Contribution ID: **1285** Type: **Talk**

Solar Neutrino Data v.s. Standard Core Physics: Reconciling CNO Flux Anomalies via Opacity and Key Nuclear Cross-Section Revisions

Wednesday 16 July 2025 17:50 (15 minutes)

This study confronts the Standard Solar Model (SSM) with observed neutrino fluxes (pp, pep, Be7, B8, CNO) by constructing parameterized solar core models (SCMs) with variable helium/metallicity profiles and equilibrium nuclear burning assumptions for pp chains. We find key tension emerges that no SCM simultaneously satisfies all observed neutrino fluxes, notably due to core temperature-driven discrepancies in pep, B8, and CNO neutrinos. Reducing radiative opacity by ˜13% or enhancing 14N(p,γ)15O rates by ˜26% aligns CNO fluxes with observations (1-sigma). Crucially, SCMs isolate opacity and nuclear rate dependencies, bypassing uncertainties from convection/diffusion physics. Future work will integrate helioseismic constraints to resolve core radius sensitivity challenges in multi-probe analyses.

Collaboration(s)

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Session Classification: SH

Track Classification: Solar & Heliospheric Physics