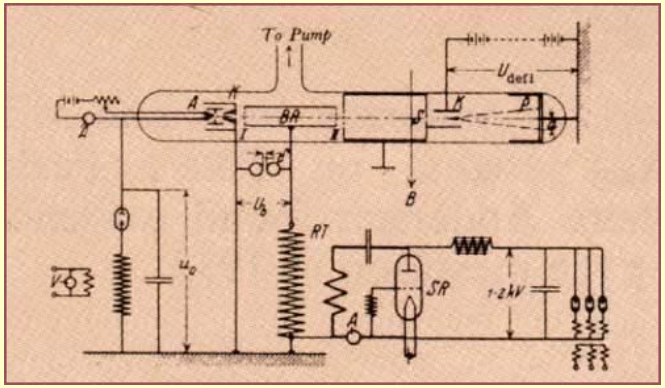
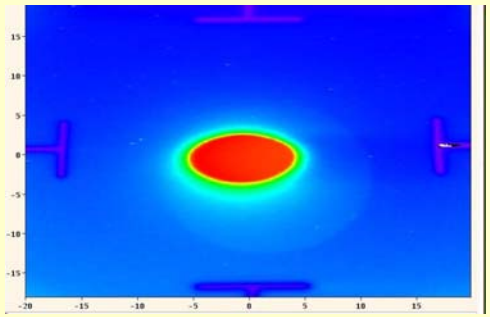

Welcome to CAS'2010
CERN Accelerator Physics School
Introductory level course
Grand hotel Varna
Bulgaria

