Status of the AMoRE experiment

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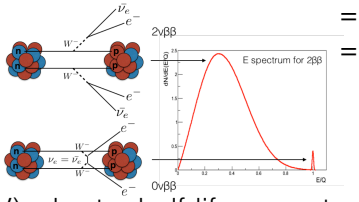
AMoRE experiment

Advanced **Mo**-based **R**are process **E**xperiment
Search for neutrinoless double beta (0νββ) decay of ^{100}Mo
Double β decay
=> In most naturally occurring even-even nuclei, single β decay is forbidden.
But, for a large number of them, double β decay is allowed.



0νββ source :^{100}Mo isotope

=> relatively high Q-value (3034 keV), shorter half-life expected
=> high natural abundance of 9.74 %

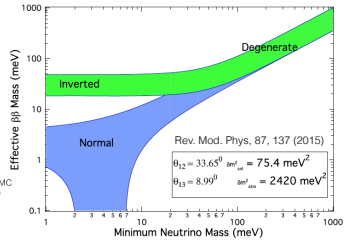
Detector (pilot) : $^{40}Ca^{100}MoO_4$ crystal with low temperature (LT) phonon and photon sensors

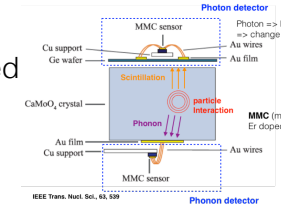
=> Scintillating crystal, Source = Detector
=> ^{100}Mo enriched (> 95 %), ^{48}Ca depleted (4.27 MeV, < 0.001 %)
=> Excellent energy resolution with LT sensors
=> Demonstrated excellent α/β separation with phonon sensor
=> Simultaneous phonon and photon detection allows further background reduction

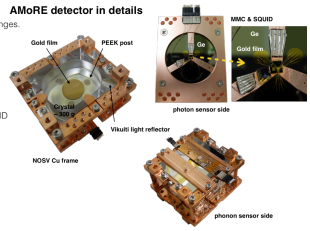
Why 0νββ ?

=>Unambiguous signature for Majorana neutrino
=>Lepton number non-conservation
=>Absolute neutrino mass scale $[T^{0\nu}_{1/2}]^{-1} = G^{0\nu}|M_{0\nu}|^2\langle m_{\beta\beta}\rangle^2$

=>Neutrino mass hierarchy
=>CP violation in the lepton sector

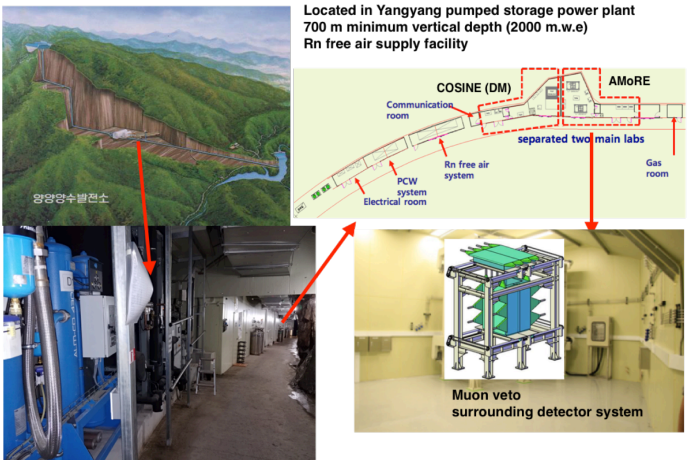




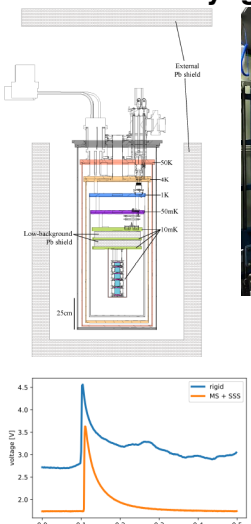


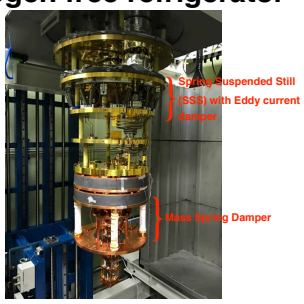
AMoRE at pilot phase

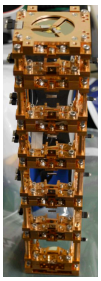
Yangyang (Y2L) underground lab

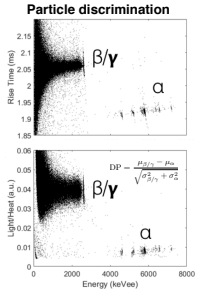


Detectors in cryogen free refrigerator





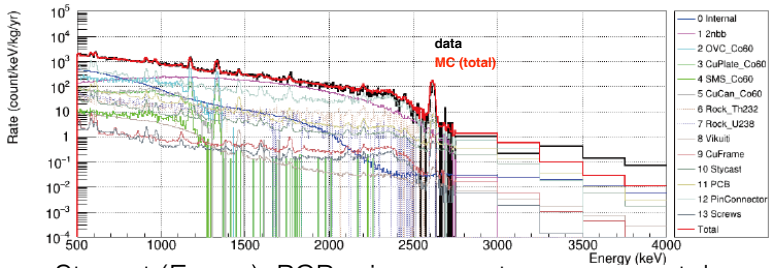




Preliminary performance

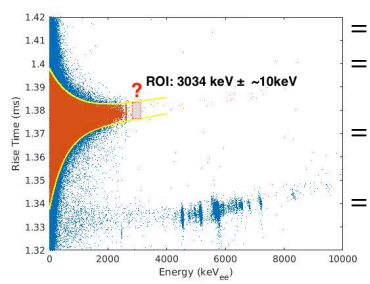
Crystals	2.6 MeV FWHM energy resolution (keV)	DP Light/Heat	DP Mean Time	DP Rise Time
SB28(0.20kg)	13.0	12.8	22.0	20.2
S35(0.25kg)	12.4	18.8	11.3	9.4
SS68(0.35kg)	20.2	16.2	6.0	5.7
SE01(0.35kg)	18.2	15.7	21.8	19.3
SB29(0.40kg)	16.0	14.1	8.6	9.8
SE02(0.34kg)	11.7	9.6	20.5	18.1

Background identification



=> Stycast (Epoxy), PCB, pin connectors near crystal seem to generate significant background.

Background rejection in ROI



=> β-like event selection
=> ^{208}Tl event rejection after ^{212}Bi α (6.2 MeV)
=> Muon veto, multiple hit rejection
=> Preliminary background level: 0.1 – 1 (cnts/keV/kg/yr) Still, improving

AMoRE-I, II

AMoRE-I

=> 13 $^{40}Ca^{100}MoO_4$ crystals
+5 other molybdate (XMoO) crystals (X:Li, Na, Pb, etc)
=> Reducing the background identified at pilot phase
=> 6 kg, 18 crystals, 3+ years data taking

AMoRE-II

=> target mass:100 kg of ^{100}Mo isotope, 5 years data taking
=> Selecting best molybdate crystals for scaling up
=> Exploiting the new underground lab in Jeongseon

Sensitivity Goal

Crystals	AMoRE-Pilot	AMoRE-I	AMoRE-II
mass	1.9 kg	~5 kg	~200 kg
Channels	12	36	1000
Background (cnts/keV/kg/yr)	0.01	0.001	0.0001
Sensitivity ($T_{1/2}$) (year)	~10^{24}	~10^{25}	~5 x 10^{26}
Location	Y2L	Y2L	New lab
Schedule	2016-2018	2018-2021	2021