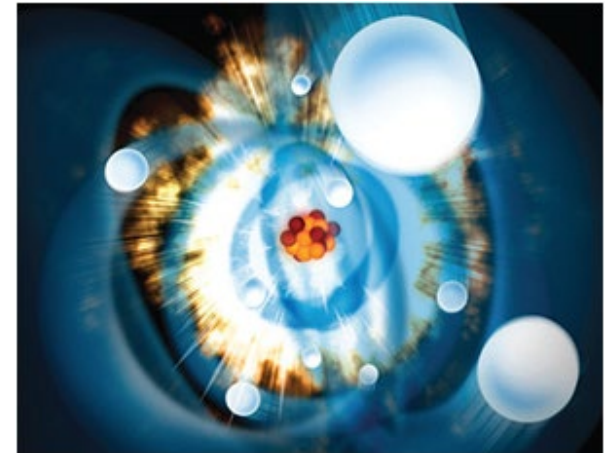
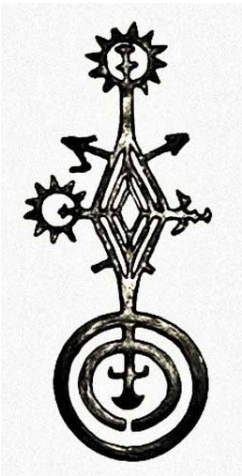




# Scientific and Technological Activities at CANDLE

B. Grigoryan



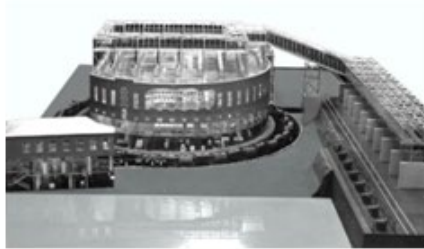


# Our Story

## 6 GeV synchrotron (1967)



A.I. Alikhanian



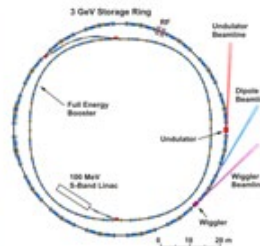
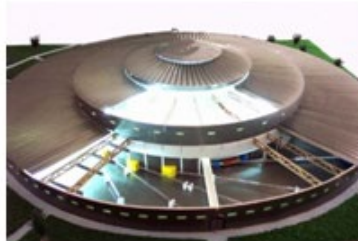
## 3 Synch Rad Beamlines (1973)



## 3 GeV CANDLE Light Source



V.M. Tsakanov



Energy	3 GeV
Current	350 mA
Circumference	216 m
Emittance	8.4 nm

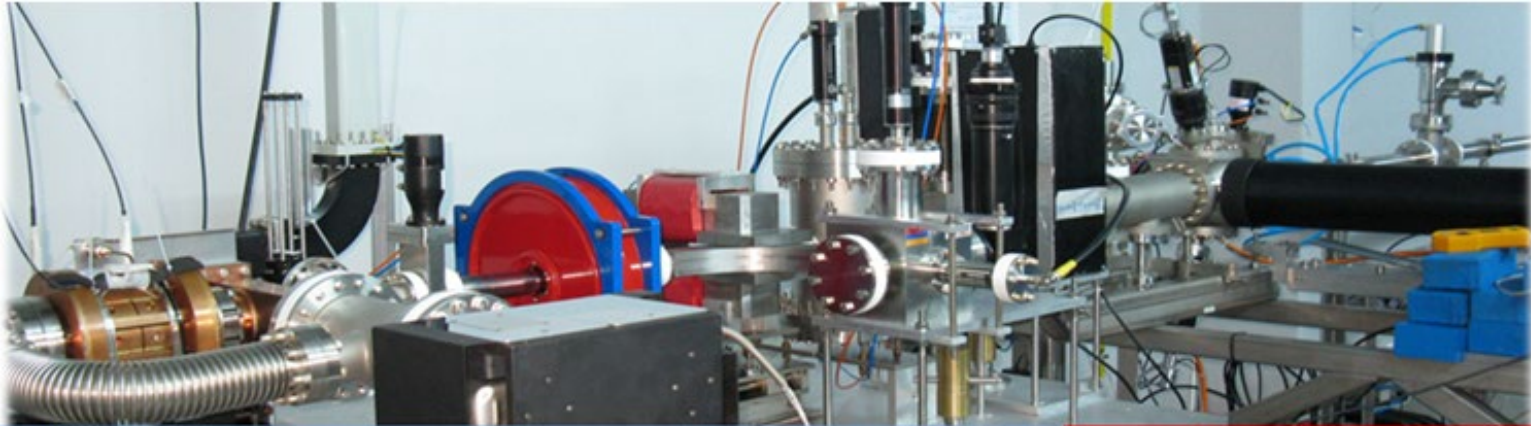
*The strong user community will emerge as the facility is readied.*

