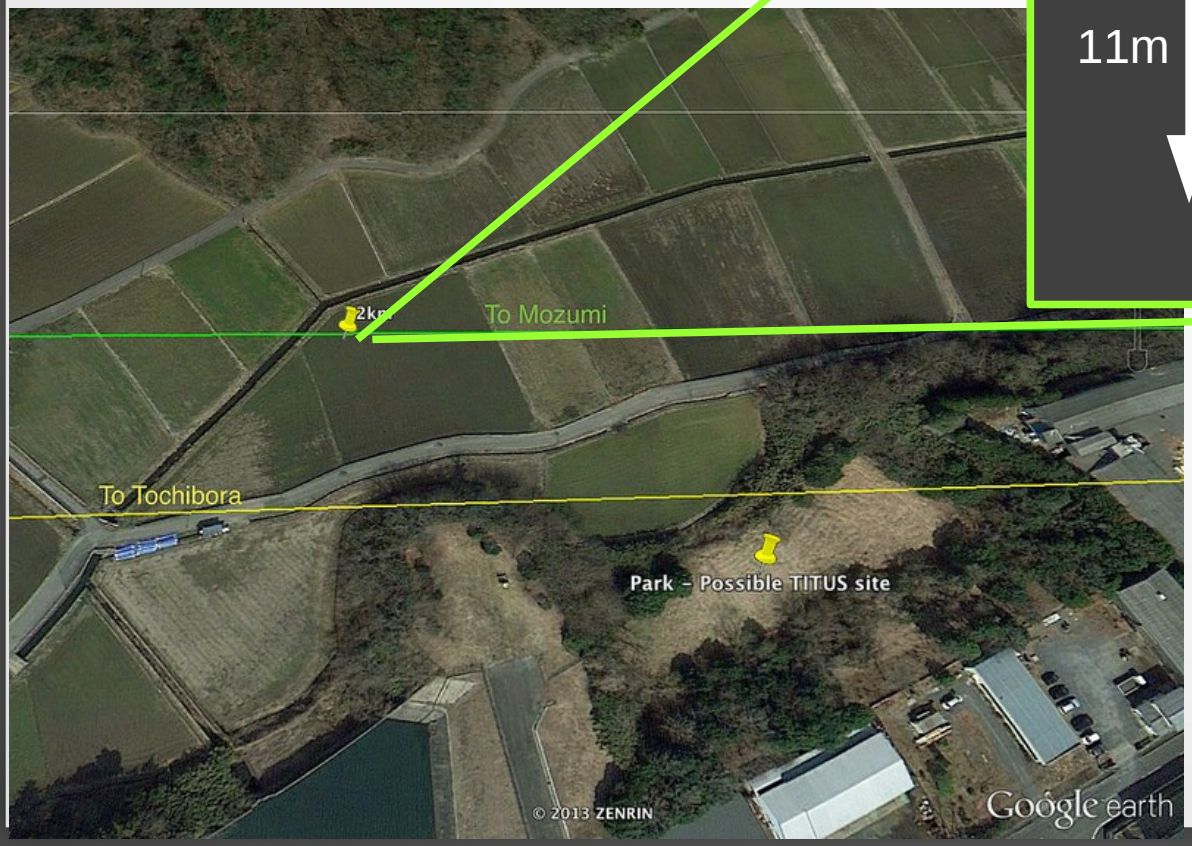
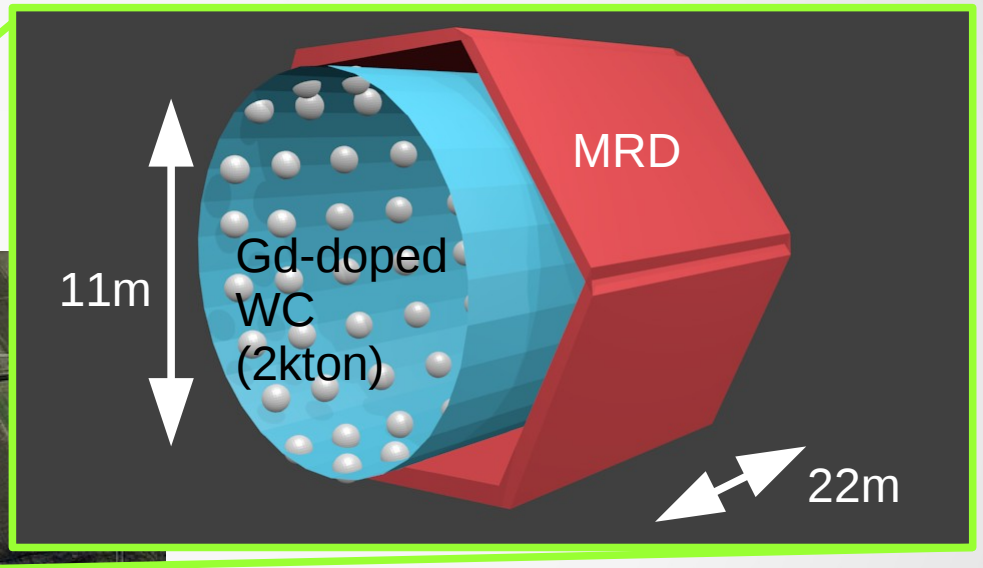
TITUS - Introduction

