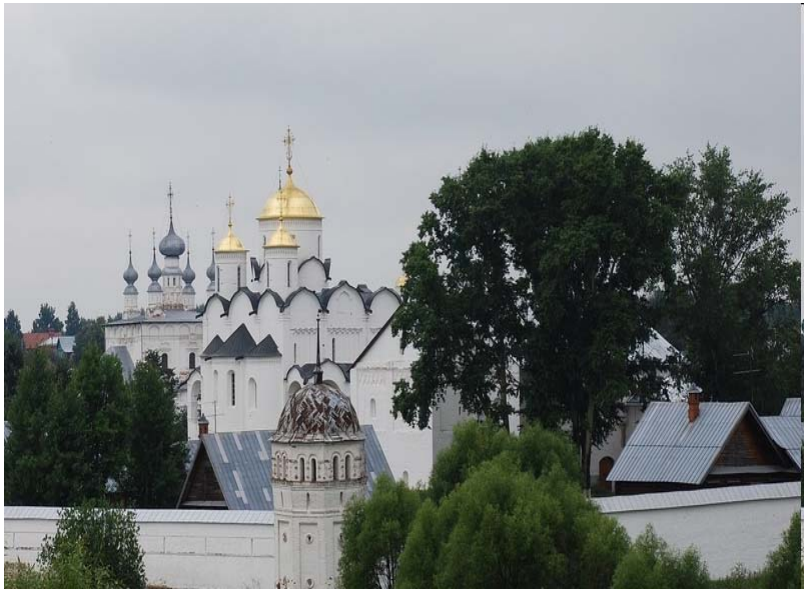
History of the 50 Year Ascent →1961 – 2011

История 50-летнего Восхождения → 1961 – 2011 г.

Nonlinear East – West Path to High-Intensity Interactions

Нелинейный Восток - Запад Путь к высокой интенсивности взаимодействий

Unbelievable / Escher Невероятно / Эшер
c. 1952



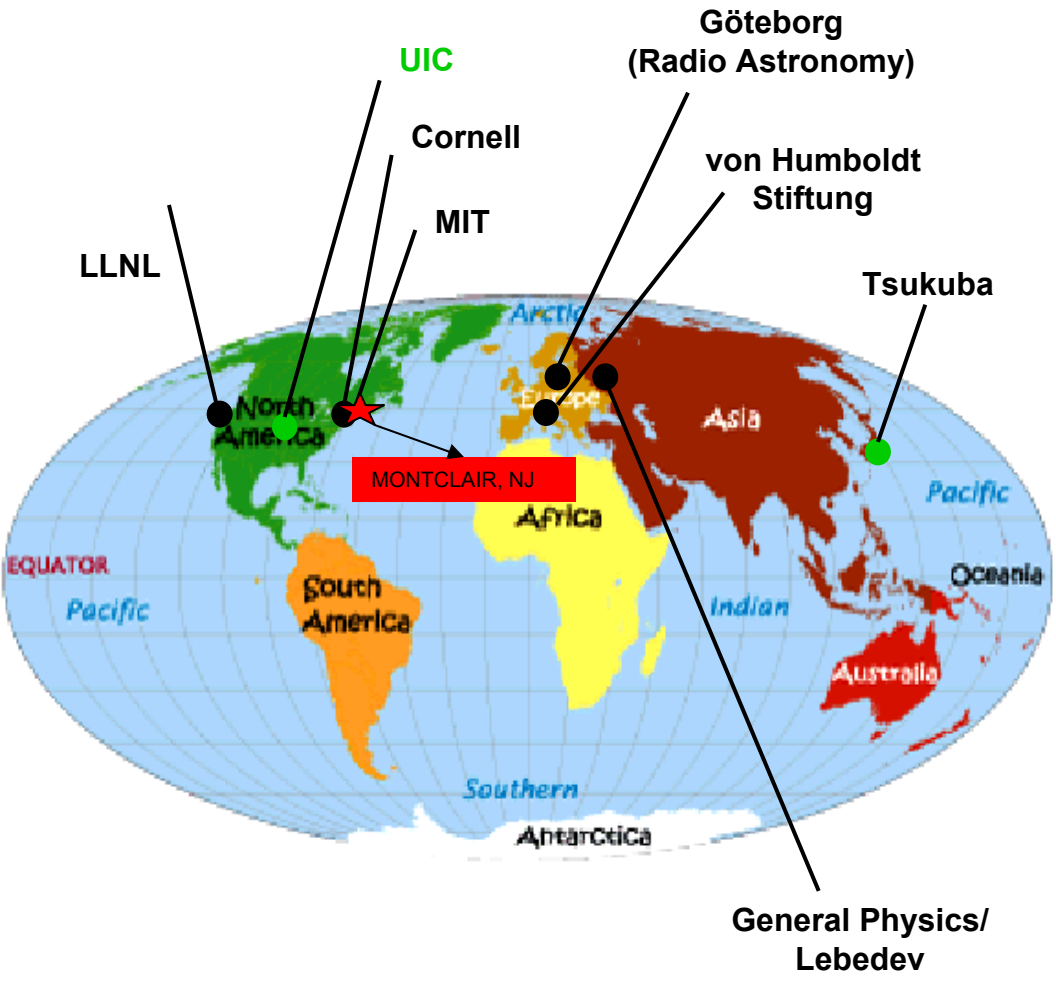
Charles K. Rhodes

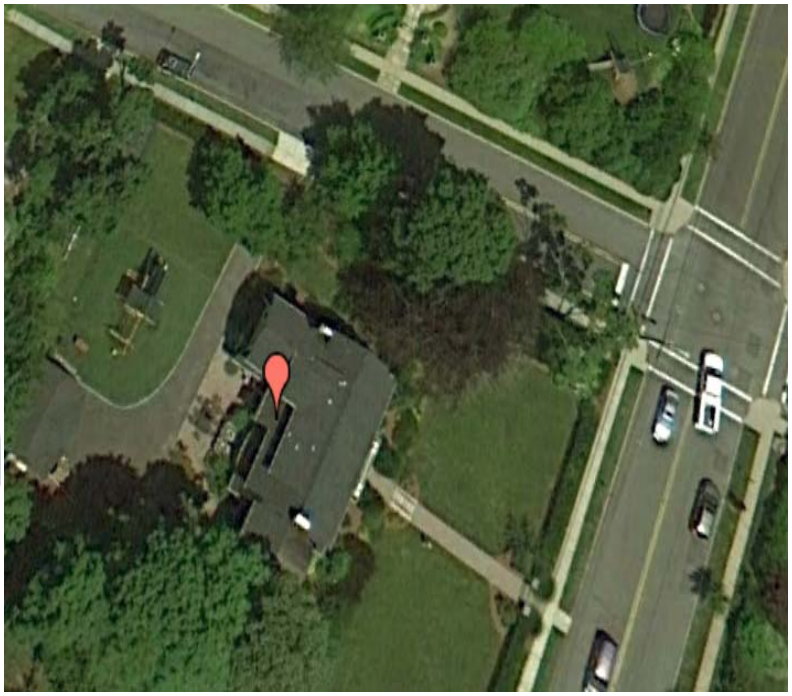
Nonlinear Optics East-West Reunion

Suzdal', Russian Federation

21-23 September 2011

Launching Point





330 Park Street

Upper Montclair, NJ

Early Days

Evelyn Kirkham Rhodes **Walter Cortlyn Rhodes, Jr.**

Upper Montclair, NJ ~ 1940-1948

Early Days

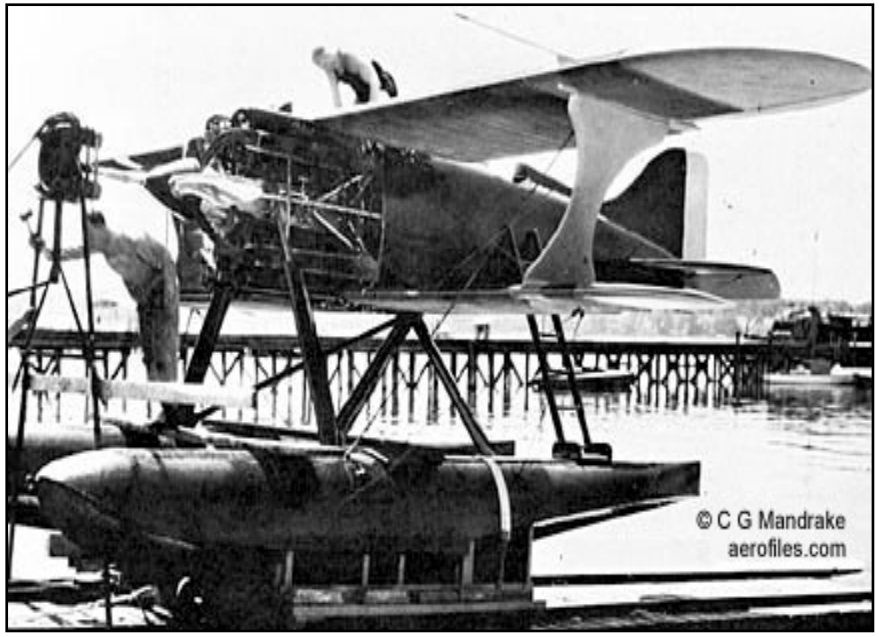
B-29

Sabre vs MiG- 15

Charles B. Kirkham **330 Park Street**

1881 – 1969 **Upper Montclair, NJ**

Kirkham-Williams Racer



Smithsonian

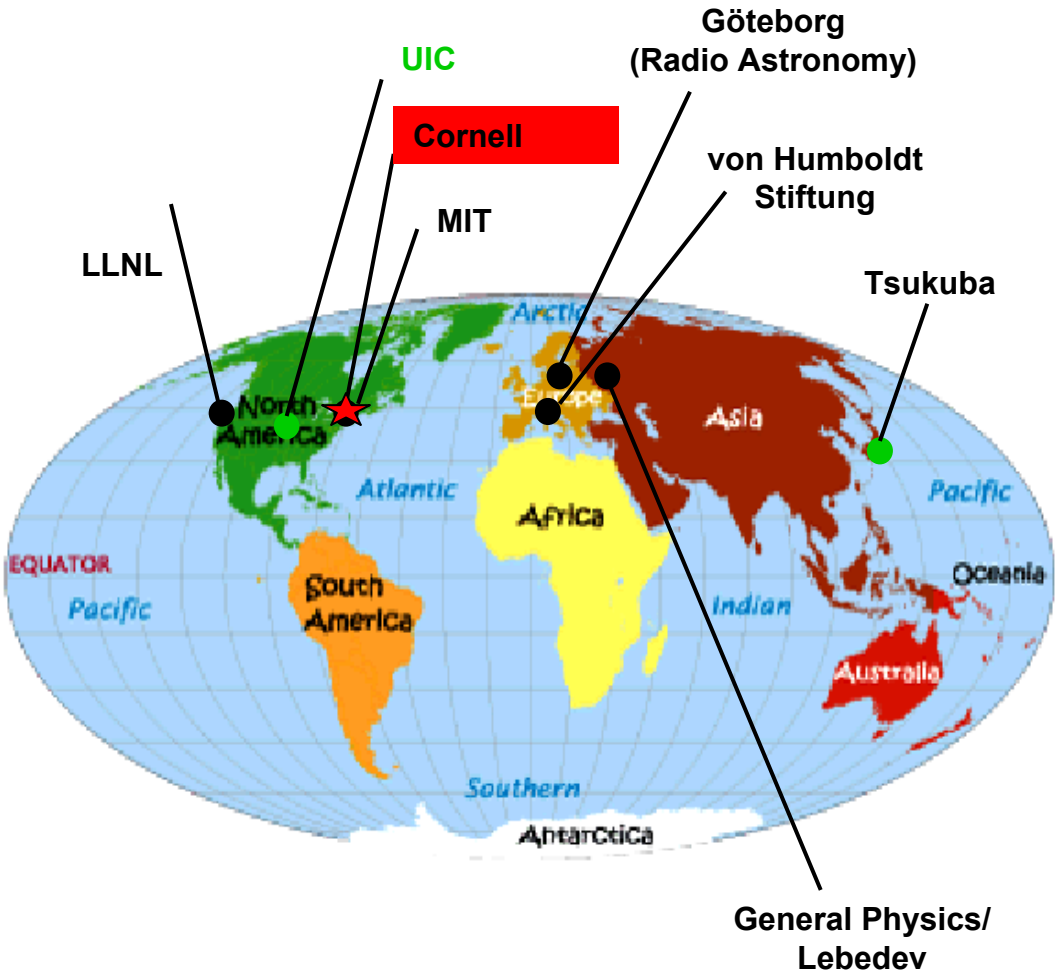
National Air and Space Museum

Washington D.C.