*Review Panel*





# AREAL Accelerator



## AREAL General Parameters:

Charge	10 - 850* pC (150-250 pC nominal)
Bunch length -FWHM (ps)	0.4 - 10
Repetition rate	1- 50 ** Hz
Transv. beamsizes (x/y)	2/3 (@ straight) 20 / 8 mm (@ dipole)
Norm. Transv. emitt. (x/y)	≤ 1 mm-mrad
Energy	≤ 5.0 MeV
Energy spread (at dipole)	< 0.5%
Experiment duration	1 - 744*** hours

\* High charge regime for dedicated experiments (achieved November 2015)

\*\* Tests were performed up to 47 Hz with nominal charge of 150 pC. (end 2015)

\*\*\* 31 days of uninterrupted operation in May-June 2014, September-October 2018.

## Fields of Potential Interest:

Solid State Physics

Biology

Molecular Physics

Optics

Material Science

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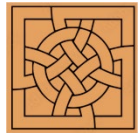
Food Processing

Chemistry

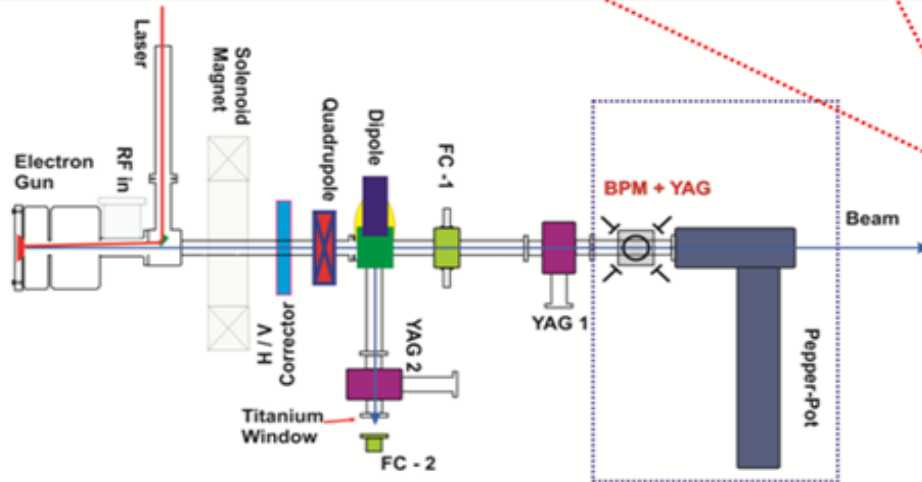
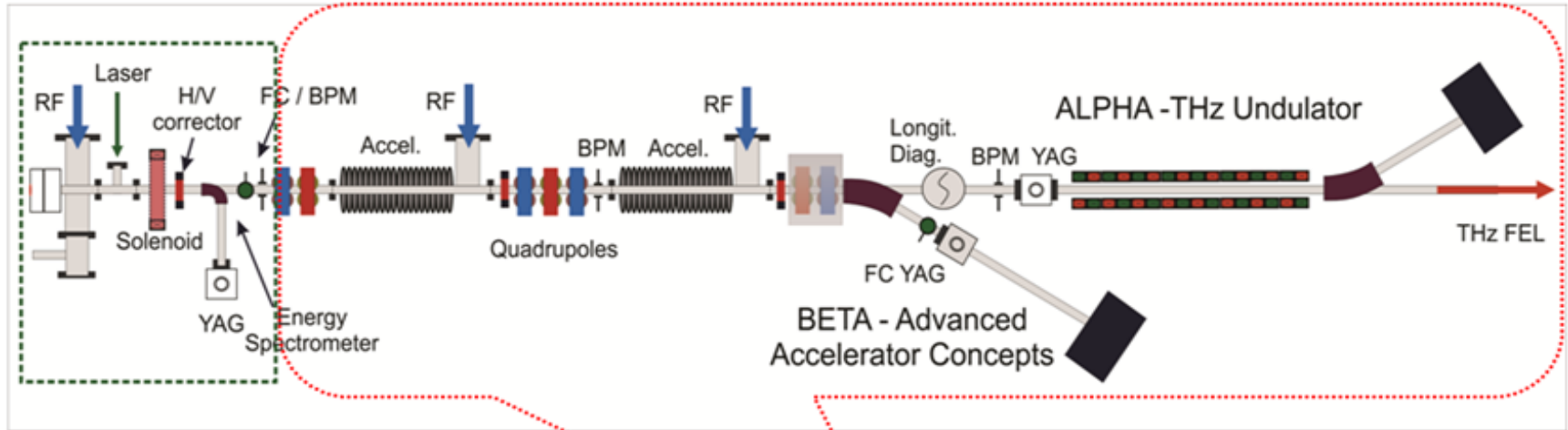
Oncology

