DOUBLE-BETA DECAY WITH THEIA

Guideline slides for discussion

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✳ Choice of isotope and fraction of loading:

   ✳   loading with several isotopes have been demonstrated: Xe, Te, Nd

   ✳   possibility of enrichment: Ca????

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Isotope	Q (MeV)	percent natural abund.	element cost [5] ($/kg)	$G^{0\nu}$ $(10^{-14}/\text{yr})$ [6]	$M^{0\nu}$ (avg) [7]	$T^{0\nu}_{1/2}$ for 2.5meV (10^{29}yrs)	tons of isotope for 1 ev/yr	equivalent natural tons	annual world production [5] (tons/yr)	natural elem. cost ($M)	enriched at $20/g ($M)	$0\nu/2\nu$ rate [2][8] (10^{-8})
^{48}Ca	4.27	0.19	0.16	6.06	1.6	2.70	31.1	16380	2.4×10^8	2.6	622	0.016
^{76}Ge	2.04	7.8	1650	0.57	4.8	3.18	58.2	746	118	1221	1164	0.55
^{82}Se	3.00	9.2	174	2.48	4.0	1.05	20.8	225	2000	39	416	0.092
^{96}Zr	3.35	2.8	36	5.02	3.0	0.93	21.4	763	1.4×10^6	27	427	0.025
^{100}Mo	3.04	9.6	35	3.89	4.6	0.51	12.2	127	2.5×10^5	4.4	244	0.014
^{110}Pd	2.00	11.8	23000	1.18	6.0	0.98	26.0	221	207	5078	521	0.16
^{116}Cd	2.81	7.6	2.8	4.08	3.6	0.79	22.1	290	2.2×10^4	0.81	441	0.035
^{124}Sn	2.29	5.6	30	2.21	3.7	1.38	41.2	736	2.5×10^5	22	825	0.072
^{130}Te	2.53	34.5	360	3.47	4.0	0.75	23.6	68	~150	24	471	0.92
^{136}Xe	2.46	8.9	1000	3.56	2.9	1.40	45.7	513	50	513	914	1.51
^{150}Nd	3.37	5.6	42	15.4	2.7	0.37	13.4	240	$\sim10^4$	11	269	0.024

   ✳   For a 20kT detector, a 0.5% loading already means 100 T of loading material (>30 T of loading isotope for Te)

   ✳   Te has a large natural abundance, Xe can be enriched

   ✳   Both of them have high Q-value

   ✳   They have the largest 0nu/2nu rate

QUESTIONS THAT WE NEED TO ANSWER:

* Goal = normal hierarchy equivalent to nEXO:
    * with Ba tagging = 7-20 meV
    * without Ba tagging = 3-9 meV

J. R. Alonso et al, BNL-106082-2014-JA, arXiv:1409.5864
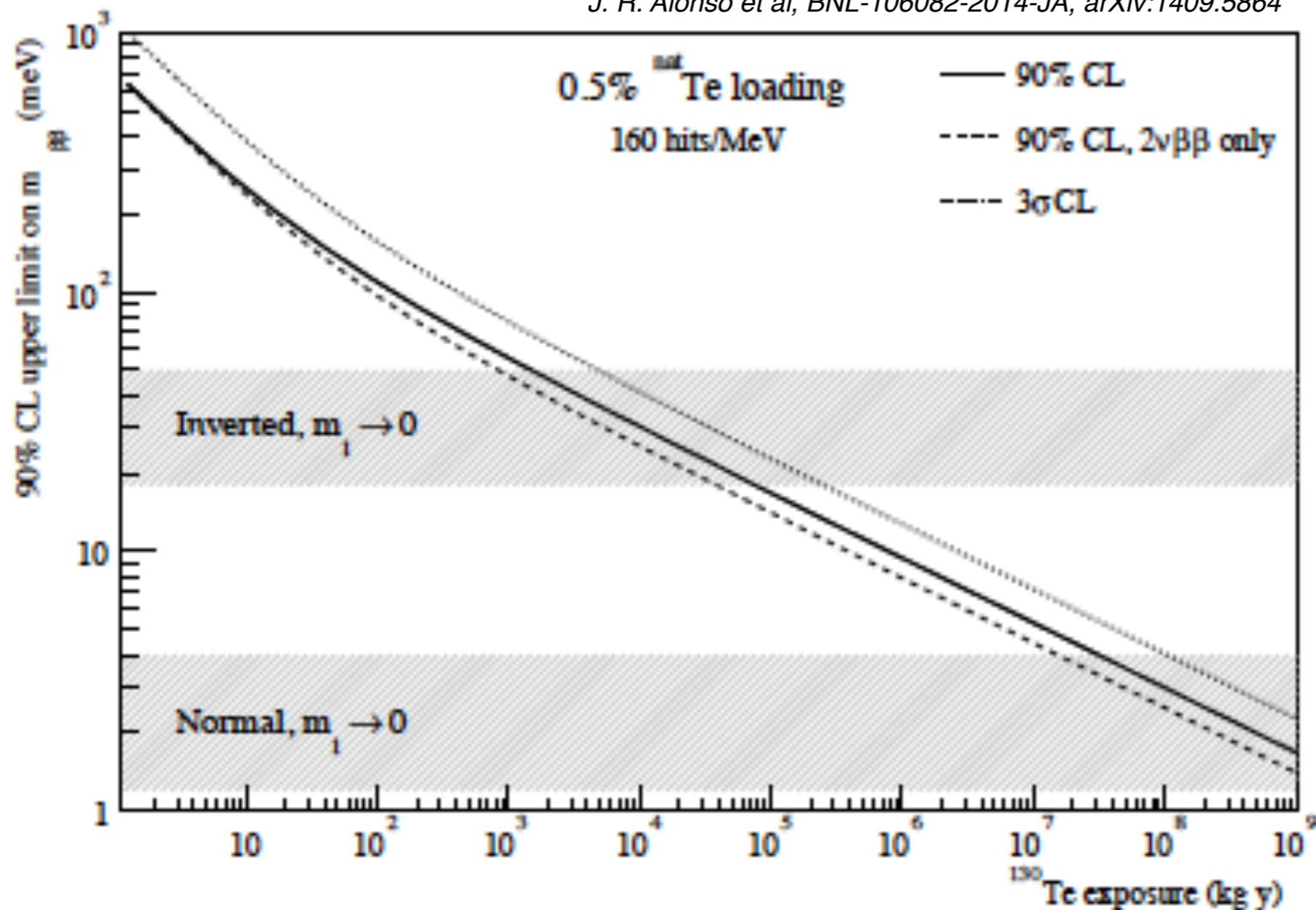
* 50T of ^{130}Te in a WbLS (50 kT with FV of 0.6)
* Light yield of 160 pe/MeV
* 15 meV in 10 years

QUESTIONS THAT WE NEED TO ANSWER:

* Understand the depth requirement: muon induced background like ^{10}C

* Understand direction reconstruction requirement: Can we reduce the ^{8}B-neutrino background?

* Understand the requirement for the light yield: High QE PMTs? Wavelength shifter? Fluor?

* Use a bag OR a balloon OR no special containment for the BB isotope?

* Understand how much PMT coverage is needed i.e resolution

* Define required purity of WbLS cocktail

CONTACTS AND MAILING LISTS

✳ General THEIA mailing list: **theia@lists.lbl.gov**

✳ Double-beta decay mailing list: **theiaDBD@lists.lbl.gov**

   ✳ Instructions can be found here: *http://theia.berkeley.edu/index.php/Help*

✳ Website: *http://theia.berkeley.edu/index.php/Neutrinoless_Double_Beta_Decay*