Contribution ID: **197** Type: **not specified**

Probing Neutrinoless Double-Beta Decay in Multiple Isotopes

Monday 9 May 2022 18:15 (15 minutes)

Next-generation searches for neutrinoless double beta ($0\nu\beta\beta$) decay plan to make use of several isotopes, including 76Ge, 100Mo, and 136Xe. We explore the effects of observations in multiple isotopes on the joint inference of the standard mass mechanism (light neutrino exchange) and an exotic short-range $0\nu\beta\beta$ mechanism. We also study the role that uncertainties in the nuclear matrix elements (NMEs) for $0\nu\beta\beta$ play in multi-isotope measurements. Bayesian sampling of high-dimensional likelihood distributions enables us to take into account the correlated uncertainties between NMEs of different isotopes. As NME uncertainties present a significant obstacle in interpreting searches, we project the reduction in uncertainties needed for robust inference about both standard light neutrino-exchange and exotic New Physics mechanisms for $0\nu\beta\beta$. Our framework therefore lays the groundwork necessary to draw meaningful conclusions from combined future data, and demonstrate that both pursuing a multi-isotope experimental suite and developing understanding of the correlations between NMEs will be key for constraining theoretical models after a discovery of $0\nu\beta\beta$.

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Session Classification: BSM II