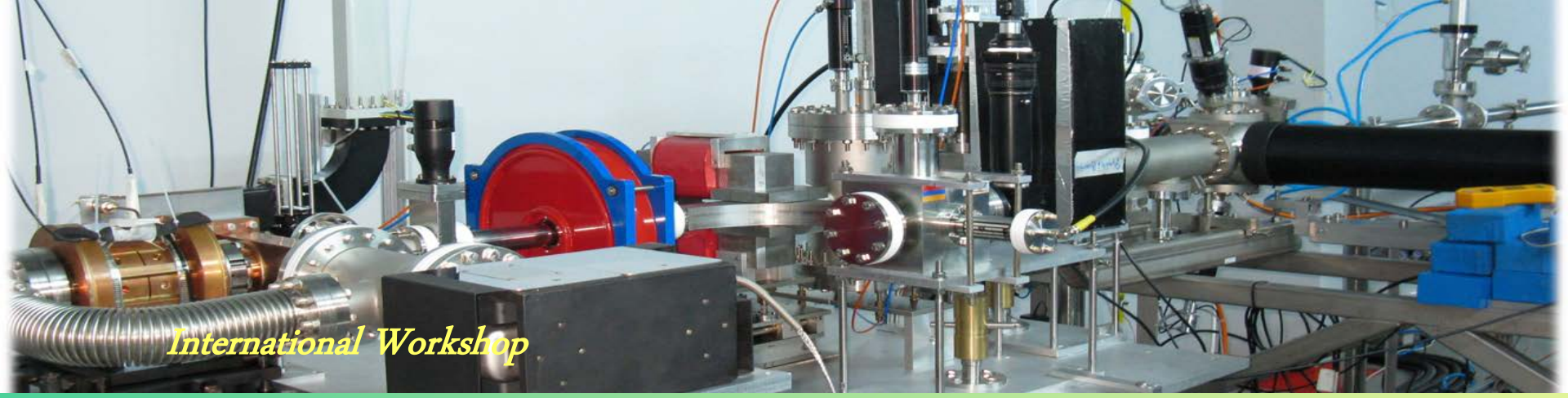


Ultrafast Beams and Applications

04-07 July 2017, CANDLE, Armenia

CANDLE

DESY

State Committee of Science

Program

- **Session 1:** ***Facilities and New Projects (V.Tsakanov)***
- **Session 2:** ***Photon Beams (D. Nikiforov)***
- **Session 3:** ***Electron Beams (H. Shaker)***
- **Session 4:** ***Applications and Experimental Techniques (B. Grigoryan)***
- **Session 5:** ***CANDLE-15 Years and Tour to AREAL (K. Floettmann)***
- **Session 6:** ***Sources, Diagnostics and Control (B. Zeitler)***

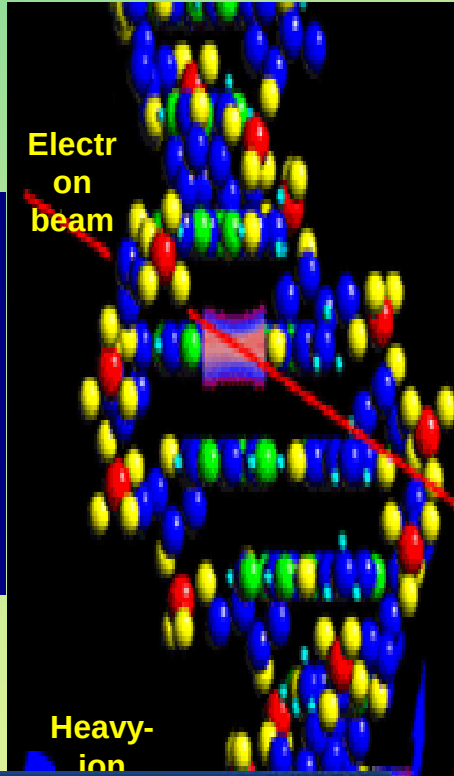
Session 7: History and Nature

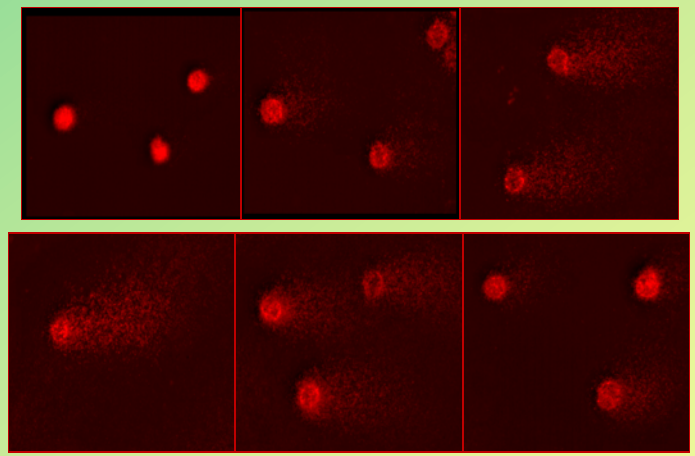
Session1: Facilities and New Projects

Ultrafast electron beam irradiation effects on DNA damage and repair in normal and cancer cells

Rouben Aroutiounian

Yerevan State University/ Inst. Mol. Biol. NAS





DNA damage

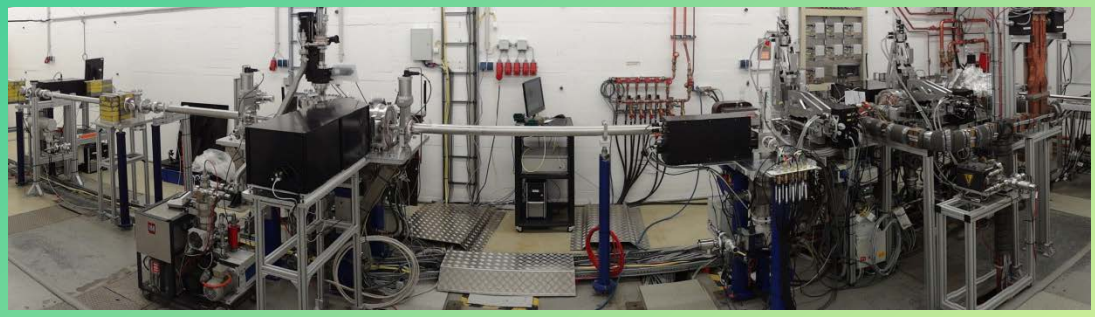
DNA-Comet assay

K-562 cell line

Session1: Facilities and New Projects

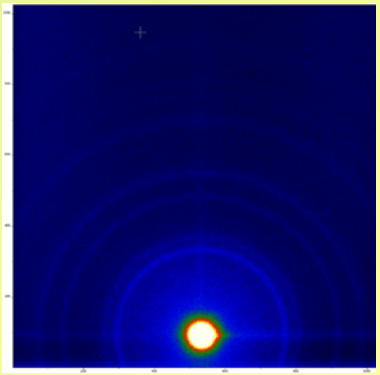
REGAE: The Relativistic Electron Gun for Atomic Exploration

K.Floettmann (DESY)



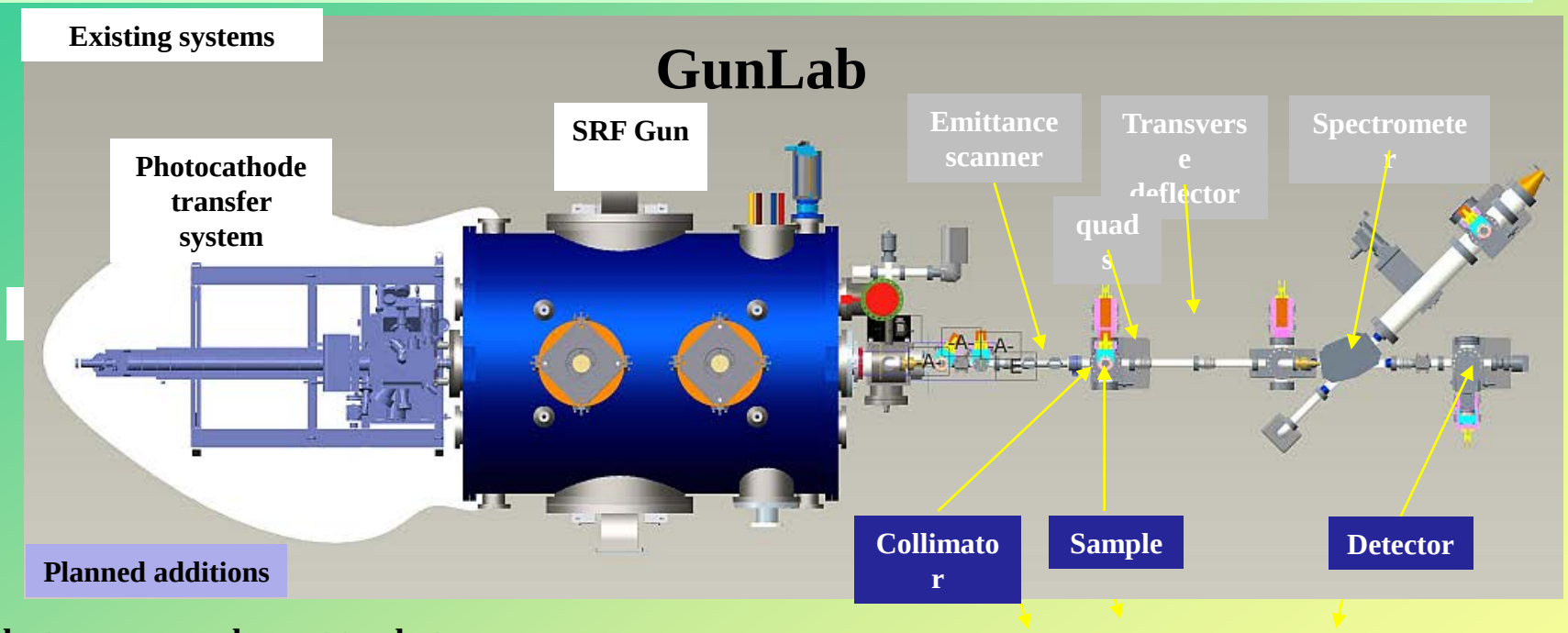
Average Energy	5.6 MeV
Energy Spread	10 keV
Bunch Charge	100 fC
Bunch Length	<10 fs (rms)
Beam Size	600 μm (rms)
Transv. Emittance	0.03 π mm mrad

- electron diffraction experiments
- time-resolved microscopy
- accel physics & machine development (DESY):
  - ultra-short, ultra-low emittance beams
  - diagnostics for low charge beams
  - synchronization and stabilization
  - laser-driven plasma experiment



Considerations of an Ultrafast Electron Diffraction experiment at HZB

Georgios Kourkafas (HZB)