Early Flight Section

1927/ ~1/2 Speed of Sound

UNIVERSITY



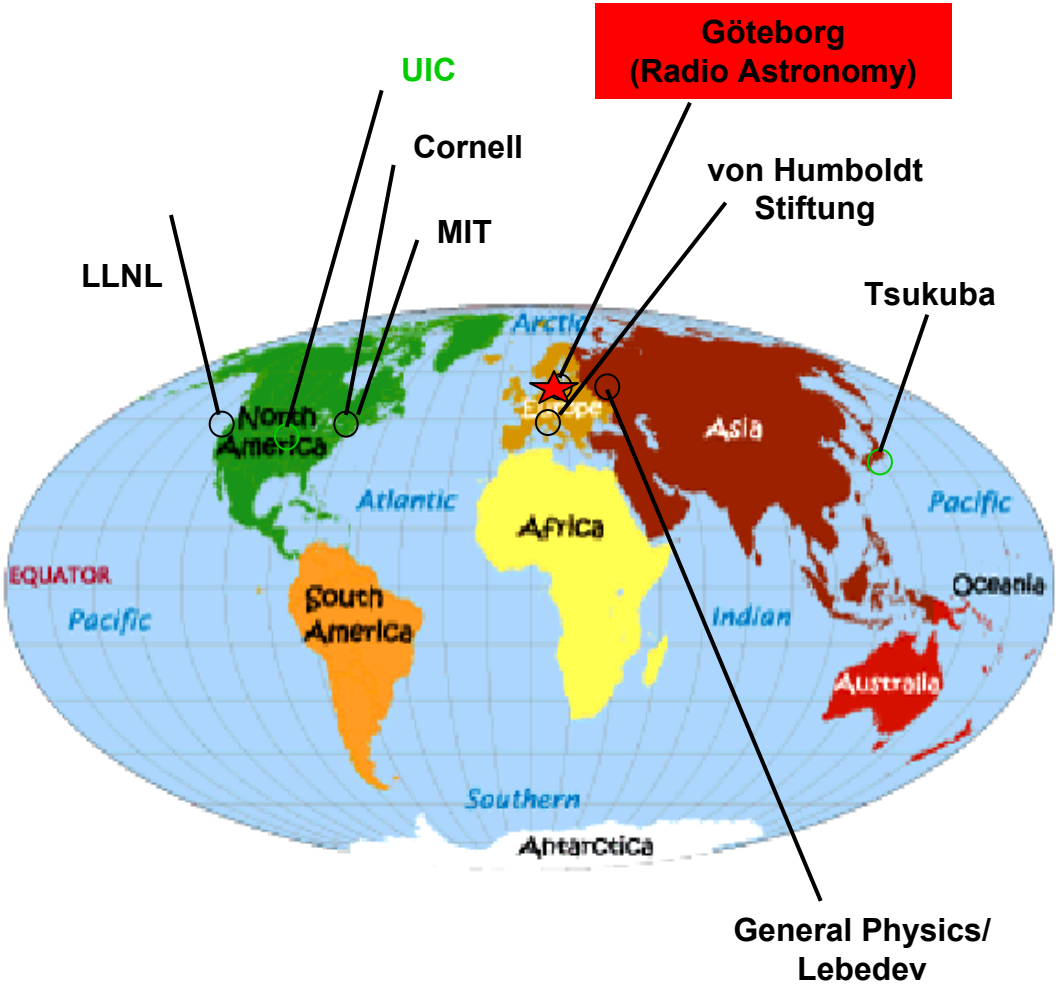
CORNELL 1962 - 1963

Professor George J. Wolga

He – Ne LASER RESEARCH

School of Electrical Engineering

1963 Summer Research



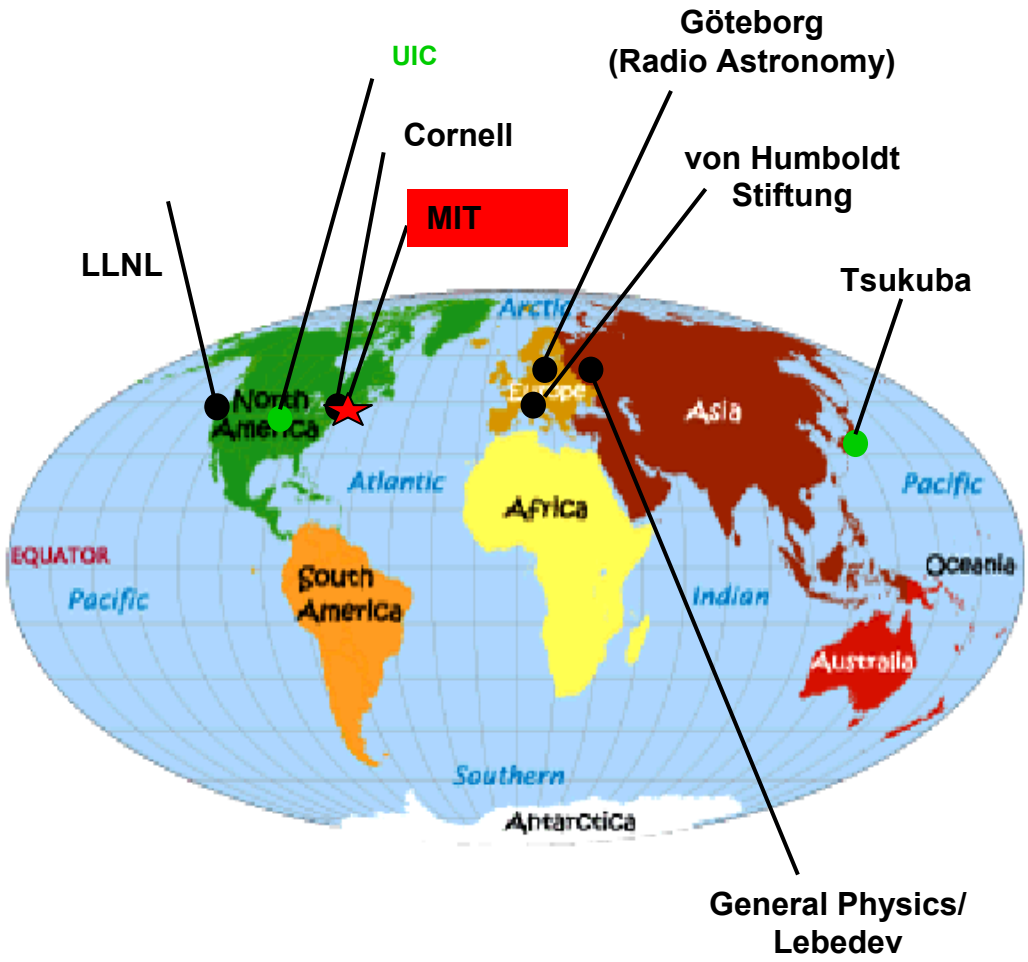
Göteborg

CHALMERS UNIVERSITY OF TECHNOLOGY / SUMMER 1963

MASER/ Radio Astronomy

K. Sigfrid Yngvesson

MIT / Graduate School



MIT/PHYSICS 1963-69

SPECTROSCOPY

PHOTON ECHO

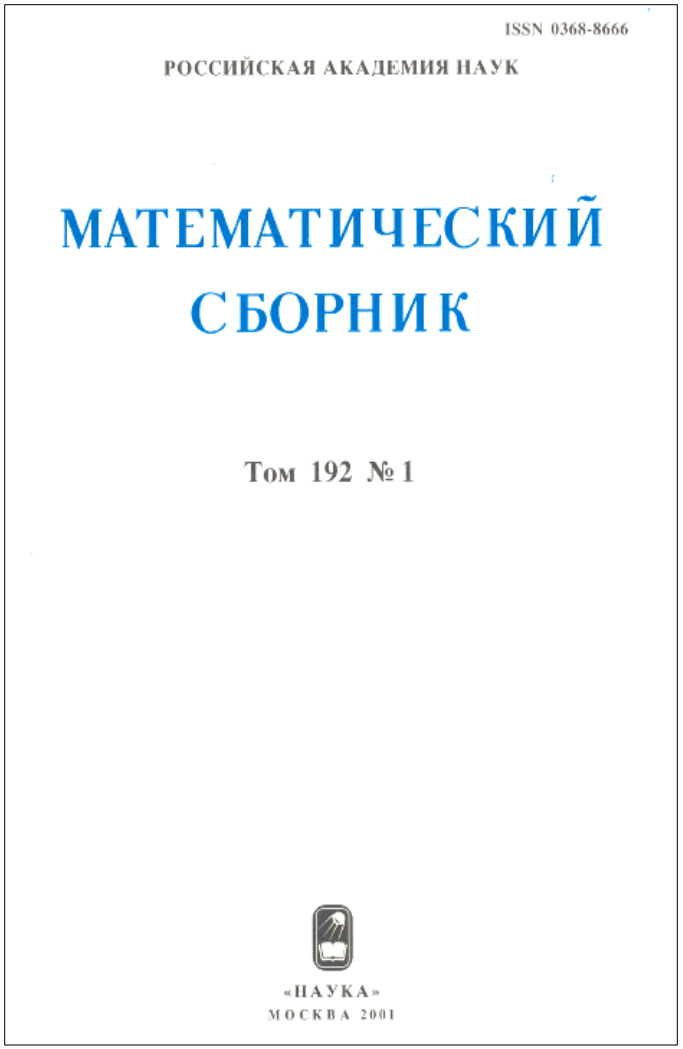
MOLECULAR ENERGY TRANSFER

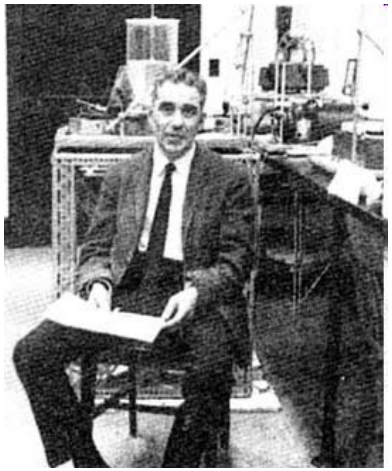
Charles H. Townes

MIT RUGBY - 1966

Ali Javan

MIT Mathematics / Norman Levinson





Norman Levinson

Norbert Wiener

A. MENAC Z. VOLOS

КУРС РУССКОГО ЯЗЫКА ПО ЗРИТЕЛЬНО-СЛУХОВОМУ МЕТОДУ

CHILTON-DIDIER AUDIO-VISUAL RUSSIAN METHOD

CHILTON COMPANY – BOOK DIVISION
Publishers
Philadelphia New-York

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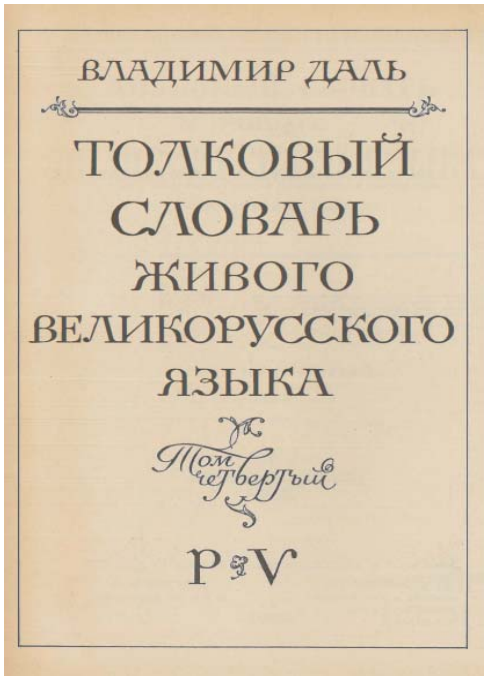
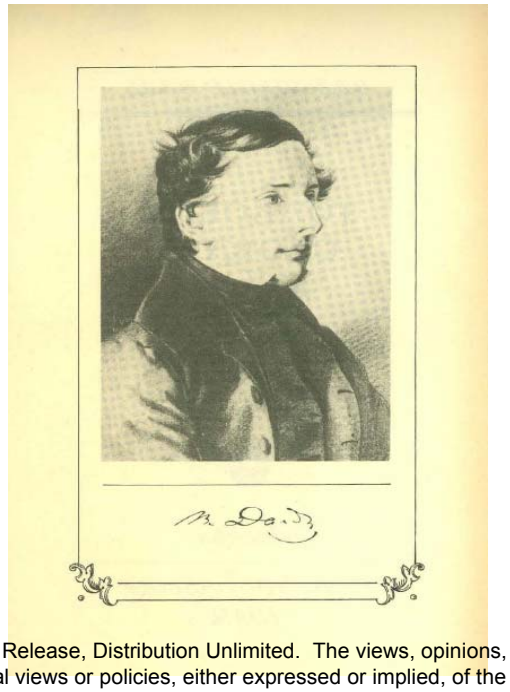
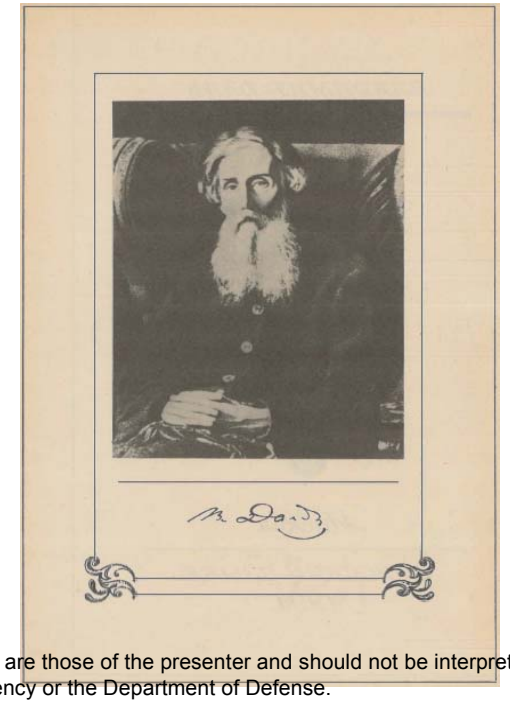
DES RUSSISCHEN VERBS
VON
RUDOLF RŮŽIČKA

