

Ab-Initio Double-Beta decays Nuclear Matrix Elements

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Progress in Ab initio Techniques in Nuclear Physics
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$2\nu\beta\beta$ vs $0\nu\beta\beta$

Decay	$2\nu\beta\beta$	$0\nu\beta\beta$
Diagram		
Half-life Formula	$[T_{1/2}^{2\nu}]^{-1} = G^{2\nu} M^{2\nu} ^2$	$[T_{1/2}^{0\nu}]^{-1} = G^{0\nu} M^{0\nu} ^2 \left(\frac{\langle m_{\beta\beta} \rangle}{m_e} \right)^2$
*NME Formula	$M^{2\nu} \approx M_{GT}^{2\nu}$	$M^{0\nu} = M_{GT}^{0\nu} - \left(\frac{g_\nu}{g_a} \right)^2 M_F^{0\nu} + M_T^{0\nu}$
**LNV	No	Yes!!!
Observed	Yes (extremely rare)	No

*NME : Nuclear Matrix Element

**LNV : Lepton Number Violation

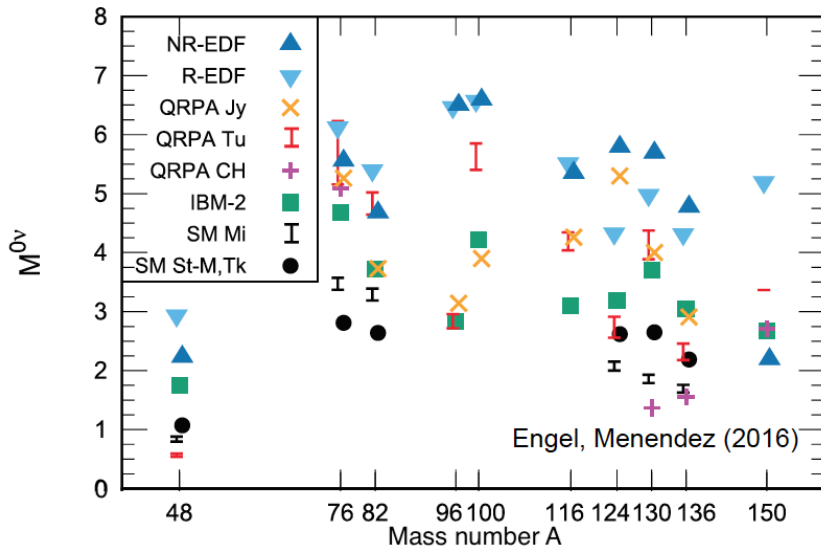
The search for $0\nu\beta\beta$

Future Experiments

Experiment	Isotope
LEGEND-1000	^{76}Ge
CUPID	^{82}Se
SNO+	^{130}Te
nEXO	^{136}Xe

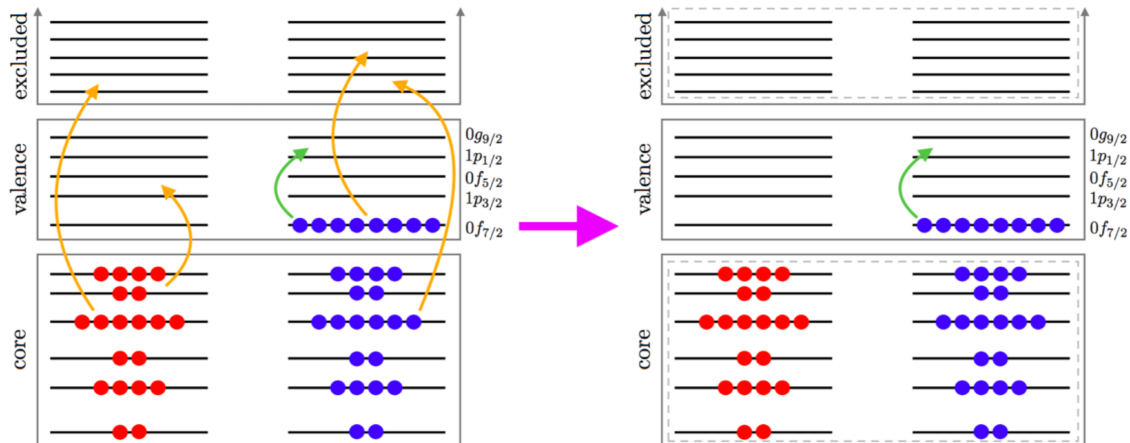
