University of Zurich[UZH]

Department of Physics

Annual Report and Highlights 2023

Winterthurerstrasse 190, CH-8057 Zurich, Switzerland

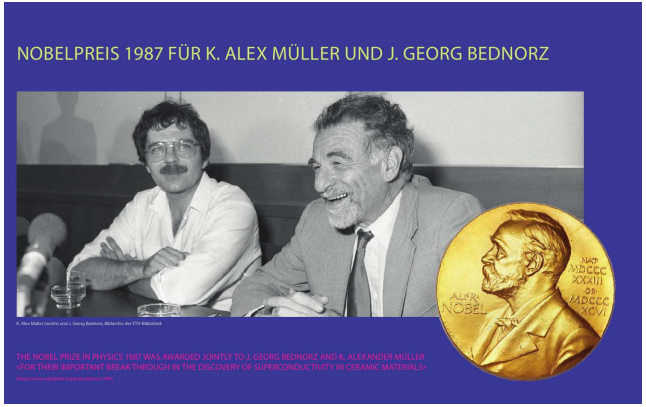
Preface

Thomas Gehrmann, Department Head

With a total of 24 research groups, the Department of Physics of the University of Zurich covers a variety of subfields of physics. Experimental activities include particle and astroparticle physics, hard and soft condensed matter physics, surface physics and nanoscience, as well as the physics of biological systems. Theoretical groups work on precision calculations of processes in quantum chromodynamics and new theories beyond the standard model of particle physics, astrophysics and general relativity, as well as topological concepts in condensed matter physics. Other physics-related groups from within the Faculty of Science and beyond are affiliated to our department, and our home page gives links to their research. Together, we can offer a broad and high quality spectrum of lecture courses as well as Bachelor, Master and semester projects to our students. The infrastructure department consisting of excellent mechanical and electronics workshops. Efficient IT and administrative support teams complete our attractive research environment.
https://www.physik.uzh.ch/en/research.html

During the year 2023, the refurbishment of the laboratory building 56 of the Physik-Institut was completed. The new building offers state-of-the-art clean-room facilities and extra laboratory space for various groups. A major initial usage of the clean-room will be the assembly of the central silicon detectors for the high-luminosity phase of the CMS experiment at CERN. In the medium term, building 56 could become home to the planned DEMETER center, which is a joint initiative with colleagues at PSI to foster detector development for applications in various subfields of physics.

The start of the year was marked by the passing of our former colleague K. Alex Müller, who died on January 9, 2023 at age 95. The eminent physicist was awarded the 1987 Nobel Prize in Physics with J. Georg Bednorz for the discovery of high-temperature superconductivity. K. Alex Müller was both a professor at the University of Zurich and a fellow at the IBM Research Laboratory in Rüschlikon. In his honour, our department set up an exhibition on high-temperature superconductivity and its applications in Irchel Lichthof during the fall semester. The display was very well-received by stud-



Exhibition in the Lichthof at Irchel campus to honour Nobel Laureate K. Alex Müller.

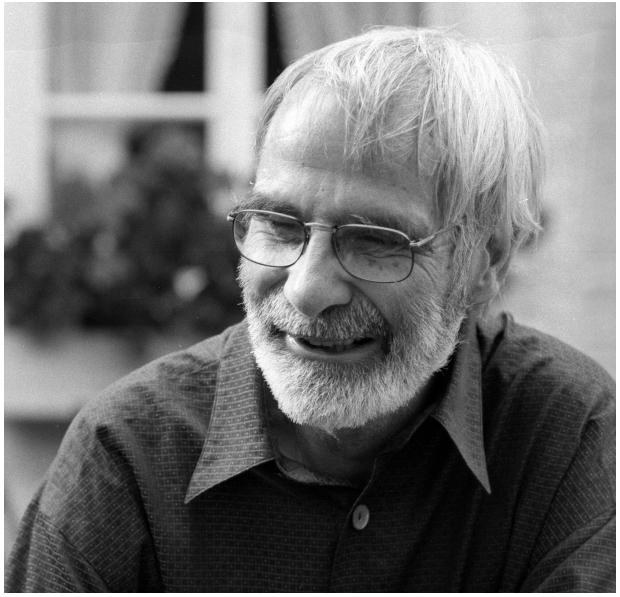
ents and academics from all faculties. We also co-organized a festive symposium that brought together friends and colleagues of K. Alex Müller, sharing recollections of their joint work and highlighting its lasting impact and present-day relevance.