ENTHÄLT ÜBER 14000 VERBEN

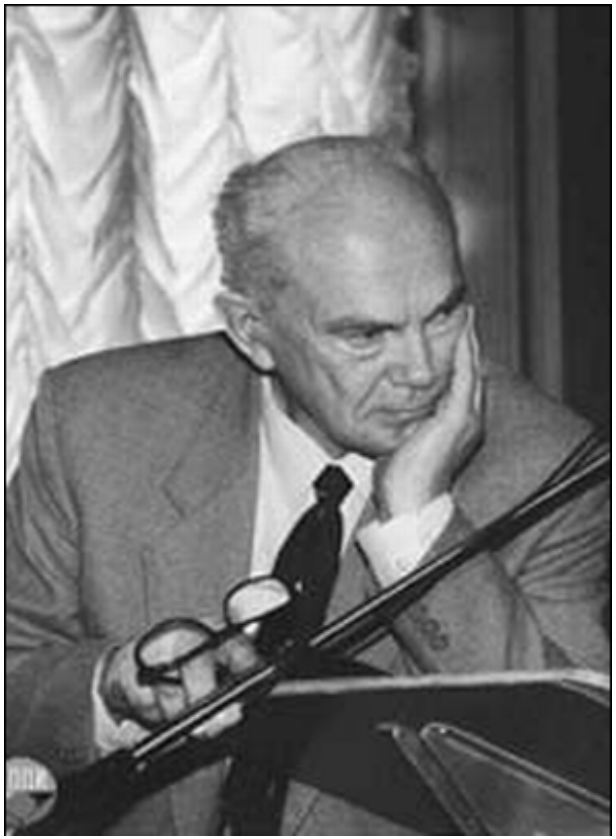
VEB VERLAG ENZYKLOPÄDIE
LEIPZIG







General Physics Institute / MIT
~ 1969



A.M. PROKHOROV
GENERAL PHYSICS INSTITUTE
RUSSIAN ACADEMY OF SCIENCES
GPI RAS

Nikolai V. Karlov

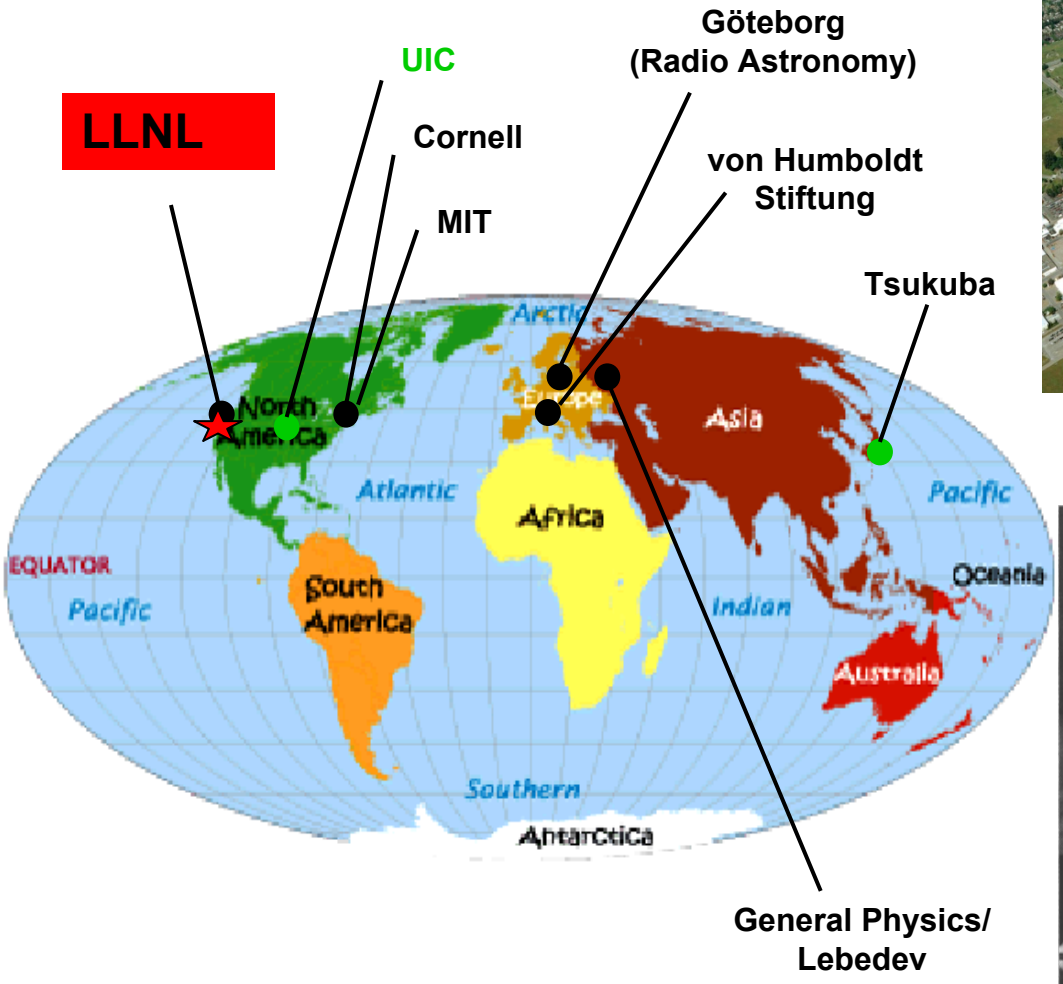
Николай В. Карлов

PHOTON ECHO

BCl_3 SF_6

FIRST POSITION / 1970

LASER FUSION



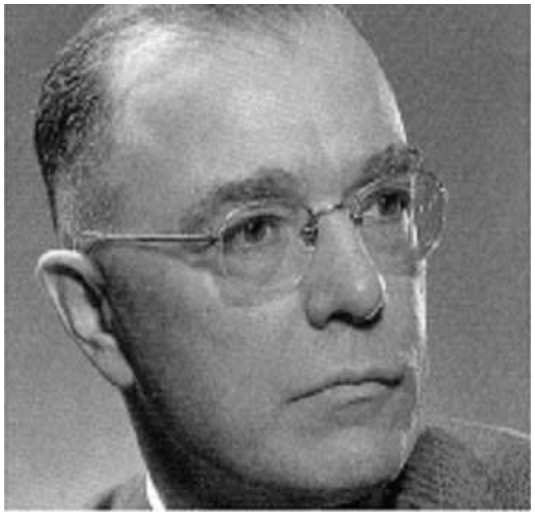
Lawrence Livermore National Laboratory (LLNL)

EDWARD TELLER

ROBERT L. CARMAN

Excimer Concept

1938



Wolfgang Finkelnburg

1960

Friedrich Georg Houtermans

~1966

Nikolay Gennadiyevich Basov

New Technologies

Control of Energy / Excimer Concept

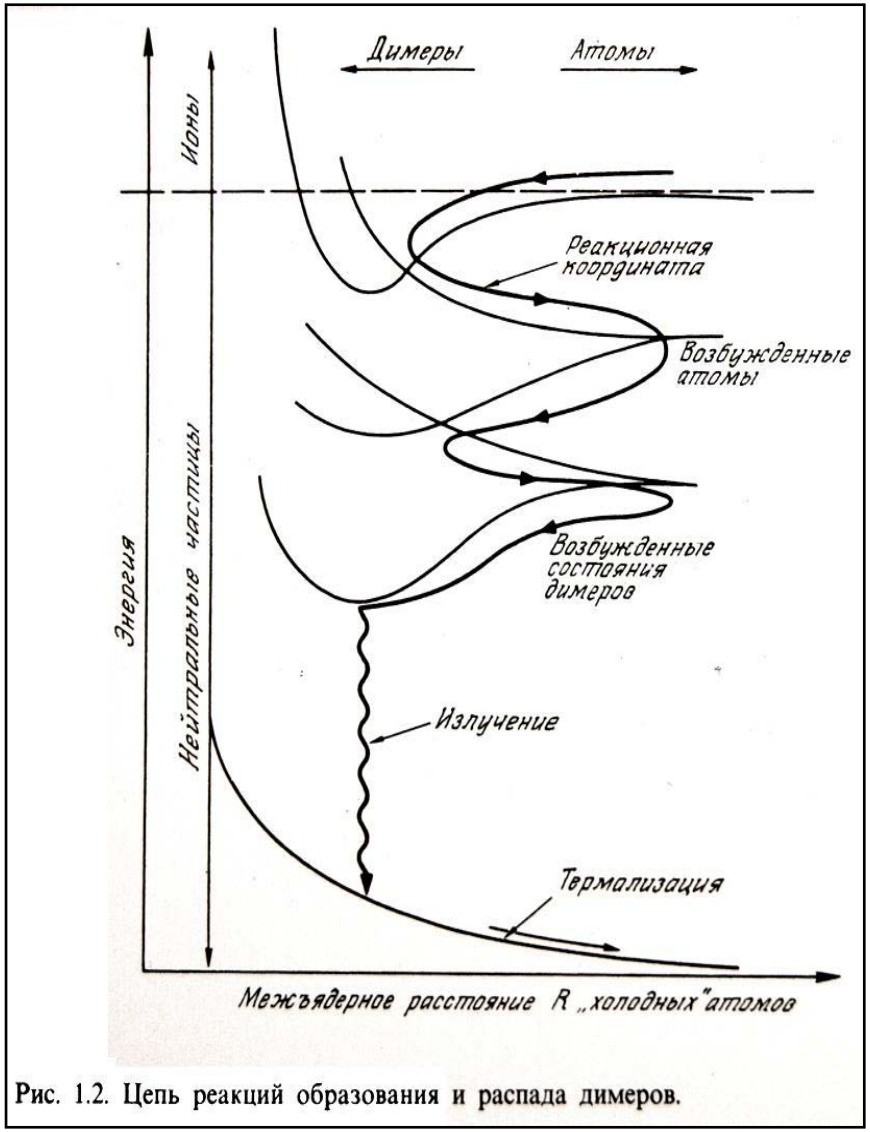


Рис. 1.2. Цепь реакций образования и распада димеров.