Medical Equipment Sterilization





# AREAL Accelerator



- AREAL-50 Upgrade Program**
- 20,50 MeV electrons
  - FEL Radiation
    - Wavelength 2- 6.7  $\mu\text{m}$
    - Frequency 45 -125 THz
    - Pulse energy 60-100  $\mu\text{J}$





# The Strategy of Institute

- **Accelerator Physics**

- CANDLE Storage ring, AREAL development
- Establishment of user community, development of accelerators for user demands
- New materials, joints, advanced properties based on technology developments. Applications.
- Scientific experiments in accelerator physics and new radiation sources

- **Applications of Radiation**

- Electron beam
- Lasers, laser processing,
- THz radiation (laser based) + undulator based (ALPHA , BETA - future program)
- X-Ray processing

- **Technology Development, Materials Science**

- Advanced materials researches (ferroelectric, ferromagnetic)
- Thin film coating
- Vacuum Welding, Brazing
- Specific scientific instrument production
- Femtolaser Fabrication
- Optical equipment development

- **Integration into International Research Infrastructures**

(European – ERIC/CERIC, Grant programs, Memberships, etc.)





# Theoretical Studies & Simulations

## • **Beam Dynamics & EM Fields**

- Concepts of new accelerators
- New sources of radiation
- Upgrade of CANDLE and AREAL