Electrons, a supplement to photons

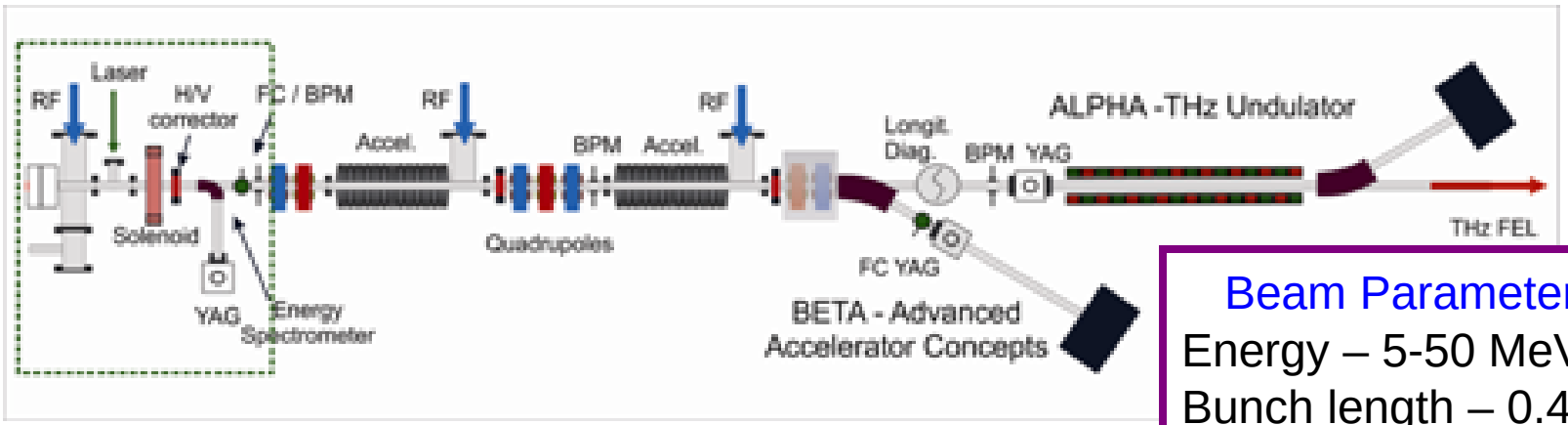
- **More suitable for surfaces, thin films, gas-phase samples, due to larger scattering cross-section**
- **Considerably less damage in biological samples:**
  - Elastic/inelastic scattering ratio 3 times smaller
- **Overall gain in efficiency of > 10^8 potentially possible**
- **Facility of smaller size and cost with higher flexibility in beam parameters**

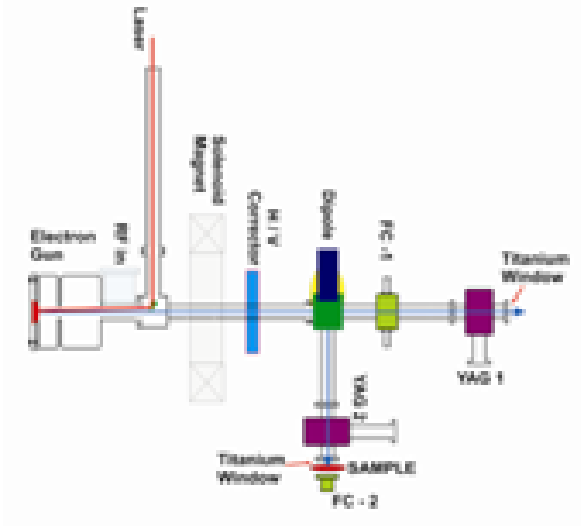
Proof-of-principle experiment

•Demonstrate first diffraction pattern from SRF gun (10 nm thick Au sample)

AREAL Facility for Ultrafast applications

B. Grigoryan





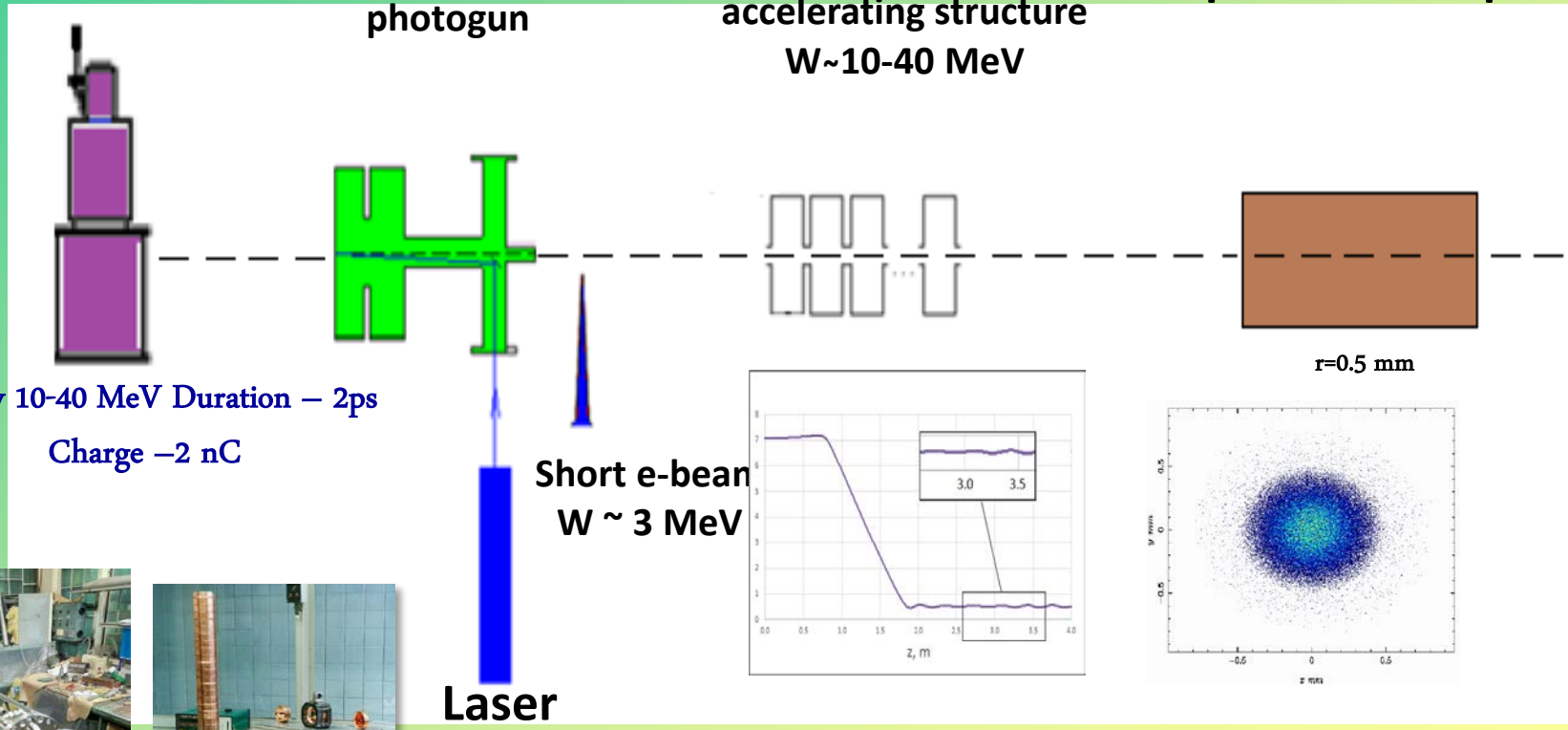
- Laser System
- RF system
- Gun and Cathode
- Timing and Synchronization
- Diagnostics and Measurements
- Machine Upgrade
- Beam Dynamics
- Experimental Stations

Beam Parameters

Energy – 5-50 MeV
Bunch length – 0.4-2 ps
Emittance – <1 μm
Bunch charge – 10-800 pC
Frequency – 1-50Hz

Design of the ultrashort electron bunch complex at BINP

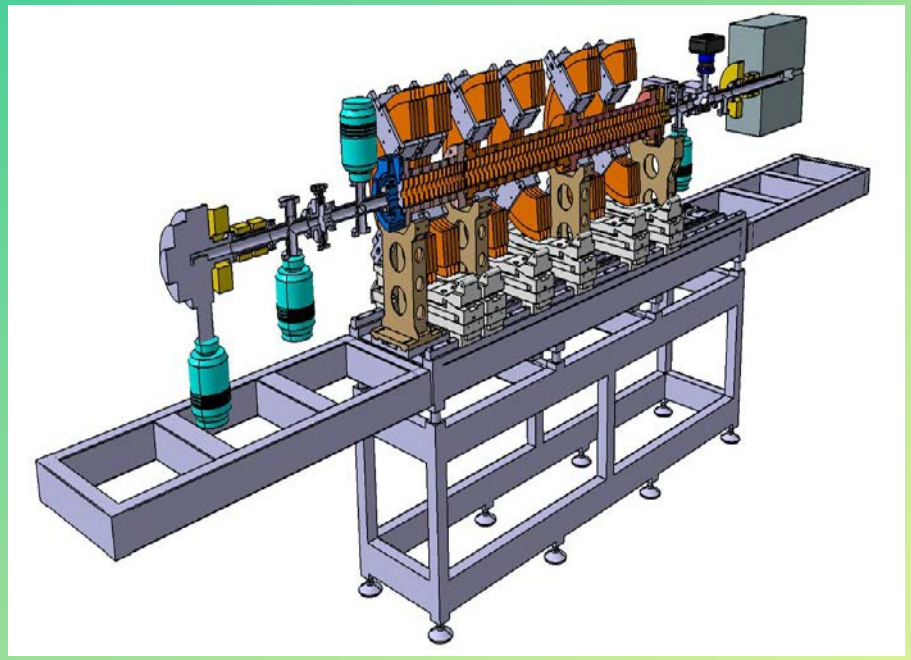
Mariya Maltseva (BINP)



Focused beam for
- mm wave structure
- Plasma accel

Electron Linear Accelerator Project in Iran

Hamed Shaker
Institute for Research in Fundamental Sciences (IPM)



Energy – 8/11 MeV

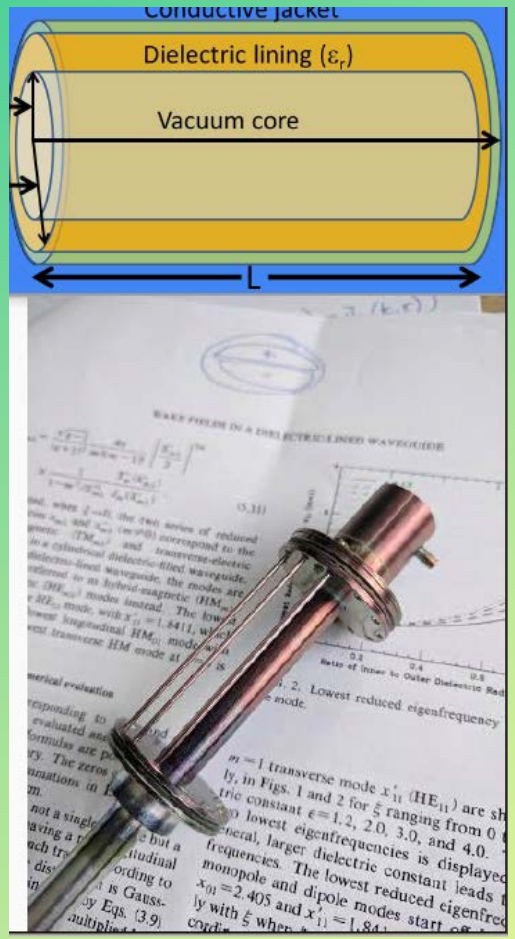
Max current – 10 mA

Repetition rate – 250 Hz

RF input power – 2 MW

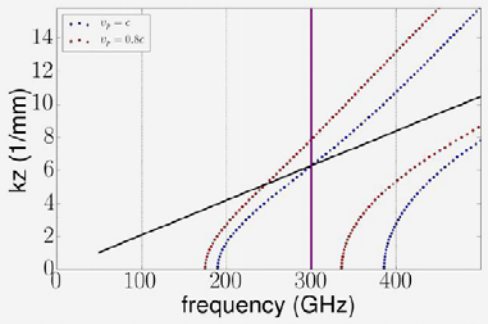
An Adiabatic Damping Phase Matching Accelerator

