Contribution ID: **201** Type: **(a) Talk abstract only**

Advances in Derisking the FCC Tunnel Design: Update from the Geological Investigation Campaign

Tuesday 20 May 2025 15:30 (30 minutes)

The Future Circular Collider (FCC) is envisioned as the next-generation particle accelerator, requiring an underground tunnel approximately 90 km in length. Given the significant scale of this infrastructure, a detailed understanding of the subsurface is critical for reducing geological and geotechnical uncertainties. This abstract provides an update on the recent progress made through the geological investigation campaign aimed at de-risking the FCC tunnel design.

The campaign integrates an extensive range of methods including high resolution 2D seismic surveys, deep drilling, laboratory testing, in situ stress measurements, and hydrogeological analysis. The multidisciplinary effort has focused on characterizing key geological domains along the proposed tunnel alignment, with emphasis on understanding lithological heterogeneity, fault architecture, and fluid flow behavior.

Particular attention has been paid to three structurally and geologically critical zones. In the Vuache region, new geophysical and stratigraphic data have revealed unexpected complexity in the Molasse formations. This has provided a clearer understanding of the peculiar topography and surface deformation patterns in the area, which are now linked to previously unrecognized structural variations within the Molasse sequence. In the Bornes Plateau, the Bornes-1 deep well successfully penetrated a large aseismic thrust sheet, offering valuable geomechanical and lithostratigraphic information about the overthrusted sedimentary pile. The data acquired here has significantly improved modeling of stress redistribution and tunnel stability within this zone.

The Mandallaz anticline remains the most geologically sensitive sector along the FCC alignment. Composed of highly fractured Mesozoic carbonates, this zone posed a potential risk for intersecting karstic voids and unpredictable groundwater behavior. However, results from the campaign have confirmed the absence of large karst cavities, a key finding that reduces immediate concerns for tunnel construction. Nevertheless, due to the complex fault geometry and fracturing patterns, further detailed investigations will be required to constrain the hydrogeological regime, predict groundwater pathways, and assess potential fluid inflow during excavation.

Overall, the geological campaign has led to the delineation of risk zones along the tunnel path, enhancing the reliability of engineering models for tunnel alignment, excavation, and support design. This proactive approach has not only reduced uncertainty but also set a new benchmark for integrating geological science into large-scale infrastructure planning. Continued work in these critical areas will be essential for ensuring the safe and cost-effective realization of the FCC project.

Author: Prof. MOSCARIELLO, Andrea (University of Geneva)

Co-authors: GABRIEL, Guihlem; CUNNINGHAM, Roddy (CERN); WATSON, Timothy Paul (CERN)

Presenter: Prof. MOSCARIELLO, Andrea (University of Geneva)

Session Classification: Civil Engineering

Track Classification: Civil Engineering