IEEE JOURNAL OF QUANTUM ELECTRONICS, VOL. QE-2, NO. 9, SEPTEMBER 1966

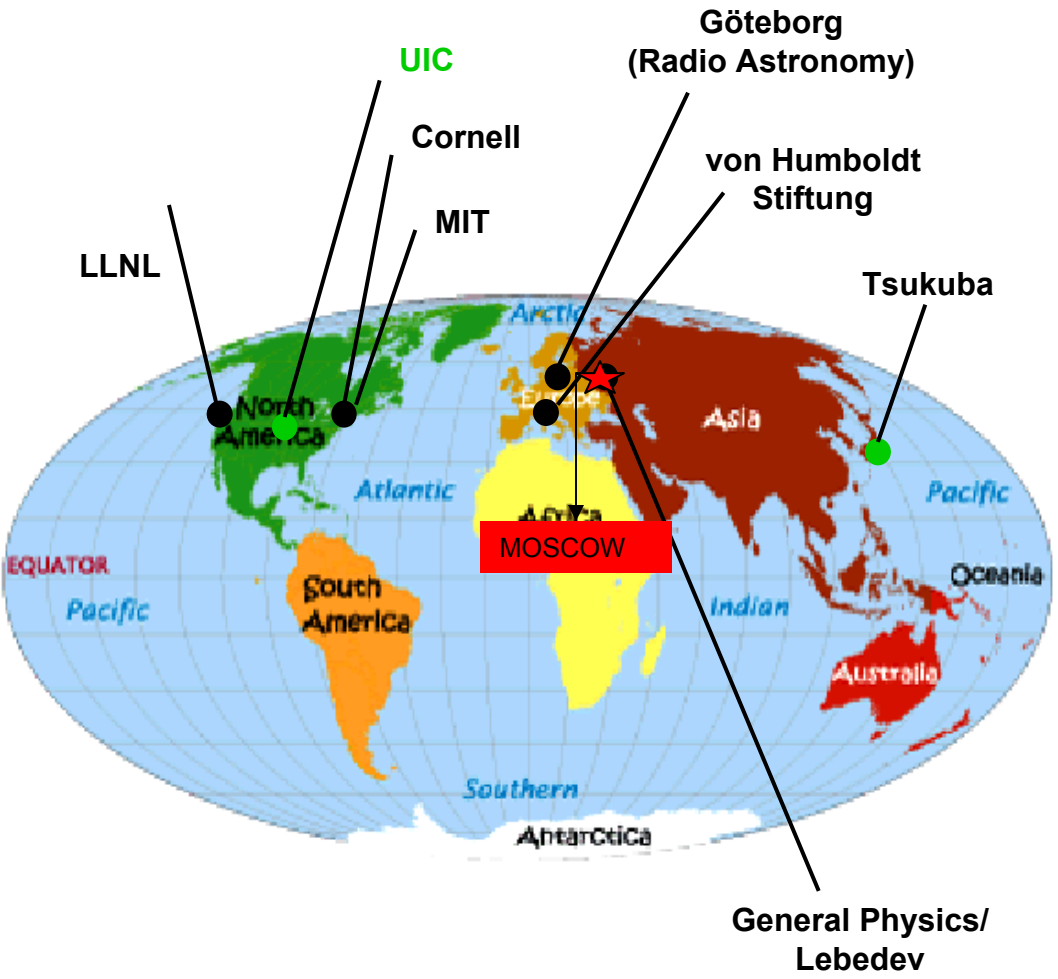
2A1(b)—Opening Remarks: Fourth International Quantum Electronics Conference

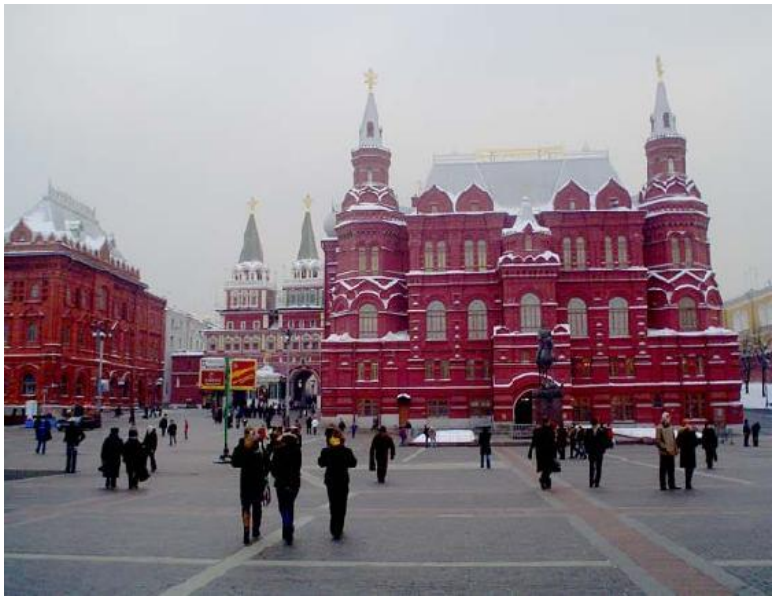
N. G. BASOV

LLNL / SPRING 1972
LLNL / BECHA 1972 a.

RUSSIA

Россия

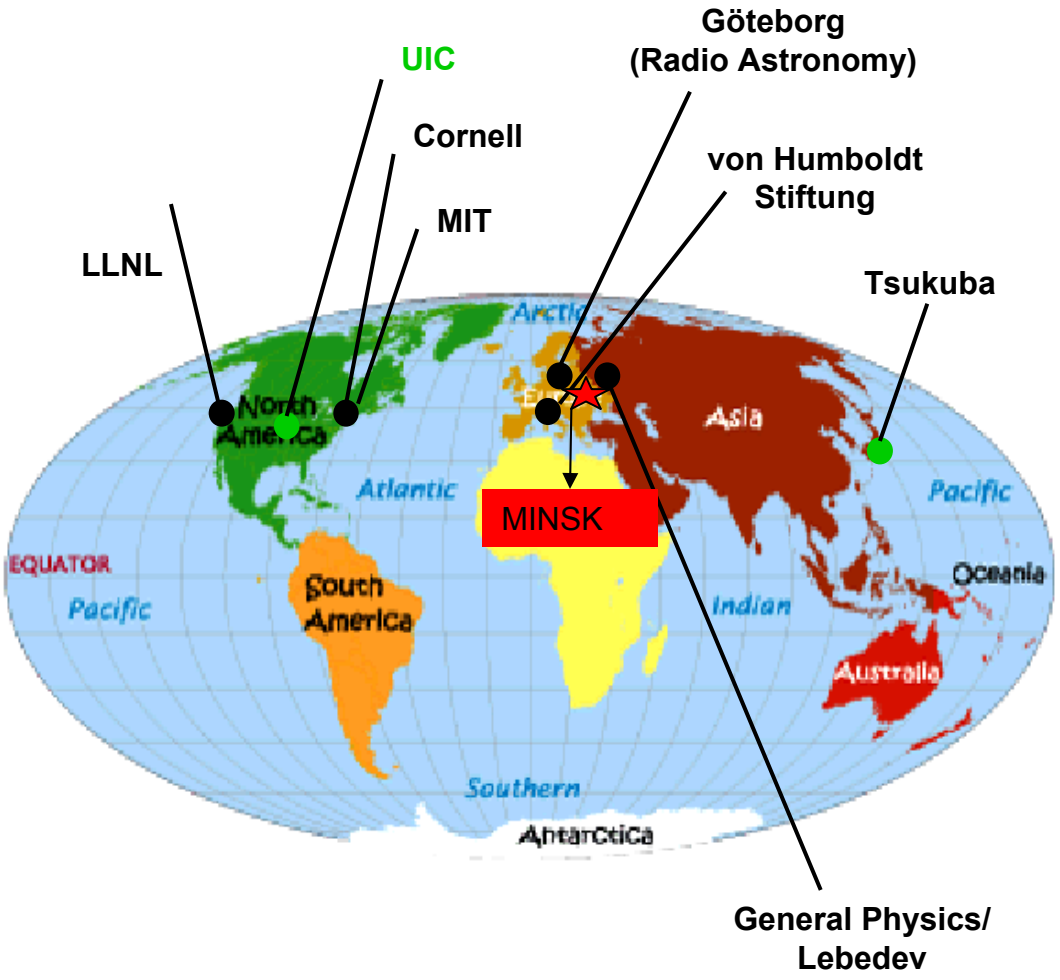




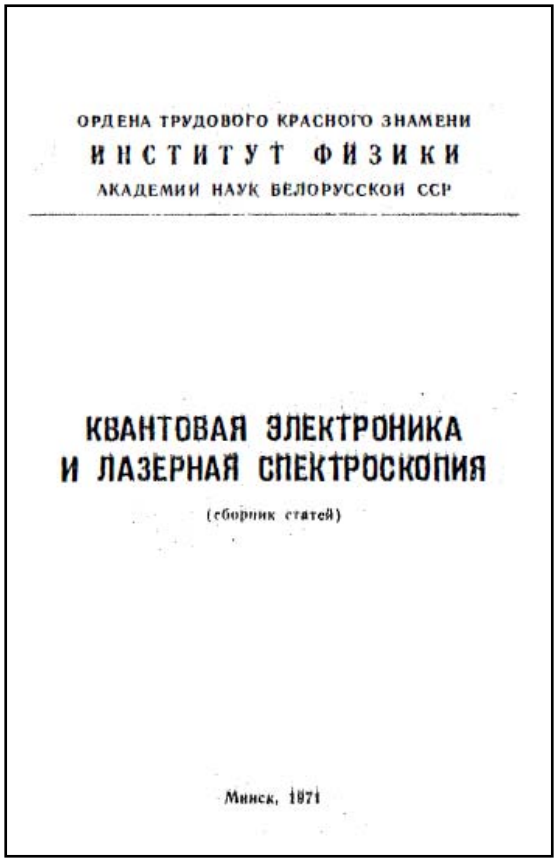
RED SQUARE, MOSCOW

КРАСНАЯ ПЛОЩАДЬ, МОСКВА

1972 / First Russian Conference



MINSK / JULY 1972

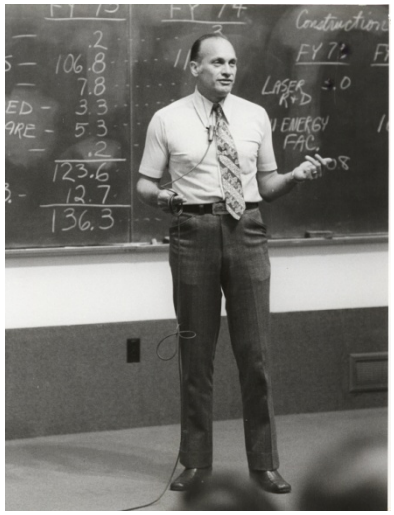

ОРДЕНА ТРУДОВОГО КРАСНОГО ЗНАМЕНИ
ИНСТИТУТ ФИЗИКИ
АКАДЕМИИ НАУК БЕЛОРУССКОЙ ССР

КВАНТОВАЯ ЭЛЕКТРОНИКА
И ЛАЗЕРНАЯ СПЕКТРОСКОПИЯ

(сборник статей)