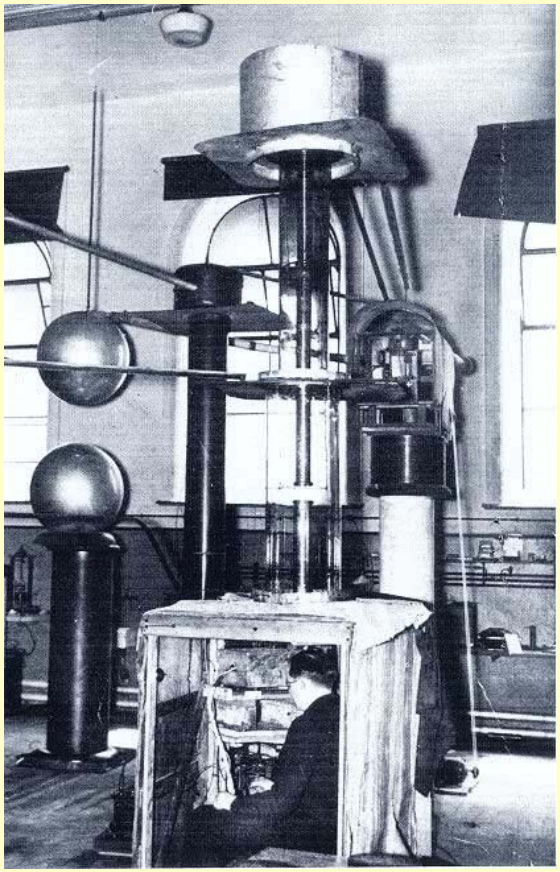


THE UNIVERSE OF PARTICLE ACCELERATORS

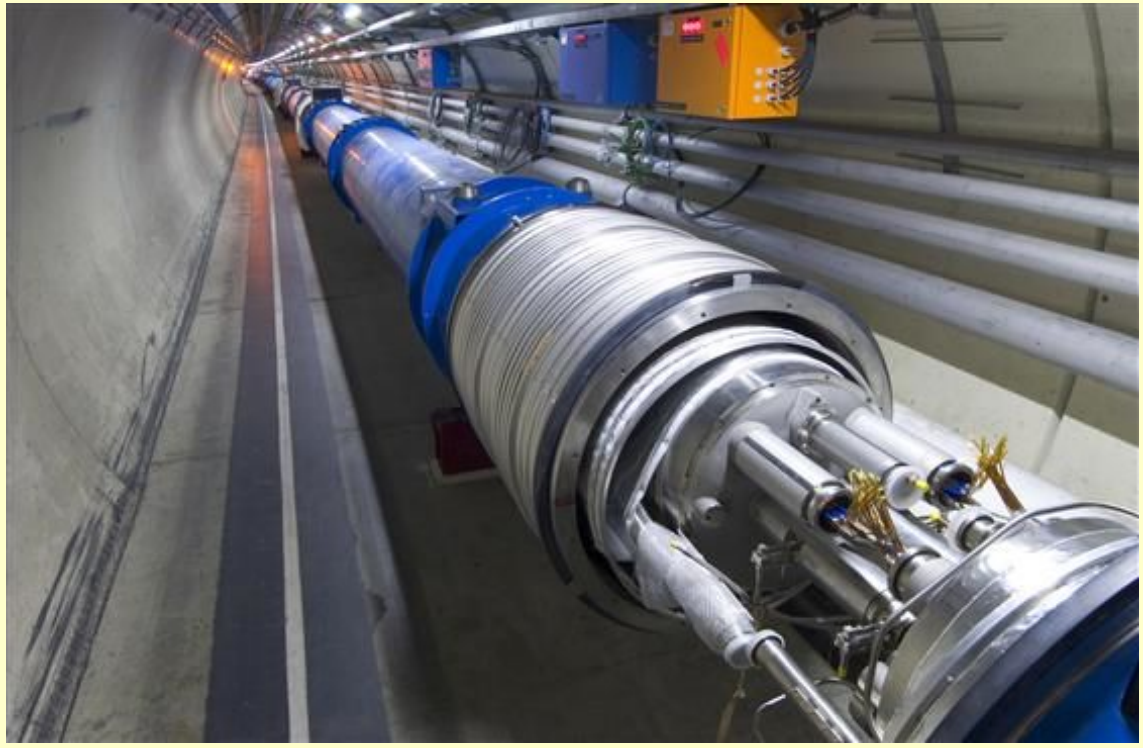
D. Dinev



Particle Accelerators – a Dynamical Area of Research and Technology

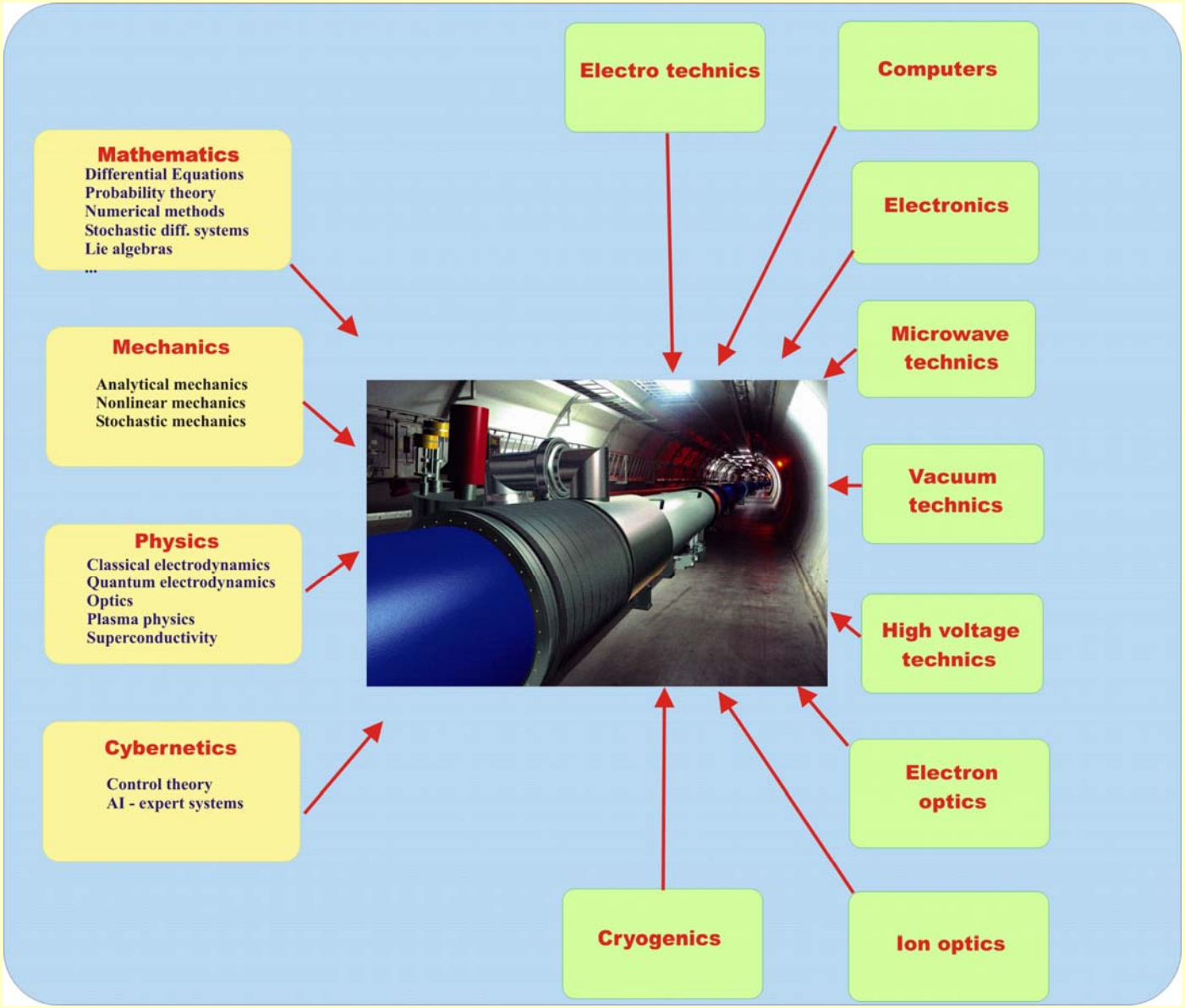


First direct-voltage accelerator, 700 keV



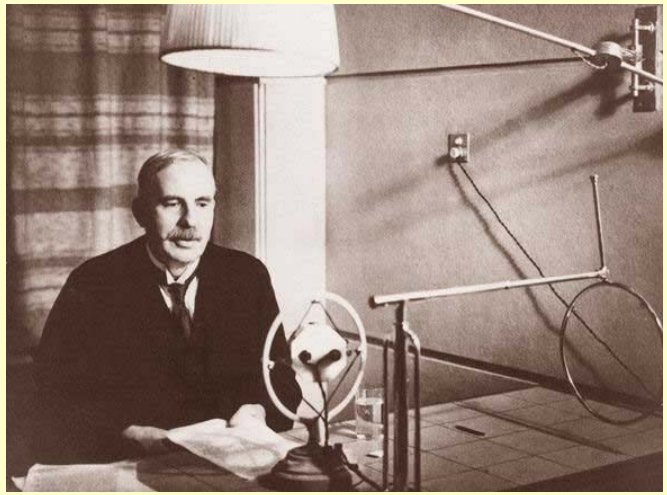
LHC

7 x 7 TeV hadron collider

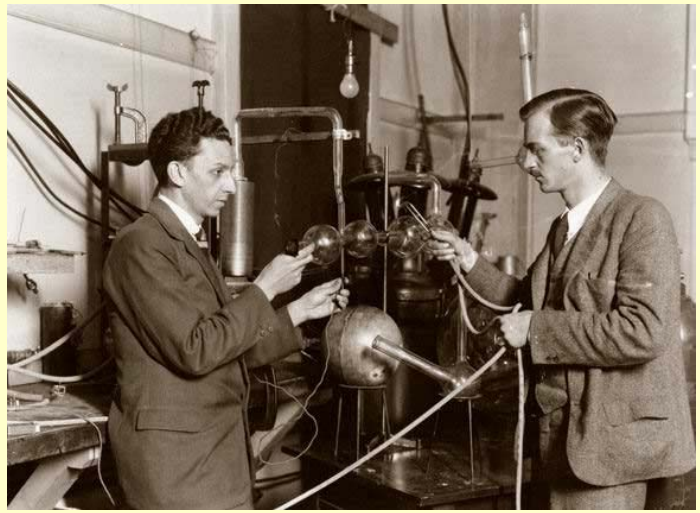


In the world of particle accelerators everyone could find for himself a source of inspiration