In 2023, our department was very happy to welcome two new research groups in theoretical physics: Max Zoller and Tomáš Bzdušek both obtained SNSF Starting Grants and joined our institute as assistant professors. Max Zoller and his group perform precision calculations in particle theory, while Tomáš Bzdušek and his group investigate topological phases and related phenomena.

Our department made substantial contributions to community-building and outreach events such as our traditional hiking day or the christmas dinner for the members of our institute and various events for high-school students including specific workshops and the participation in the international masterclasses in particle physics. Finally, our institute organised an open day and contributed to the Scientifica 2023 with an exhibit on the basic building blocks of matter, with guided visits to the XENOSCOPE facility, a fun show on physical effects and with an astronomy theatre performance.

This booklet aims give a broad idea of the wide range of research pursued in our department and refers the more interested reader to the research websites. Presenting individual highlights with pride, we thankfully acknowledge the continued support from the Kanton Zürich, the Swiss National Science Foundation, the European Commission, and others who have made this fundamental research possible.

Prof. em. Dr. Franz Waldner, 1928 –2023



Prof. em. Dr. Franz Waldner was Professor for Experimental Physics at our institute from 1964 until his retirement in 1995.

After completing his training as a primary school teacher, Franz Waldner worked for three years before continuing his training as a secondary school teacher and teaching at this level for a short time. From 1955 he studied physics at the University of Zurich and obtained his doctorate in 1963 under Professor Ernst Brun with a thesis on "Paramagnetic electron resonance of Fe3+ in MgAl2O4". In 1964 Franz Waldner was appointed assistant professor and in 1979 full professor in experimental physics at the University of Zurich. In 1969 he spent a year at the Argonne National Laboratory (USA), where he was not only very curious to learn about new research approaches and a different institute culture, but also intensively engaged with American society.

Franz Waldner's research interests were very broad, ranging from electron spin resonance, crystallography, magnetism and superconductivity to complex non-linear systems and the movement of desert ants.

While still a student, he worked as an assistant in Hermann Wäffler's group and, among other things, carried out measurements of cosmic radiation on the Jungfraujoch. As an

assistant professor, Franz Waldner set up the electron spin resonance (ESR) laboratory at the former Physics Institute, where the measurement of paramagnetic ions as probes in single crystals was started. In collaboration with the future Nobel laureate Professor K. Alex Müller and the crystallographer Professor Fritz Laves, ESR was used for the first time to determine the structure of solids, an essential basis for later studies of high-temperature superconductivity. Later, the ESR research group studied quasi-two-dimensional magnets in the form of layered structures. It was shown experimentally that the dimensionality essentially determines the critical dynamics. Very weakly damped spin waves could be excited at low dimensionality and used to study non-linear phenomena. This laid the foundation for his later research on superconductors, quantised lattice vibrations, spinors, skyrminons and solitons.

After his retirement, Franz Waldner continued to work intensively on scientific topics, mainly from a theoretical point of view and with the help of simulations. He regularly published the results. One of his latest publications, which appeared in 2018, describes a model with random perturbations that describes the search pattern of desert ants.

Franz Waldner's research was characterised by an incredible curiosity and interest. He successfully transferred this to his employees time and time again. He was open to many new ideas and willing to break new grounds. He is described as an internationally recognised and well-connected, modest scientist with a generous personality, to whom research and findings were more important than his own person.

In addition to his in-depth specialist lectures, Franz Waldner also taught first-year medical and physics students for many years. He understood how to present complex topics in a clear, didactically sophisticated and humorous way, and was not shy about going to a conference to demonstrate a soliton with a vector arrow.

Franz Waldner took great care of his doctoral and diploma students. He was always available to answer questions and for discussions and looked after the staff in his group with great commitment.

Even after his retirement, Franz Waldner remained very close to the Institute, taking an interest in current research topics and innovations in the workshop. He visited the institute on Open Days and joined the Christmas dinner, and even in his old age took part in the traditional Institute walk.