Минск, 1971

B. I. Stepanov Institute of Physics



Roger Batzel

LLNL Director

Carl Haussmann

Associate Director

ROBERT L. CARMAN

CHARLES K. RHODES

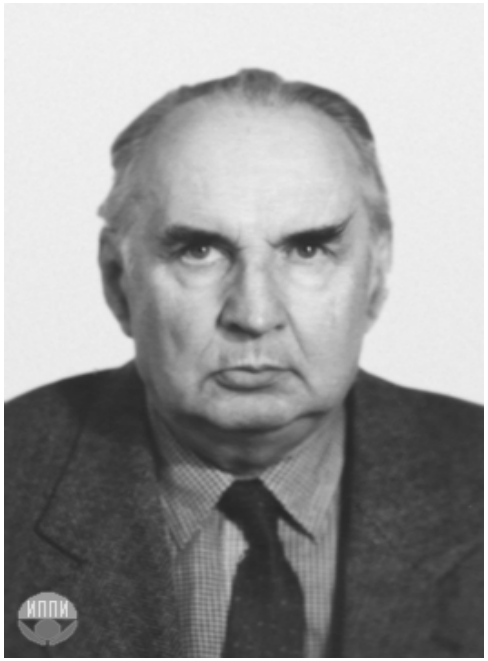
RUSSIA 1972 - 1995

General Physics Institute

ALEXANDER M. PROKHOROV

Director/General Physics Institute, Moscow

Lebedev Physical Institute



Igor' Il'ich Sobel'man

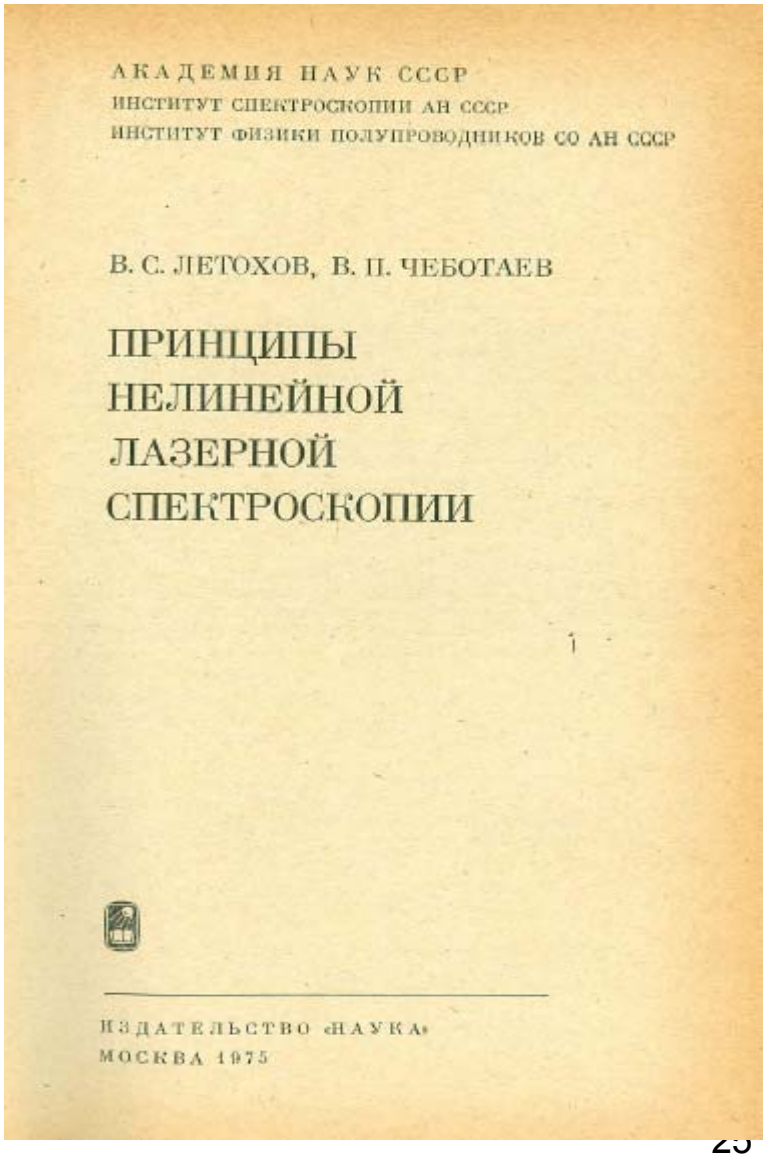
26 January 1927 – 23 November 2005

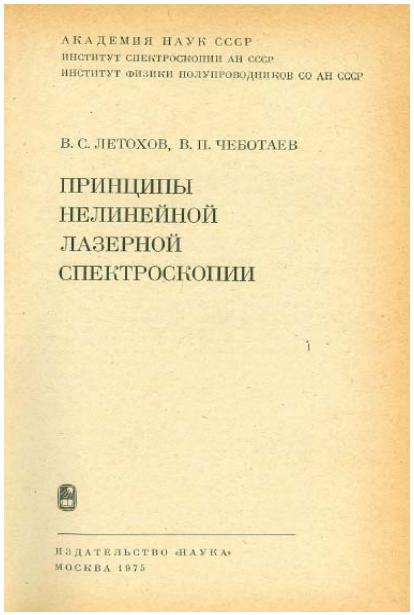
Molecular Laser Isotope Separation

~ 1975

C. Paul Robinson (Los Alamos/Sandia)

V S Letokhov





- "Characteristics and Optimization of the Two-Photon-Excited 16-μm Laser in $^{14}NH_3$," H. Pummer, W. K. Bischel, and C. K. Rhodes, *J. Appl. Phys.* 49, 976 (1978).
- "Measurement of 16-μm Emission of a Two-Photon-Excited Ammonia Laser," H. Flicker, R. F. Holland, W. K. Bischel, H. Pummer, and C. K. Rhodes, *J. Appl. Phys.* 49, 2983 (1978).

EDWARD TELLER with PRESIDENT RONALD REAGAN

SDI Underground Committee

~ 1985 - 1990

RUSSIA

Igor Knyazev

ИГОРЬ КНЯЗЕВ

General Physics Institute (GPI)

Novodevichy Cemetery

Grave of Feodor Chaliapin

Памятник Федору Шаляпину

Grave of Arkadiy Raikin

Памятник Аркадию Райкину

RUSSIA

COVER SHEET FOR PROPOSALS TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATIONAL UNIT (Indicate the most specific unit known, i.e. program, division etc.)		PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE
SUBMITTING INSTITUTION CODE (if known)	FOR RENEWAL ☐ CONTINUING AWARD ☐ ACCOMPLISHMENT BASED RENEWAL ☐ REQUEST, LIST PREVIOUS AWARD NO.:	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? Yes___ No XX IF YES, LIST ACRONYM(S)

NAME OF SUBMITTING ORGANIZATION TO WHICH AWARD SHOULD BE MADE (INCLUDE BRANCH/CAMPUS/OTHER COMPONENTS)
Department of Physics, University of Illinois at Chicago

ADDRESS OF ORGANIZATION (INCLUDE ZIP CODE)
(M/C 273), Box 4348, Chicago, IL 60680

IS SUBMITTING ORGANIZATION: ☐ For-Profit Organization; ☐ Small Business; ☐ Minority Business; ☐ Woman-Owned Business

TITLE OF PROPOSED PROJECT
"Theoretical Investigations of Electromagnetic Propagation of Ultra-Intense Radiation in Plasmas

REQUESTED AMOUNT	PROPOSED DURATION	DESIRED STARTING DATE
310,078	3 years	1 January 1991

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW:

- ☐ Animal Welfare
- ☐ Endangered Species
- ☐ Human Subjects
- ☐ Marine Mammal Protection
- ☐ Pollution Control
- ☐ National Environmental Policy Act
- ☐ Research Involving Recombinant DNA Molecules
- ☐ Historical Sites
- ☐ Interdisciplinary
- XX International Cooperative Activity
- ☐ Research Opportunity Award
- ☐ Facilitation Award for Handicapped
- ☐ Proprietary and Privileged Information

PI/PD DEPARTMENT	PI/PD ORGANIZATION	PI/PD PHONE NO. & ELECTRONIC MAIL
Department of Physics	University of Illinois at Chicago	(312) 996-4868

PI/PD NAME/TITLE	SOCIAL SECURITY NO.*	HIGHEST DEGREE & YEAR	SIGNATURE
Albert A. Michelson Professor of Physics, Charles K. Rhodes	139 30 8306	Ph.D., 1969	
ADDITIONAL PI/PD (TYPED) Keith Boyer	529 03 4646	Ph.D., 1949	Keith Boyer
ADDITIONAL PI/PD (TYPED) Alexander M. Prokhorov		1939	See Appendix D for signature
ADDITIONAL PI/PD (TYPED) V. V. Korobkin		Ph.D., 1967	See Appendix D for signature
ADDITIONAL PI/PD (TYPED)			

For NSF Use:

TO BE COMPLETED BY THE AUTHORIZED ORGANIZATIONAL REPRESENTATIVE. By signing and submitting this proposal, the prospective grantee is providing the certifications set forth in (1) *Grants for Research and Education in Science and Engineering*, NSF 83-57 (rev. 11/87), and (2) Appendix C, 45CFR 620, Subpart F (Requirements for a Drug-Free Workplace).

(If answering yes to either, please provide explanation.)	YES	NO
Is the organization delinquent on any Federal Debt?		
Is the organization presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?		

AUTHORIZED ORGANIZATIONAL REP. NAME/TITLE (TYPED)	SIGNATURE	DATE	TELEPHONE NO.
Karen R. Hitchcock, Vice Chancellor for Research	Karen R. Hitchcock	7/12/90	
OTHER ENDORSEMENT (optional) NAME/TITLE (TYPED)			

*Submission of social security numbers is voluntary and will not affect the organization's eligibility for an award. However, they are an integral part of the NSF information system and assist in processing the proposal. SSN solicited under NSF Act of 1950, as amended

NSF Form 1207 (3/89)

1990

Dr. Keith Boyer

Founding Director of LANL Laser Program

APPENDIX C

АКАДЕМИЯ НАУК

СОЮЗА СОВЕТСКИХ СОЦИАЛИСТИЧЕСКИХ РЕСПУБЛИК

ACADEMY OF SCIENCES OF THE USSR

Москва, В-71
Ленинский проспект, 14
Телефон: 232-29-10
Телекс: 7564 ANS SU
Для телеграмм: Москва В-71
Наука

Moscow V-71
Leninski prospect, 14
Telephone: 232-29-10
Telex: 7564 ANS SU
Cable: Moscow V-71, Nauka

_____№_____

National Science Foundation
Washington, D.C. 20550

NSF Division of Physics

Proposal-processing Unit-Room 223
Attention: US-USSR Cooperative Science Program

The administration of the USSR Academy of Science submits to the National Scientific Foundation the proposal for the Cooperative Research in Theoretical Physics / Theoretical Atomic, Molecular, Optical and Plasma Physics in the framework of the project "Theoretical Investigation of the Nonlinear Propagation of Intense Ultrashort Laser in Plasmas". It considers this project to be of utmost importance for basic physics.

The joint research will be conducted within three years (from January 1991 till December 1993) by the investigators from the University of Illinois, Chicago (C.K. Rhodes and K. Boyer), the General Physics Institute of the USSR Academy of Science (A.M. Prokhorov, V.V. Korobkin, A.V. Borovskiy) and the Moscow State University Research Computer Center (A.B. Borisov, O.B. Shiryaev). This fundamental research will make a contribution to the new area of quantum electronics related to the the nonlinear optics of intense ultrashort laser pulses. The main goal of this research is

to develop the new theory describing completely the propagation of this kind of pulses in material mediums (in particular in plasmas). It should be emphasized that nowadays such a theory is of fundamental significance for the theoretical physics. As a part of this project new mathematical methods and software based on this theory will be designed for computer simulation of the propagation of intense ultrashort laser pulses in matter and a set of appropriate computations will be carried out.

The scientific knowledge of the participants and the resources of both sides complement each other fortunately and this gives reasons to think that the present cooperative project will result in essential progress in modern quantum electronics and both sides will benefit from it.

The administration of the USSR Academy of Science will as far as possible support this cooperative research.

Sincerely yours

Alexander M. Prokhorov

Academician

Chairman, the Department of General Physics and Astronomy of the USSR Academy of Science

Director, General Physics Institute of the USSR Academy of Science

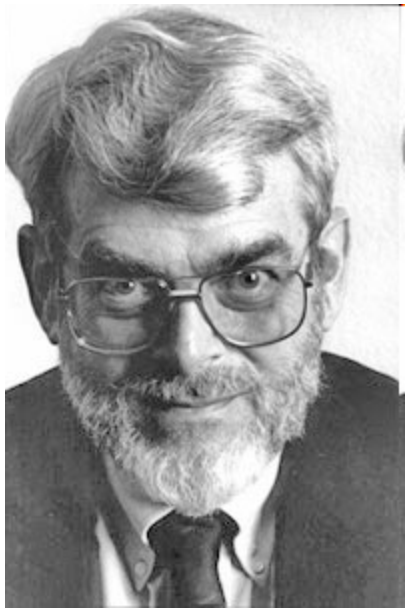
IEEE JOURNAL OF QUANTUM ELECTRONICS, VOL. 25, NO. 12, DECEMBER 1989

Prospects for X-Ray Amplification with Charge-Displacement Self-Channeling

JOHNDALE C. SOLEM, TING SHAN LUK, KEITH BOYER, AND CHARLES KIRKHAM RHODES, FELLOW, IEEE

(Invited Paper)

Abstract—We develop an analytic theory of charge-displacement self-channeling: a mechanism that can dynamically trap a short intense pulse of light. We focus our attention on the case of most interest for X-ray amplification: the strongly saturated channel, for which all free electrons are expelled from the channel core and the channel walls are overdense. Some curious results are: 1) the intensity at the channel walls is independent of the total laser power, 2) the radius of the channel increases very slowly with laser power, asymptotically as the fourth root, and 3) the power in the channel wall is a constant. The channel is energetically stable in the sense that a bifurcation will cause a net increase in the electrostatic potential energy, but is only marginally stable against relativistic filamentation in the walls. We also find that the channel is an effective waveguide for all secondary radiation. Scaling studies show a substantial advantage exists by using the highest frequency driving laser available. Since very large energy-deposition rates from multiphoton coupling are expected, the channel is ideal for generating coherent short-wavelength radiation, perhaps well into the X-ray range.