Paying tribute to the pioneers of particle accelerators



E. Rutherford



J. D. Cockcroft and E. Th. S. Walton

Van de Graaff

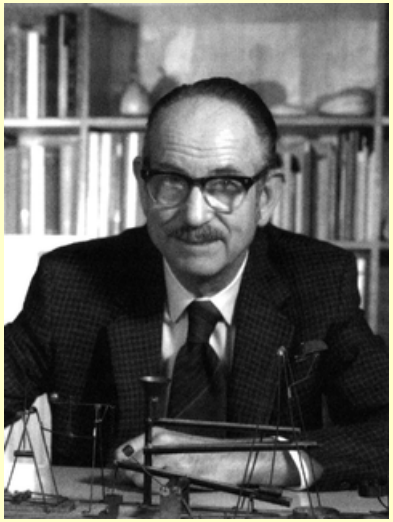
R. Wideroe

L. W. Alvarez

E. Lawrence

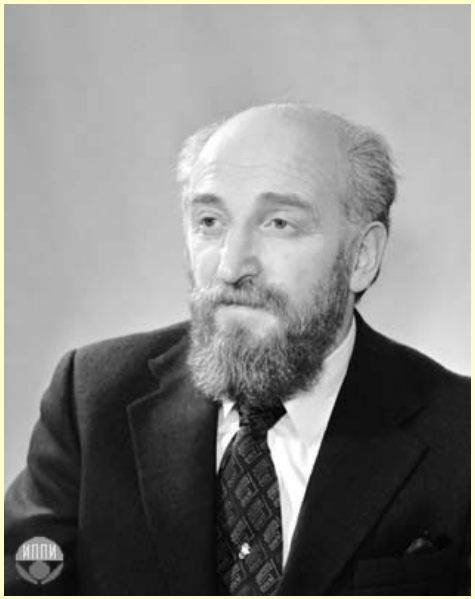
D. Kerst

V. I. Veksler

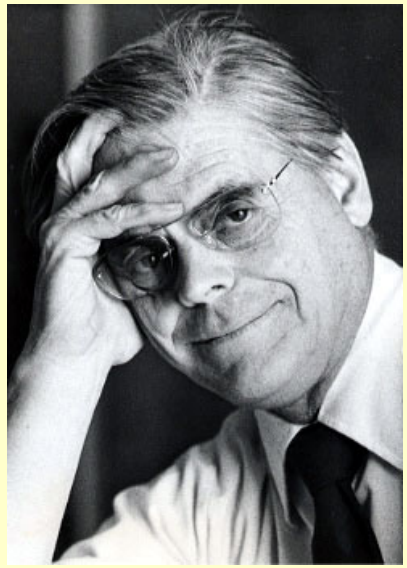


E. M. McMillan

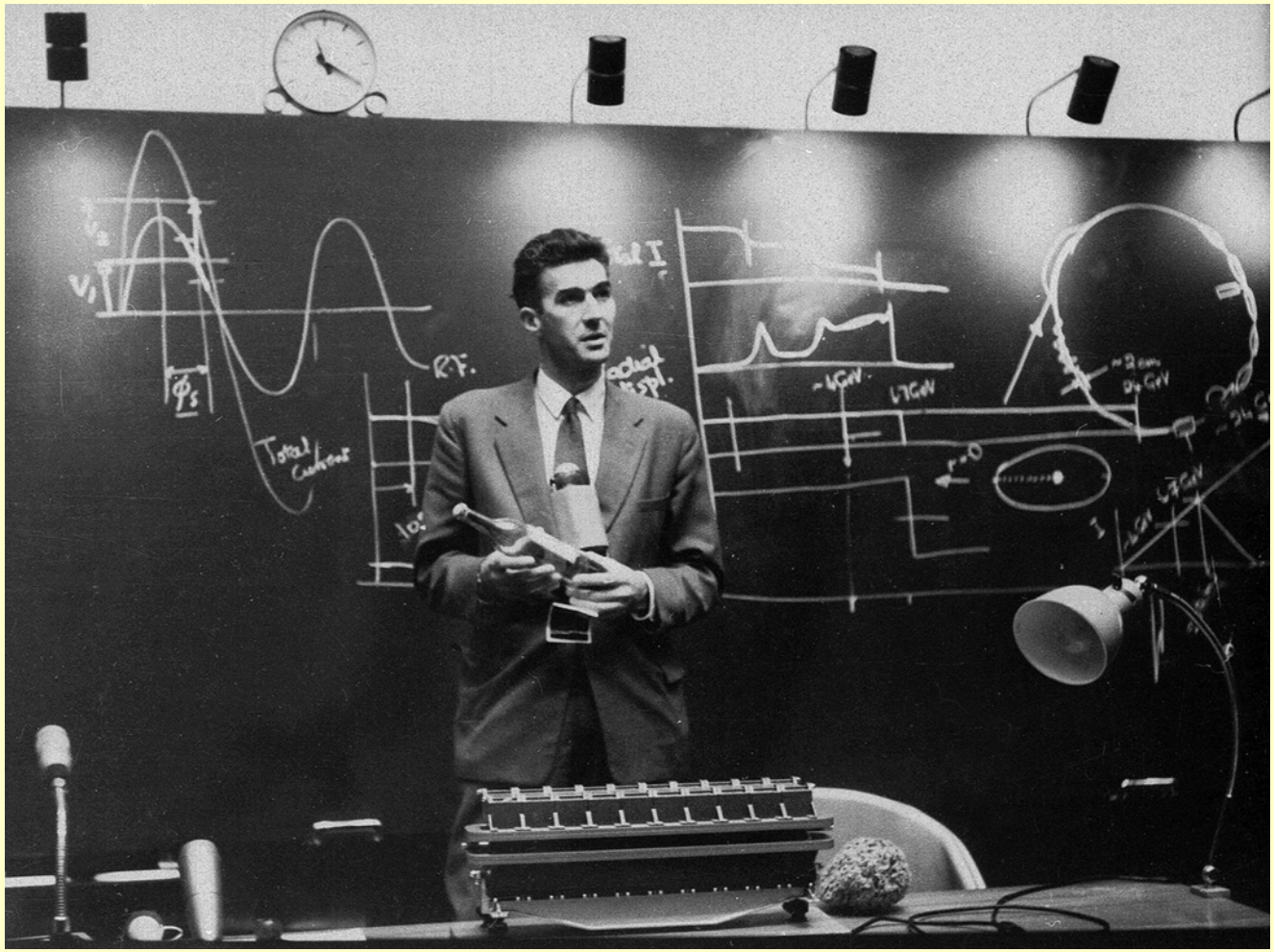
M. S. Livingston



G. I. Budker



R. Wilson



Sir John Adams

ACCELERATORS and BULGARIA

25 MeV Betatron Simens, Center for cancer therapy

Aurora-4, Chemical University, Bourgas

ELV-1, “Electron”, Hrabarsko

Microtron MT-16, PU

Neutron generator NG-12, INRNE

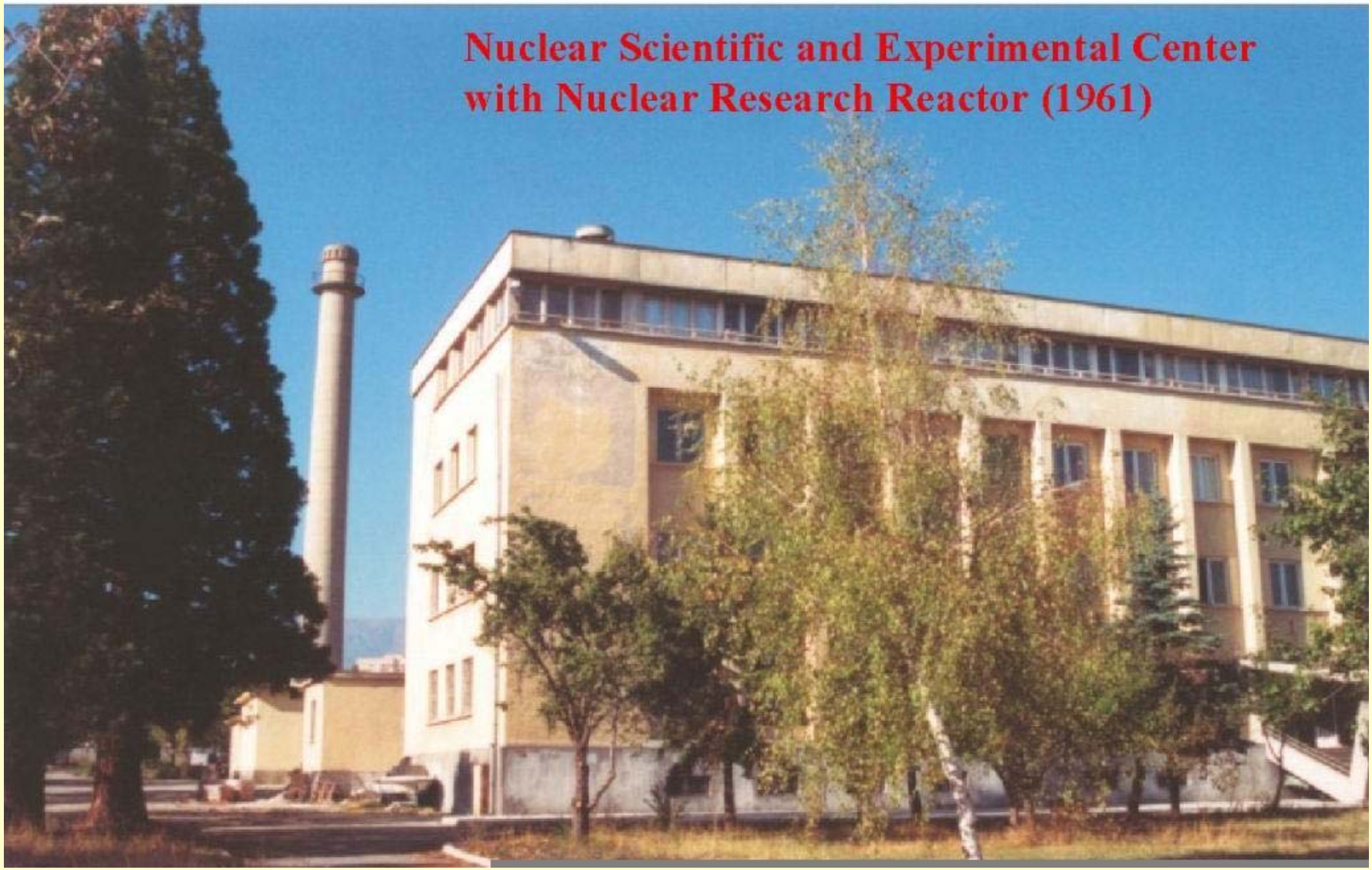
ELV-1

Linear electron accelerators for cancer treatment

NEPTUN, 9 MeV

Institute for Nuclear Research and Nuclear Energy

Bulgarian Academy of Sciences

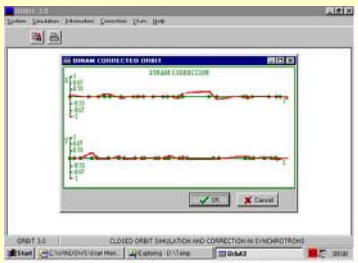

