100 Years Institute for Theoretical Physics

1922-1933: The „Golden Era“

Until 1920, Physics in Göttingen was part of the Philosophical Faculty, and organized in „Abteilungen“. At the time of **Max Born**‘s appointment (1920, successor of **Peter Debye**), the Faculty for Mathematics and Natural Sciences was founded, and Physics was re-organized in four institutes, with one professor each:

Erstes Physikalisches Institut (Robert W. Pohl)
Zweites Physikalisches Institut (James Franck)
Institut für theoretische Physik (Max Born)
Institut für angewandte Elektrizität (Max Reich)


Max Reich, Max Born, James Franck, Robert Pohl

At this epoch, Physics worldwide struggled with the puzzles of the quantum phenomena of atoms. In July 1925, Born’s assistant **Werner Heisenberg** formulated multiplication rules for the transition amplitudes between the stationary orbits of the Bohr atomic model. This is regarded as the birth of quantum mechanics. **Max Born**, together with **Pascual Jordan** (who had completed his doctorate under Born’s supervision in 1924), formulated „matrix mechanics“ as the first form of quantum mechanics. This was generalised in the famous joint paper by the three men, the „Dreimännerarbeit“ of November 1925. After Schrödinger created wave mechanics (proven to be equivalent to Matrix QM by von Neumann), Born contributed the probability interpretation of the wave function, both for position and momentum.

These discoveries overturned our understanding of nature. Modern science and technology are unthinkable without them.

1933-1945: Nazi era

In 1933, Born was suspended from his professorship as so many other academics of Jewish descent, and later deprived of his German citizenship. **Fritz Sauter** replaced him at the institute, until his position was given to **Richard Becker** (1936-55) who had just been denied the succession of Sommerfeld in Munich in favour of a representative of the ideologically correct „German Physics“ (denial of relativity and uncertainty). He succeeded to keep a high standard both in teaching and research (plastic and magnetic properties of materials).

1945-1970


Hund's 70th birthday (1966): Friedrich Hund, Werner Heisenberg, and Max Born

Becker’s successor was **Friedrich Hund** (1957-64). Hund made fundamental contributions regarding the application of quantum mechanics to describe the behavior of nuclei, atoms and molecules. He discovered quantum tunneling and the famous Hund’s rule is key to understand all multi-electron atoms. In chemistry, Hund-Mulliken theory revolutionized the understanding of chemical bonds. Hund could considerably extend the institute: with **Gerhart Lüders** (1960-82) and **Hans-Jürgen Borchers** (1966-91), „axiomatic quantum field theory“ became a central research topic. **Max Kohler** (1966-79) worked on transport theory and general relativity. **Helmut Steinwedel** (1957-59) was „extraordinary“ professor.


Hans-Jürgen Borchers

In axiomatic QFT, Lüders has proven versions of the fundamental Spin-Statistics and PCT theorems. Borchers sharpened the view of superselection sectors, and his „Borchers classes“ revealed a surprising connection between scattering theory and locality. **Helmut Reeh** (1971-97) contributed insights on symmetries of QFT, based on the Reeh-Schlieder theorem. The pioneer of axiomatic QFT Arthur S. Wightman (Princeton) was awarded a honorary PhD (1987).

1970-2005

During the expansion period of german universities, further positions were created: **Gerhard Hegerfeldt** (1974-2005, QFT and quantum optics), **Hansjörg Roos** (1980-2000, thermodynamics in QFT), **Hubert Gönner** (1980-2002, general relativity and its extensions, history of physics).

Kurt Schönhammer (1984-2011) consolidated the research field „Theoretical Condensed Matter Physics“, in which **Thomas Pruschke** (2003-2016) opened new roads using computational methods. **Annette Zippelius** (1988-2017) and **Reiner Kree** (1989-2022) developed the broad area of „Statistical Physics“.

Whereas several positions were discontinued in the 1990s, **Detlev Buchholz** (1997-2010) was appointed as Borchers’ successor to continue axiomatic and mathematical quantum field theory. This research direction was complemented in the department by the creation of the new research focus „Experimental Particle Physics“.

2005-2022

In 2005, the Faculty of Physics, until then scattered over several locations in downtown Göttingen, moved to the new building at Friedrich-Hund-Platz 1 on the North Campus.

QFT is continued by **Karl-Henning Rehren** (2002, mathematical QFT), **Laura Covi** (2010, Dark Matter) and **Steffen Schumann** (2017, numerical methods for collider physics).

Condensed matter theory is represented by **Stefan Kehrein** (2011, analytical methods) and **Fabian Heidrich-Meisner** (2018, numerical methods). The main focus of the CMT group is the new field of non-equilibrium phenomena in quantum many-body systems.

With **Marcus Müller** (2005) working on biophysics and **Matthias Krüger** (2018) and **Peter Sollich** (2018) working on non-equilibrium statistical mechanics, modern applications of statistical physics are pursued at our institute.

Nobel prize winners:

Werner Heisenberg (1932), Max Born (1954), Herbert Krömer (PhD student of Becker, 2000).

Max Planck medalists:

Heisenberg (1933), Jordan (1942), Hund (1943), Born (1948), Debye (1950), Lüders (1966), Borchers (1995), Buchholz (2008), Zippelius (2022).

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