F. Lemery (DESY)

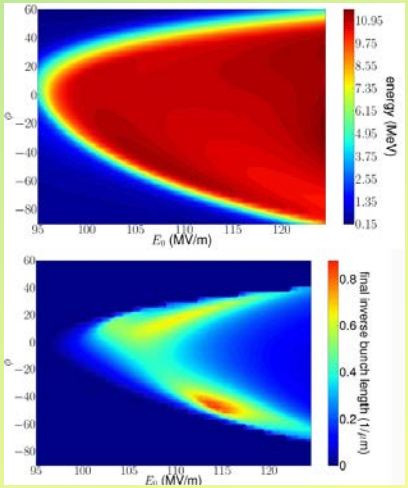


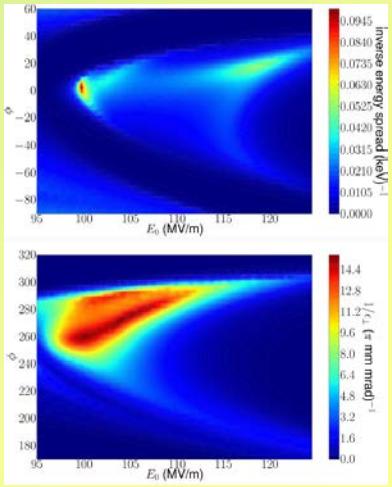
Phase velocities in DLWs

- The inner radius and dielectric thickness determine the phase velocity of the structure.
- Generally, thicker linings lead to slower phase velocities.
- Can we generate a tapered DLW to maintain phase matching with an accelerating low-energy bunch?



Dispersion curve for quartz DLWs with different thicknesses for same inner radius of 0.5 mm. The solution corresponding v p = c is illustrated in blue dots with corresponding dimension (a, b, r) = (0.5 mm, 0.590 mm, 4.41), the red dots correspond t a solution for v p = 0.8c with corresponding structure (a, b, r) = (0.5 mm, 0.612 mm, 4.41).

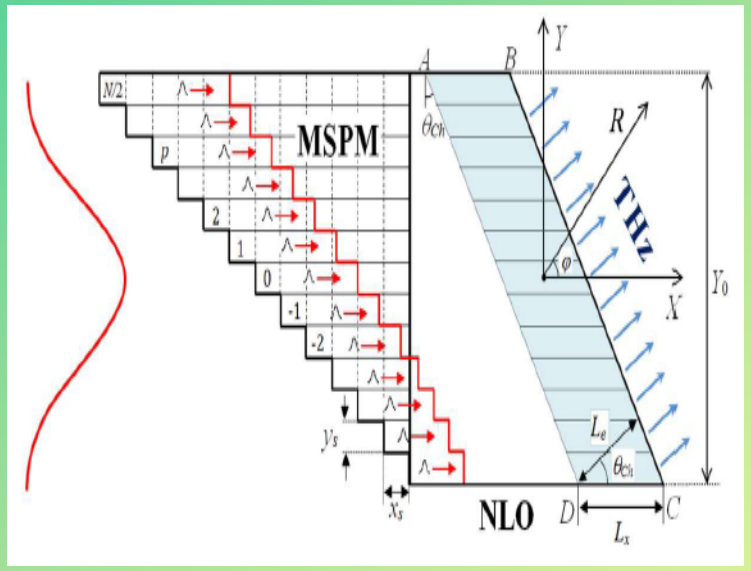


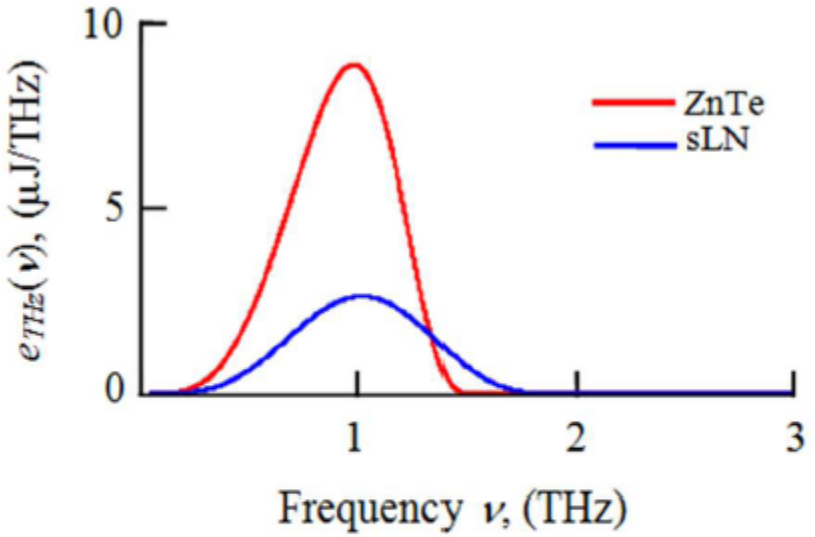


Session2: Photon Beams

A New Scheme of High-Energy THz-Pulses Source Using Nonlinear Crystal with Attached Multistep Phase Mask

Yuri Avetisyan (Yerevan State University)





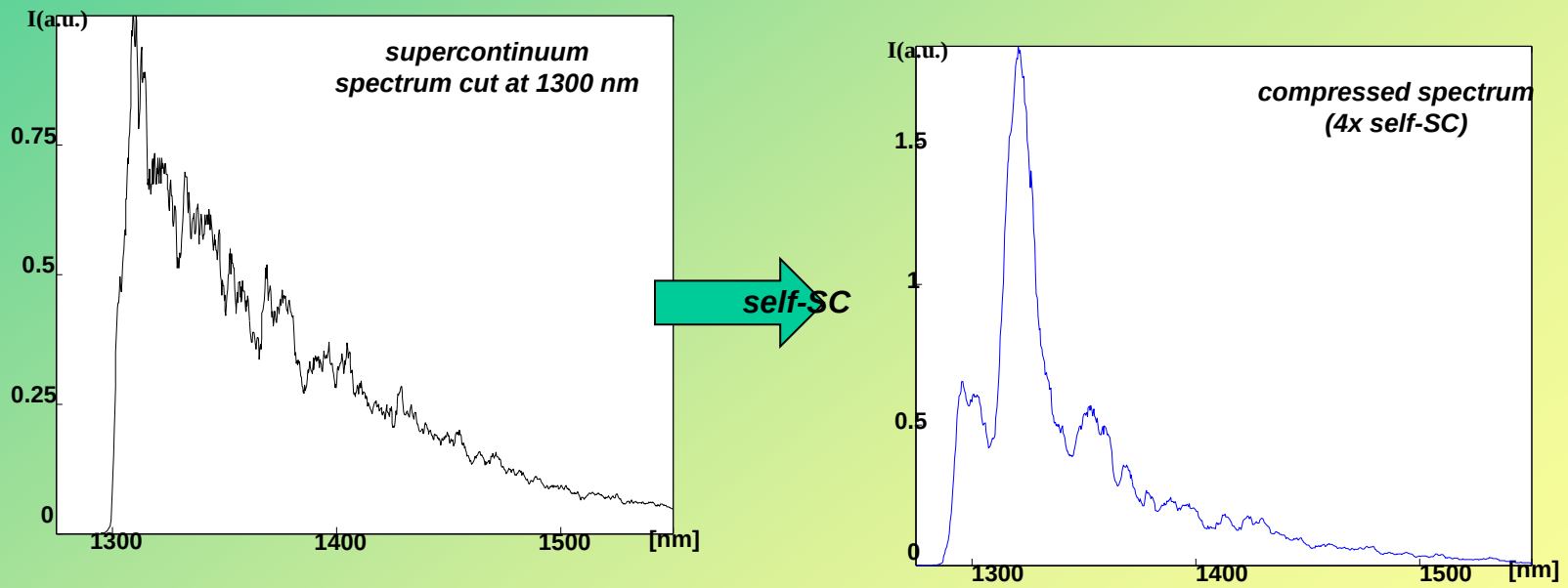
$Э_{THz}$ = 10.5 μJ and 4.1μJ for ZnTe and LN

ε_L = 0,9 mJ and 0,5 mJ for ZnTe and LN

Experimental Demonstration of Spectral Self-Compression of Supercontinuum Radiation Fraction

H.Tonoyan (YSU/ CANDLE)

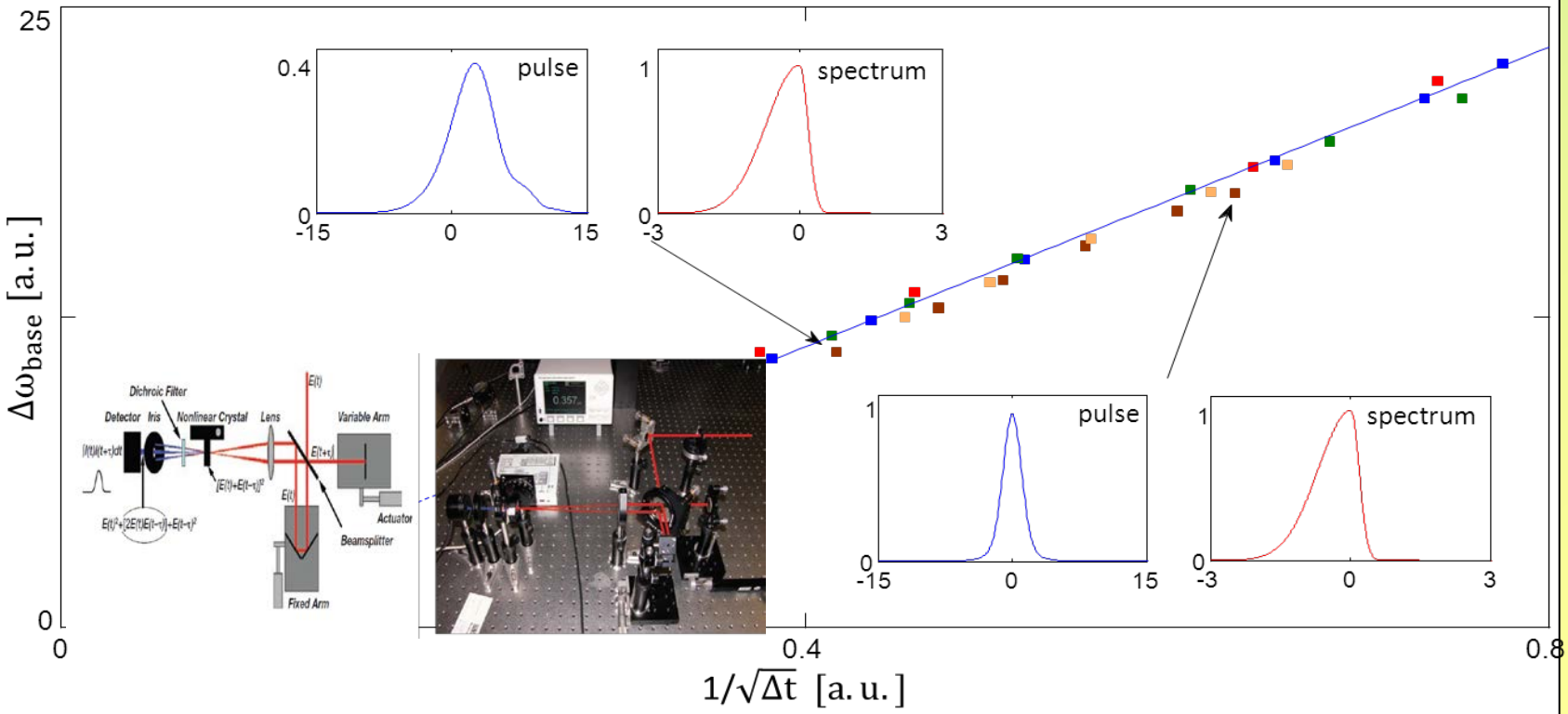
Experimental results of spectral -SC



- 30% self-SC in a hollow-core fiber @800nm central wavelength
- 4x self-SC of fraction of noisy supercontinuum spectrum