Nuclear Scientific and Experimental Center
with Nuclear Research Reactor (1961)

Particle Accelerators Group

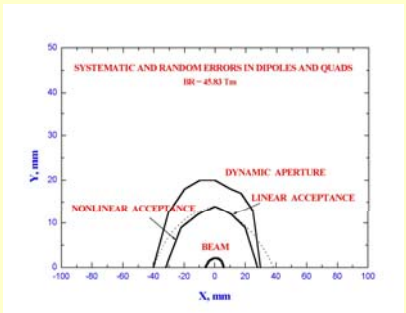
Main activities:

- **Beam dynamics in particle accelerators**
- **Computer control and diagnostics in accelerators**
- **Electron and ion sources**
- **Electron and ion optics**

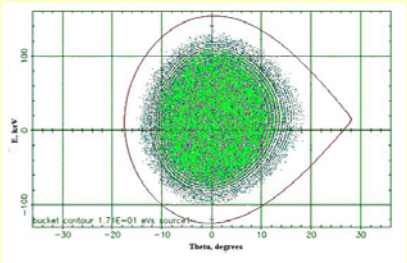
Selected examples:



Closed orbit correction in COSY-Julich

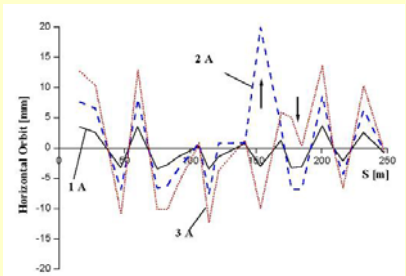


Dynamics aperture in Nuclotron

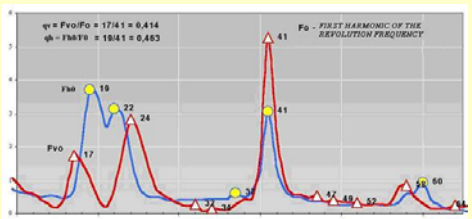


Adiabatic capture in Nuclotron

Accelerator simulation code ORBIT-3.0



BRM measurement in Nuclotron



Tune measurement in Nuclotron

Publications:

The members of PAG have published more than 200 papers.

D. Dinev. Particle accelerators. Academic Press, Sofia, 2006

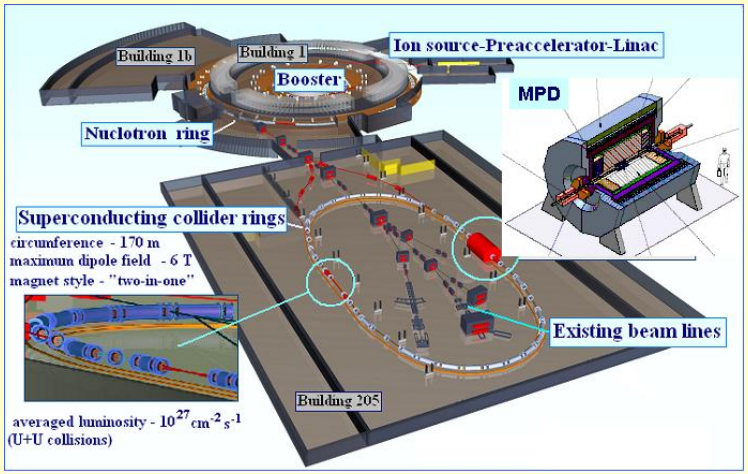
Organized conferences:

- **"Relativistic Nuclear Physics", Varna,**

  1995, 1996, 1997, 1998, 2001

Academician V. Kadyshevsky opens RNP'01

Current projects:

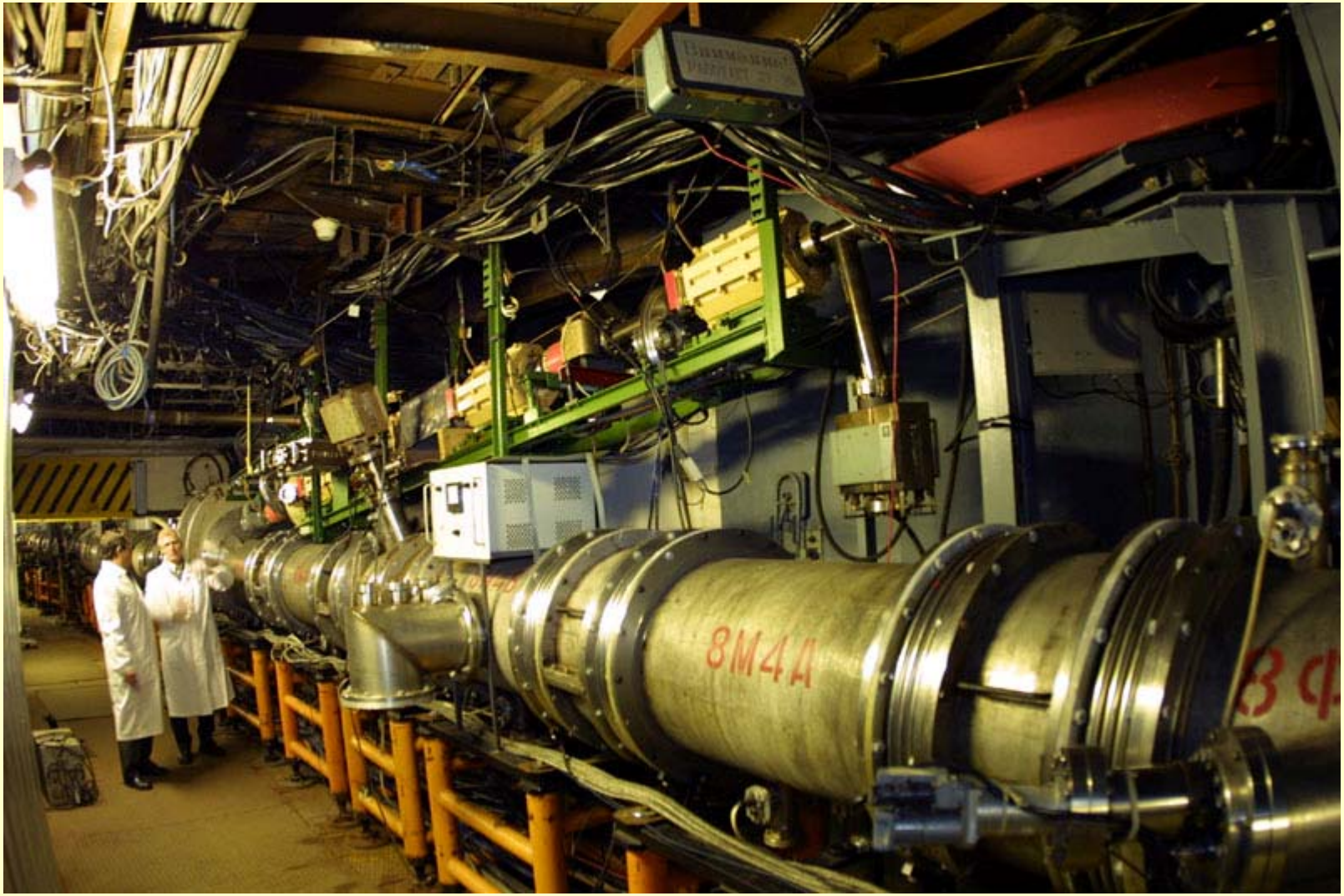


Heavy ion collider NICA in JINR-Dubna

JINR Veksler-Baldin Laboratory of High Energy Physics

Superconducting heavy ion synchrotron NUCLOTRON,

March 1993, 6 GeV/u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HEAVY ION COLLIDER NICA