## • **RF Systems Laboratory**

- RF resonators, waveguides
- Radiation sources

## • **Advanced Materials & Microdevices**

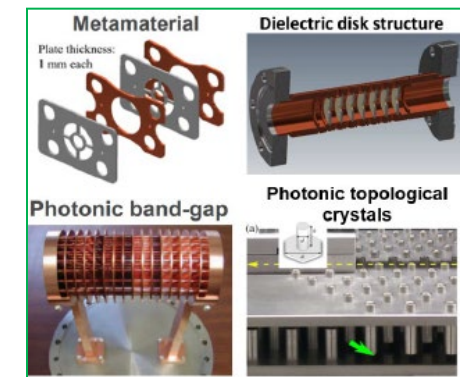
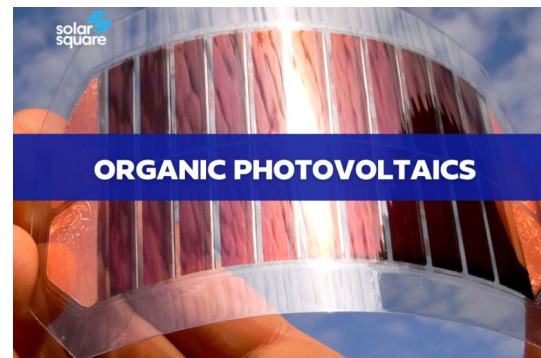
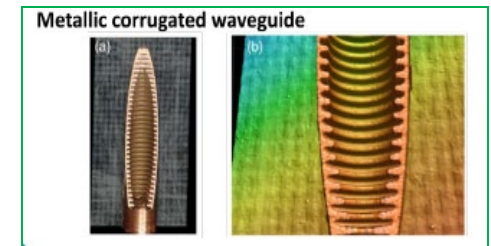
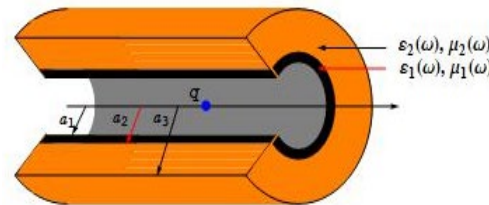
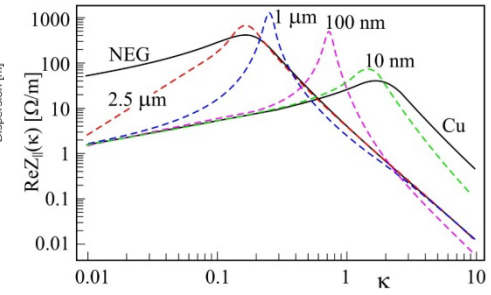
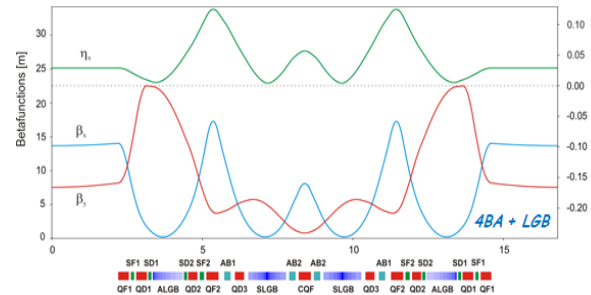
- New materials for accelerators
- New types of solar cells

## • **Engineering Dept., Vacuum Laboratory**

- Mechanical machining simulations
- Study of vacuum-tight materials

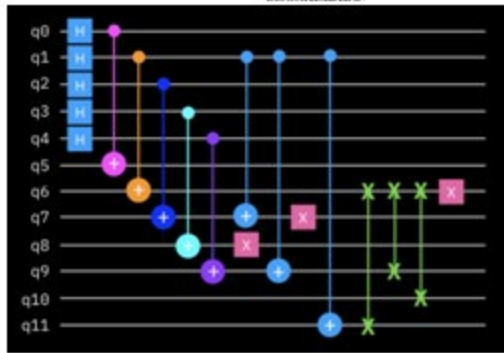
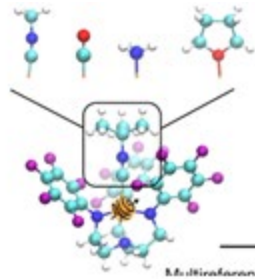
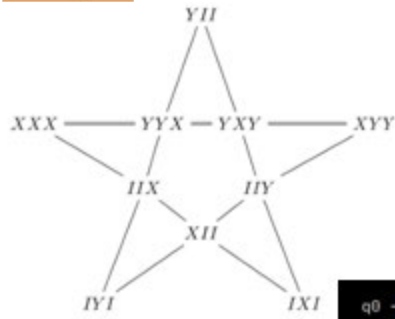
## • **Laboratory of Experimental Biology**

