TITUS : An Intermediate Detector for the Hyper-K Experiment

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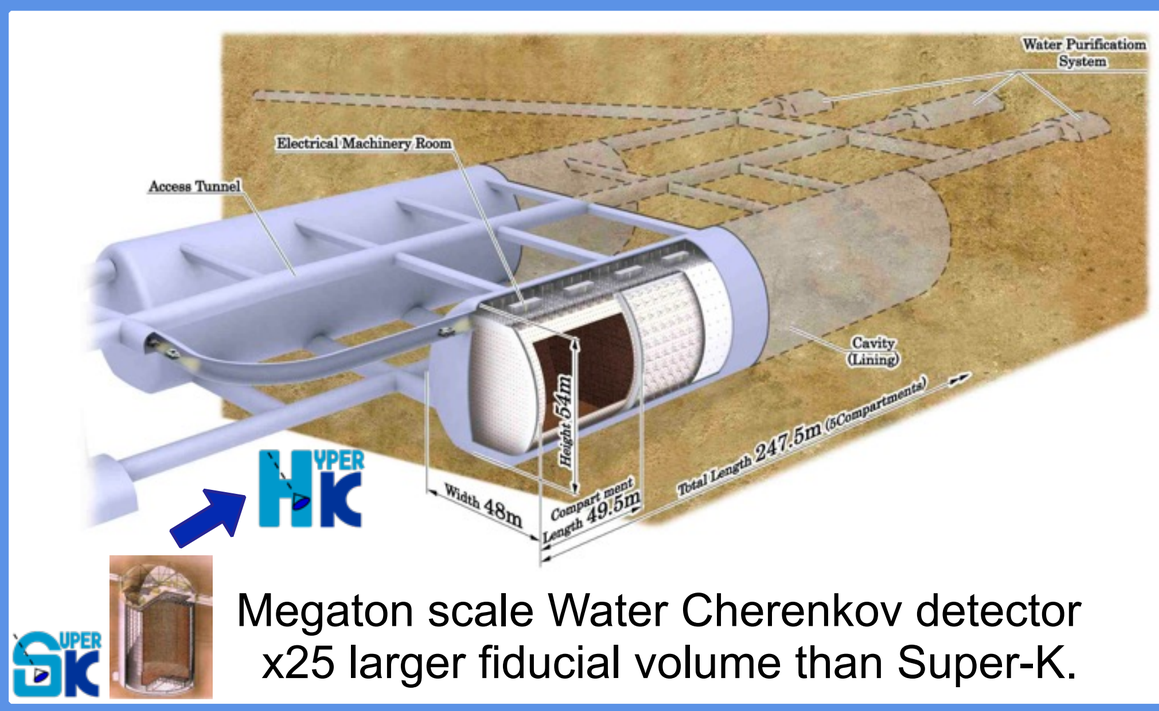
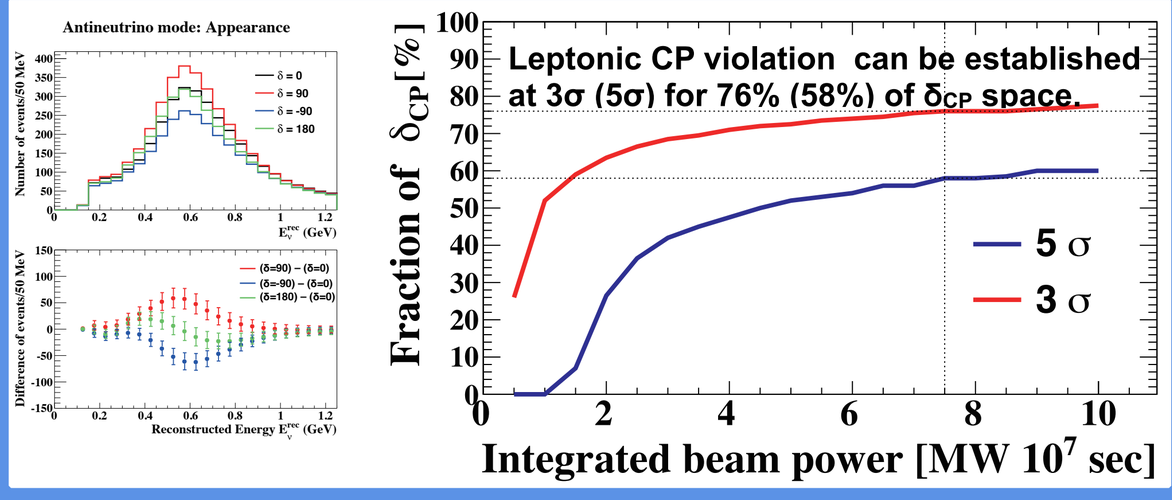
THE UNIVERSITY OF WARWICK