Nuclotron-based Ion Collider fAcility

Project, 2006

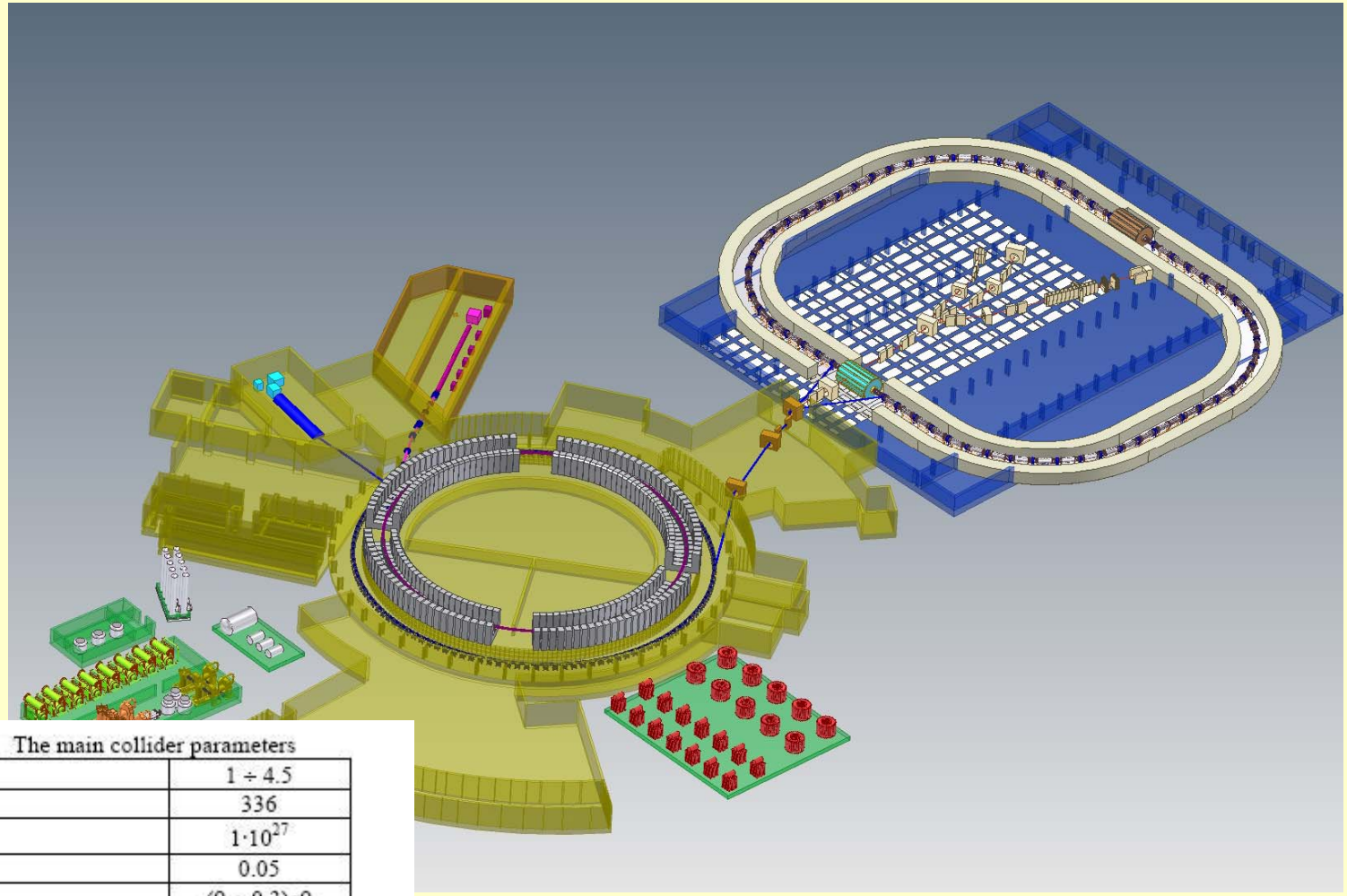
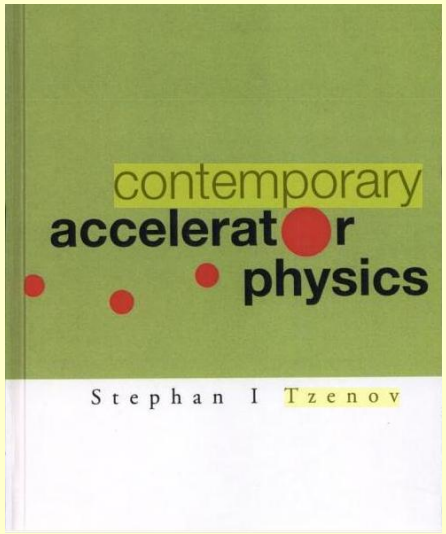


Table. The main collider parameters

Ion energy range, GeV/u	1 ÷ 4.5
Ring circumference, m	336
Luminosity, $cm^{-2} \cdot s^{-1}$	$1 \cdot 10^{27}$
Lasslett tune shift (2.5)	0.05
Ion number per bunch	(9 ÷ 0.3)e9
Rms unnormalized beam emittance π·mm·mrad	30.0 ÷ 0.03
Rms momentum spread σ_p	1e-3
Rms bunch length σ_s, m	0.6
Transition energy GeV/u	3.2 ÷ 14.2 (16 "machines")
Number of bunches	32
Number of RF harmonics	160
Beam-beam parameter (2.7)	(1 ÷ 7)e-3

Prof. S. Tzenov

STFC, Daresbury, UK



EMMA – First non-scalable FFAG accelerator, Daresbury

Dr. D. Kaltchev

TRIUMF, Vancouver, CA

- **Beam-beam effects**
- **DA integrator, Lie algebra code**
- **LHC collimation**
- **RI project in TRIUMF**

LHC collimator prototype

Dr Ivan Enchevich – The first Bulgarian having specialized in the field of particle accelerators and the founder of PAG

1980 – Dr. I. Enchevich (left) and Prof. V. P. Sarantsev, one of the pioneers of the new acceleration methods (midle).

Science in Bulgaria

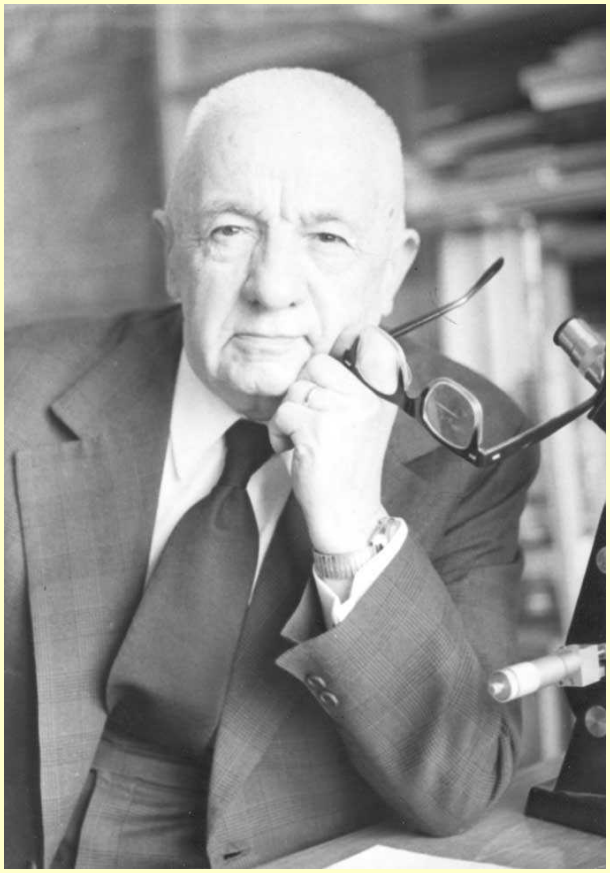
Bulgarian Academy
of Sciences

Sofia University

Prominent Bulgarian Scientists

Acad. Georgi Nadjakov

(1897 – 1981)



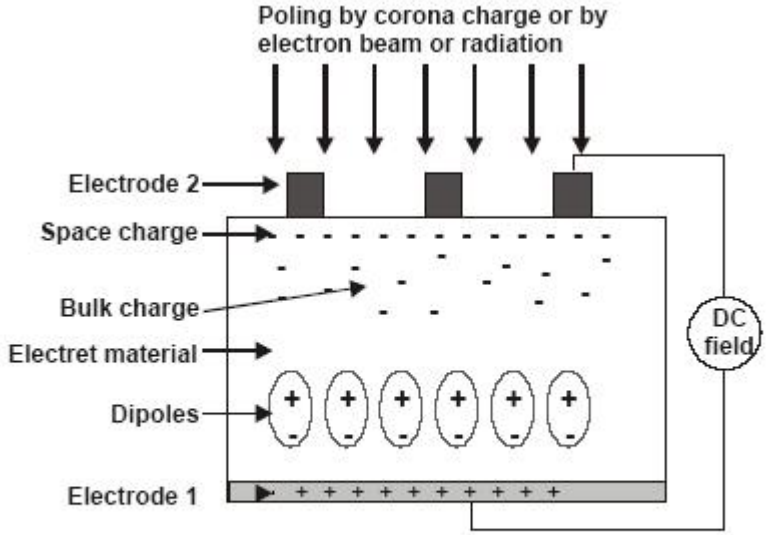


Figure 2. Different mechanisms of charge trapping in an electret material.

