

Fall 2021 Colloquium

Department of Physics & Astronomy, Texas A&M University-Commerce

Nov 11, Thursday, 4-5 PM

Live Zoom Meeting

<https://tamuc.zoom.us/j/99681875042>

Meeting ID: 996 8187 5042

Nuclear Physics

The CNO cycle and the CNO Neutrinos in our Sun

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Dr. Michael Wiescher received a Ph.D. degree (1980) in Physics at the Universität Münster, Germany. He worked as a postdoc at Ohio State University and CalTech between 1980 and 1984, and as a senior researcher at Universität Mainz Germany until 1986. Dr. Wiescher began his appointment as an assistant professor at the University of Notre Dame in 1986, where he is currently doing research in nuclear physics as a full professor. More information can be found at <https://physics.nd.edu/people/faculty/michael-wiescher/>

Abstract

The origin of the solar neutrinos is typically associated with the mechanism of our sun converting four hydrogen nuclei to helium while converting two protons into neutrons by a weak interaction process. The discrepancies between neutrino observation and prediction were known for years as the solar neutrino problem in nuclear astrophysics. With the confirmation of neutrino oscillations the solar neutrino problem is considered to be solved and neutrinos offer a unique tool for observing the interior of the sun. The bulk of the solar neutrinos are originated in the pp-chains which carry more than 97 % of the energy production of the sun, the remaining energy comes from the catalytic CNO cycles, which dominate the hydrogen burning of more massive stars. The CNO cycles are associated with the origin of the CNO neutrinos from the β -decay of ^{13}N , ^{15}O in the first CNO cycle. The observation of these neutrinos would provide a direct way of measuring the metallicity (or CNO abundances) in our sun, addressing the present discrepancies between the spectroscopic results from surface studies and predictions from helioseismology, which should agree with each other in the framework of the standard solar model. A critical parameter for these studies are the reaction rates of $^{12}\text{C}(p,\gamma)^{13}\text{N}$ and $^{14}\text{N}(p,\gamma)^{15}\text{O}$ at solar temperatures. I will discuss new experimental studies to determine these rates and remove the still existent uncertainties that affect the CNO abundance predictions of the standard solar model.