

Symposium The Charm of Unconventional Hadrons (SYUH)

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The strong interaction is the dominating force inside the atomic nucleus, binding quarks into nucleons and determining the dynamics of nuclear matter. Recent years have seen the discovery of multiple objects, where quarks are bound into unconventional configurations, beyond the long established quark model. This symposium will trace how experiments with heavy quarks have lead to spectacular breakthroughs and shed new light on long standing questions on the physics of quarks.

Overview of Invited Talks and Sessions

(Lecture hall ZHG105)

Invited Talks

SYUH 1.1	Tue	10:45–11:00	ZHG105	The social life of quarks — ●MAREK KARLINER
SYUH 1.2	Tue	11:00–11:15	ZHG105	The enigmatic strong interaction — ●CHRISTOPH HANHART
SYUH 1.3	Tue	11:15–11:30	ZHG105	Paving the future: new experimental approaches to subatomic forces — ●CHIARA PINTO
SYUH 1.4	Tue	11:30–11:45	ZHG105	Tracks and Tetraquarks — ●MIKHAIL MIKHASENKO

Sessions

SYUH 1.1–1.5	Tue	10:45–12:30	ZHG105	The Charm of Unconventional Hadrons
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SYUH 1: The Charm of Unconventional Hadrons

Time: Tuesday 10:45–12:30

Location: ZHG105

Invited Talk

SYUH 1.1 Tue 10:45 ZHG105

The social life of quarks — ●MAREK KARLINER — School of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel

In the recent years experiments in high energy accelerators have discovered a large number of unusual heavy "cousins" of the proton, i.e. strongly-interacting particles, collectively known as hadrons. Ordinary hadrons are either baryons, containing three quarks, or mesons containing a quark and an anti-quark. The new unusual hadrons contain either two quarks and two antiquarks, in which case they are known as tetraquarks, or four quarks and an antiquark, and are known as pentaquarks. They are often referred to as multiquark, or exotic hadrons. With the large number of such exotics discovered so far, it becomes increasingly important to discuss what additional multiquark states are likely to be observed and how are quarks organized in these exotic hadrons. In my talk I will discuss both questions, providing some guidelines about essential differences between the two types of exotics.

Invited Talk

SYUH 1.2 Tue 11:00 ZHG105

The enigmatic strong interaction — ●CHRISTOPH HANHART — IAS-4, Forschungszentrum Jülich, Jülich

It is the strong interaction that is responsible for forming nuclei, the cores of atoms, by binding protons and neutrons together. The same force, albeit with a quite different mechanism, is also creating protons and neutrons themselves by forming bound states of quarks and gluons. The strong interaction still is the least understood part of the Standard Model*even though the underlying theory, Quantum Chromodynamics (QCD), has been known for several decades. In this presentation the key features of QCD are reviewed and observable consequences presented.

Invited Talk

SYUH 1.3 Tue 11:15 ZHG105

Paving the future: new experimental approaches to subatomic forces — ●CHIARA PINTO — CERN, Geneva, Switzerland

Investigating the strong interaction among hadrons remains one of the central challenges in modern nuclear and particle physics. In recent years, innovative experimental techniques have been developed to probe this fundamental force. Among them, femtoscopy enables the study of particle correlations at femtometer scales, while the measurement of hypernuclei -nuclei containing a strange baryon- offers unique insights into the strong interaction in systems beyond ordinary matter.

This contribution presents the current status of these measurements at the Large Hadron Collider, along with an outlook on upcoming experimental programs aimed at advancing our understanding of the structure and dynamics of subatomic systems.

Invited Talk

SYUH 1.4 Tue 11:30 ZHG105

Tracks and Tetraquarks — ●MIKHAIL MIKHASENKO — Ruhr Universität Bochum, Germany

Over the past century, our ability to observe the quantum world has progressed from foggy trails in bubble chambers to sharp images of fleeting subatomic events. The Large Hadron Collider and its dedicated beauty experiment, LHCb, represent the pinnacle of this technological evolution—machines that have grown ever larger and more precise, driving forward both fundamental science and technological innovation. Among the most intriguing results are exotic hadrons—unusual combinations of quarks that challenge the traditional view of how matter is bound. This talk will trace the experimental journey that led to the discovery of this growing zoo of heavy exotic particles and explore how the long-standing dream of observing a tetraquark stable under the strong interaction is becoming less elusive.

Discussion

SYUH 1.5 Tue 11:45 ZHG105

Charmed by hadrons - a flavorful debate — ●SEBASTIAN NEUBERT¹, CHIARA PINTO², CHRISTOPH HANHART³, MAREK KARLINER⁴, and MIKHAIL MIKHASENKO⁵ — ¹Universität Bonn — ²CERN — ³Forschungszentrum Jülich — ⁴Tel Aviv University — ⁵Ruhr Universität Bochum

The interplay between theory and experimental efforts is crucial for the advancement of our understanding of the strong interaction and its complex spectrum of bound states. The scientific discourse of the field is not only driven by the search for new methodologies, but also by the quest for the most useful paradigms and degrees of freedom to describe the world of quarks. It is often characterized by debates on seemingly disparate concepts of the nature of hadrons. Subatomic molecules or compact multiquark systems can all explain part of the phenomena observed, but a unifying picture seems elusive. The four speakers of this symposium will engage in a panel discussion and bring this debate to the audience, to share the intrigue around those fascinating quantum systems and discuss avenues into future research of the most mysterious of the fundamental interactions.