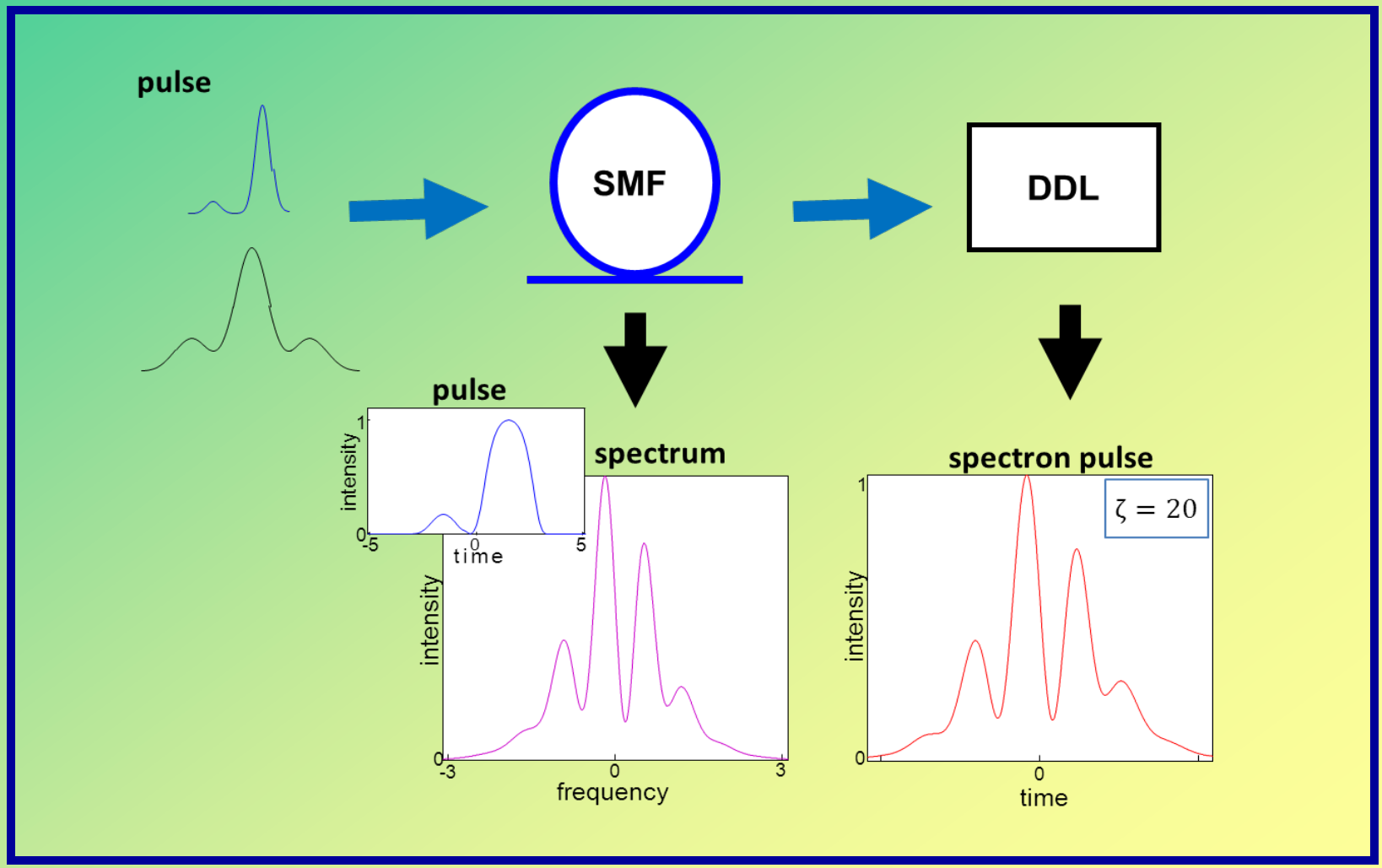
Similariton Based Technique for Determination of Femtosecond Pulse Duration

Karapet Manukyan (YSU)



Phase peculiarities of Spectron: Numerical analysis

Narek Karapetyan (YSU/CANDLE)

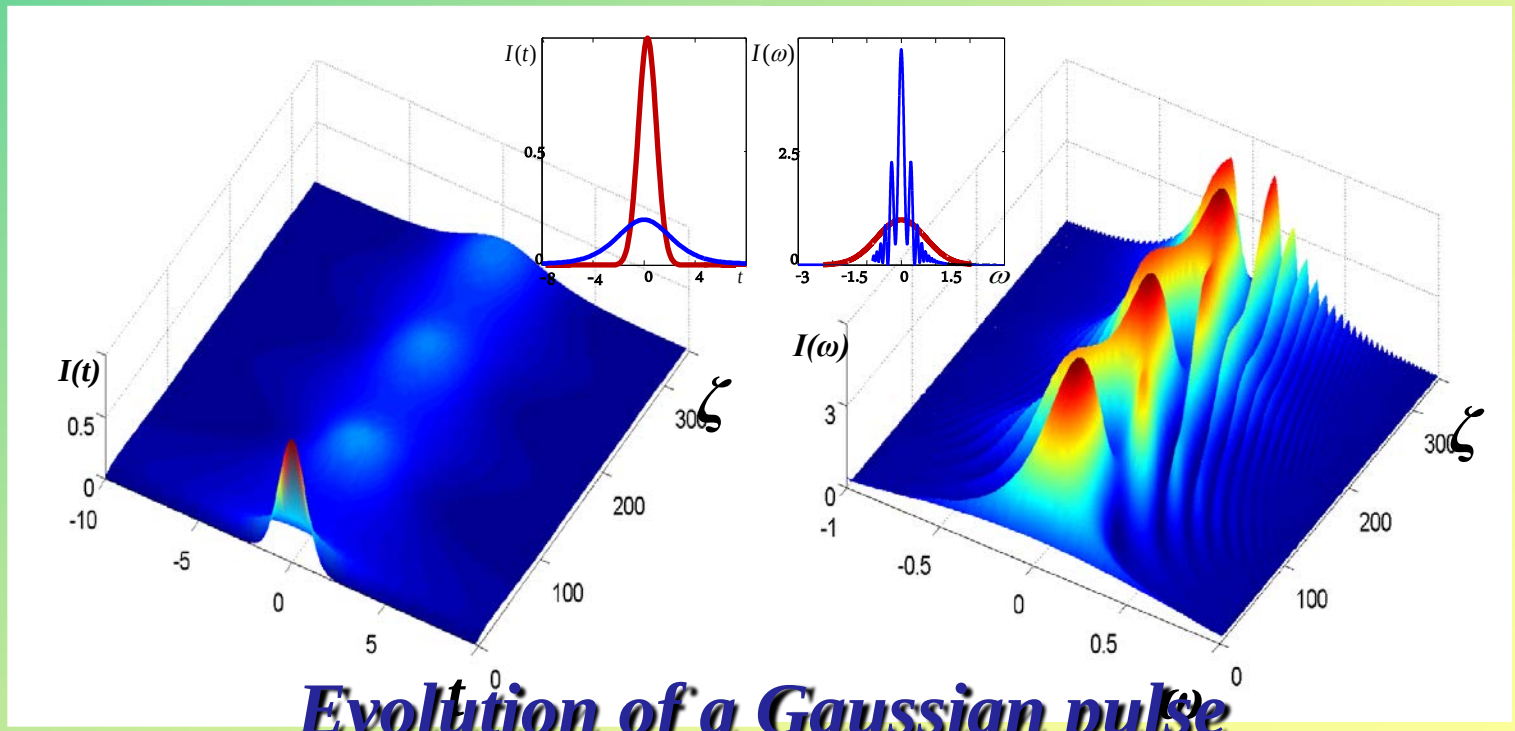


Numerical Study of Femtosecond Signal Spectral Compression

M.Sukiasyan (YSU/ CANDLE)

9x self-SC at ζ=86, R=0.6

- Self-SC of coherent pulses through numerical simulations
- Demonstration of 100x self-SC for Gaussian pulse



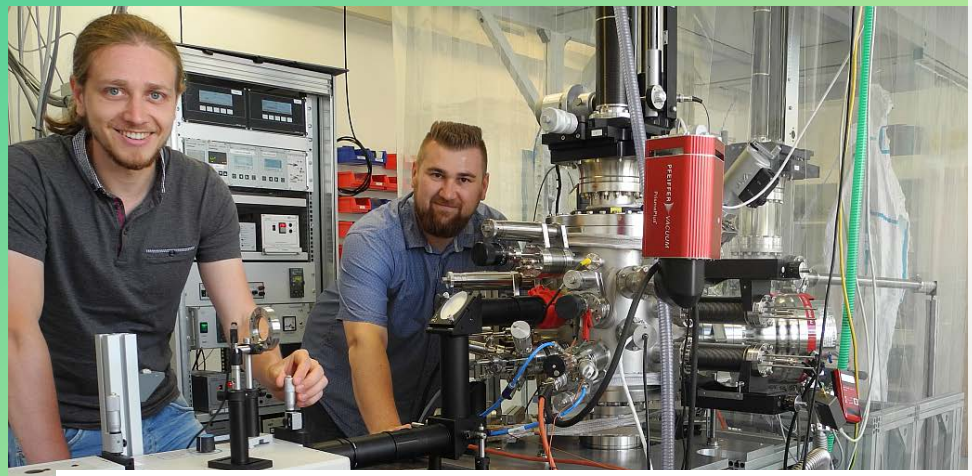
Evolution of a Gaussian pulse

Session 3: Electron Beams

SRF Gun Development for High Brightness, Short Pulse Applications

Thorsten Kamps (HZB)

Photocathode R&D at HZB



Development of reproducible growth procedures for photocathodes with high quantum efficiency, smooth surface and long operational lifetime.

