Preface

Thomas Gehrmann, Department Head

With a total of 22 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

The year 2020 posed an enormous set of challenges onto our department. With the Covid19-related lockdown in mid-March all teaching activities were moved to a purely online modus in record time, and most of the laboratory-based research was closed down for several months. Many of the department members showed a lot of creativity, initiative and determination to meet these challenges and to improvise solutions at all levels. These developments enabled us to start the fall term with hybrid courses combining classroom work with online elements, which was switched to an all-online format later on. It allowed many of us to experiment with novel teaching formats, several of which will remain in use once we are back to normal campus life.

The physics department plays a very visible role in the newly designed 'Science Exploratorium' on Irchel Campus that was opened in November 2020, with large-scale exhibits of high-temperature superconductivity, of the dark matter search with the XENON experiment, and of elementary physics with the CMS experiment. A 1:10 scale model of CMS is one of the visual highlights of the Exploratorium, and

the high-temperature superconductors allow for live demonstration experiments.

The physics department was evaluated by an external panel of experts during 2020, cumulating in an online site-visit in November. The diversity of our research portfolio was demonstrated through a line-up of video clips with lab visits and short introductions to ongoing projects. Preparing the evaluation helped the department to identify its strategic development priorities for the coming years. The experts' visit highlighted the performance and devotion of the department's members to common goals in research, training and teaching.

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.

Exhibit on superconductors at the Science Exploratorium on the Irchel Campus.

Prof. em. Peter Truöl, 1939 – 2020

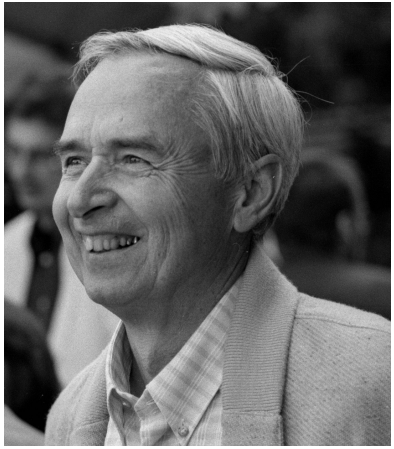
Prof. em. Dr. Peter Truöl was Professor for Elementary Particle Physics at our institute from 1971 to 2006. Here, he initiated the transition of experimental research from medium-energy to high-energy physics.

After studying physics, mathematics and chemistry in Göttingen and Zurich, Peter Truöl received his PhD under the supervision of Prof. Verena Meyer at the University of Zurich in 1967 with a thesis on the properties of the ^{10}B nucleus. He then continued his scientific research at the University of California, Berkeley, and soon afterwards became assistant professor at the University of California, Los Angeles. In 1971, he returned to Zurich for his habilitation. Here he introduced elementary particle physics to the curriculum of physics.

In 1988 Peter Truöl became full professor of experimental physics. His research group experimented in international research groups at accelerators in Berkeley, Los Alamos, Brookhaven, at PSI, at CERN and at DESY. In his scientific work, he was equally interested in the experimental aspects, the theoretical understanding and last but not least the linguistic quality of the publications.

Peter Truöl taught physics students in elementary particle physics for many years and gave the basic lectures for students of medicine and biology countless times. In doing so, he succeeded in conveying to his audience the fascination of researching fundamental physical questions and in making physics a basic subject for future scientists. Peter Truöl was Director of the Department of Physics of the University of Zurich from 1999 to 2003 and served as Dean of the Faculty of Mathematics and Natural Sciences from 2003 to 2006 and on the Board of Science Alumni from 2007 to 2012. After his retirement, he remained closely associated with current research projects in physics and the University of Zurich.

Prof. em. Günter Scharf, 1938 – 2020



Prof. em. Dr. Günter Robert Scharf was full professor of theoretical physics at the University of Zurich from 1970 to 2006. In particular, he was a capacity in mathematical physics.

Günter Scharf studied physics in Göttingen, Giessen and at ETH where he graduated in 1962. In 1965 Scharf received his doctorate under Prof. Armin Thellung at the Institute for Theoretical Physics at the University of Zurich. His dissertation on near-periodic potentials helped to establish his reputation as a mathematically precise theoretical physicist. In 1969 he was awarded his habilitation and in 1970 he was appointed professor of theoretical physics at the University of Zurich. In 2006 he was retired, but remained active as a researcher until shortly before his death.

