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Supernova neutrinos as a probe of CP

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There have been considerable efforts to measure the parameters of the neutrino mixing matrix PMNS (Pontecorvo-Maki-Nakagawa-Sakata). The least known of these parameters is the complex CP-violating phase, $\delta_{\rm CP}$. Accelerator experiments are the leading candidates to measure it with high significance. Supernova neutrinos, on the other hand, have never been considered to this date, due to their small energy, high uncertainty, and, most of all, lack of information about the full flavor components of the flux. This work is intended to address some of these issues and offer a complementary probe of such parameter.

We show how it is possible to extract some information about the PMNS matrix complex phase, $\delta_{\rm CP}$, using supernova neutrinos. First, we use the next-to-leading order (NLO) calculation for the cross-section of neutrino-electron elastic scattering to distinguish between muon neutrinos and tau neutrinos at the detection. Consequently, one can use this flavor information to probe the CP-violating phase. We also explore the possibility of detecting high energy (100-200 MeV) neutrinos from shock acceleration which can also produce muons in the detector and provide a clear signal of flavor conversion that can also be used as a probe of $\delta_{\rm CP}$.

Poster prize

Yes

Given name

Leonardo Jose

Surname

Ferreira Leite

First affiliation

University of Campinas

Second affiliation

Institutional email

lfleite@ifi.unicamp.br

Gender

Male

Collaboration (if any)

Autori principali: Sig. FERREIRA LEITE, Leonardo José (University of Campinas (Unicamp)); Prof. BRDAR, Vedran (Oklahoma State U.); Prof. XU, Xunjie (IHEP - Beijing); PARKER, george (Johannes Gutenberg University Mainz)

Relatore: Sig. FERREIRA LEITE, Leonardo José (University of Campinas (Unicamp))

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