Accelerating Technology @ NTUA/IASA

Evangelos Gazis

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NTUA/IASA Accelerator Team

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NTUA: School of Applied Mathematics & Physics Sciences

- Evangelos Hristoforou, Konstantinos Politopoulos, Sotirios Kokosis, Elena Alexendratou

NTUA: School of Electrical & Computing Engineering

- Dimitris Bantekas, Nikolaos Vordos

International Hellenic University, Physics Dept.

- Theodoros Apostolopoulos, Katerina Pramatari, Dimosthenis Kotsopoulos, Angeliki Karagiannaki

Athens University of Economics & Business, Dept. of Telecommunications

CLIC/CTF3/CLeAR Collaboration

- The NTUA/IASA Team has a consistent contribution to the CLIC Collaboration, supervising **6 PhD theses** and many **MSc theses** in the subjects:

  - Beam Dynamics, CLIC
  - Physics of Damping Rings, CLIC
  - Mechanical Design, Construction & Commissioning of the Beam Girders, CLIC
  - Longitudinal Instabilities in RF system, LHC
  - Beam optics for proton beam HL-LHC
  - Mechanical Design of the Accelerating Discs, CLIC
  - DAQ & Control System of a Radiation Protection platform via Augmented Reality, ATLAS Cavern
  - Photocathode study, e-gun and electron beam optics for XFEL, Compact Light
  - Radiation Study of the XFEL, Compact Light
  - Dosimetry Studies of a FLASH-RT facility

COMPACT LIGHT COLLABORATION – XLS,

https://www.compactlight.eu/, 2018 – 2022, funded H2020

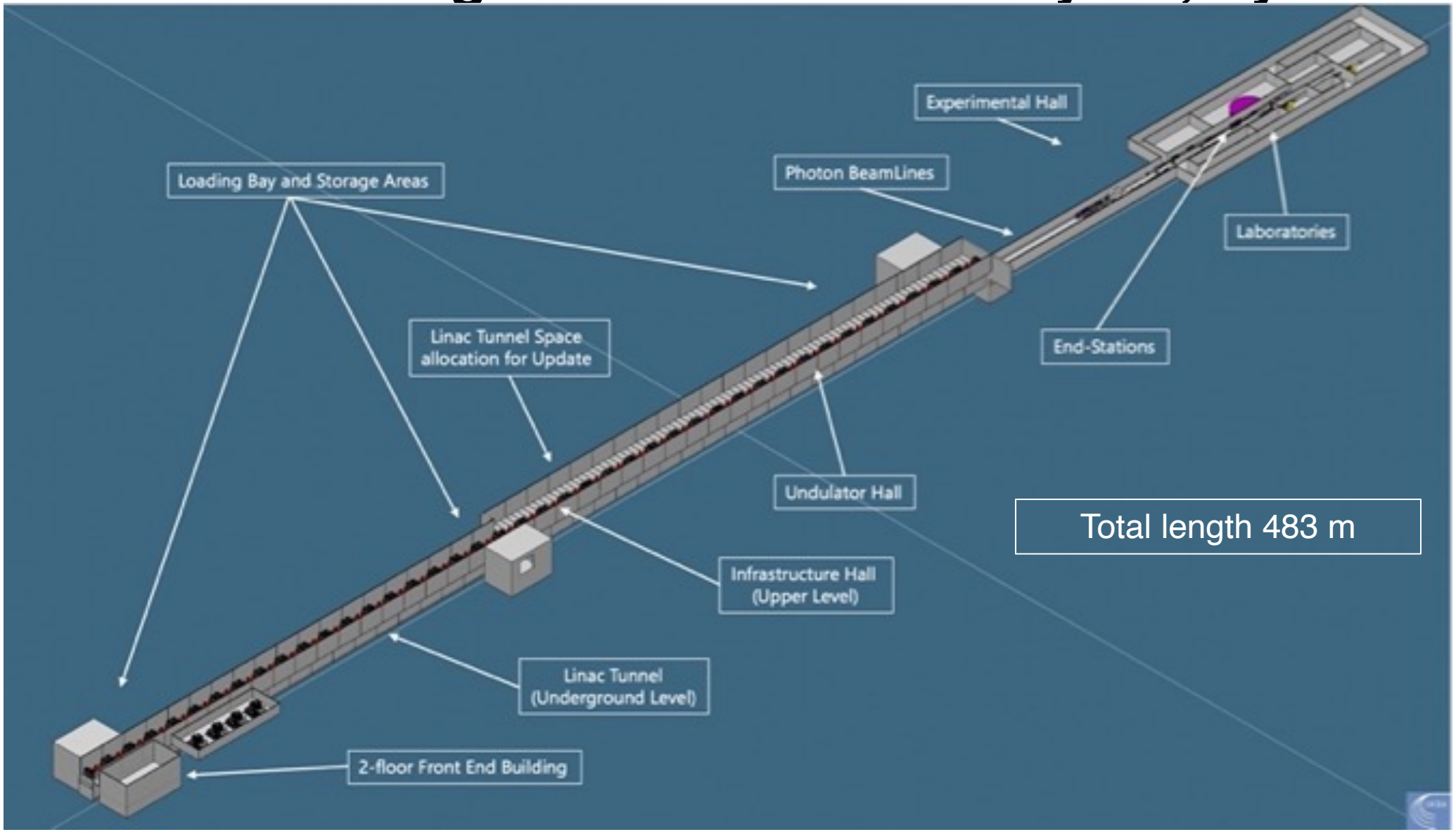
The Greek Team has contributed to Injector Design, **Beam Dynamics**, **3D CAD layout design** and **Financial Analysis** of the delivered desing