TITUS (Tokai Intermediate Tank for Unoscillated Spectrum)

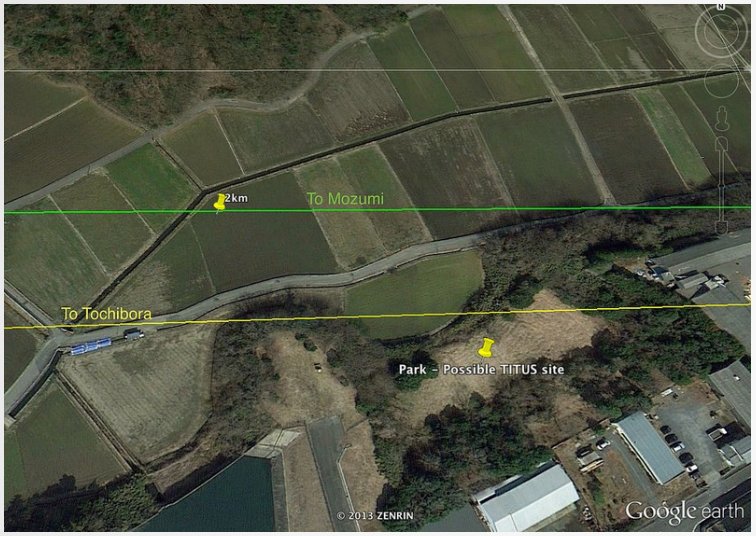


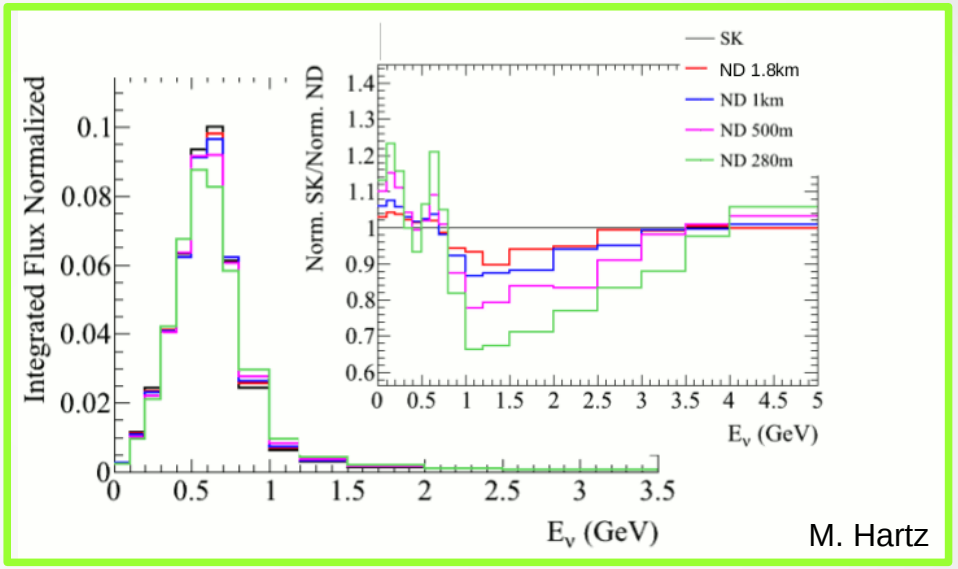


Francesca Di Lodovico
QMUL
5th Hyper-K Open Meeting
ND/Beam premeeting
19 July 2014