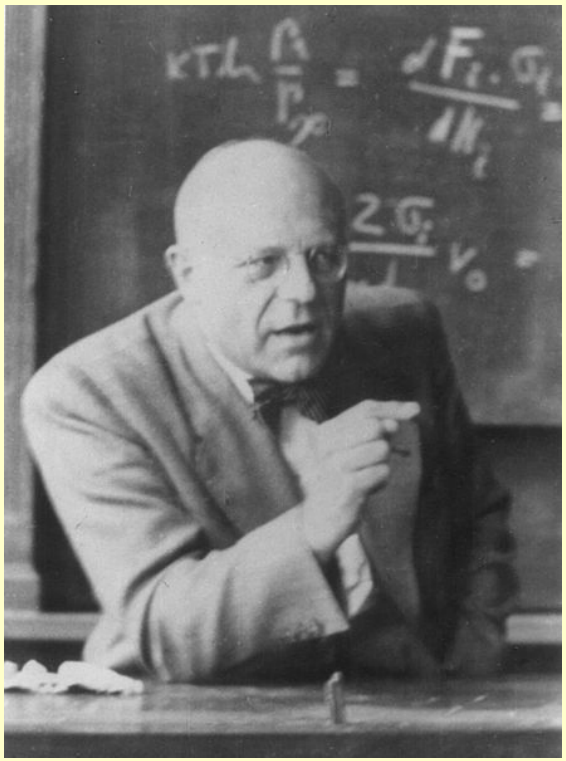
Solid State Physics

Discover Photoelectrets (G. Nadzakov. Chem. Rev. 1037, v. 204, p. 1865)

worked with P. Langevin and M. Curie

Prof. Ivan Stranski

(1897 – 1979)



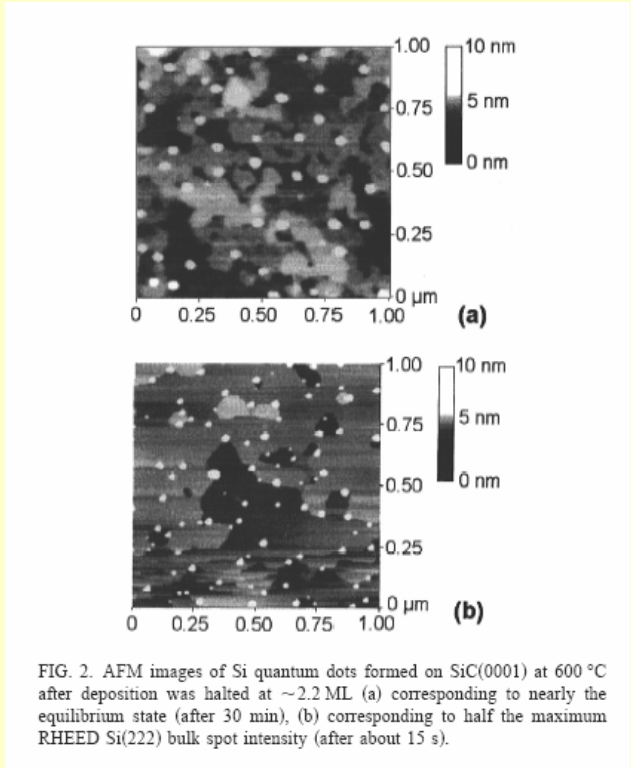


FIG. 2. AFM images of Si quantum dots formed on SiC(0001) at 600 °C after deposition was halted at ~2.2 ML (a) corresponding to nearly the equilibrium state (after 30 min), (b) corresponding to half the maximum RHEED Si(222) bulk spot intensity (after about 15 s).

Physical Chemistry – Theory of Cristal Growth

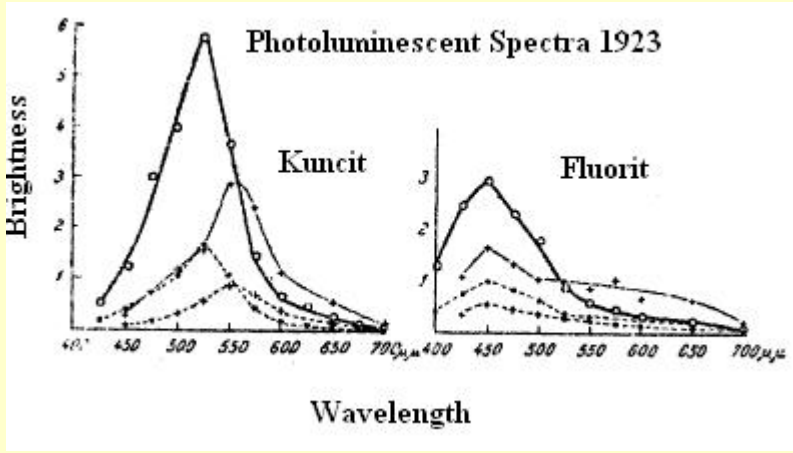
(Stranski – Krastanov growth)

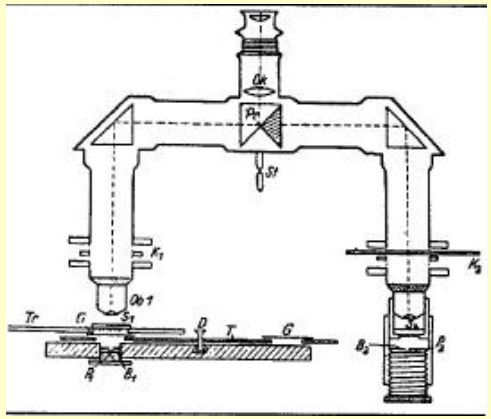
Rector of Technical University, West Berlin (1951 – 1953)

Director of Fritz Haber Institute, West Berlin (1953 – 1963)

Prof. Elizaveta Karamihailova

(1897 – 1968)