Preparation chamber

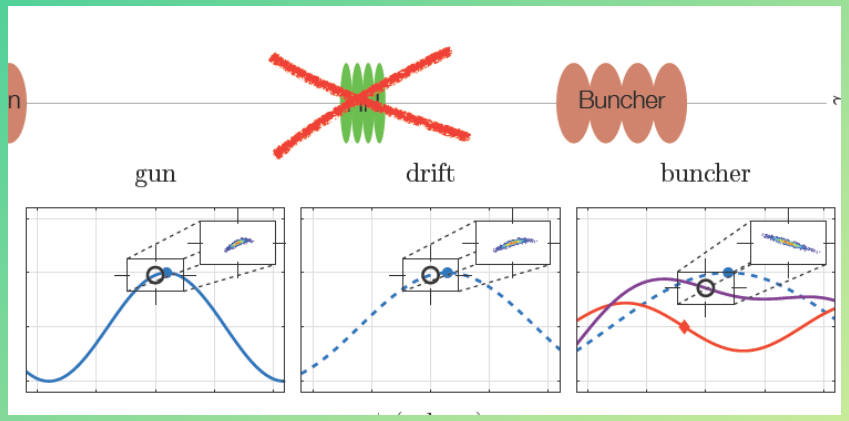
- Effusion cell for Sb, SAES Dispenser for K and Cs
- Sequential growth and co-deposition of K and Cs
- e-beam evaporator for Mo
- Bake-out for 72h at 120°C, base pressure at p = $3x10^{-10}$ mbar
- LN2 cooling of cathode substrate
- Monitor the growth process by mass spectrometer and photocurrent

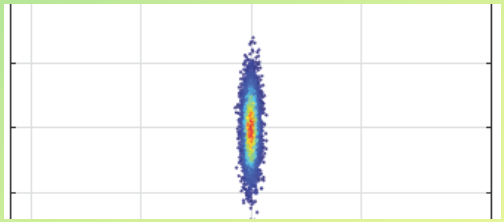
Surface Analysis chamber

- Chemical analysis by X-ray photoelectron spectroscopy (XPS)
- Momentatron for emittance measurement (MSc thesis, M. Schmeißer)
- Spectrally resolved QE response measurement (MSc thesis, H. Kirschner)

Linearization of the Longitudinal Phase Space without High Harmonic Field

B. Zeitler (Hamburg Uni/ CFEL)

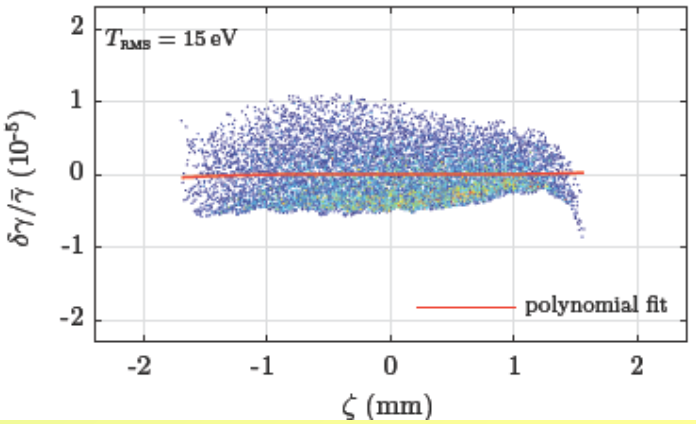




Q (fC)	$t_{em,RMS}$ (ps)	ζ_{RMS} (nm)	t_{RMS} (fs)	CR
1	0.8	24	0.08	10000
10	1.0	58	0.2	5000
100	1.7	190	0.6	2500
1000	2.4	513	1.7	1400
2000	2.8	753	2.5	1000

Benno Zeitler | benno.zeitler@desy.de |

> T = 3.9 MeV, T_{RMS} = 15 eV



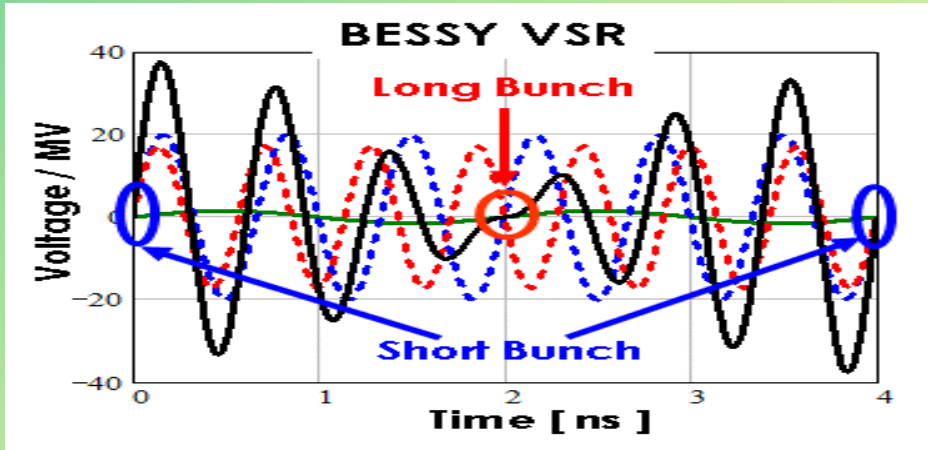
SRF Implementation in BESSY VSR for Picosecond X-ray Pulse Production

A. Tsakanian (HZB)

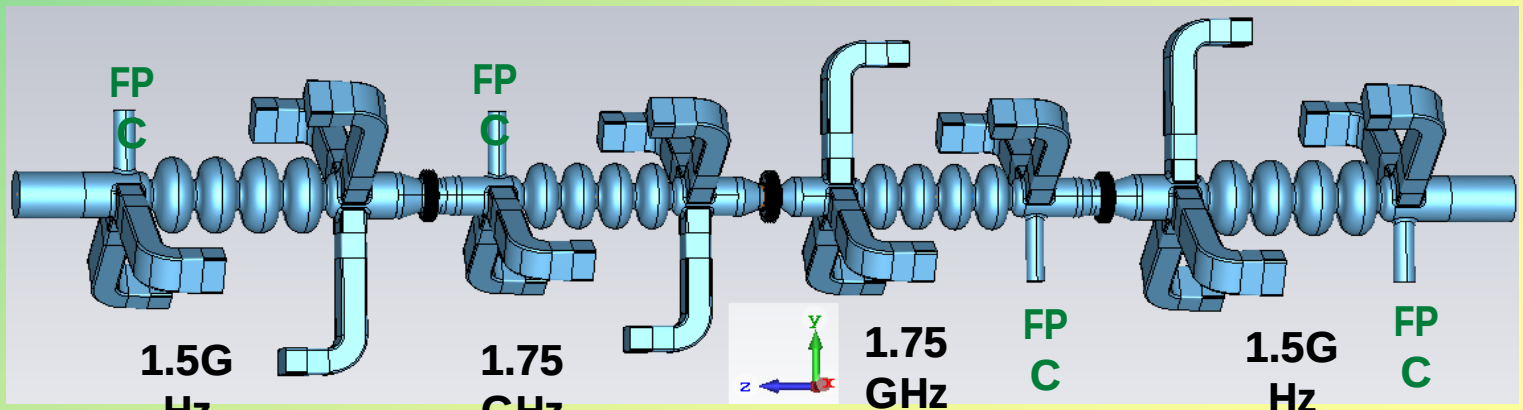
Accelerating Voltage

Bunch rms length

15ps 1.7ps

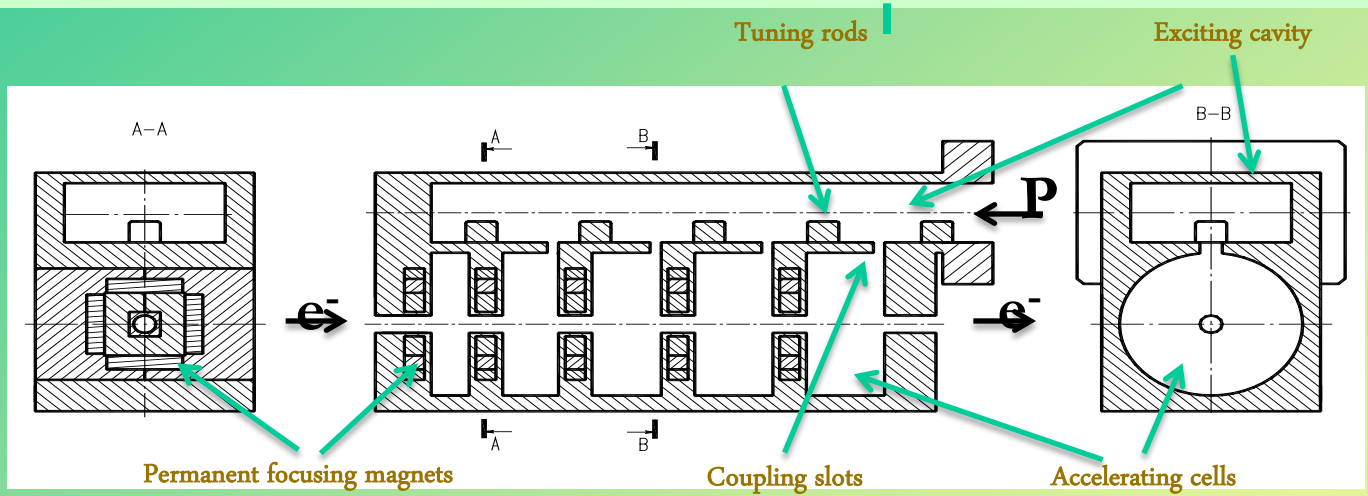


Optimization of the SRF cavity with HOM damping

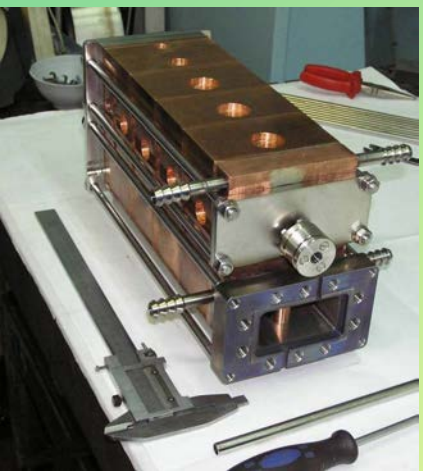


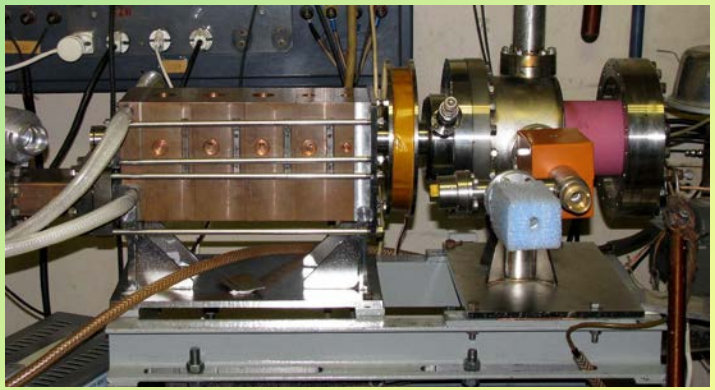
RF gun based on parallel coupled accelerating structure for high charge and low emittance

D.A. Nikiforov (BINP)