Statistical Data

179 personnel

- professors: 23
- affiliated professors: 10
- senior researchers: 20
- postdoctoral researchers: 40
- PhD students: 67
- engineers and technicians: 22
- administration: 7
- + research assistants

391 students

~80 new students

197 bachelor	17 BSc degrees
79 master	29 MSc degrees
115 PhD	34 PhD degrees

13 SNF prof. and ERC grants

- 37 SNF or EU research grants
- 6 fellowships
- 36 UZH and other grants

383 publications

- 360 peer reviewed papers
- 22 conference proceedings
- 1 books & others

356 conference and workshop contributions

- 198 talks at conferences
- 91 seminar and other talks
- 34 posters
- 33 outreach

Outreach

Awards

- Livio Redard-Jacot: Dectris prize
- Mohammad Alminawi: Soluyanov prize
- Adinda de Wit: Guido Altarelli Award

Events

- 2nd Women in Physics Career Event
- Open Day of the Institute
- Scientifica
- Symposium and Exhibition to commemorate Nobel Prize-Winning Physicist K. Alex Müller

Workshops & Visits

- Guided tours through the Science Pavilion UZH
- More than 30 Workshops in the Science Lab UZH

Scientifica – the Zurich Science Days

Booth on particle physics
Labtour to XENOSCOPE
Theatre on black holes
Physics show

Exhibition on gravitational waves in the Science Pavilion UZH.

Teaching

bachelor
3
major options

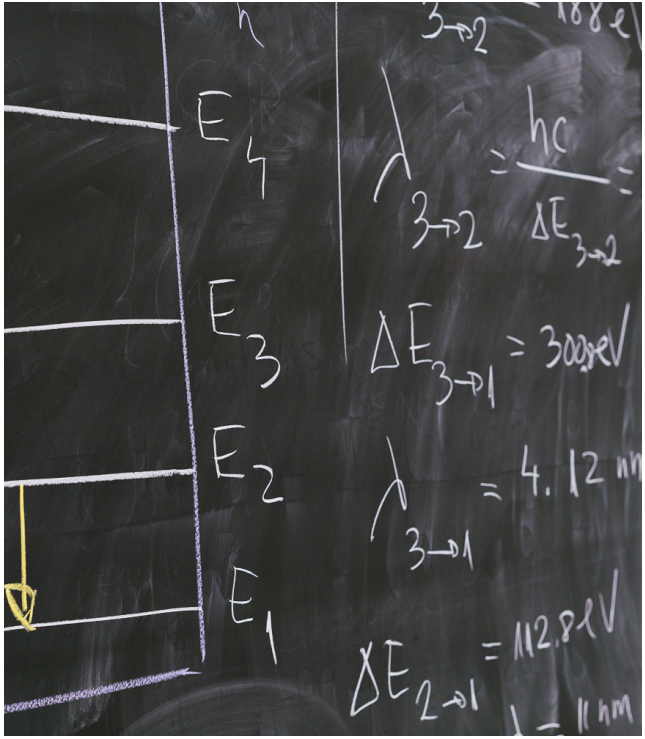
180 ECTS physics
150 ECTS physics/30 ECTS minor
120 ECTS physics/60 ECTS minor

4
master
programs

particle physics
condensed matter
astro(particle) & cosmology
bio- & medical physics

service lectures
1445
students

550	medicine
600	biology & biomedicine
150	chemistry
70	teacher
75	minors



Demonstration experiments

A macroscopic demonstration of magnetic spin resonance

Magnetic spin resonance is demonstrated by a spinning ball containing a magnet along the spin direction (black top). When the spinning ball is in a constant vertical field (left image), the spin precesses along the applied field at a constant angular frequency. By adding a second, horizontal field (right image), the precession direction changes. If the horizontal field is rotated at the original precession frequency, the spin precesses to the horizontal position. This corresponds to resonant absorption of electromagnetic radiation at the Larmor precession frequency. Using such a macroscopic demonstrator, the different concepts leading to magnetic spin resonance can be discussed one by one, giving a clear picture of the physical process at play.