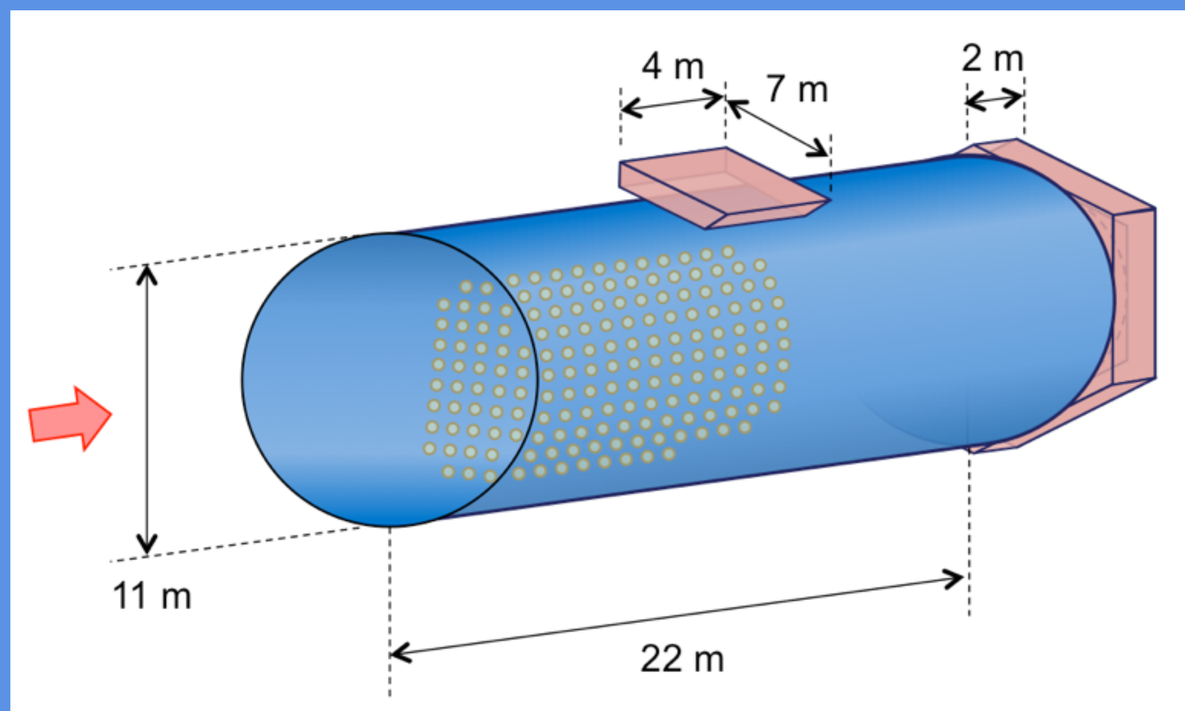
Hyper-K Experiment



Megaton scale Water Cherenkov detector
x25 larger fiducial volume than Super-K.



TITUS Detector Concept



2km from the neutrino beam source to match the far detector flux.

Identical target nucleus and detector technologies as the far detector to maximise the cancelation of systematic uncertainties.

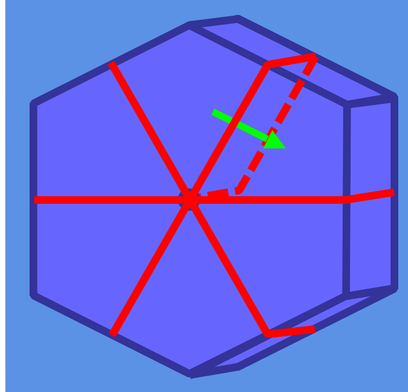
Neutron tagging by capture on Gadolinium.

