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Observation of CNO cycle solar neutrinos in Borexino

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The Borexino detector, located at the Laboratori Nazionali del Gran Sasso in Italy, is a radiopure 280 ton liquid scintillator detector with a primary goal to measure low-energy solar neutrinos created in the core of the Sun. These neutrinos are a consequence of nuclear fusion reactions in the solar core where Hydrogen is burned into Helium and provide a direct probe of the energy production processes, namely the proton-proton (*pp*) chain and the Carbon-Nitrogen-Oxygen (CNO) cycle. The fusion of Hydrogen in the case of the CNO cycle, which is expected to contribute in the order of less than $\sim$ 1% to the total solar energy, is catalyzed by Carbon, Nitrogen, and Oxygen directly depending on the abundances of these elements in the solar core. Neutrinos from the *pp* chain have been studied in Borexino with outstanding precision through the measurement of *pp*, *pep*, ^{7}Be, and ^{8}B neutrinos over the past decade, while the existence of neutrinos from the CNO cycle have been confirmed recently for the first time with a high statistical significance. The measurement of CNO neutrinos is challenging due to the high spectral correlation with the decay electrons of the background isotope ^{210}Bi and the *pep* solar neutrino signal. The experimental achievement of thermal stabilization of the Borexino detector after mid 2016, has opened the possibility to develop a method to constrain the ^{210}Bi rate through its decay daughter and α emitter ^{210}Po which can be identified in Borexino with an efficiency close to 100 percent on an event-by-event basis. Moreover, the flux of *pep* neutrinos can be constrained precisely through a global analysis of solar neutrino data which is independent of the dataset used for the CNO analysis. This talk is dedicated to the first experimental evidence of neutrinos produced in the CNO fusion cycle in the Sun which is at the same time the dominant energy production mechanism in heavier stars compared to the Sun in the Universe.

Reference to paper (DOI or arXiv)

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