



Contribution ID: 270

Type: **Plenary**

Peering Inside the Proton: How Lattice QCD Reveals the Building Blocks of Matter

Wednesday 3 December 2025 13:45 (45 minutes)

The proton sits at the heart of every atom, yet its internal structure remains one of the deepest challenges in physics. Its properties, such as its mass and spin, do not arise simply from its constituent quarks, but from the complex, strongly interacting dynamics of Quantum Chromodynamics (QCD). At low energies, QCD is strongly coupled and resists analytic solutions, making the emergent structure of hadrons a profound challenge. Lattice QCD offers a unique window: by discretising space and time, we can compute proton properties directly from the underlying theory. In this talk, I will show how lattice QCD calculations illuminate the proton's inner workings, such as its mass, spin, and charge distributions. I will also discuss how these results underpin precision tests of the Standard Model and highlight the interplay between lattice results and experimental measurements, and discuss how upcoming advances in algorithms and exascale computing promise to transform our quantitative understanding of hadronic structure.

Author: Dr ZANOTTI, James (The University of Adelaide)

Presenter: Dr ZANOTTI, James (The University of Adelaide)

Session Classification: Plenary

Track Classification: Topical Groups: Nuclear and Particle Physics