- AI based bioinformatics

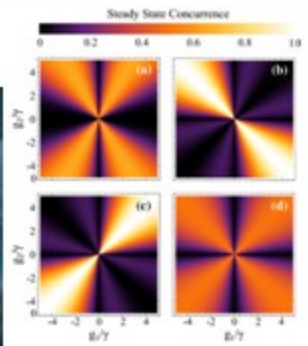
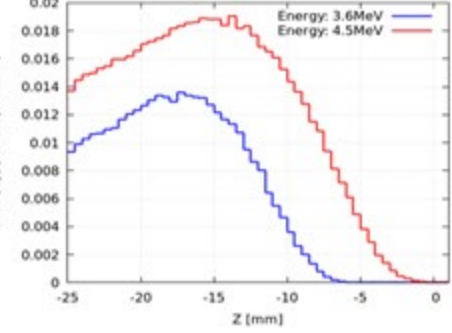
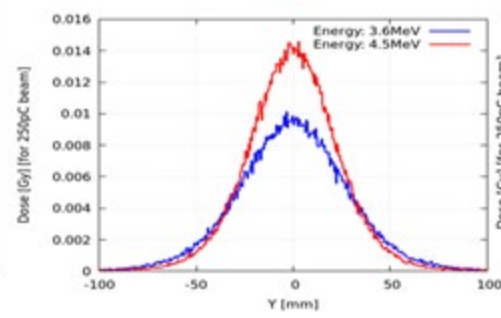
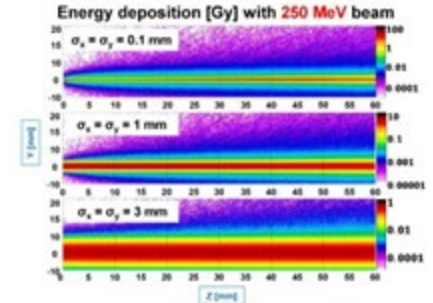
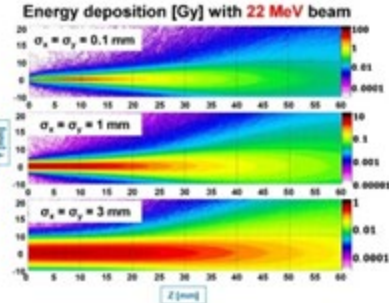