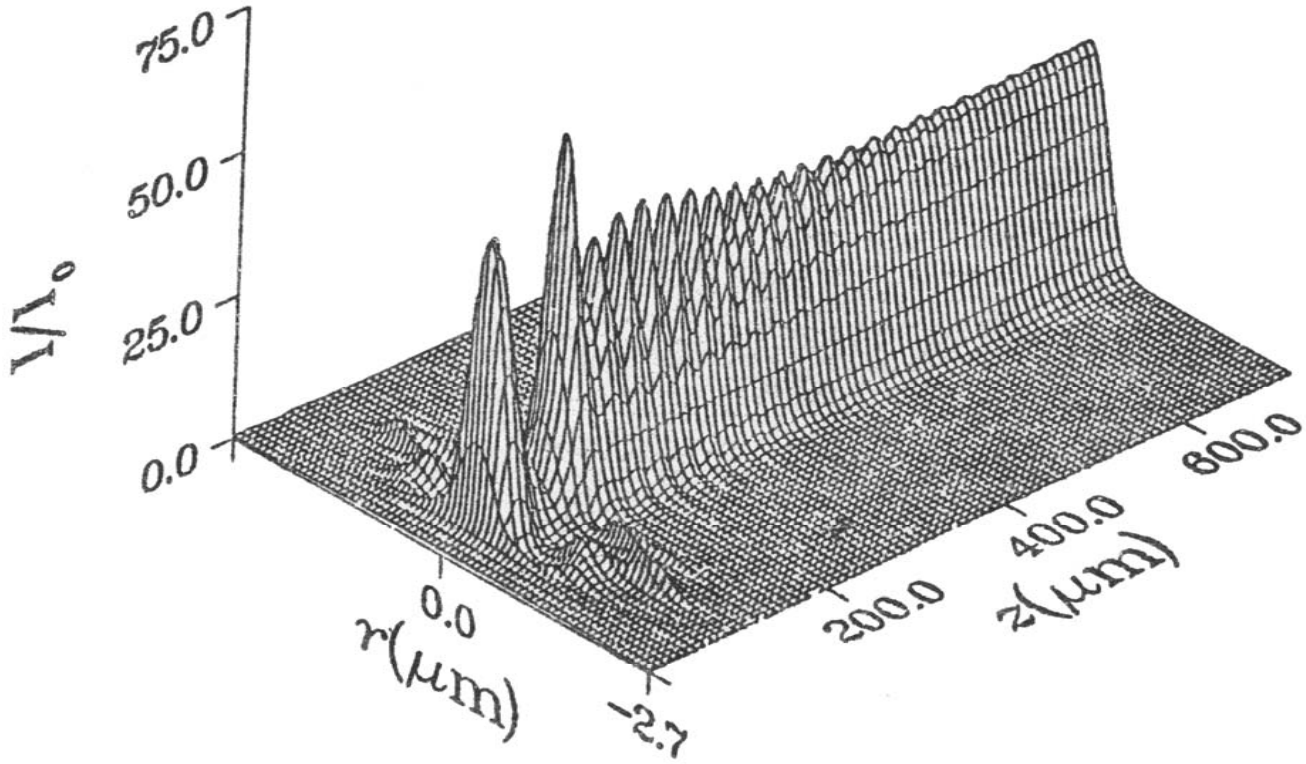
Johndale C. Solem

1989

***LANL Robert Oppenheimer* Chair**

Russian Academy – UIC Exchange Program

First Results



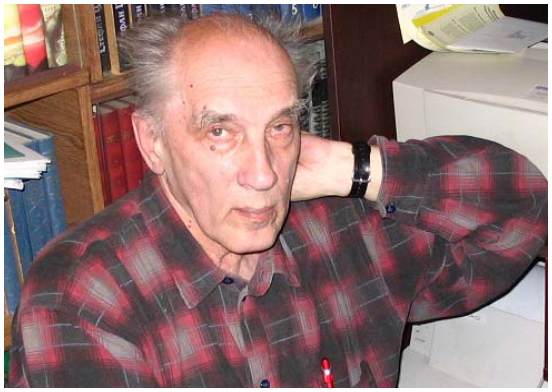
Alex Borisov

First Calculations of Focusing Dynamics 1990 - 91

- **Channels would form**
- **Revealed the mechanism**

Russian Academy – UIC Exchange Program

Alexander Prokhorov



V. V. Korobkin

Mikhail Romanovsky

Alex Borisov

Oleg B. Shiryaev

VOLUME 68, NUMBER 15 PHYSICAL REVIEW LETTERS 13 APRIL 1992

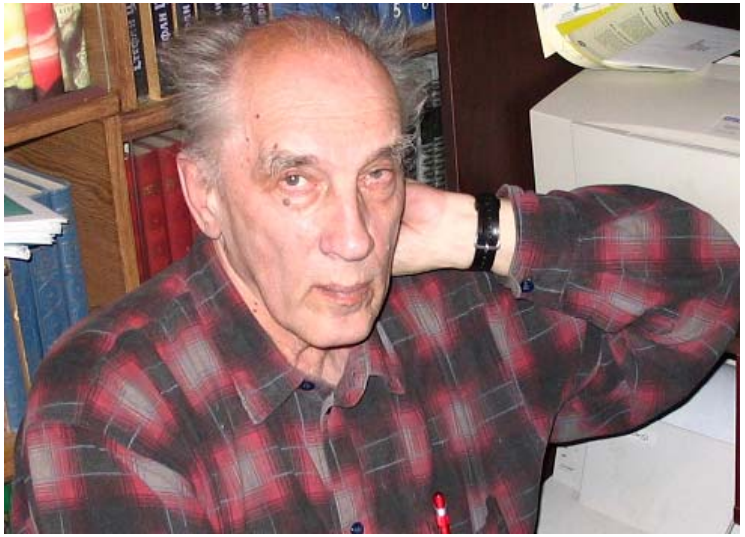
Observation of Relativistic and Charge-Displacement Self-Channeling of Intense Subpicosecond Ultraviolet (248 nm) Radiation in Plasmas

A. B. Borisov,[1] A. V. Borovskiy,[2] V. V. Korobkin,[2] A. M. Prokhorov,[2] O. B. Shiryaev,[1] X. M. Shi,[3] T. S. Luk,[3] A. McPherson,[3] J. C. Solem,[4] K. Boyer,[3] and C. K. Rhodes[3]

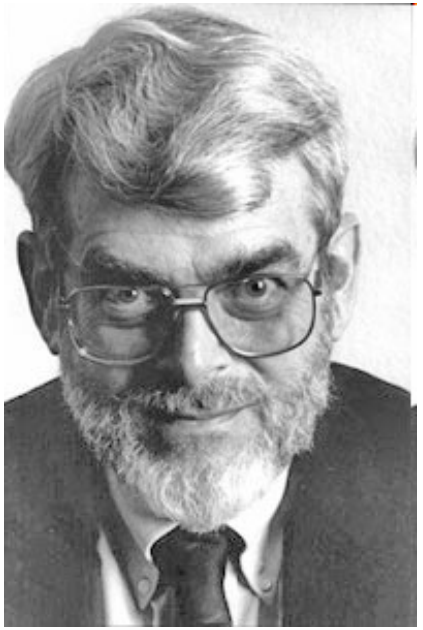
[1]*Laboratory for Computer Simulation, Research Computer Center, Moscow State University, Moscow, 119899, Russia*
[2]*General Physics Institute, Academy of Sciences of Russia, Moscow, 117942, Russia*
[3]*Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680*
[4]*Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545*

(Received 13 November 1991)

Aleksander M. Prokhorov



V. V. Korobkin



Johndale C. Solem

Original Observation

VOLUME 68, NUMBER 15 PHYSICAL REVIEW LETTERS 13 APRIL 1992

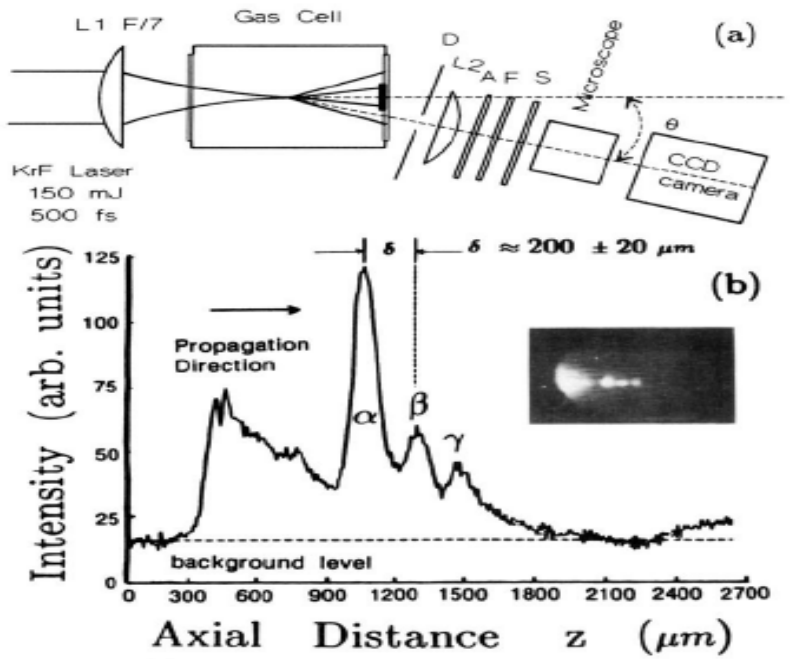


FIG. 1. (a) Experimental apparatus used in studies of propagation. See text for description. (b) Data concerning the pattern of propagation observed with a single pulse in N_2 at a density of $\sim 1.35 \times 10^{20}$ cm^{-3}. The maximum intensity is half the detector (CCD) saturation. The radiation is incident from the left. Inset: Photographic data with a vertical spatial resolution of ~ 10 μm. The graph illustrates the one-dimensional axial profile taken along the direction of propagation (z) of the photographic data (inset). The spacing of the maxima, $\delta = 200 \pm 20$ μm, is indicated.

EXCEPTIONAL SIGNIFICANCE

- **Heralds years of important future results**

Samarkand, Uzbekistan / May 1990

ИЗВЕСТИЯ АКАДЕМИИ НАУК СССР

Т. 55, № 4 СЕРИЯ ФИЗИЧЕСКАЯ 1991

УДК 533.8

Т. С. ЛУК, А. МАКФЕРСОН, Г. И. ГИБСОН, К. БОЕР,
Ч. К. РОУДС

ИССЛЕДОВАНИЯ МОЛЕКУЛЯРНЫХ *X*-ЛАЗЕРОВ *

Предложена новая концепция молекулярного *X*-лазера. Она включает: 1) новую субпикосекундную лазерную технологию сверхвысокой яркости; 2) недавно открытый механизм возбуждения молекул в сильном поле; 3) новый режим каналированного распространения лазерного импульса. Молекулярный подход позволяет достичь высокого уровня возбуждения в плотной холодной среде и осуществить перестройку частоты *X*-лазера.

First Observation of Cluster X-Ray Production

Multiphoton-induced X-ray emission at 4–5 keV from Xe atoms with multiple core vacancies

A. McPherson, B. D. Thompson, A. B. Borisov, K. Boyer & C. K. Rhodes

Department of Physics (M/C 273), University of Illinois at Chicago, 845 West Taylor Street, Chicago, Illinois 60607–7059, USA

SEVERAL recent experimental findings[1–3] have pointed to a possible route for making an X-ray laser, which could in principle provide an imaging system capable of molecular resolution[4]. The method involves the multiphoton excitation of atoms in van der Waals clusters or in molecules to yield ions with core-electron vacancies[1,2], which can then decay by emission of X-rays, in conjunction with a self-chanelling propagation mode of electromagnetic radiation[3]. The multiphoton excitation may be stimulated by ultrahigh-brightness, subpicosecond pulses of laser light[5]. We have previously observed[2] emission of X-rays from L-shell transitions in core-excited krypton atoms using this approach. Here we report the multiphoton production of X-rays of wavelength 2–3 Å from highly ionized xenon atoms which possess a large number of inner-shell vacancies while retaining several electrons in relatively weakly bound outer orbitals. Atoms with this 'inverted' electronic configuration are designated 'hollow atoms'[6,7]. We find that generation of hollow atoms can become the dominant excitation mode

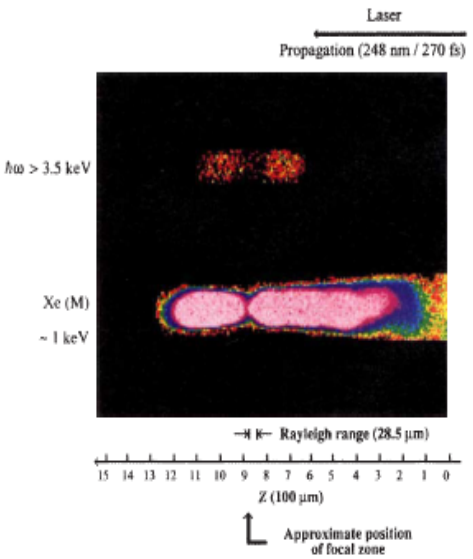
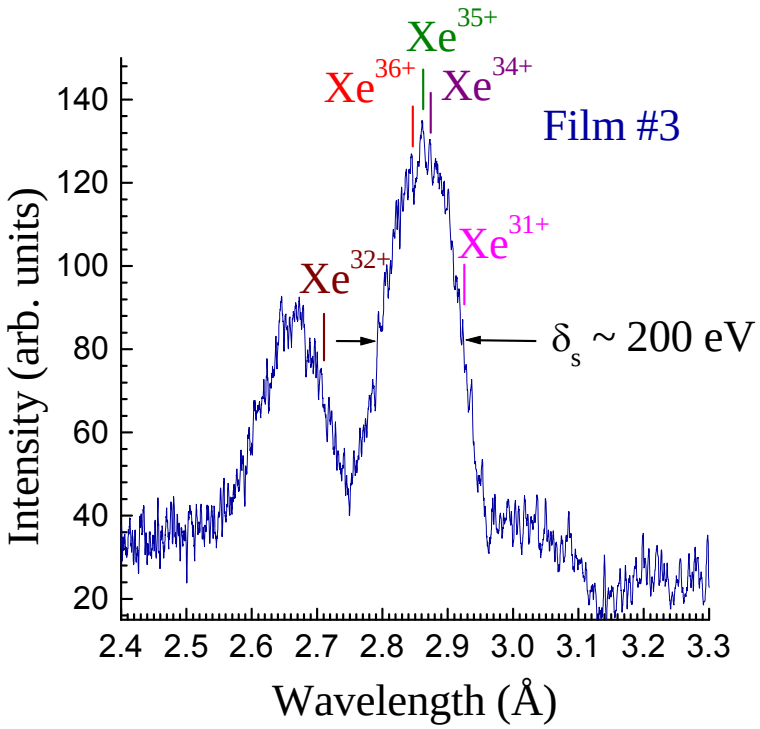
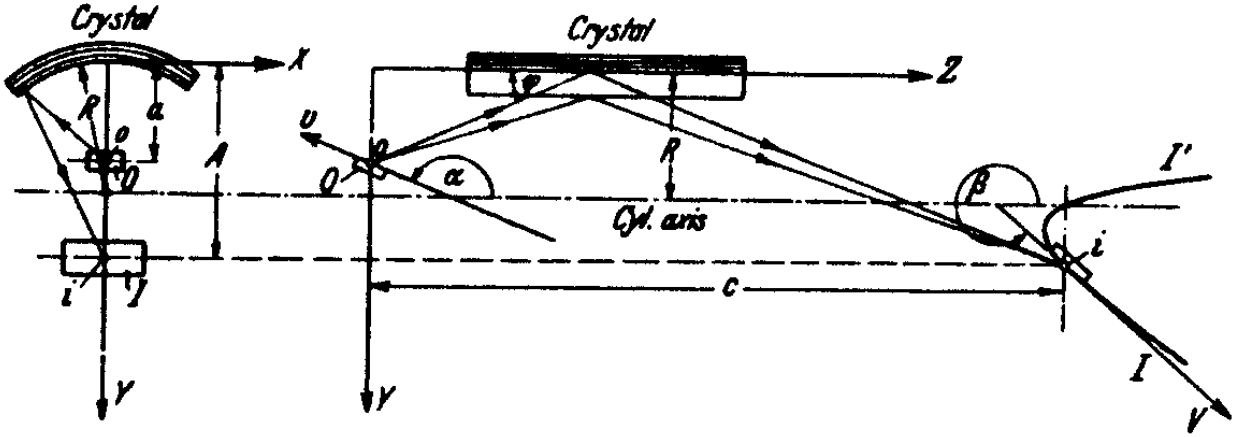


