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An integrated approach to solar physics: combining multi-instrument observations with multi-physics simulations

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Two major questions in solar physics remain unresolved: how the solar corona reaches temperatures of several million degrees and why plasma composition is fragmented in the solar atmosphere and wind. New missions like Solar Orbiter and Parker Solar Probe now offer a unique chance for comprehensive, multi-layer solar analyses.

Recent collaborations between space and ground-based observatories have produced the most detailed dataset of solar active regions, key sources of the slow solar wind and coronal mass ejections affecting Earth. Analyzing these datasets is complex, necessitating specific support from the modeling, from basic connectivity tools to sophisticated MHD simulations.

Over the last six years, we developed a high-order model to consistently address the various layers of the solar atmosphere, integrating multiple physical processes such as multi-fluid effects (partial ionisation, collisions) and atmospheric wave-based heating.

This seminar will overview these challenges and show how an integrated observation-modeling approach can address them, advancing our understanding of the Sun.