Status of XMASS experiment

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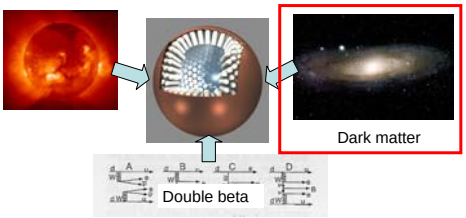
on behalf of the XMASS Collaboration

1. Introduction

➢ What's XMASS

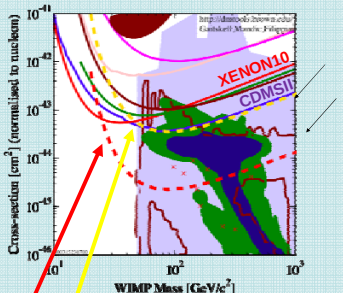
Multi purpose low-background and low-energy threshold experiment with liq. Xe

- Xenon detector for Weakly Interacting MASSive Particles (DM search)
- Xenon MASSive detector for solar neutrino (pp/^{7}Be)
- Xenon neutrino MASS detector (ββ decay)



Expected sensitivity for Dark Matter

- 100kg xenon target
- Expected BG: 10^{-4} count/day/kg/keV



10days $\sigma_{\chi p}$>3x10^{-44} cm^2
1year $\sigma_{\chi p}$>2x10^{-45} cm^2
for 50GeV WIMP, 90%CL

The XMASS Collaboration

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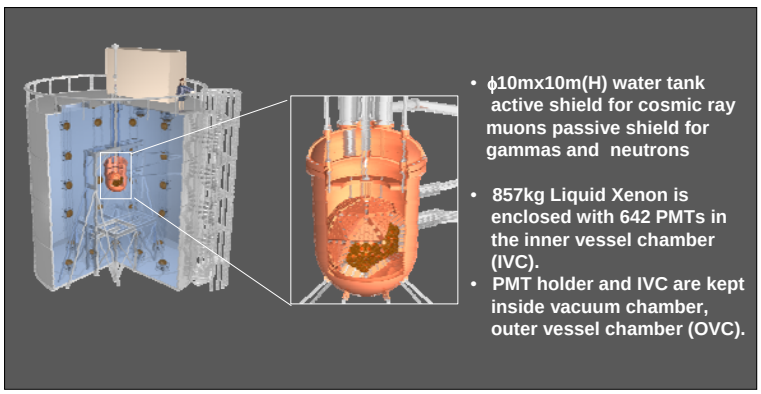
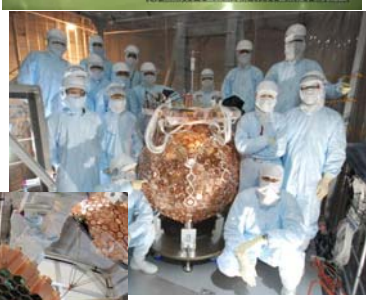
2. Construction of The XMASS 800kg detector

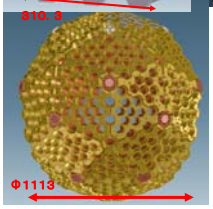


- ϕ10mx10m(H) water tank active shield for cosmic ray muons passive shield for gammas and neutrons
- 857kg Liquid Xenon is enclosed with 642 PMTs in the inner vessel chamber (IVC).
- PMT holder and IVC are kept inside vacuum chamber, outer vessel chamber (OVC).


PMT installation to upper half sphere.

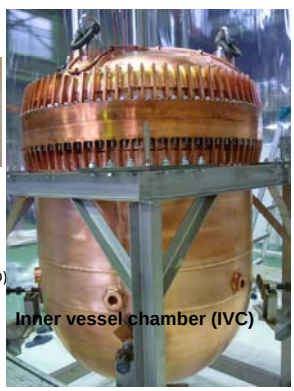

Newly excavated experimental hall.
Water tank and xenon tank





Triangle: basic structure

- 60 triangles made PMT holder
- One triangle has ~10 PMTs
- Total: 642 PMTs
- 630 hexagonal PMTs (R10789-11)
- 12 circle shape PMTs (R10789-11MOD) at peak position.
- Photo coverage: 62.4%
- Outside diameter 1113
- Inner diameter ~800


Inner vessel chamber (IVC)

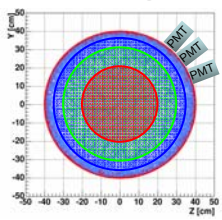

Outer vessel chamber (OVC)


Upper sphere after all PMT installation.


To reduce amount of xenon, gap between PMT holder and IVC are filled with copper filler.

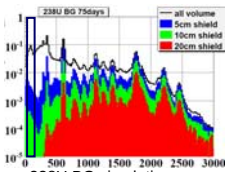
3. Background reduction techniques

Self-shielding for BG from detector material



Liquid Xenon has large Z and acts as a shield of γ from the detector material.

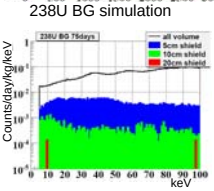
The largest BG source is PMT. (We developed new ulatra low RI PMT with Hamamatsu. RI level is 1/100 of ordinary PMT. Still largest RI source.)



238U BG simulation

238U 0.704 +/- 0.282 mBq/PMT
232Th 1.51 +/- 0.31 mBq/PMT
60Co 2.92 +/- 1.61 mBq/PMT
40K <5.10E-03

20cm Xe is used for shield
Fiducial Volume is 100kg
(Full Volume is 857kg)



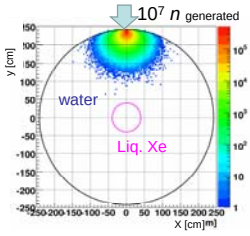
gammas < 10^{-5} counts/day/kg/keV

Water shield for external BG

Water tank is used as a passive shield for external γ and *n*

Fast neutron flux @ Kamioka mine: ~1.2 x10^{-5} /cm^2/sec

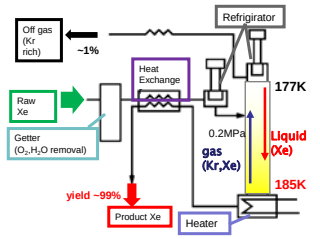
Assuming all neutron's energies are 10 MeV very conservatively

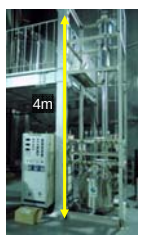


5m-ϕ water tank is large enough to shield n and γ

Xenon purification for reducing internal BG

(1) Kr removal by distillation



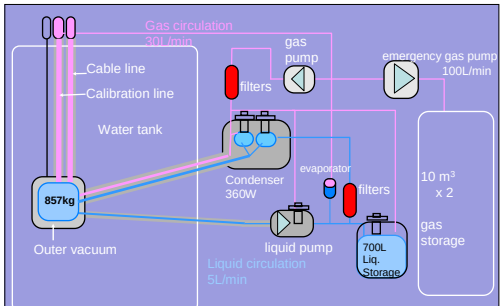


^{85}Kr is a BG source
- ^{85}Kr / Kr = 1.2 × 10^{-11}
- Q_β = 687keV
- τ =10.8 year

	Boiling point (@0.2MPa)
Xe	178K
Kr	140K~150K

Target: Kr < 1ppt
(rejection factor of 1/10^5 is required)

(2) Rn removal with continuous Xe circulation



Xe circulation system
To remove Radon emanated from detector materials

Target:
^{222}Rn<0.6mBq/ton