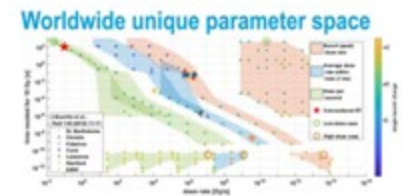
# Theoretical Studies & Simulations



Qubit 1      Qubit 2

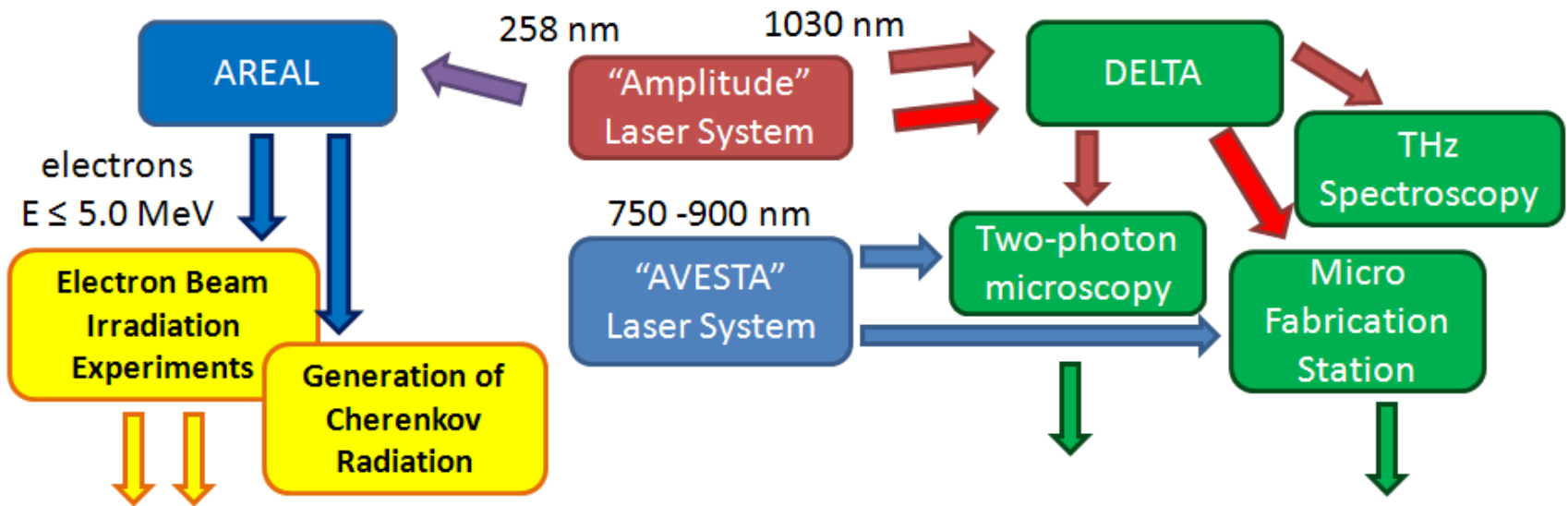


## FLASHlab@PITZ





# Experimental Possibilities at CANDLE



## Actual possibilities

## Upcoming / Upgrade

RF Measurements, (Rohde&Schwarz joint educ. center), Timing and Synchronization LAB.		X-Ray Irradiation processing
Experimental Biology LAB	Vacuum Technology, Brazing, Welding LAB	Scanning Electron Microscope
Advanced Materials & Microdevices LAB	Scientific Engineering Workshop	Magnetic Measurements LAB

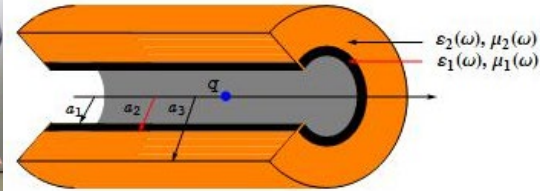
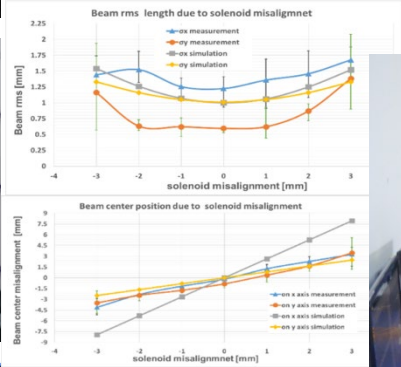
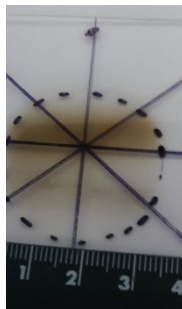
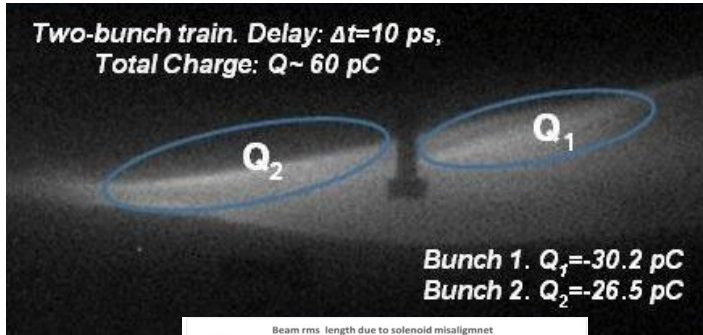
Electron Beam E = 20, 50 MeV
FEL (ALPHA) $\lambda = 2.5 - 30 \mu\text{m}$ pulse energy 60-100 mJ
0.35 THz Radiation & acceleration (BETA)