Prototype structure with 2450 MHz

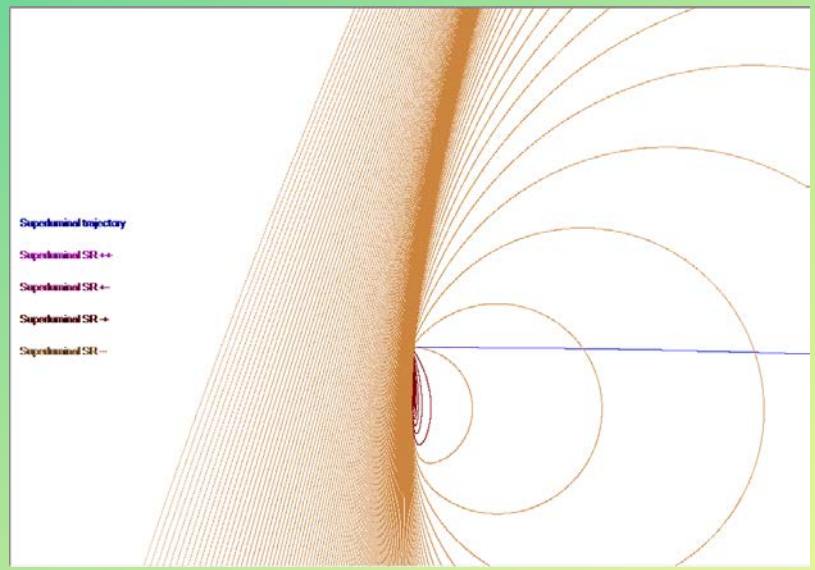




Beam current 500 mA Duration 2.5 ns Energy 4.5 MeV

Synchrotron Radiation Reflection from Outer Wall of Vacuum Chamber

S.G. Arutunian (Yerevan Physics Institute)

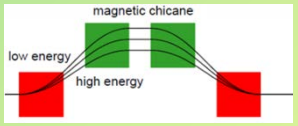


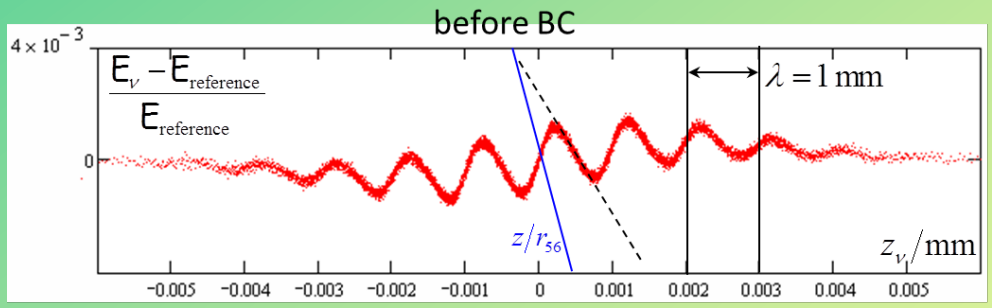
- fine spatial structure of synchrotron radiation
- fields structure is thinner than interparticle distances
- Important for beam dynamics

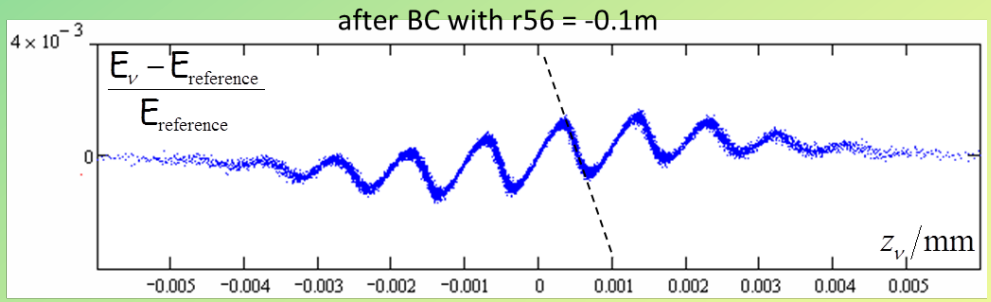
Wakefields and Impedances

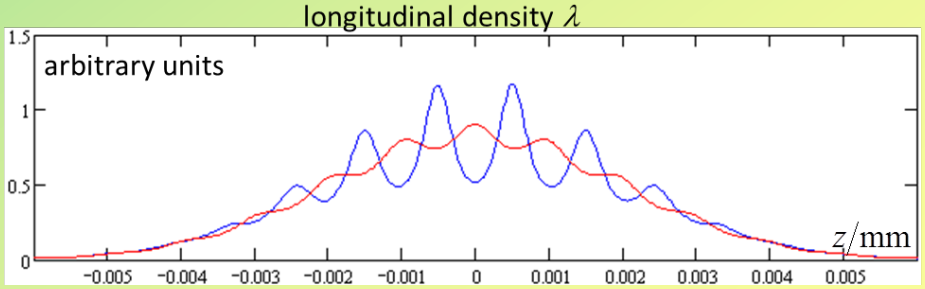
Martin Dohlus (DESY)

Energy spread and density modulation for 4 magnet chicane (BC)



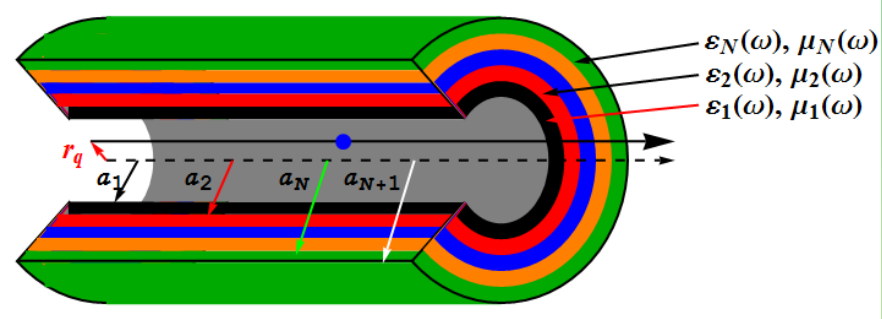


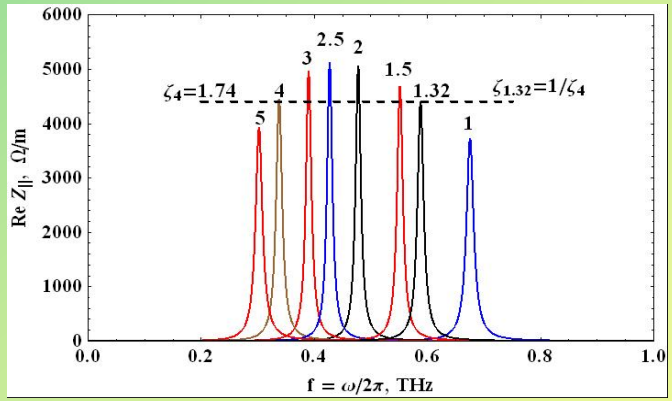


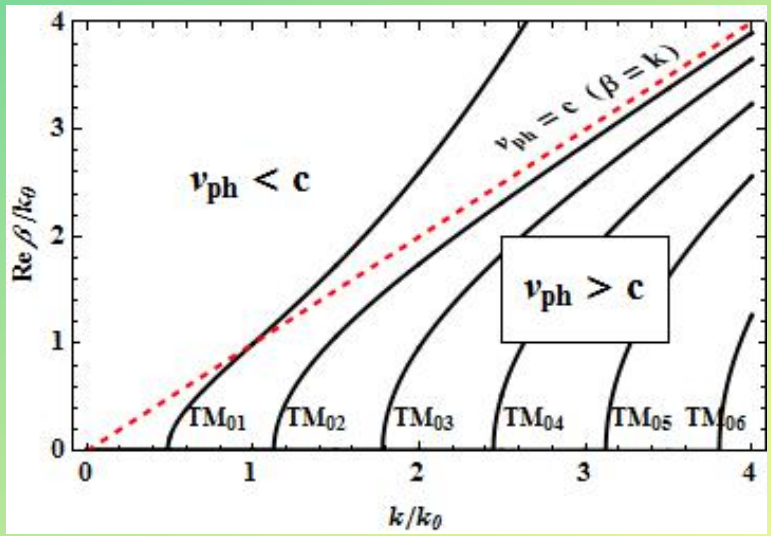


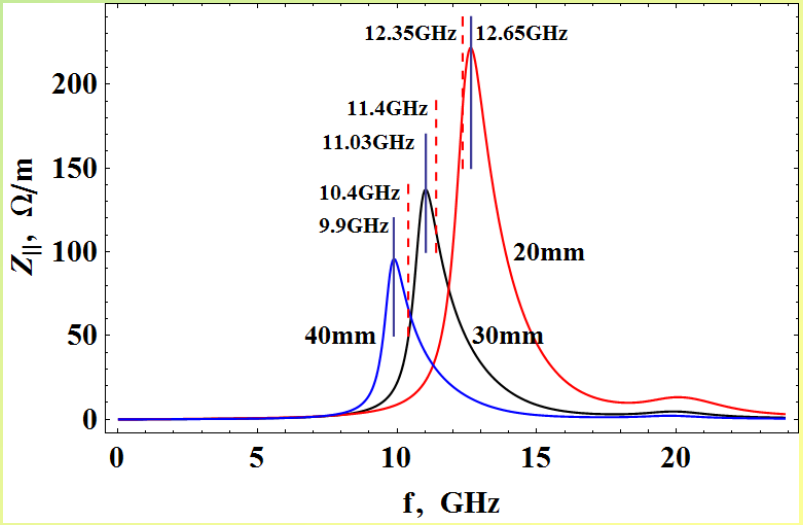
The THz Radiation in Laminated Structures

M. Ivanyan (CANDLE)



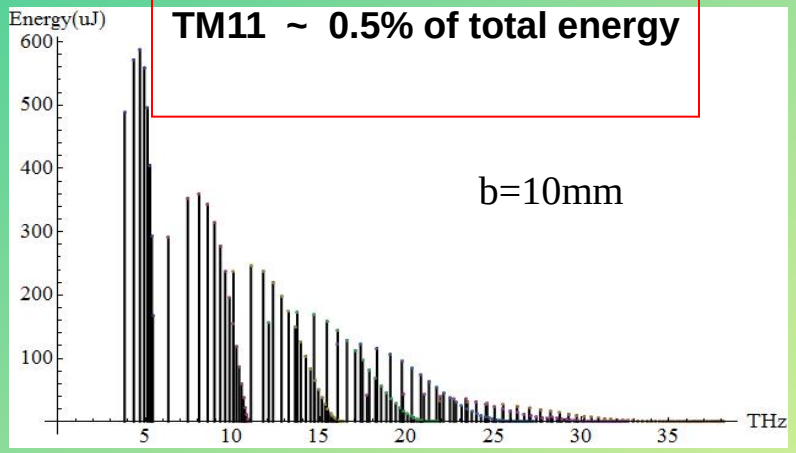






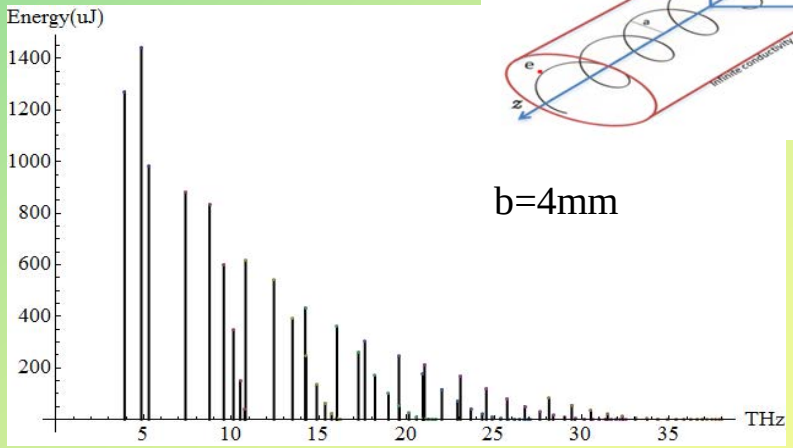
Mode Filtration and Enhancement of the Helical Undulator Radiation in Waveguide