A **C**onceptual **D**esign **R**eport – **CDR** was delivered among many other innovative reports, where it is proposed an **Innovative and Compact accelerator for Free Electron Laser – FEL** with **High Electron Beam Energy** and **High Intensity of Coherent X-rays**.

Our Contribution, three MSc theses were developed:

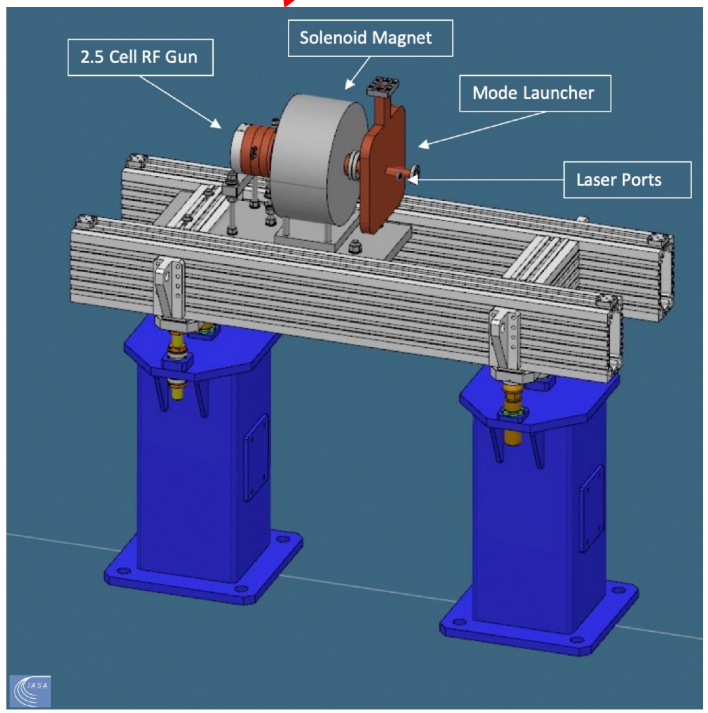
- ❑WP1: Co-coordination of the project
- ❑WP3: Laser/Photocathode (coordinator)
  - ❖ e-Gun, Injector mechanical design
- ❑WP6: Beam dynamics simulation and generic
  - ❖ algorithms (ASTRA, GIOTTO)
- ❑WP7: 3D Model design & Parameters List
  - ❖ Solenoid shielding and Magnet design
  - ❖ Cost, SWOT, Risk & Market Analysis
  - ❖ Cost to Benefit Analysis
  - ❖ Transfer Technology to industry
  - ❖ Data Management Planning