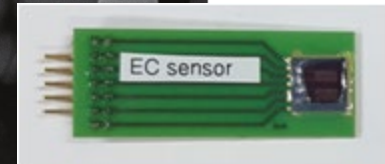
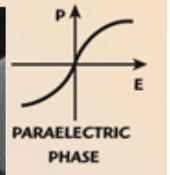
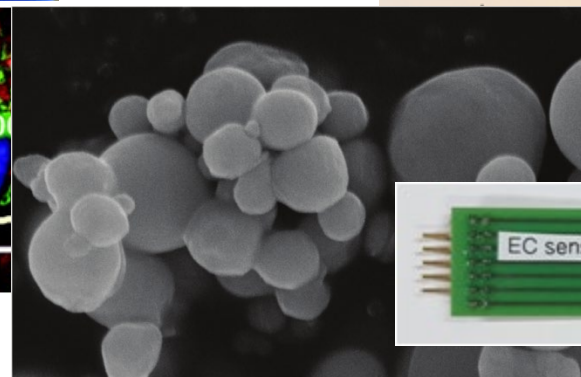
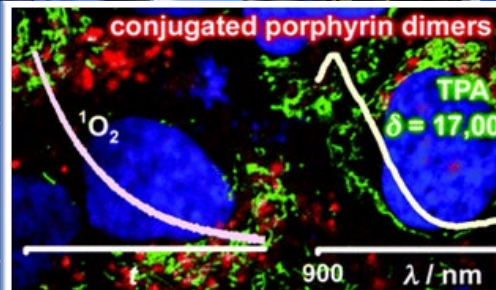
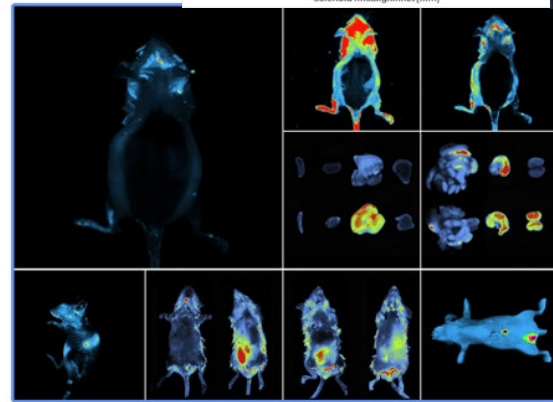




# Experimental Activities



- BARIUM, STRONTIUM
- OXYGEN
- TITANIUM



200 nm EHT = 15.00 kV Signal A = InLens Date : 28 Oct 2014  
WD = 9.6 mm Mag = 50.00 KX Time : 10:25:08





# Experimental Activities

## • Running Experiments:

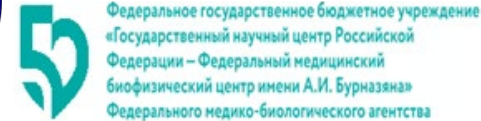
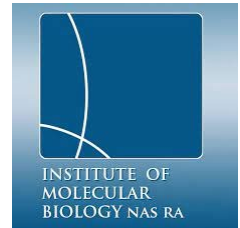
- Material Science (4)
- Radiation Biology (5)
- Accelerator Concepts (4)
- New equipment developments for accelerators (3)

## • Participating Institutes

- Alikhanyan National Lab (YerPhi)
- Institute of Molecular Biology NAS RA
- Yerevan State University
- Armenian National Agrarian University
- National Polytechnic University of Armenia
- Institute of Applied Problems of Physics, NAS RA

## • International Collaboration on Experimental Program

- DESY – Hamburg, Germany
- PITZ (DESY) – Berlin, Germany
- PSI – Villigen, Switzerland
- INFN – Rome, INFN-Milano, Italy
- Universities of Bologna and Brescia, Italy
- Federal Medical-Biophysical Center after A.I. Burnazyan, RF
- [Royal Holloway University of London](#)
- [Joint Institute for Nuclear Research –JINR](#)