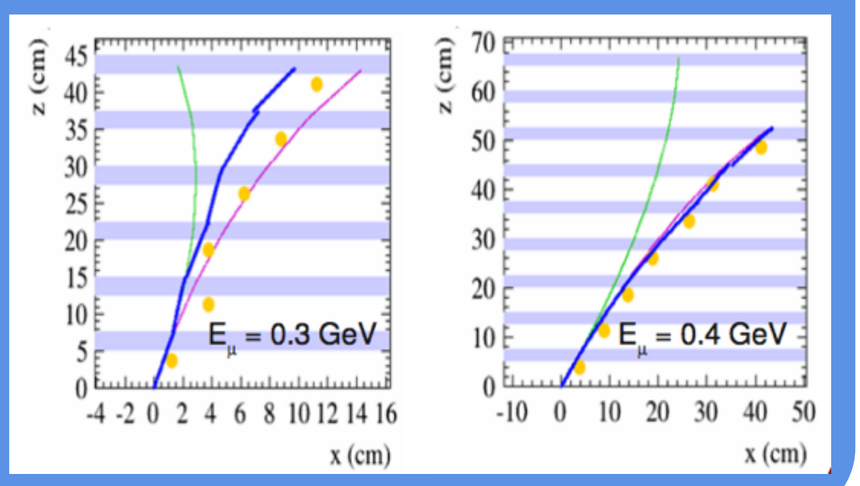
Magnetised Muon Range detector for sign selection and measure escaping muons.

Muon Range Detector

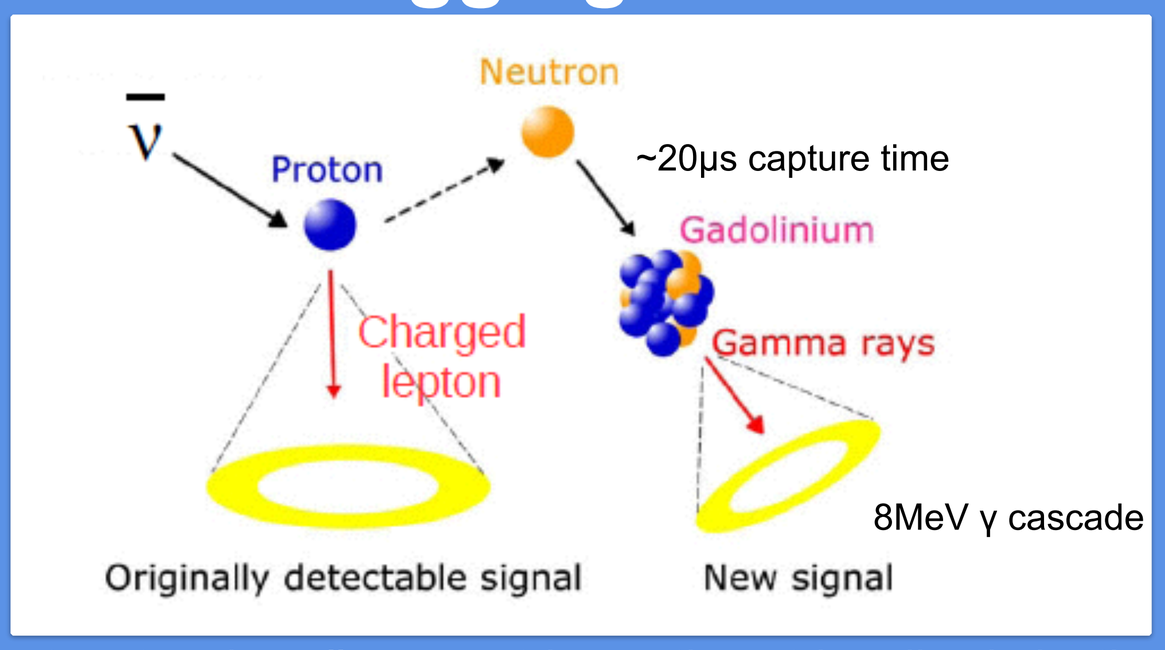
18% of muons range out. Some can be recovered with MRD.