3D CAD model Design of the Baseline Layout, by our team

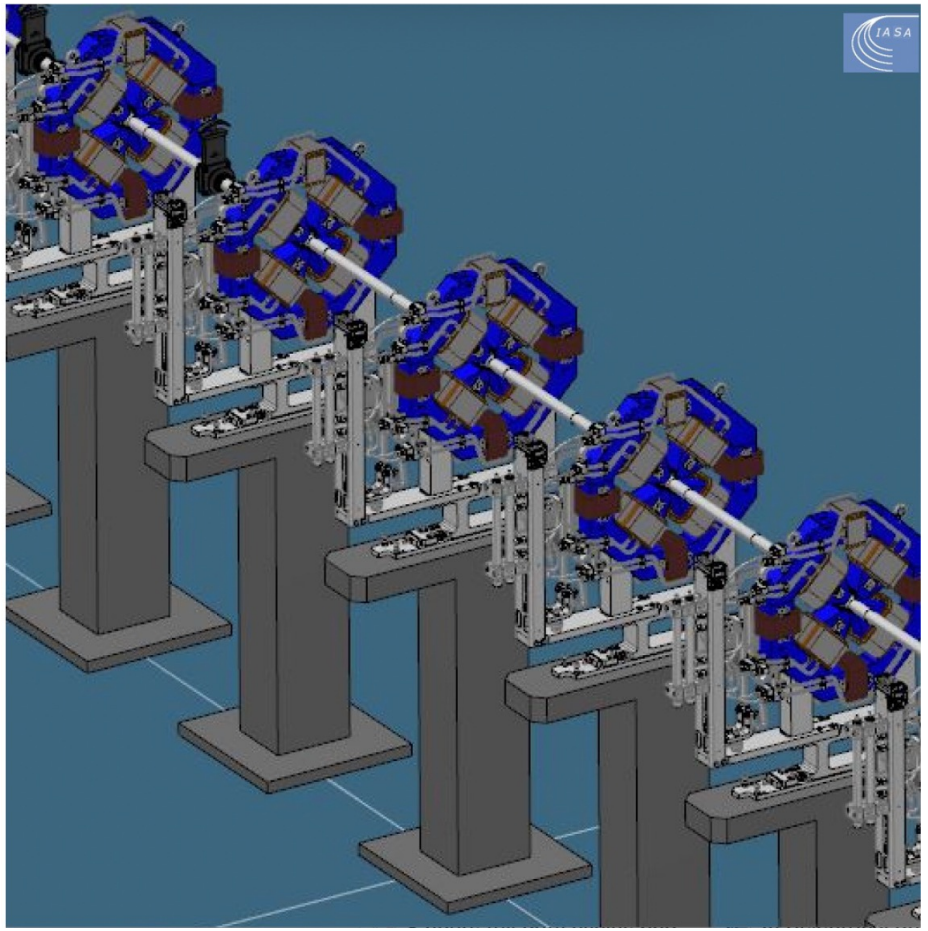


The Greek TEAM participation – IASA/ESS

Cell C-band gun parameters and **3D design**, with **solenoid**, **mode launcher**, **laser ports**



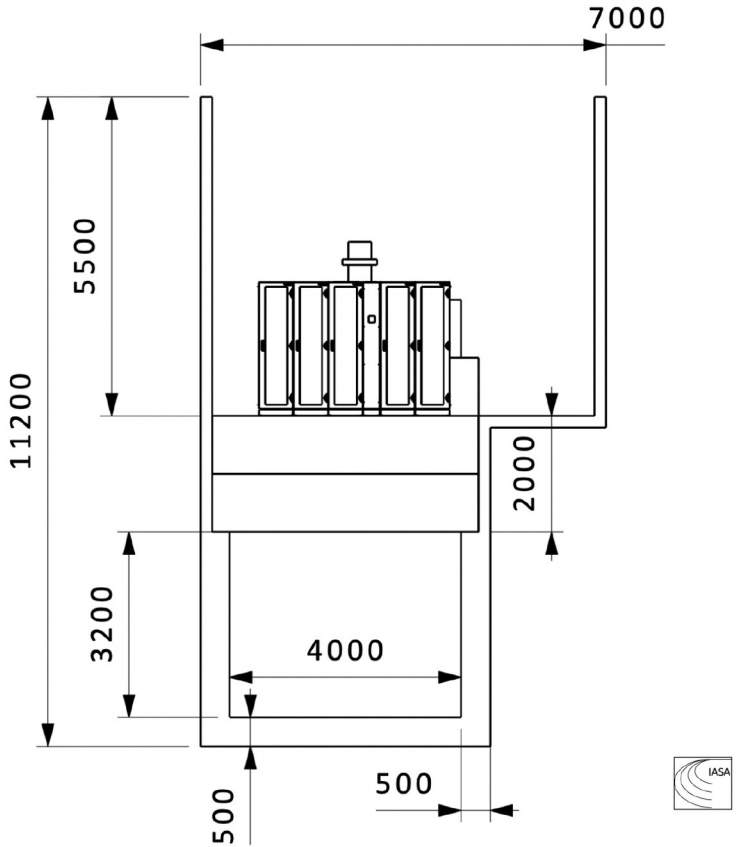
Close up view of the **quadrupoles** with **embedded steerers**