A.Grigoryan- CANDLE

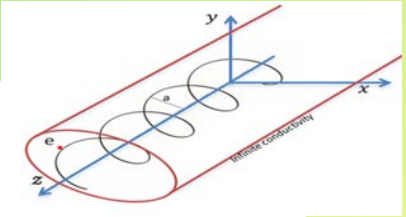


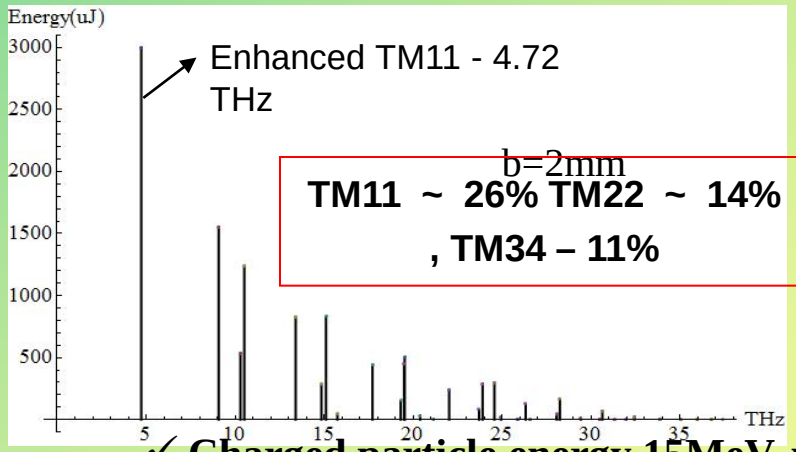
TM11 ~ 0.5% of total energy

b=10mm



b=4mm

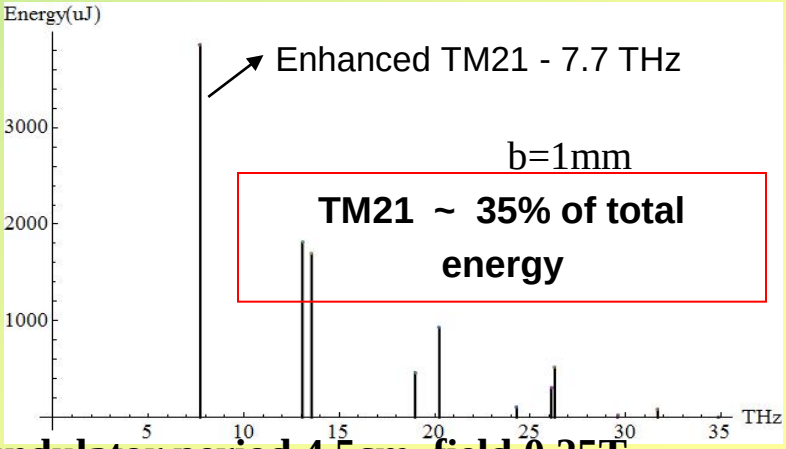




Enhanced TM11 - 4.72 THz

b=2mm

TM11 ~ 26% TM22 ~ 14% , TM34 – 11%



Enhanced TM21 - 7.7 THz

b=1mm

TM21 ~ 35% of total energy

✓ **Charged particle energy 15MeV, undulator period 4.5cm, field 0.25T.**

Laser driven facility for irradiation experiments, two-photon microscopy and microfabrication

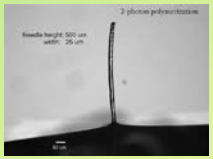
A. Yeremyan (CANDLE)

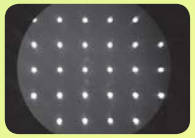
DELTA

Fabrication of glass-based optical elements

2-photon polymerization

Patterning of SC and metallic surfaces





250 fs, 50 MHz
1030 nm, 25nJ

Osc

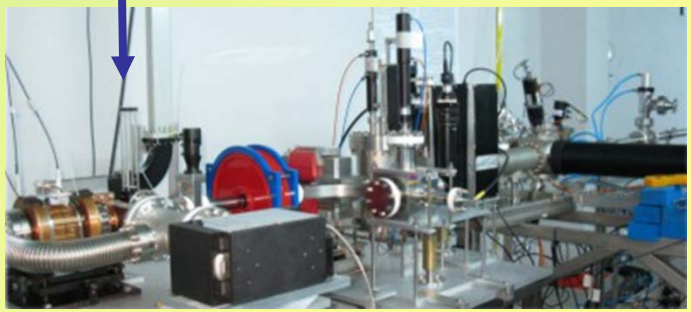
Ampl

FHG

0.4--8 ps, 1--100 Hz
258 nm, 425uJ

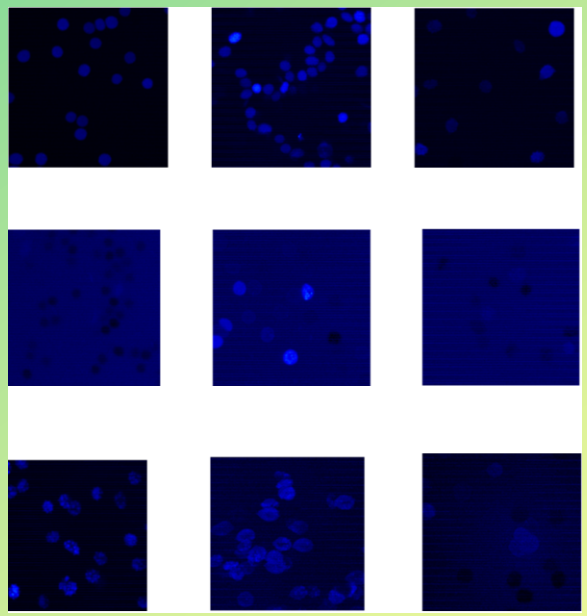
AREAL

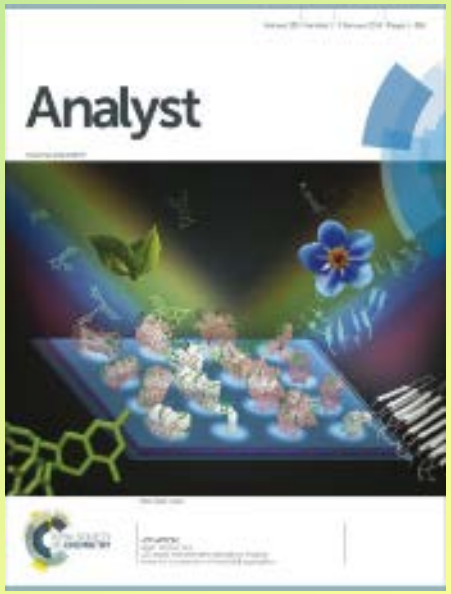
LASER



The Study of Natural Antiaging Compounds at DELTA Two-Photon Microscopy Station

G. Tsakanova (Inst. of Mol. Biology)

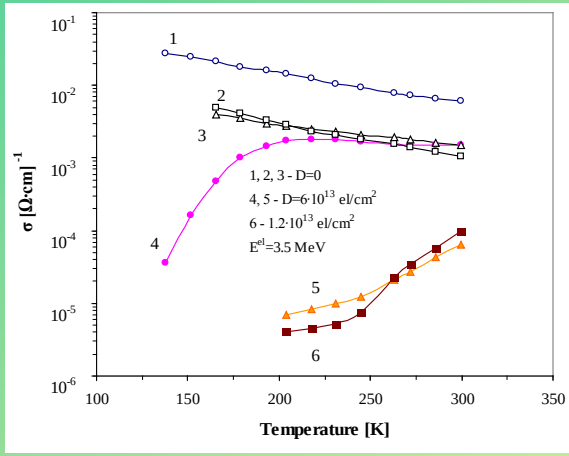




A novel approach for the investigation of oxidative stress in living human RBCs.

Peculiarities of Ultrafast Irradiation Effect on the Properties of Silicon Crystals

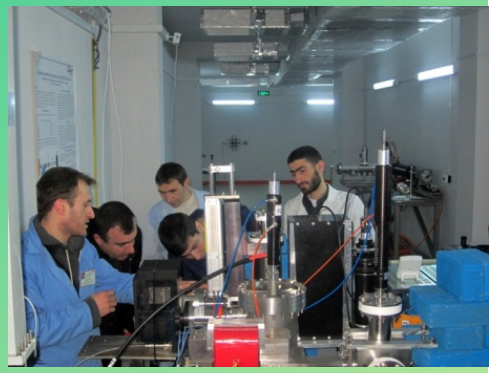
H. Yeritsyan (YerPhI)

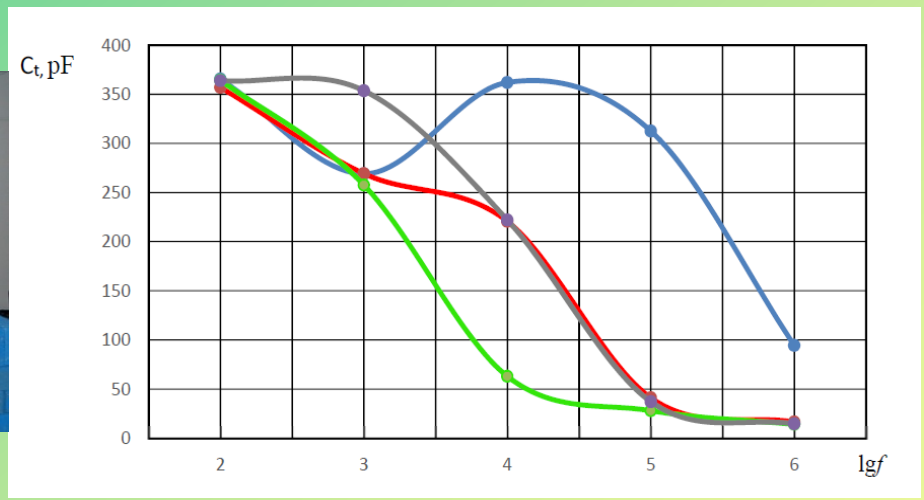


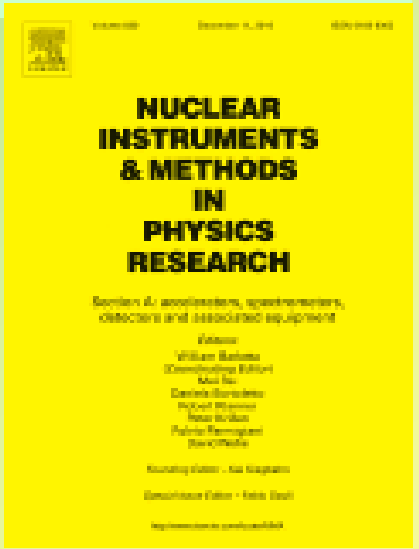
- **Sub-Picosecond electron irradiation has a significant effect on the electrical physical properties of silicon crystal.**
- **It was shown that stable at room temperatures radiation defect formation in silicon crystal takes place in stages forming the clusters.**

The Effects of Ultrafast Irradiation on $Ba_xSr_{1-X}TiO_3$ Ferroelectric Thin Films

Norayr Martirosyan (AEU)