A 1.5T magnetised iron-scintillator sandwich allows sign-selection. This provides in-situ validation of the neutron capture technique.

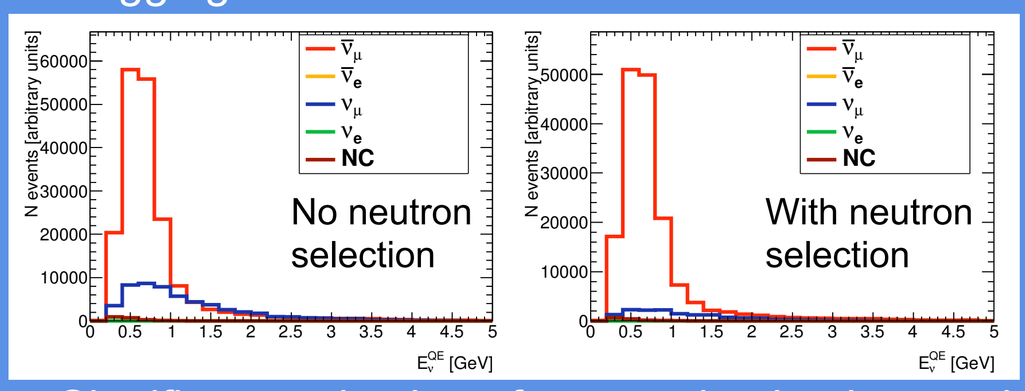




Neutron Tagging



Neutron tagging allows neutrino-anti-neutrino discrimination.



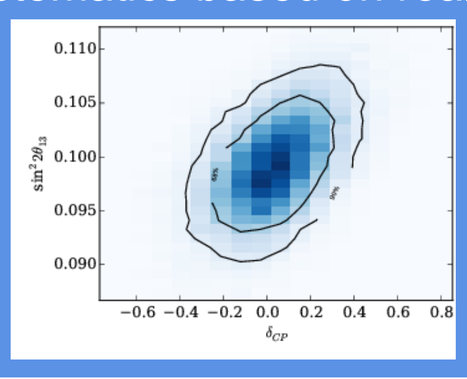
Significant reduction of wrong-sign backgrounds.

Allows selection and study of non-quasi-elastic backgrounds.

δ_{CP} Sensitivity

Systematic	N_{FHC}^{HK}	N_{FHC}^{TITUS}	N_{RHC}^{HK}	N_{RHC}^{TITUS}	R_{FHC}	R_{RHC}	$\frac{(R_{RHC})}{(R_{FHC})}$
Interaction Syst.	24.1	24.4	11.4	12.0	4.2	4.5	1.9
Flux Syst.	6.5	6.6	6.0	6.3	0.9	1.0	1.3
Total Syst.	21.8	21.9	14.2	14.4	4.5	4.3	2.4
Statistical	2.5	0.1	3.2	0.2	2.5	3.1	4.3
Stat. + Syst.	21.4	21.4	11.8	11.2	5.1	5.6	4.9

Overall systematic uncertainty on near-to-far ratio ~2.4%.
Systematics based on real experience from T2K.



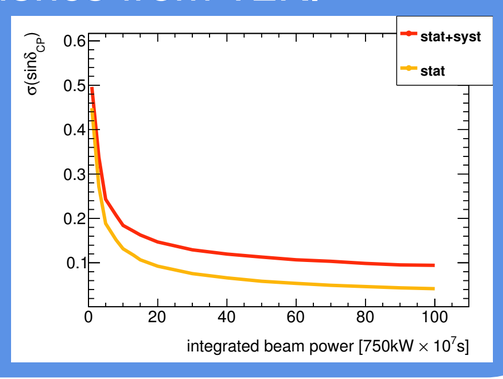


Photo Sensors

← Testing of high QE PMTs

LAPPD (Large Area Picosecond Photo-detector) option under study →