FIG. 1 X-ray images produced by a single exposure with the double pinhole camera. The upper and lower pinholes correspond to the Xe(L) and Xe(M) emissions, respectively. The pinholes had a diameter ~100 μm, limiting the spatial resolution to that value. The stagnation pressure of the pulsed jet was 75 pounds per square inch above atmospheric pressure and the temperature of the nozzle was 233 K. The approximate location of the focal region is indicated along with the corresponding Rayleigh range of the focusing system ($f/3$). The more restricted spatial distribution of the shorter wavelength emission ($\hbar\omega_x > 3.5$ keV) is expected, as significantly higher intensities are needed for the L-shell excitation relative to those required for the corresponding M-shell excitation[1,2]. Intensity grey scale is presented in pseudocolour.



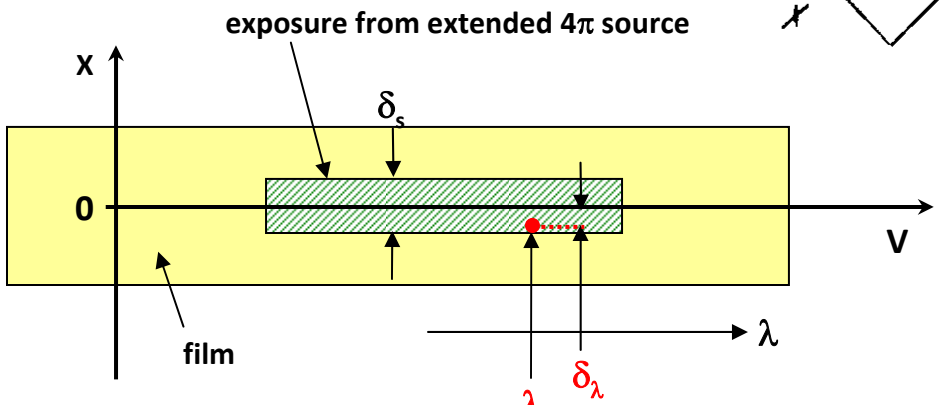
Xe(L) ~ 4.5 keV

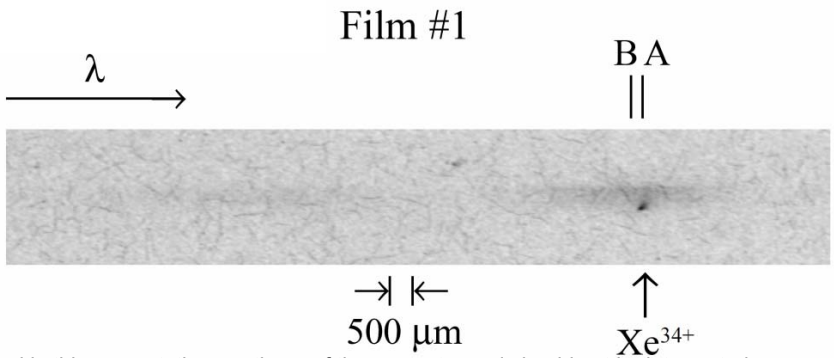
Detailed Geometry of the von Hámos Crystal Spectrometer



P.N. Lebedev Physical Institute of the Russian Academy of Science

Alexander Petrovich Shevel'ko

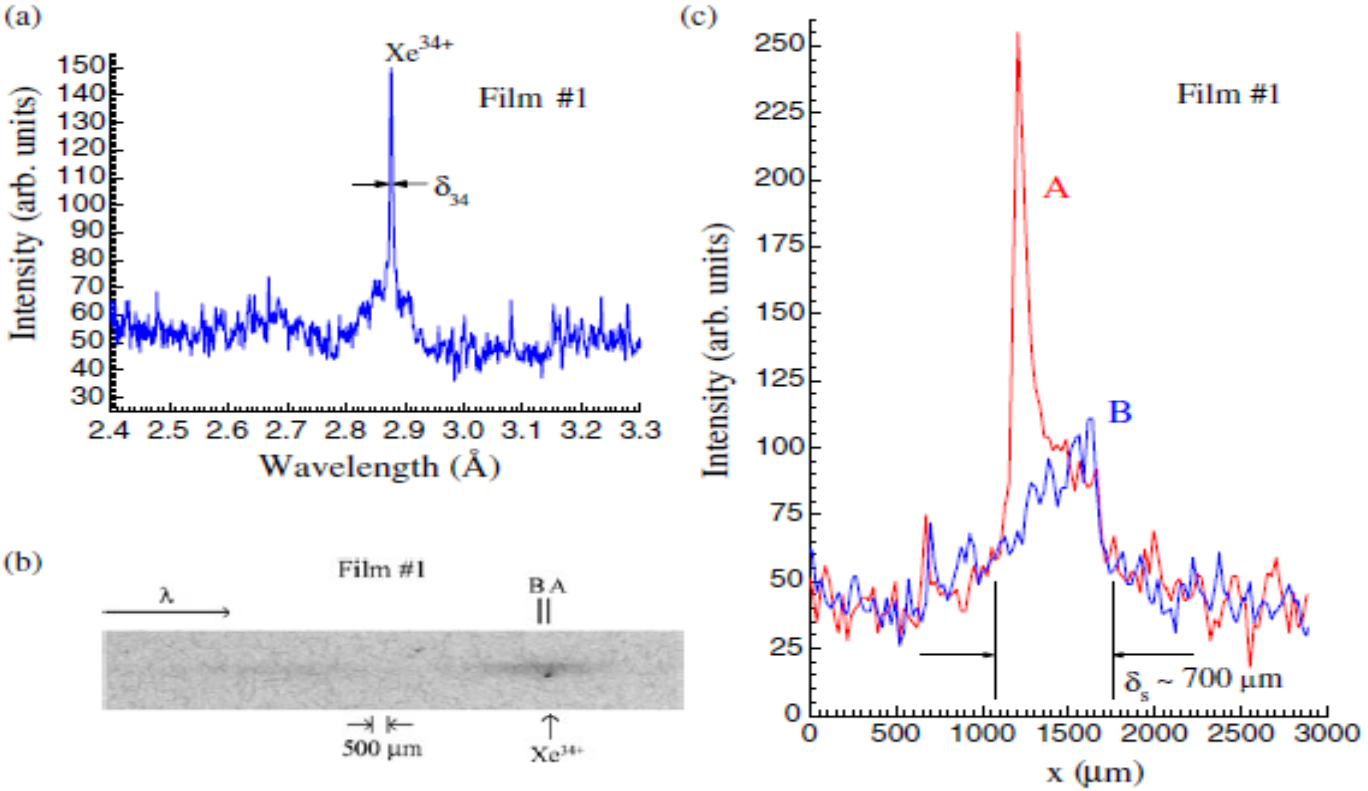




INSTITUTE OF PHYSICS PUBLISHING JOURNAL OF PHYSICS B: ATOMIC, MOLECULAR AND OPTICAL PHYSICS
J. Phys. B: At. Mol. Opt. Phys. 36 (2003) 3433–3455 PII: S0953-4075(03)60402-5

Ultrabright multikilovolt coherent tunable x-ray source at $\lambda \sim 2.71$–2.93 Å

Alex B Borisov[1], Xiangyang Song[1], Fabrizio Frigeni[2], Yevgeniya Koshman[3], Yang Dai[3], Keith Boyer[1] and Charles K Rhodes[1,2,3,4,5]

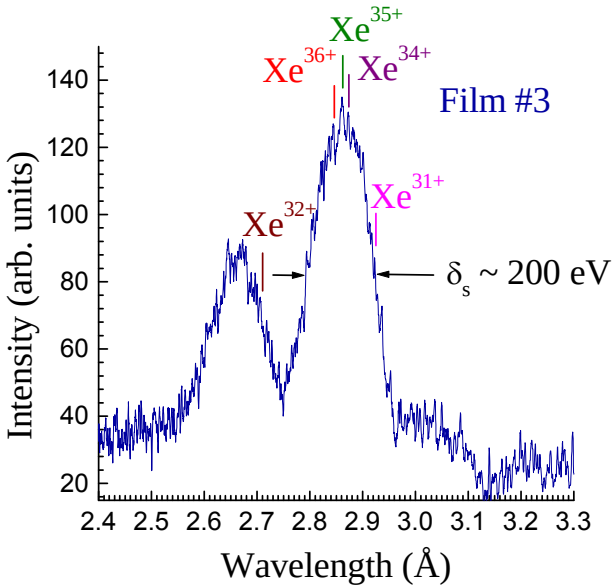


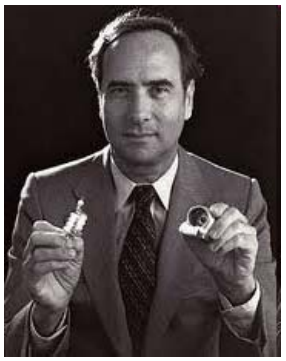
First observation of amplification at 2.85 Å

Xe(L) Amplification

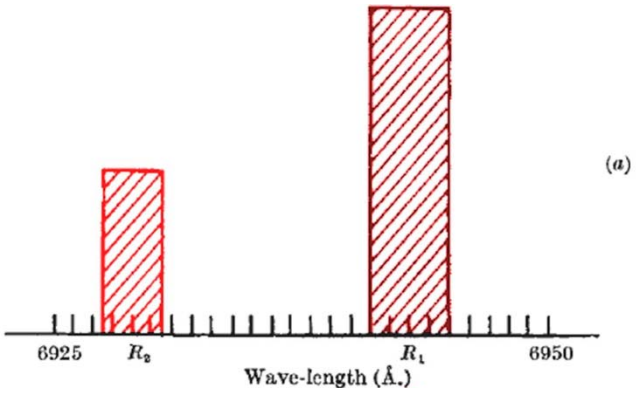
Xe(L)

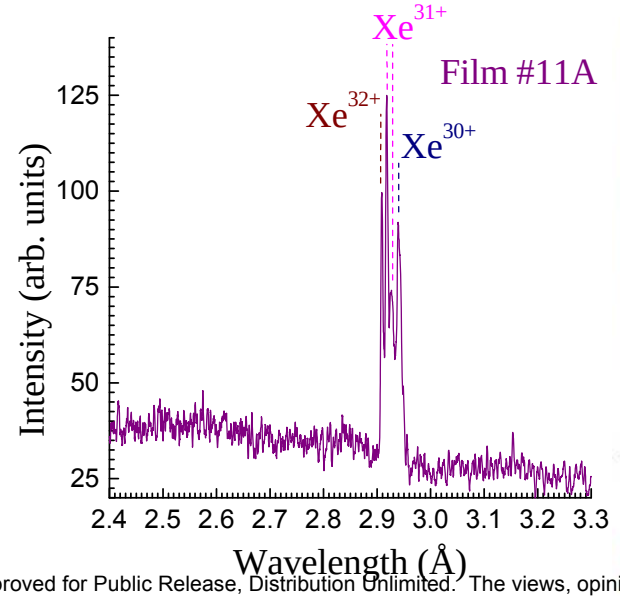
Ruby

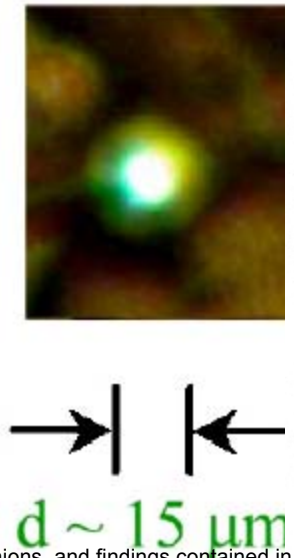




T. H. Maiman







International Science and Technology Center
Executive Summary Page

Date Received: (Center Use Only) [redacted]

ISTC No. (Center Use Only) [redacted]

Title: "Civilian Application of Ultrabright Laser Produced X-Ray Sources"

Proposing Institutions: Univ. of IL at Chicago (U.S.)
Lebedev Phys. Institute in Moscow

Proposing Spokesperson: Dr. Charles K. Rhodes (U.S.)
Dr. I. I. Sobel'man (Russia)

Address: UIC, Physics Dept. (M/C 273)
801 W. Taylor St., Room 2136
Chicago, IL 60607-7059 (U.S.)