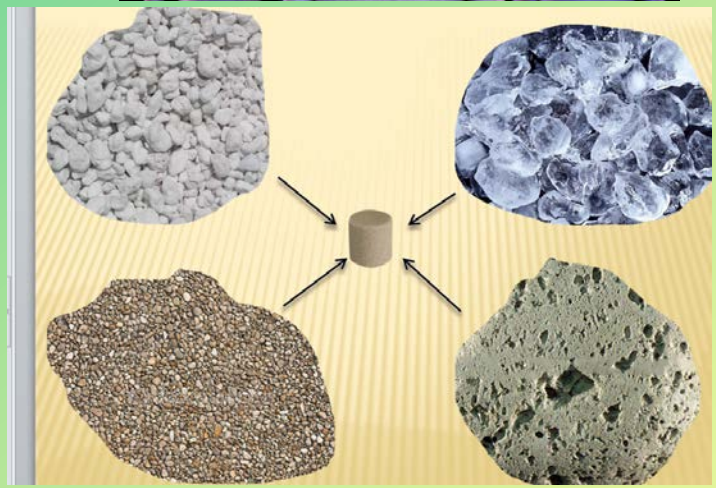


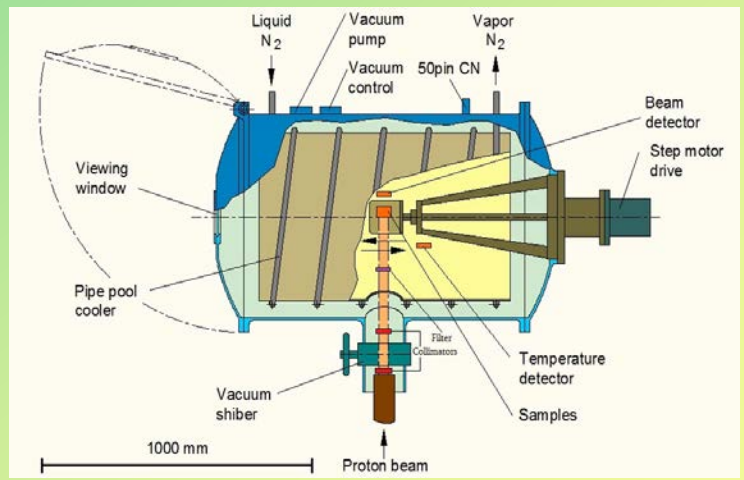
Before-blue line; after the first irradiation-red;
after the second irradiation-green; after the third irradiation-purple.

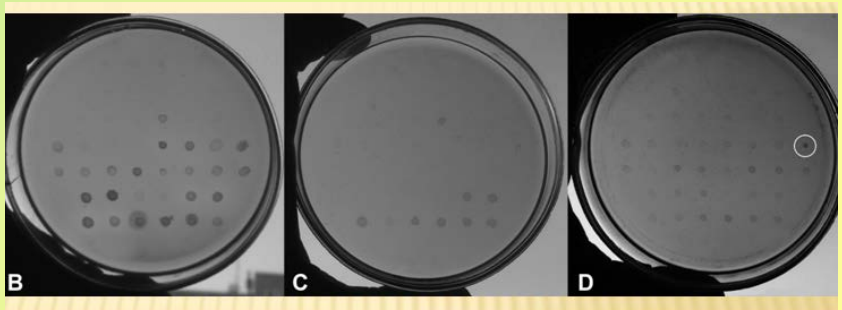
AREAL Ultrafast Beam Application for Modeling the Microorganisms Survival in Space

Garnik Khachatryan (YerPhI)

From Aliens to real experiments

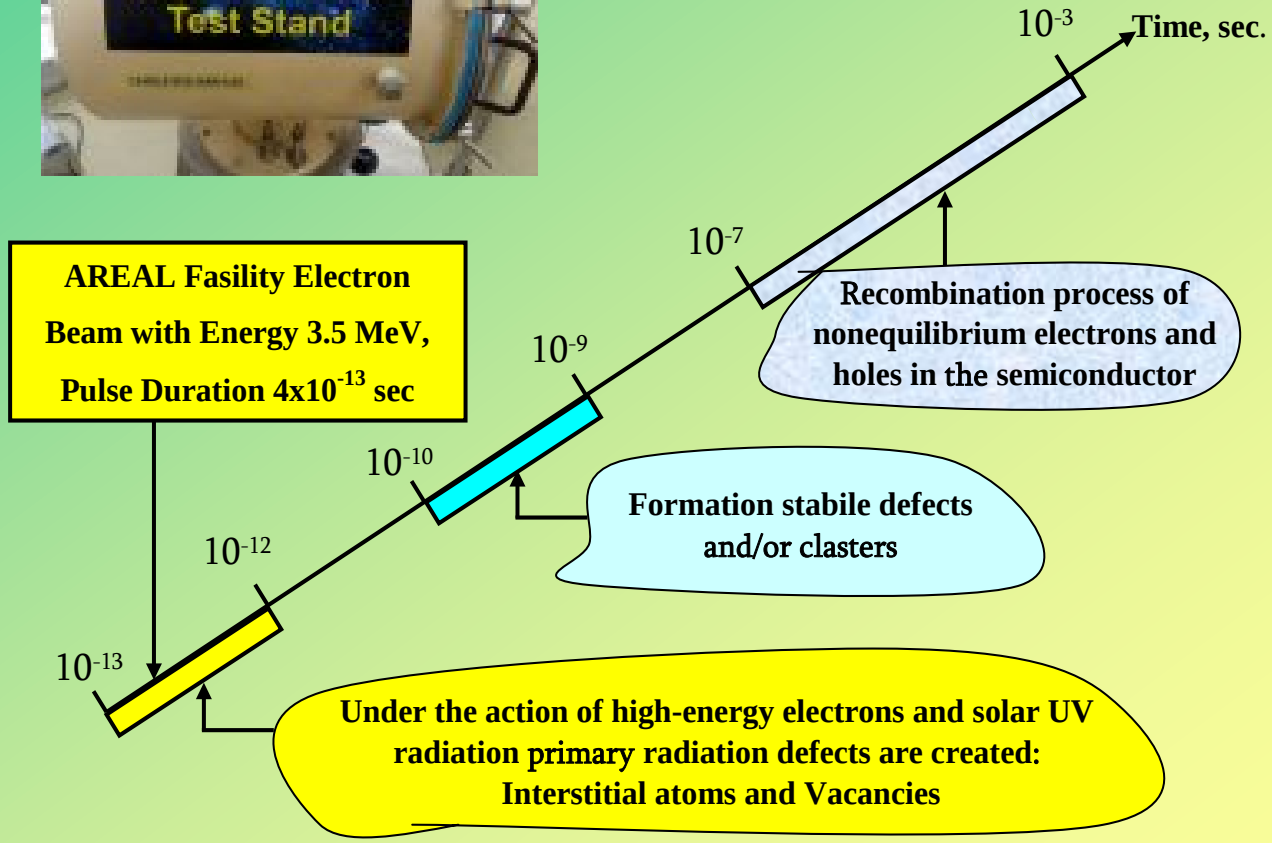


- 



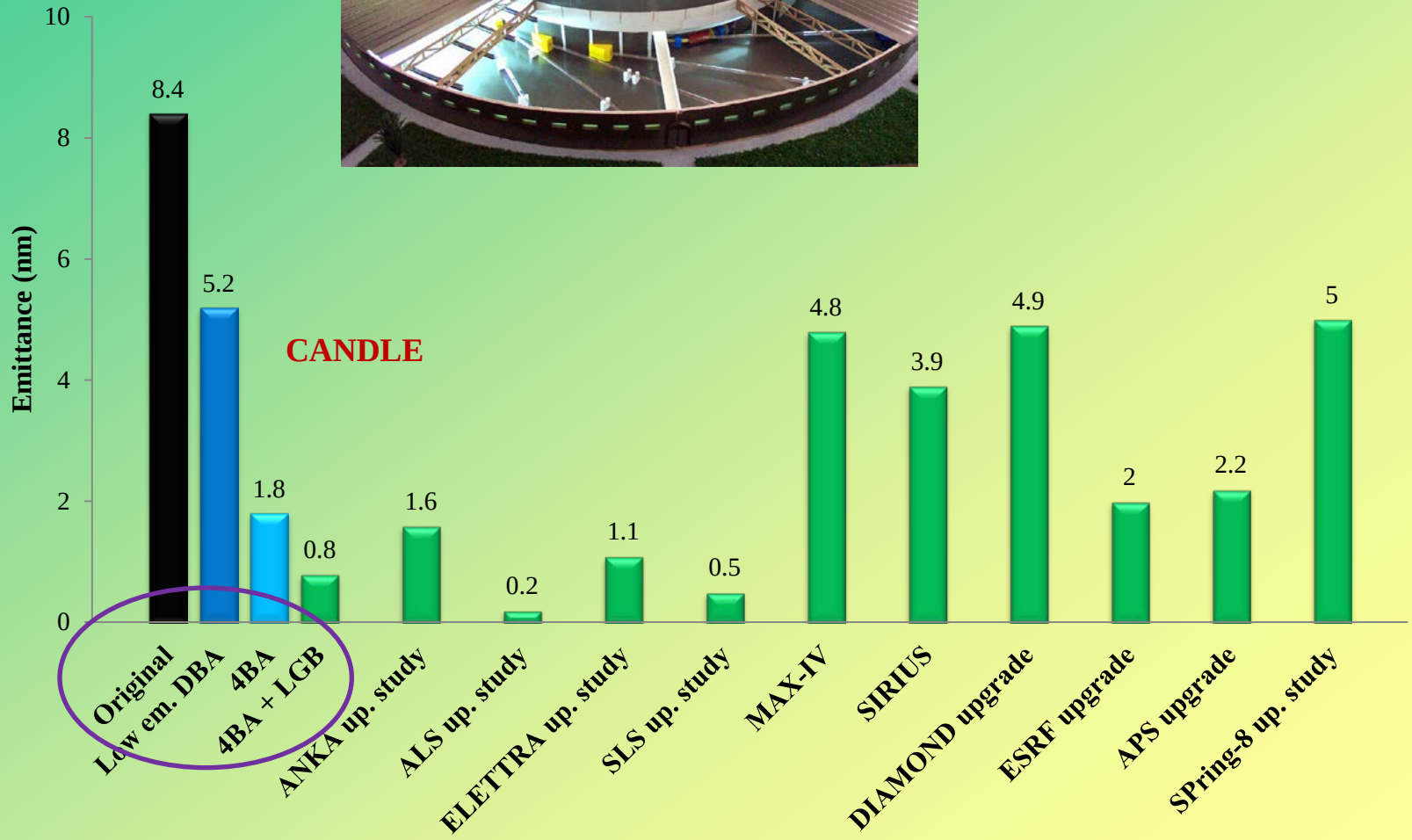
Material Research under Extreme Condithons at AREAL

Aram Sahakyan YerPhI)



Low Emittance CANDLE Storage Ring

A. Sargsyan



Summary

- The expanding and growing fields of ultrashort electron pulses application both in advanced accelerators and natural sciences
- New experimental techniques like ultrafast electron microscopy
- Development of more sophisticated diagnostic tools for femto and attosecond pulses
- Ultrafast timing technique for time-resolved experiments
- New ideas and concepts for generation of ultrashort ultra-bright electron beams

Session 7: History and Nature

7:00 Start from Hotel

7:45- Ararat

8:30- Noravank

11:30-Shaki Waterfall

12:30-family camp, 13:00 – lunch

15:00 – Caraunge Observatory Stone

Beautiful evening

9 July

Weather

23-26 degree (12)


See You at UBA 2019