**Idaho State University  
Physics Colloquium**

***Search for Charge Parity (CP) violation in Neutrino Oscillations***  
  
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In the Standard Model of particle physics, the neutral fermions and anti‐fermions are the nearly massless neutrinos that appear in 3 flavors (νe,νμ,ντ) and in 3 antineutrino flavors (𝜈̅ ௘, 𝜈ఓ̅, 𝜈̅ ఛ). In 1998, a study of neutrinos produced in the atmosphere were found to “shapeshift” or oscillate into different flavors, depending on the ratio of their distance travelled and their energy. This is described by the PMNS neutrino mixing matrix which is modeled on the CKM quark mixing matrix. In 2002, CP violating decays of neutral B mesons were observed proving that the CKM quark mixing matrix includes a complex phase. Now, the holy grail in neutrino physics is the search for CP violating neutrino and antineutrino oscillations that would prove the PMNS neutrino mixing matrix is also includes a complex phase. The experimental search for CP violation measures if the oscillation probabilities, P(νμ→νe) and P(𝜈ఓ̅→𝜈̅ ௘), are equal or not.     In this colloquium, a pedagogical discussion will be presented of neutrino physics and the recent measurements by the T2K collaboration of 3 sigma evidence of CP violation in neutrino oscillations. This has been published in the journal Nature.  In addition, statistical methods of hypothesis testing CP violation and combining experimental results will be presented.

**Monday, April 12 2021**  
**Via Zoom(**[**https://isu.zoom.us/j/85670323948**](https://isu.zoom.us/j/85670323948)**)  
4:00 – 4:50 pm**