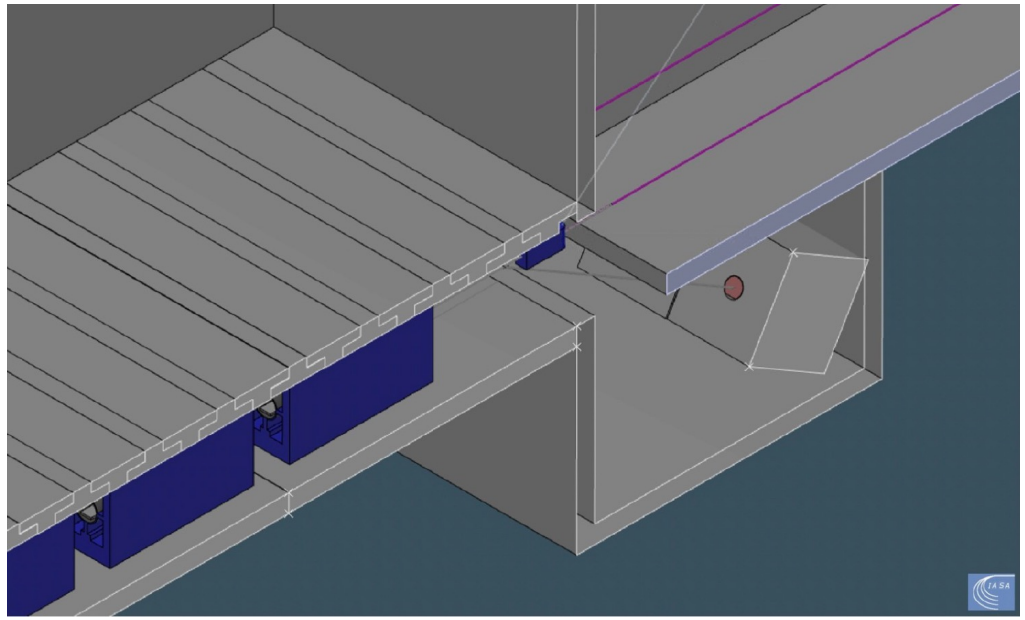


The Greek TEAM participation – IASA/ESS

The building, cross section of the tunnel, the dogleg area and the beam dump

Name	Length (m)	Width (m)	Height (m)
Linac Tunnel/Undulator Hall	329	4.0/8.5	3.2
Infrastructure Hall	329	7.0/11.0	5.5
Experimental Hall	154.6	5.9/24.9	4.0
Total:	483.6		





EuPRAXIA PLASMA ACCELERATION – 2022 – 2026, funded by EU ESFRI Project

- **15** International Laboratories + **25** Associate Laboratories from Europe, China, USA.
- **IASA**, main partner, plus **NTUA** and **AUEB** associate partners from Greece.