U.S. Institution:

Telephone: (312) 996-4868

FAX: (312) 996-8824

	YR 1	YR 2	YR3
Total Cost:	135,838	154,513	138,283
Funds from ISTC:	———	———	———
From Other Sources:	1,029,000	approx. 1,000,000	approx. 1,000,000

Project Duration: Three Years

Project Site: UIC Physics Dept. (U.S.)
Lebedev Physical Inst. (Russia)

Facilities: High power femtosecond laser technology (U.S.)
X-Ray spectroscopy technology (Russia)

Equipment: XUV and x-ray spectrographs, microphotometer, XUV and x-ray optical elements, computers

Proposal Summary

New heretofore unstudied states of plasmas, embodying both high electron density and exceptionally high specific power densities, can be produced with modern femtosecond laser technology. Preliminary experiments have shown that such plasmas are unusually powerful sources of radiation in the x-ray range. This radiation can be used for both (1) basic studies of this new high-density plasma and (2) a range of important applications involving condensed matter. Among the most significant applications foreseen is the development of a high-resolution microholographic imaging technology applicable to structural assays of living material for biology and medicine and an understanding of the detailed structure of advanced materials. The scientific expertise and technologies necessary to advance this new area of research are assembled in a complementary fashion by the joint participation of two internationally prominent groups, one at the Lebedev Physical Institute in Moscow, in cooperation with the Institute of Applied Physics (Nizhny Novgorod), and the other at the University of Illinois at Chicago. The former represents extensive experience in x-ray spectroscopic instrumentation and relevant theoretical aspects of plasma dynamics while the latter provides advanced high-power laser technology and broad experience in applying it to the study of physical interactions. This effort unites these two groups in a collaborative program which mobilizes the research toward important peaceful endeavors. We foresee the development of attractive career opportunities in the civilian sector for all participants with the proposed program.

Participants:	Dr. Charles K. Rhodes, Director - Laboratory for Atomic, Molecular & Radiation Phys.	Dr. I. I. Sobel'man, Director - Optical Division
Affiliation:	University of Illinois at Chicago	Lebedev Physical Institute in Moscow
Speciality:	Plasma and Atomic Physics, Laser Technology	Atomic and Plasma Physics, Optics, Spectroscopy

(continued on Page 2)

Appendix F

P.N. LEBEDEV PHYSICAL INSTITUTE
ACADEMY OF SCIENCES
Физический институт имени П.Н.Лебедева
Leninsky Prospect 53, 117924 Moscow
Cable: Moscow V-333 FIAN
Tel: 135-22-50, Telex: 411479 NEOD SU
Fax: (095) 135 7880/938 2251
Email: OSPEC@SCI.FIAN.MSK.SU

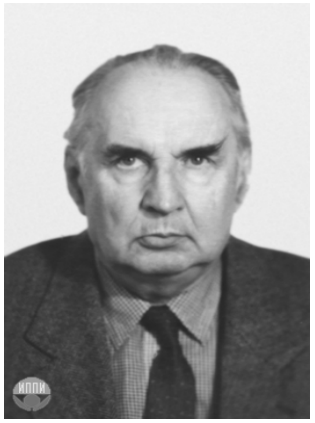
International Science and Technology Center
[Approval of the project proposal]

The administration of the P.N.Lebedev Physical Institute of Russian Academy of Sciences submit to the International Science and Technology Center the proposal for the joint research entitled "XUV Spectroscopy of LLP at Extremely High Power Inputs"

The joint research will be carried out during two years (from January 1993 till December 1994 by the investigators from University of Illinois at Chicago (Prof. C.K.Rhodes and coworkers) and from the Optical Division of Lebedev Institute (Prof. I.I. Sobelman and coworkers) with participation of the scientists from the Institute of Applied Physics (Nizhny Novgorod).

The proposed project is based on the leading directions of research of the Optical Division of Lebedev Institute which are connected with modern applications of atomic spectroscopy. The development of the project will be of great interest for the Lebedev Institute and the administration of the Institute will support the efforts of participants.

92

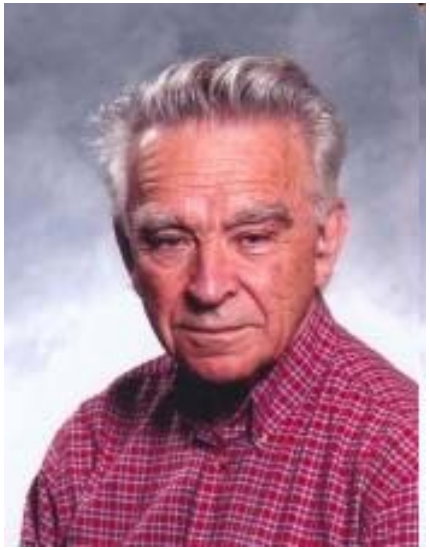


Igor' Il'ich Sobel'man

The scientific expertise of the participants from both sides promise the new fundamental scientific results.

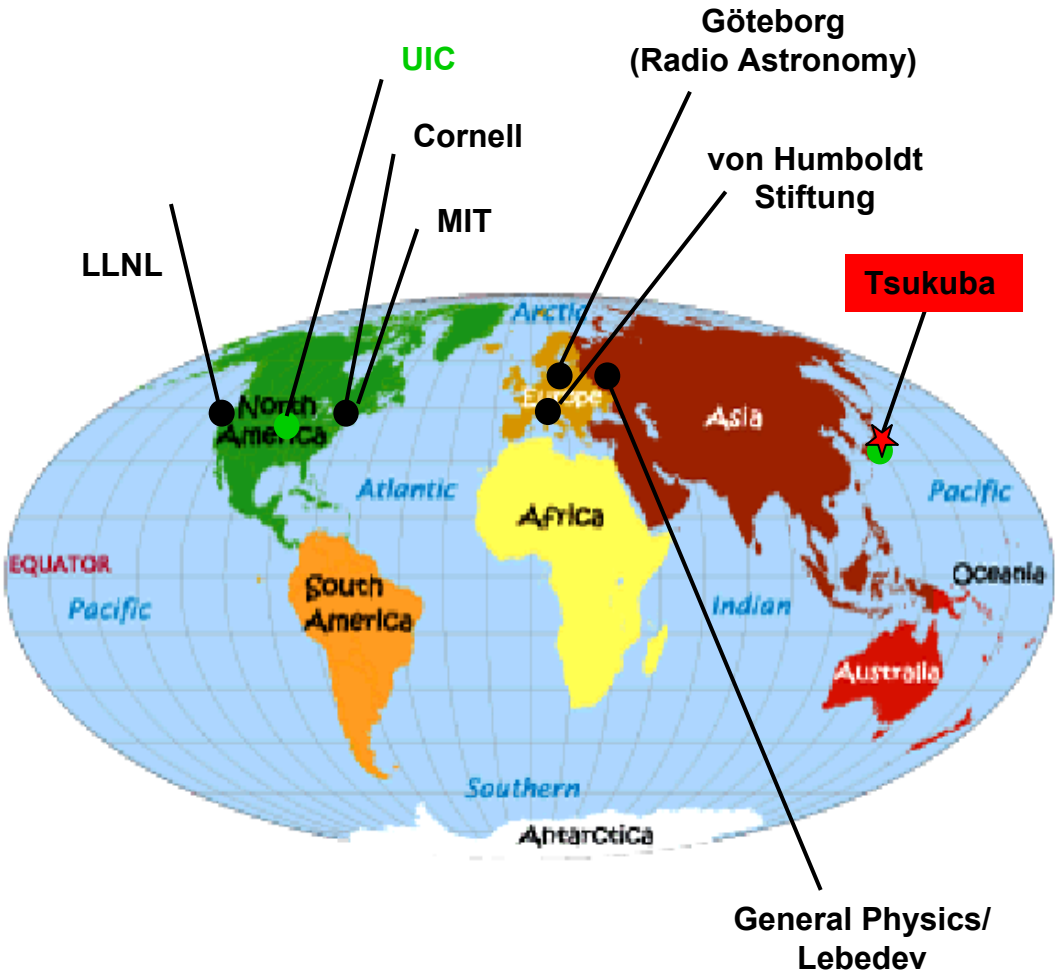
Director
of the Lebedev Physical Institute
academician L.V.Keldysh

Academician-Secretary
of the General Physics and Astronomy
Department of the Russian Academy of
Sciences



L. V. Keldysh

JAPAN 1996 - 2000



TARA / Japan 1996 - 98

TARA

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2011 Kansai / Nara　年関西/奈良

РУССКО-ЯПОНСКИЙ
СЛОВАРЬ
Изд-ва «Кэнкюся»

Под редакцией
М. Того, С. Сомэя,
Т. Исоя, С. Исияма

研究社露和辞典

編　者

東郷正延・染谷　茂
磯谷　孝・石山正三

ИЗДАТЕЛЬСТВО «КЭНКЮСЯ»

Гении

Emil Gilels

Эмиль Гилельс

Sviatoslav Richter, ca. 1935

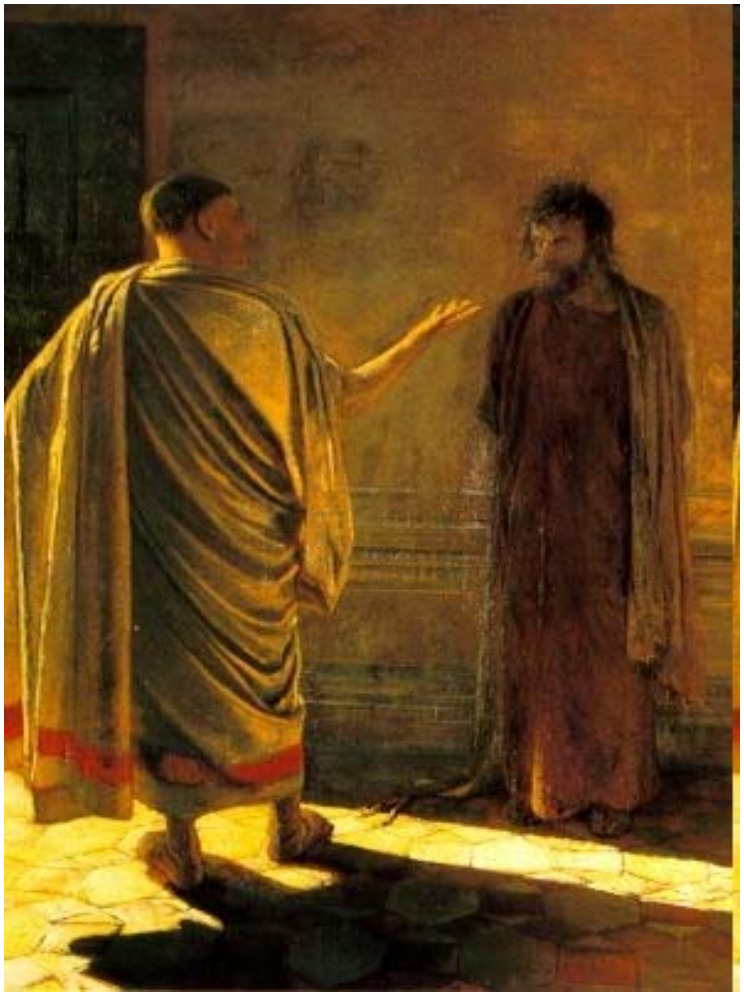
Святослав Рихтер

Гении

Performance: Rachmaninoff: Prelude No 5 in G minor Op 23, USSR, 1943

Commentary by: Evgeny Kissin

Что есть истина?



Христос и Пилат, Николай Николаевич Ге, 1890 г. (“What Is Truth?” Christ and Pilate, by Nicolaĭ Ge, 1890)

ЧТО ЕСТЬ НАШ ВЫВОД ?