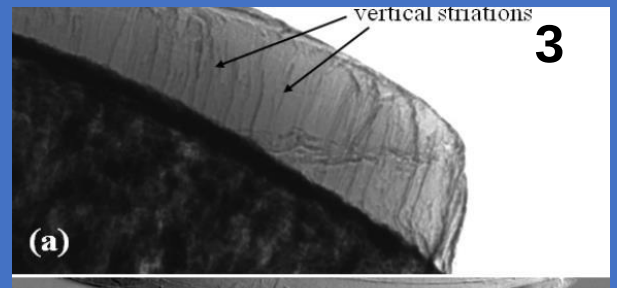
Synchrotron light X-rays with phase contrast PCI versus standard X rays Absorption Imaging AI



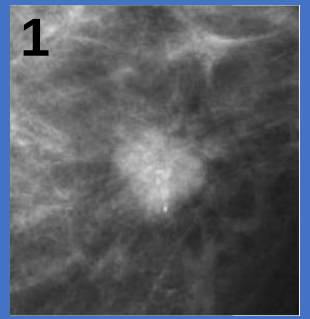
AI



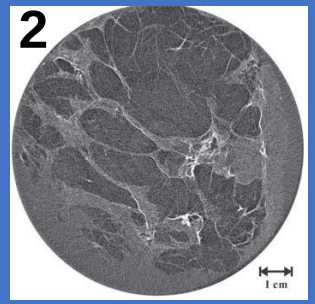
AI



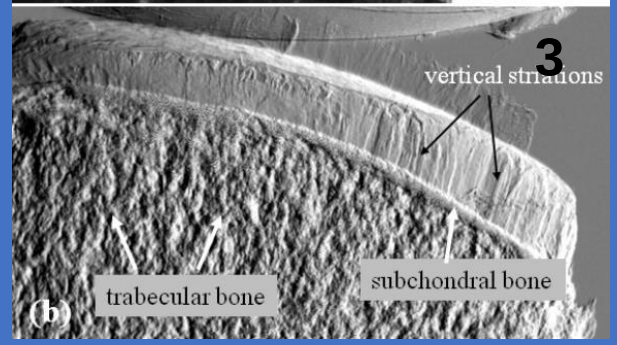
AI



PCI



PCI



PCI

PCI and AI comparison for sodt tissues:

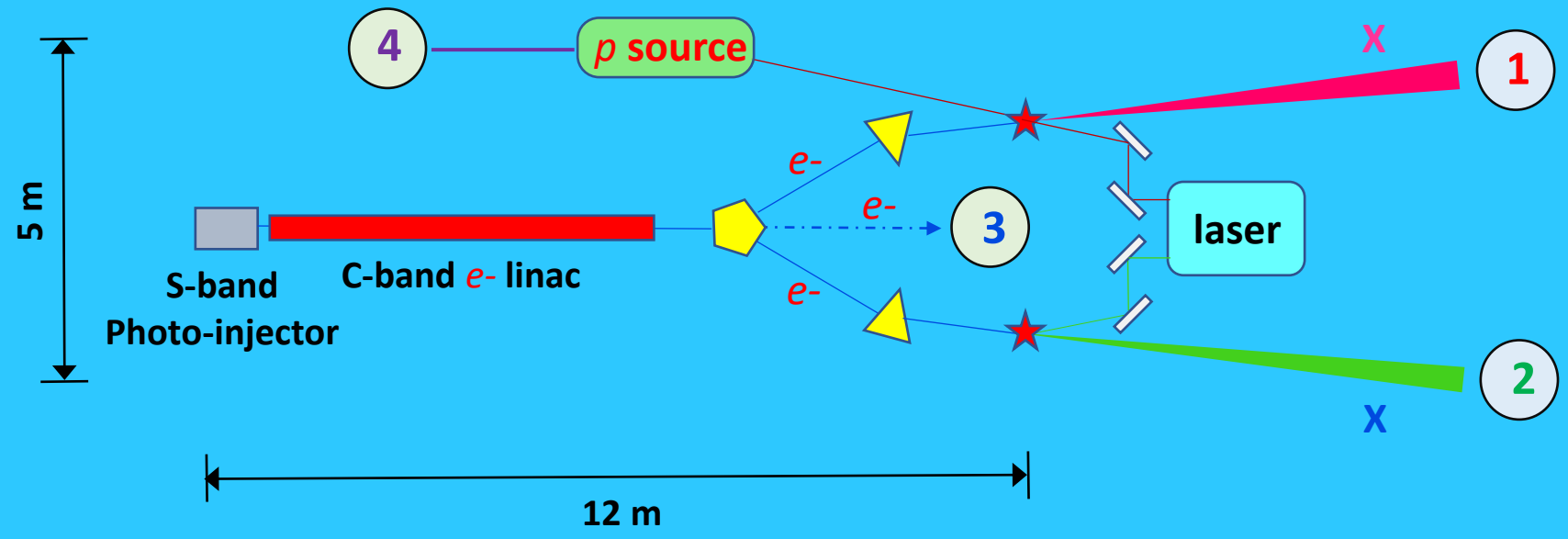
1 mammography

2 Breat tissue

3 Join cartilage

Courtesy by G. Tromba @ SYRMEP

CXS to epX: four beam lines



APPLICATIONS

Medical Imaging

Industrial Non-destructive tests

Cultural Heritage Science

Research

Flash radiobiology

1 *X-ray* energy $E_X \leq 500\ keV$

2 *X-ray* energy $E_X \leq 1\ MeV$

3 *e-* energy $E_e \leq 165\ MeV$

4 *p* energy $E_p \leq 5\ MeV$

Pulse duration $1 \div 5\ ps$

Proprietary open source beam dynamics software

Micromaps Tracking code 2D with exact linear otical functions computati

Halodyn Tracking code 2D - 3D with space charge

AlaDyn Maxwell Vlasov 2D and 3D code

Earth – centaurus

Four spheres: atmosphere, hydrosphere, lithosphere, biosphere

Software development

Variational and reversibility indicators. Poincaré recurrences and extreme events

Koopmann-EDMD dynamic interpolation, AI and deep learning techniques.

Analysis of climate models and data

An agreement will be established the UNIBO center **ALMA CLIMATE**

1

2

3

4

https://centri.unibo.it/climate/en

Complex – centaurus

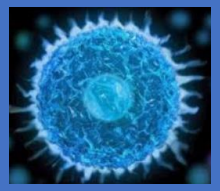
Four levels: complex atoms, organs, automata, networks of automanta

A complex atom is a self replicating Von Neumann automaton.

Theoretical and software development to analyze complex systems

Biosystems modeling, mobility models and data analysis

1



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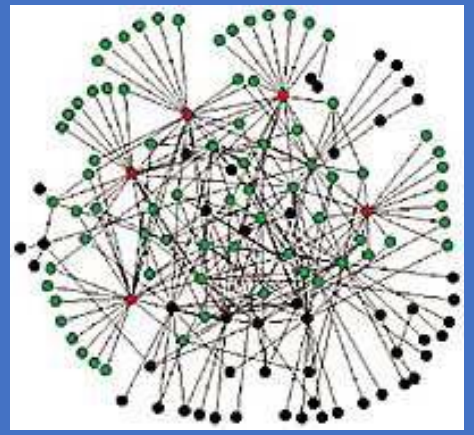

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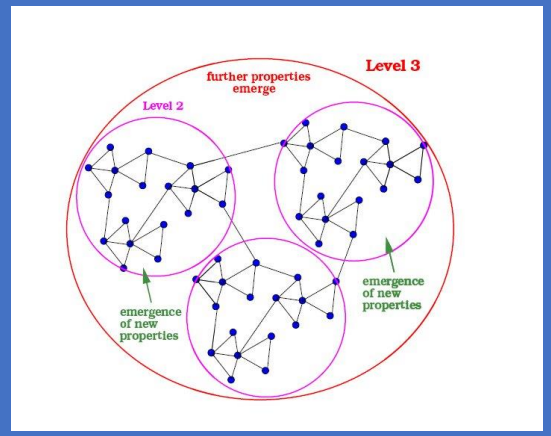
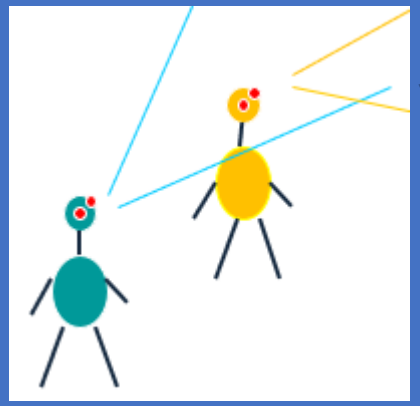


4



Non Newtonian gas of automata

https://iopscience.iop.org/article/10.1209/0295-5075/78/58003 (2007)
https://www.maggiolieditore.it/9788838744617-la-citt-liquida.html (2010)

Founders profile

Giorgio Turchetti

CV

Professor of Mathermatica Physics

Bologna University until 2012

Dynamical and complex systems

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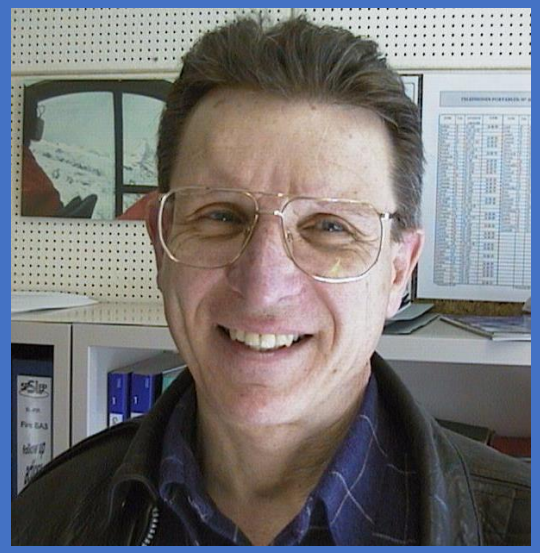

Massimo Placidi

CV

Accelerator physicist

CERN until 2004

LBNL and Lyncean Tech. until 2016

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http://www.physycom.unibo.it/index.php