From arXiv:1902.04097

Current status of the NMEs



VS-IMSRG

The Valence-Space - In medium Similarity Renormalization Group



Payne, Thesis 2018

Results for $2\nu\beta\beta$ in ^{48}Ca

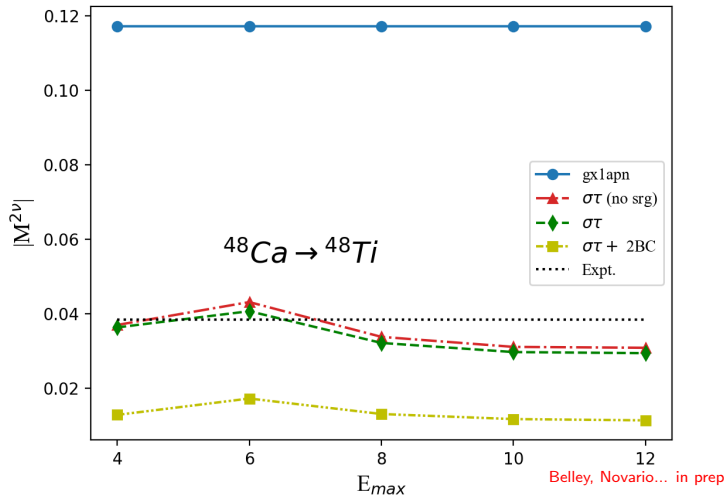
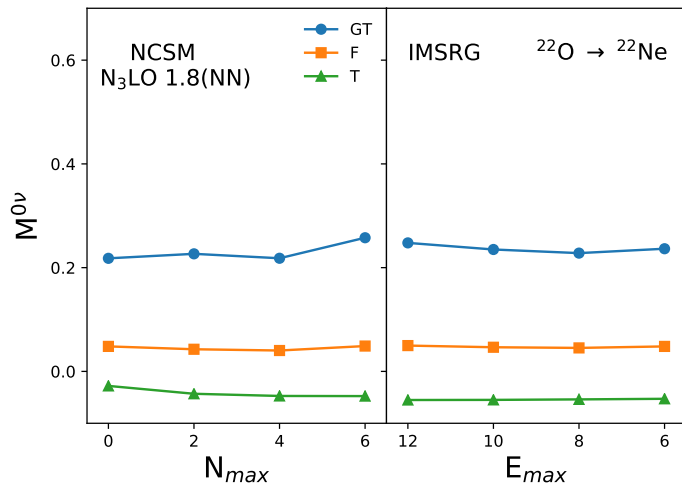
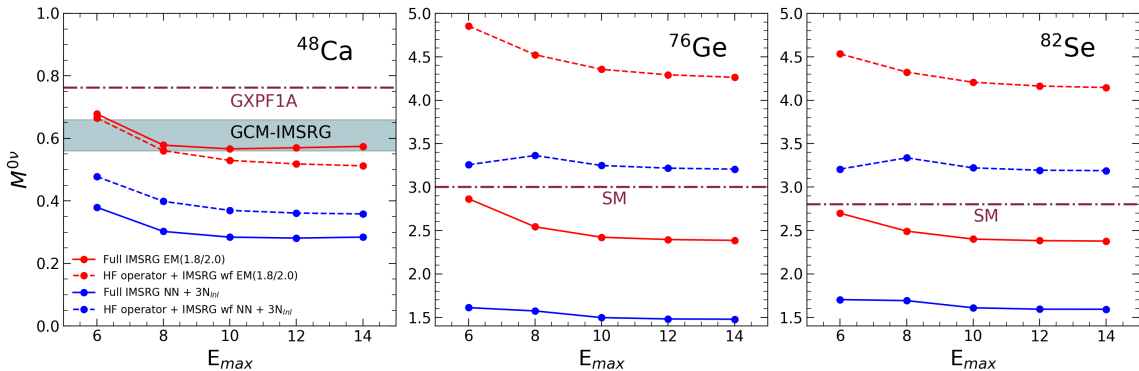


Figure 1: Convergence of $M^{2\nu}$ as a we increase E_{\max}

Comparison with NCSM in ^{22}O



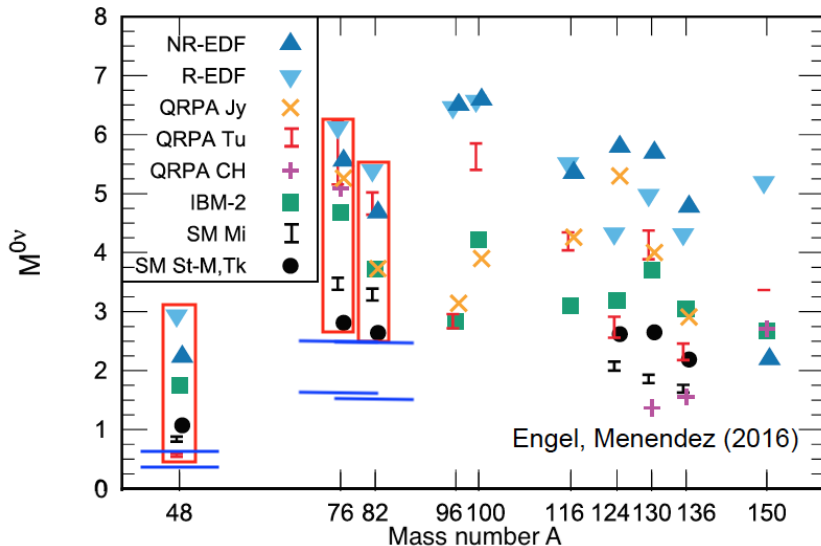
Results for $0\nu\beta\beta$



Belley, Payne, Stroberg, JDH, Miyagi... in prep

Figure 2: Convergence of $M^{0\nu}$ as we increase E_{max}

Results for $0\nu\beta\beta$



Conclusion and Outlook

- Used the VS-IMSRG to compute $2\nu\beta\beta$ matrix element in ^{48}Ca .
- Benchmarked $0\nu\beta\beta$ with NCSM
- Computed $0\nu\beta\beta$ matrix elements for ^{48}Ca , ^{76}Ge and ^{82}Se .
- Working on some preliminary results for ^{130}Te and ^{136}Xe .

THANK YOU!

Questions?