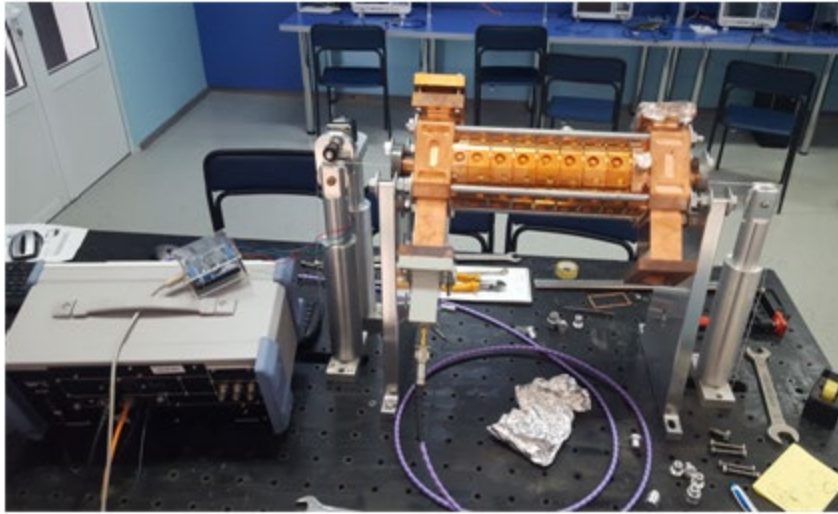


# Scientific Instrumentation Workshop

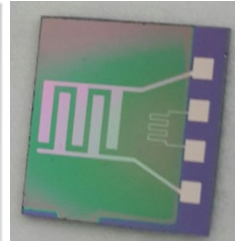
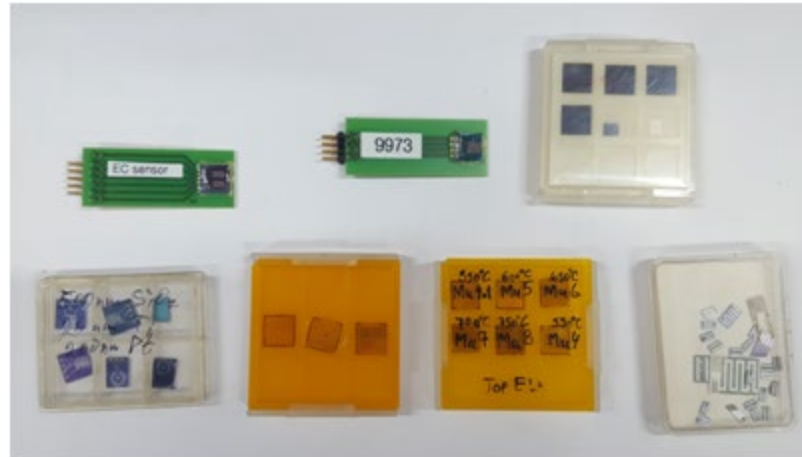




# Technology Developments



- RF Technologies
- Thin film coating
- Vacuum technologies, brazing/welding
- Ferro-electric, Ferro-magnetic materials
- New material joints for accelerators
- Accelerator equipment development
- Development of THz radiation sources





# International Collaborations



UNIVERSITÀ  
DEGLI STUDI  
DI BRESCIA



POLITECNICO  
MILANO 1863  
DIPARTIMENTO DI FISICA



TECHNISCHE  
UNIVERSITÄT  
WIEN  
Vienna | Austria





# Summary of Activities

- Advanced materials researches for:
  - New concepts of accelerators
  - Radiation sources
  - Advanced instrumentation (microchips, controllers, etc.)
- Radiation biology
  - Ischemic diseases
  - Oncology
  - Genetics
  - Organs on chip (Recently Started)
- Electric and magnetic properties changes of materials under direct irradiation by low energy **ultrashort** electron beams.
- Scientific engineering and instrumentation development





# THANK YOU FOR ATTENTION !