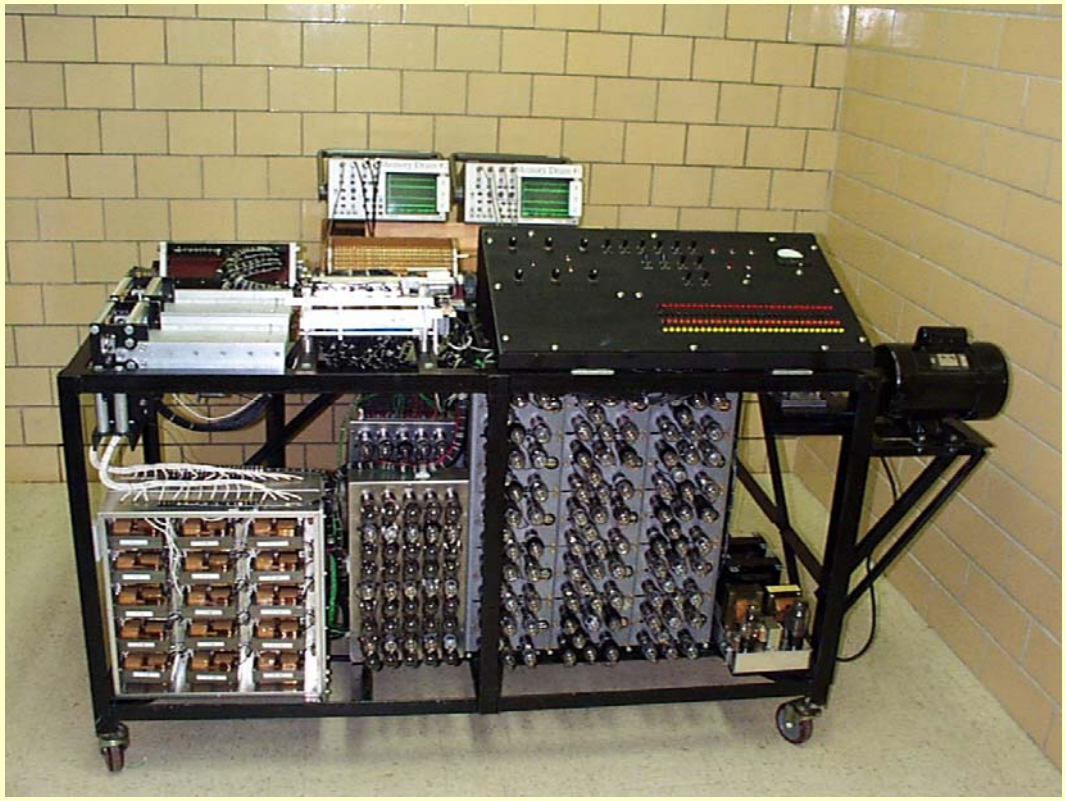
Experimental Nuclear Physics

Radioactivity Pioneer

1921 – Institut fur Radiumforschung, Wien

1937 – Cavendish Laboratory

Prof. John Atanasoff
(1907 – 1995)



First digital computer (ABC) built in Iowa

University with Clifford Berry in 1939

Acad. Wenceslav Andreitcheff

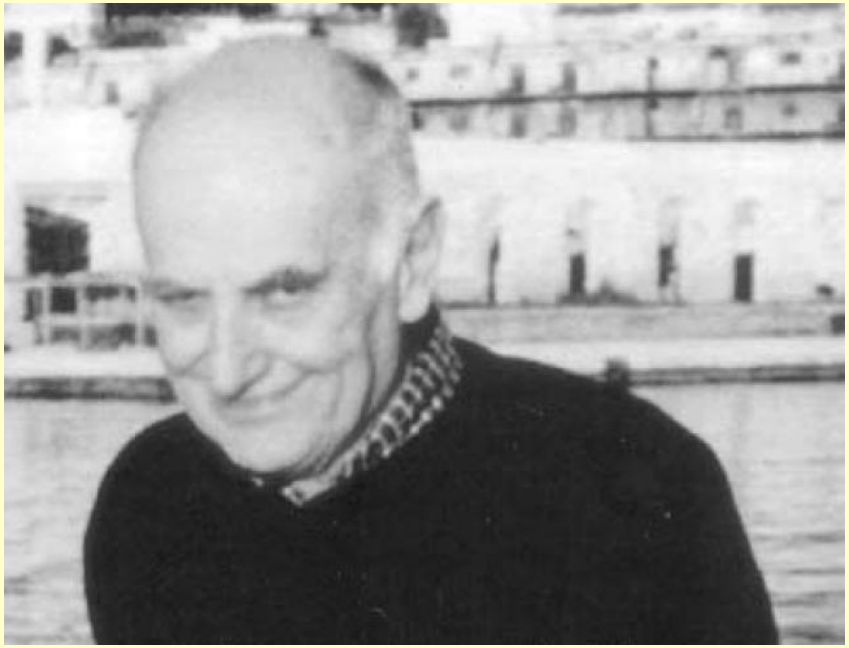
(1941 – 2001)

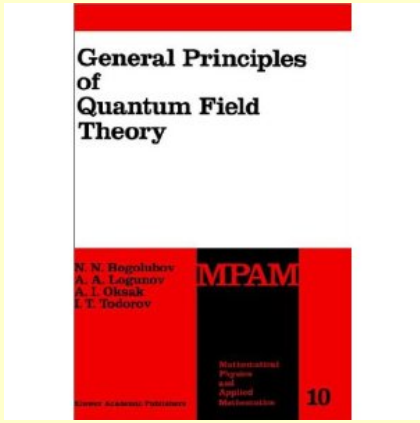
Nuclear Physics

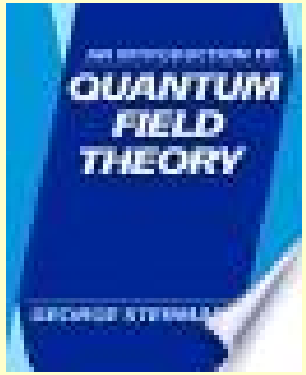
- **Measurement of sub nanoseconds nuclear lifetimes**
- **Systematic of EM nuclear transitions**
- **Nuclear models**

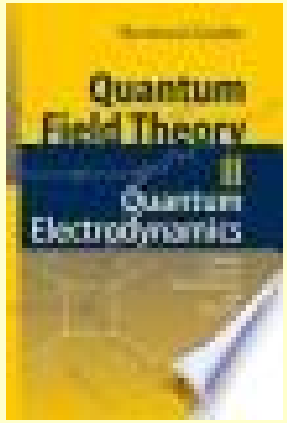
Acad. Ivan Todorov

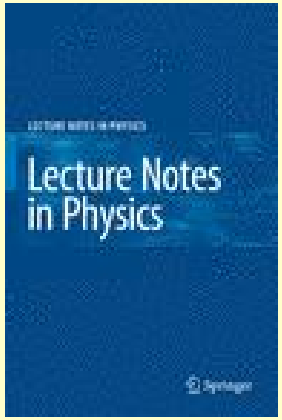
b. 1933











Theoretical Physics – Quantum Field Theory


THANK YOU FOR YOUR ATTENTION