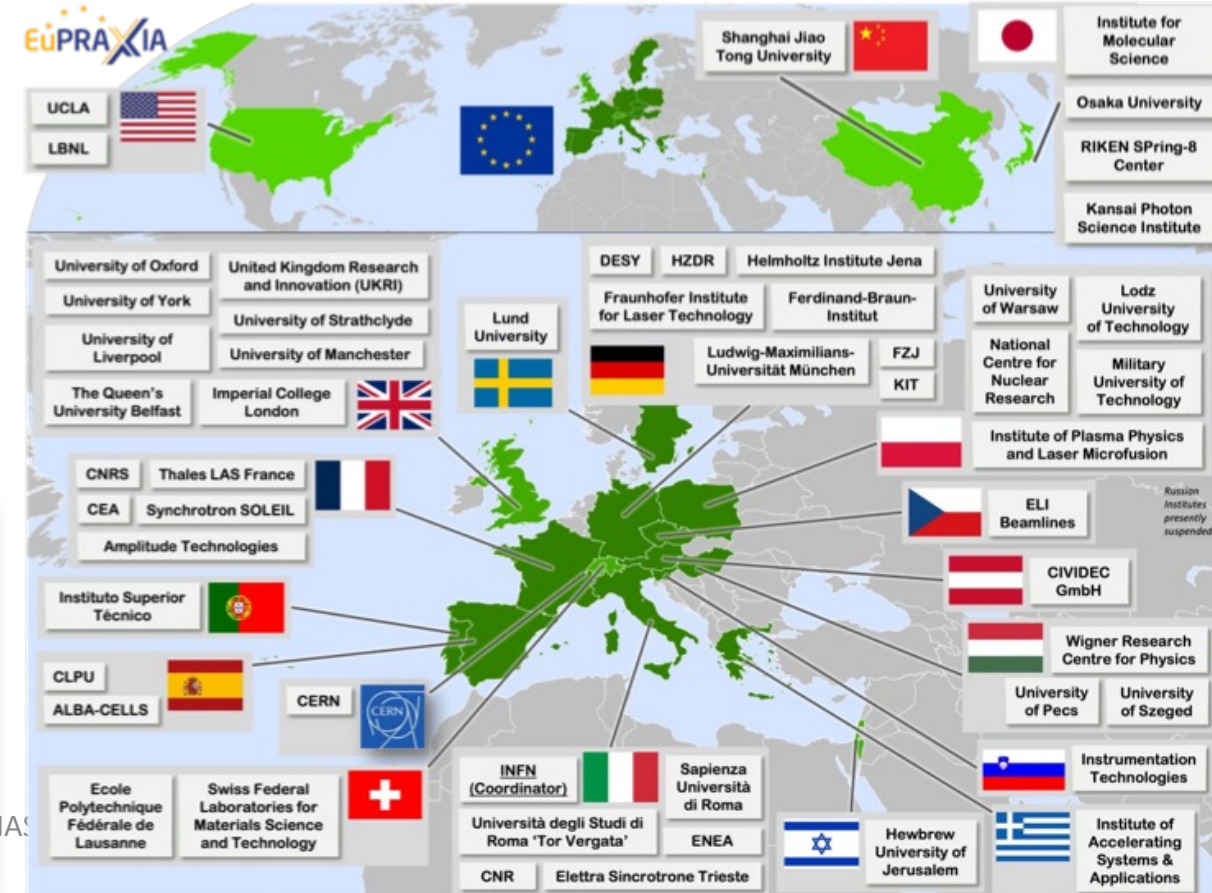
- The Greek Team is contributing to the **Beam Dynamics**, **Injector design**, **3D CAD layout design**,
- Applications in Medicine and Materials, Extension of the Collaboration, Financial Analysis of the project.

http://www.eupraxia-facility.org/

Building a facility with very high field **Plasma Accelerators**, driven by lasers or beams obtain **1 – 100 GV/m** accelerating field

*Delivers 10-100 Hz **ultra-short** pulses*

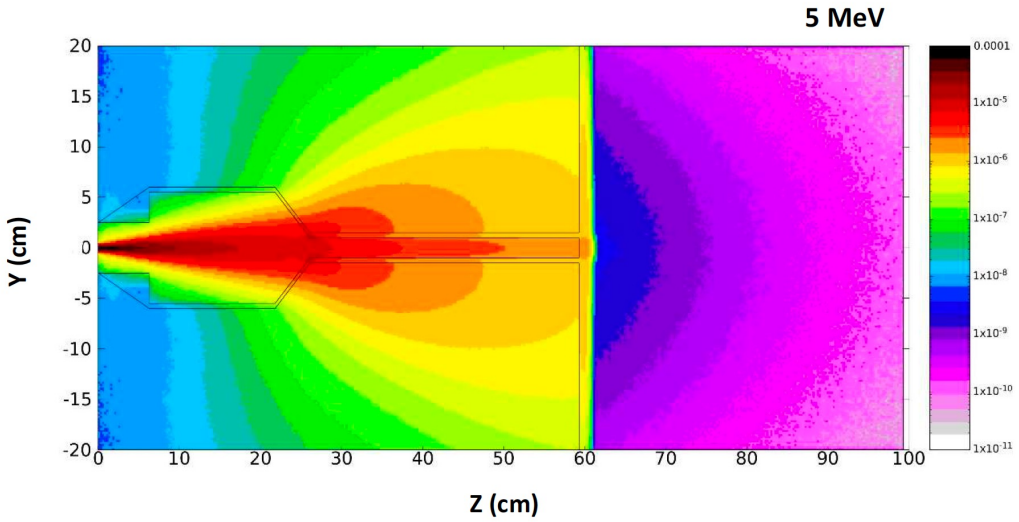
- **Electrons** (0.1-5 GeV, 30 pC)
- **Positrons** (0.5-10 MeV, 10^6)
- **Positrons** (GeV source)
- **Lasers** (100 J, 50 fs, 10-100 Hz)
- **Betatron X rays** (1-110 keV, 10^{10})
- **FEL light** (0.2-36 nm, 10^9-10^{13})