Günter Scharf's work was characterised by mathematical clarity, fundamental physics questions and large range of topics. Thus, he often advanced some areas of theoretical physics off the tracks of general trends. These include above all his work on the renormalisation of gauge theories and on gravitation, in which he decisively developed the methodology of Epstein and Glaser. His studies on the linearised Boltzmann equation, the theory of lasers and spin waves in ferromagnetic materials were also influential.

Scharf's lectures were distinguished by clarity of terms and connections. His books on classical and quantised field theories impress with their clear and intuitive approach and have become standard works for many researchers.

Another, perhaps surprising side of Scharf was his relationship to applied physics. In recent years, he has worked with cardiologists and engineers to develop a novel system for the localisation of cardiac arrhythmias, from which a successful start-up company has emerged.

Statistical Data 2020

187 personnel

- professors: 19
- associated professors: 10
- senior researchers: 20
- postdoctoral researchers: 46
- PhD students: 70
- engineers and technicians: 23
- administration: 6
- + research assistants

370 students

~65 new students

190 bachelor	17 BSc degrees
68 master	12 MSc degrees
112 PhD	19 PhD degrees

11 SNF prof. and ERC grants

- 36 SNF or EU research grants
- 5 fellowships
- 34 UZH and other grants

355 publications

- 329 peer reviewed papers
- 18 conference proceedings
- 8 books & others

150 conference and workshop contributions

- 70 invited talks
- 46 seminar and other talks
- 9 posters
- 25 outreach

Outreach

Awards

- Jens Oppliger: UZH Semester award
- Claudio Andrea Manzari: Vito Volterra Prize for young researchers
- Claudio Andrea Manzari: LHCP2020 poster prize
- Frank Schindler: SPG Thesis award
- Stefan Hochrein: UZH Semester award
- Denys Sutter: Core Coaching grant from Innosuisse
- Nudzeim Selimovic: first prize on the Bosnian competition for best outreach video
- Laura Baudis: finalist at the Falling Walls and Berlin Science Week

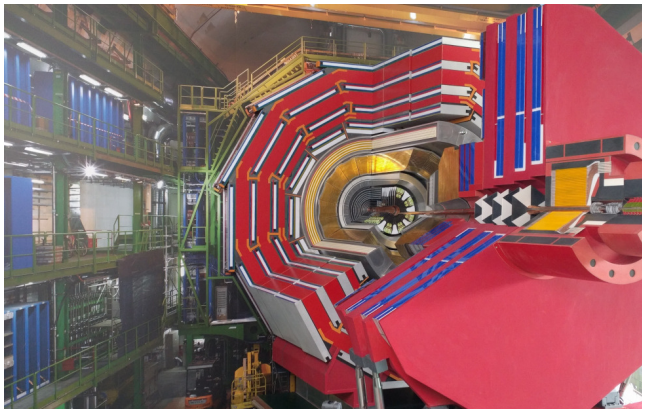
Videos

https://www.physik.uzh.ch/en/Videos-of-Research-Groups

- 26 Videos of the research groups
- Physics department in 5 minutes

Science Exploratorium UZH on Irchel Campus

The newly opened Science Exploratorium hosts several interactive stations that put a spotlight on selected research topics. The physics department contributed with an exhibit on superconductivity, a to-scale interactive replica of the CMS detector, and a recently decommissioned dark matter detector.



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
astrophysics & cosmology
bio- & medical physics

service lectures
1342
students

570	medicine
500	biology & biomedicine
180	chemistry
80	teacher
12	minors

Demonstration experiments

A mechanical implementation of Lorentz-transformations

In order to enable a more intuitive approach to special relativity, we have constructed a mechanical implementation of Lorentz-transformations, where the distortions of space-time are directly visualized. With the indicated space-time coordinates, the rest frame is along the vertical direction, indicated by the black line in the left figure. The mechanical implementation allows for a shift of a moving frame (blue line) to the new rest frame, see right figure. After this change of frame of reference, its effects on other coordinates can be directly inspected. As an example a third frame of referece indicated by the red line can be used for this. This e.g. allows for a direct demonstration of the effects of time-dilation and length contraction among others.