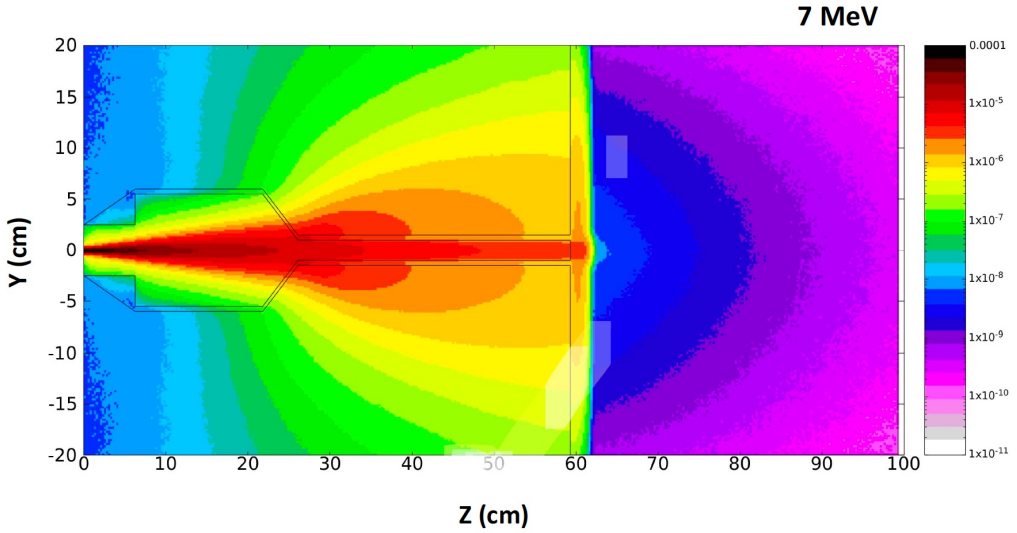


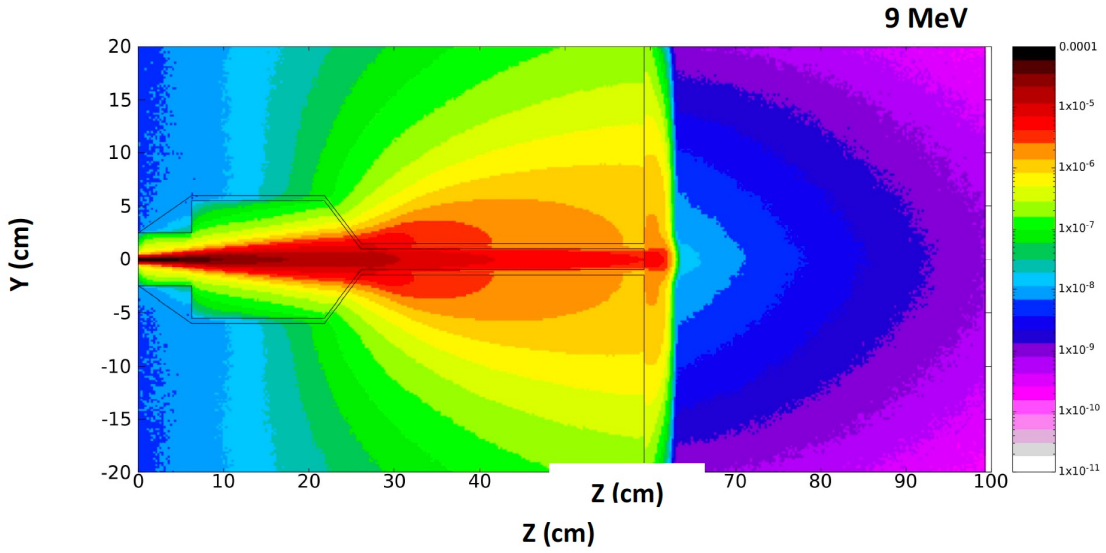
Topics of research: proteins, viruses, bacteria, cells, metals, semiconductors, superconductors, magnetic materials, organic molecules

MSc thesis by Melina Moniaki

2D FLASH beam distribution simulation with FLUKA, E = 5, 7, 9, 50, 100 MeV and 1.2 GeV – PMMA Applicator & Phantom

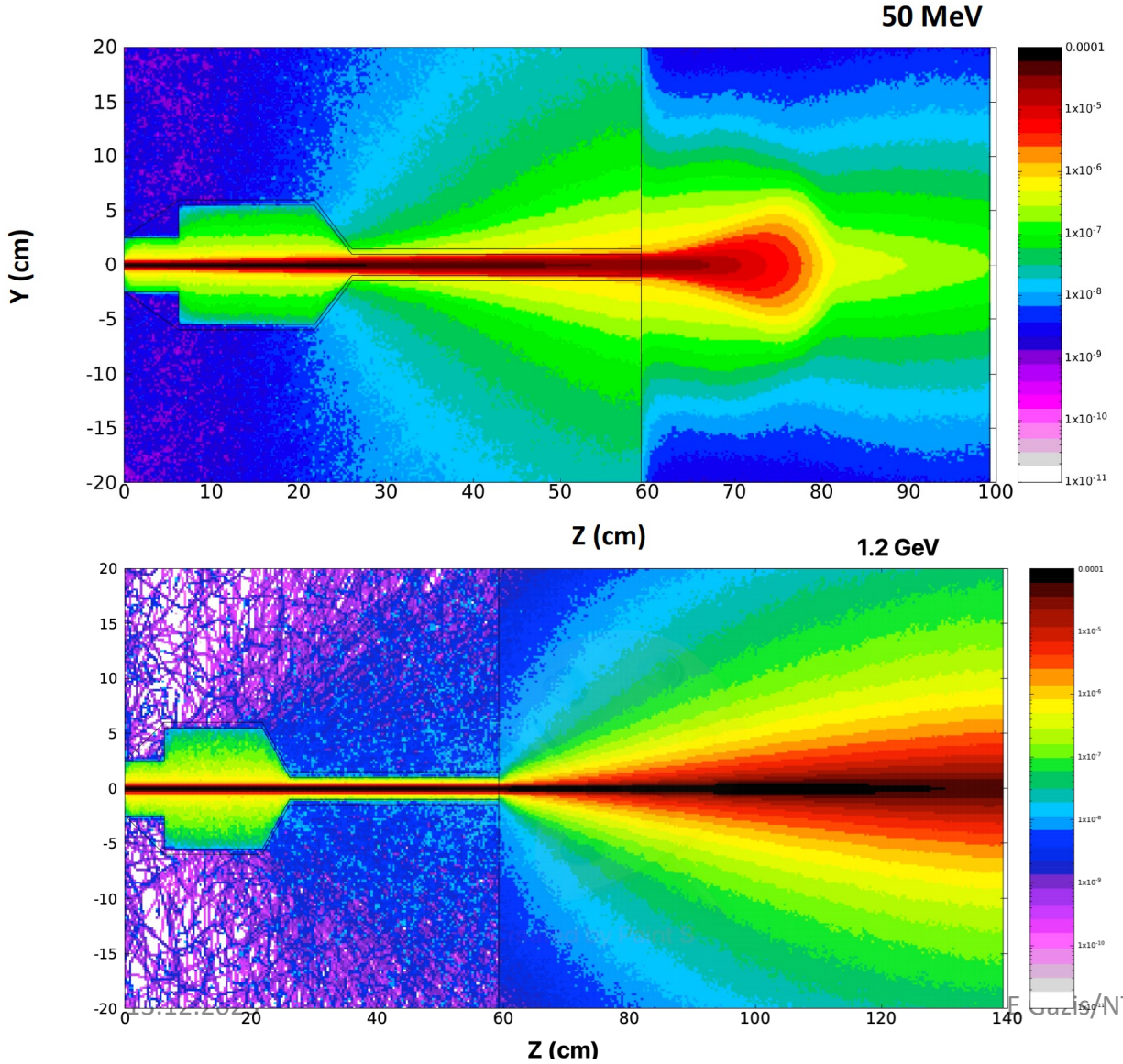


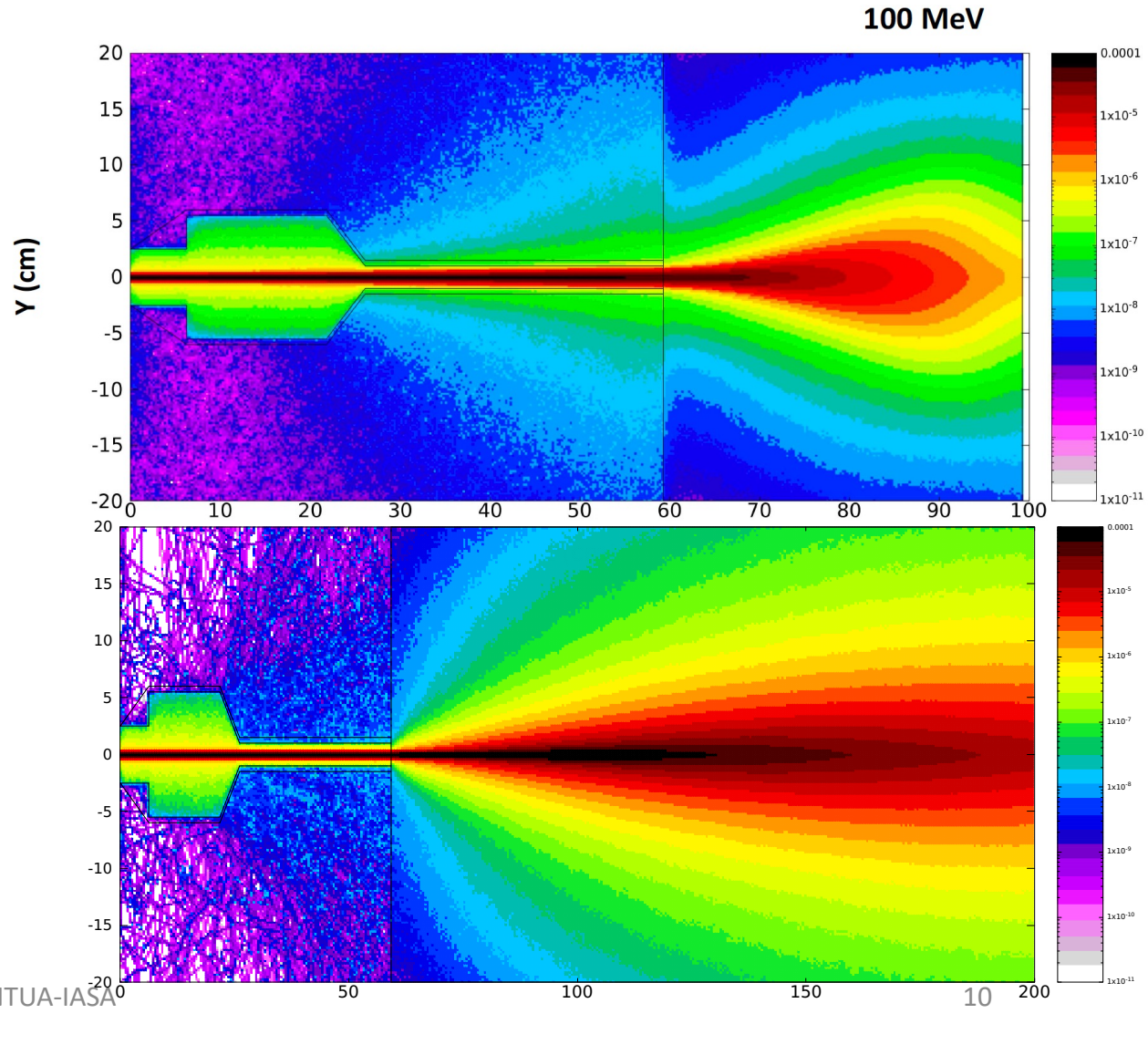




MSc thesis by Melina Moniaki

2D FLASH beam distribution simulation with FLUKA, E = 5, 7, 9, 50, 100 MeV and 1.2 GeV





Accelerator Technology Laboratory @ NTUA

- E-Gun – RF Cavity – Accelerator Structure

- Cathode
  - Thermionic cathode + RF unit + S-band structure (3 GHz, TM110 mode) →→ **100 MeV**
  - Cu-Photocathode/Ti-Saphire laser + RF unit + S-band/C-band structure (4-8 GHz) →→ **300 MeV**

European Laboratories Cooperation

- **CERN** : **P**roton **S**ynchrotron-PS, **S**uper **P**roton **S**ynchrotron-SPS, **L**arge **H**adron **C**ollider-LHC,

  Compact **Li**near **C**ollider - CLIC

- **LNF-INFN Frascati** : XFEL, PWFA
- **Univ. Roma 1, La Sapienza** : FLASH-RT
- **Univ. Roma 3, Tor Vergata** : Beam Instrumentation
- **ELETTRA, Trieste** : Synchrotron Radiation Facility, XFEL
- **European Spallation Source-ESS, Lund** : Proton linac, Neutron pulsed beam
- **MAX IV, Lund** : Synchrotron Radiation Facility, XFEL