TITUS - Location

- Minimize beam differences with Hyper-K at ~2km



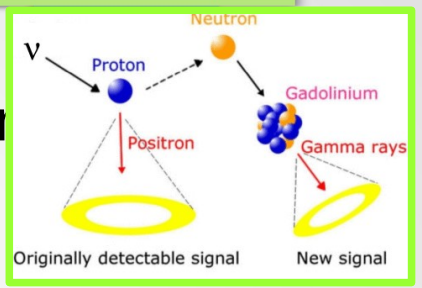


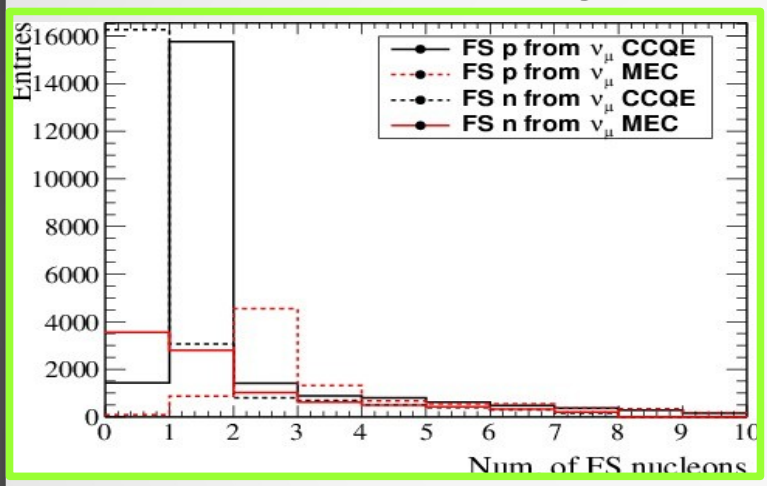
- The detector can work at a different distance but the aim is to minimize the effect from the beam at 2km.
- Previous experience with sites discussed with Ishida-san.
- Visual inspection in March by D. Derwust, H. O'Keeffe, R.Sacco. Enjoy brief video! https://www.flickr.com/photos/robsacco/12896555024/

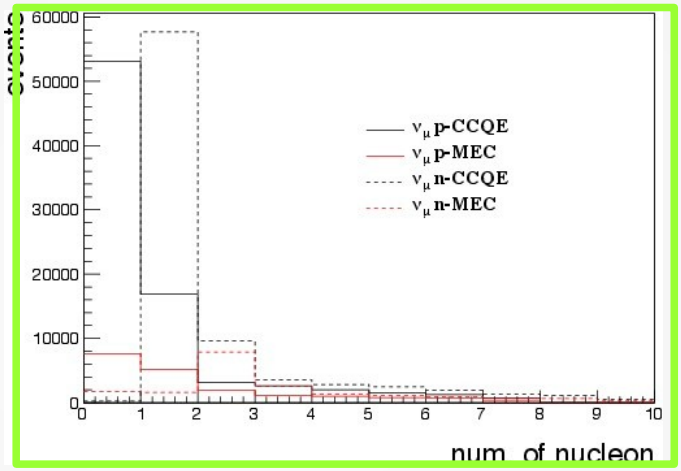
TITUS – Water Tank

Talks by M.Malek and D. Hadley

- Water → same target as Hyper-K and 4π coverage
- G_d-doped: original idea to exploit G_d for ν/anti-ν separation and use it for background reduction







$\nu + n \rightarrow l^- + p$

$\bar{\nu} + p \rightarrow l^+ + n$

Example cuts to select the signal:

- Nu-mode beam: captured neutron = 0
- Antinu-mode beam: captured neutron = 1

Cuts select CCQE and reduce CC-other, NC and anti-nu (nu) events

Main current objective is to test the procedure w/ recoed data

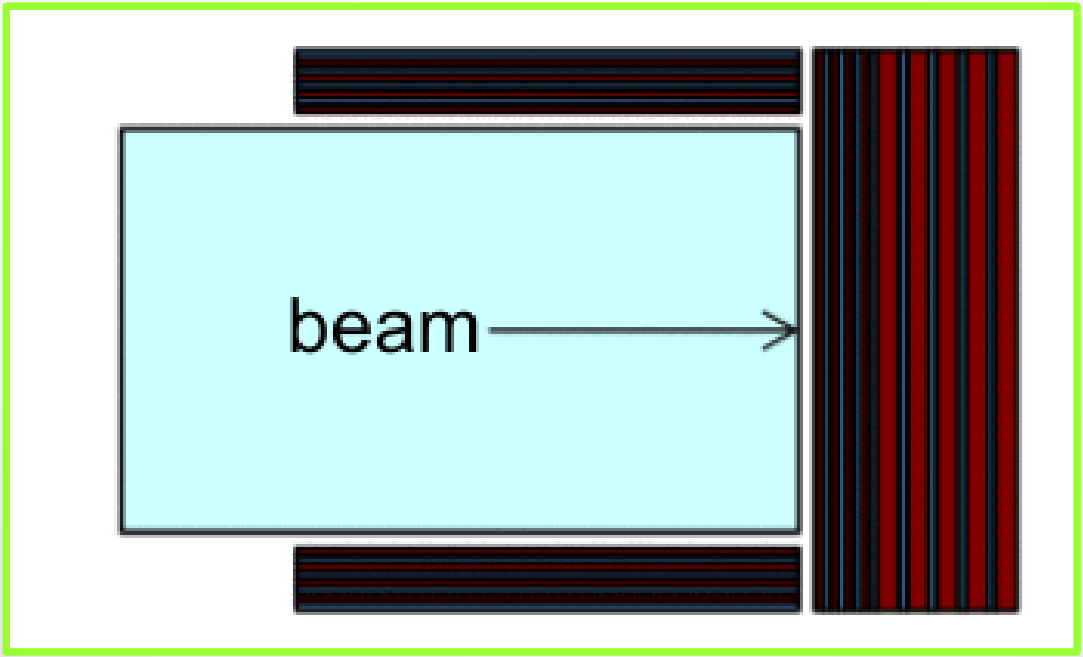
Very good initial preliminary results (to be improved w/ eg selection):

Purity ν-mode (CCQE: 37 → 63 %), $\bar{\nu}$-mode (CCQE 55 → 82%)

TITUS - MRD

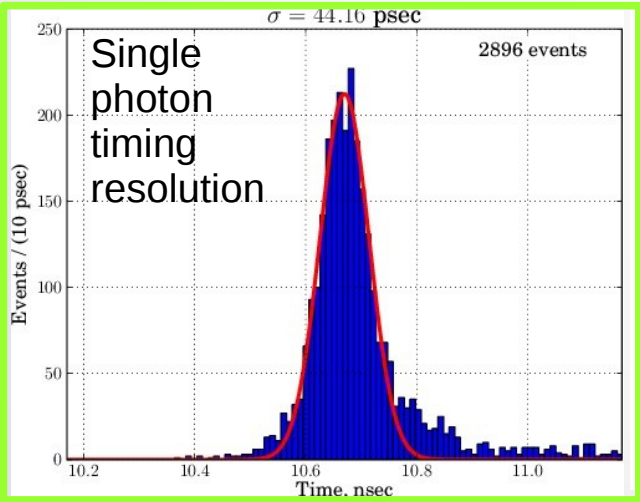
Talk by M. Rayner

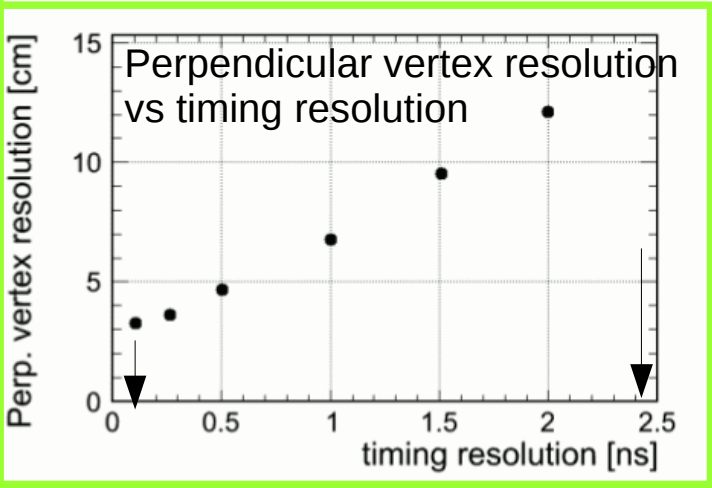
- The WC tank is surrounded by a Muon Range Detector to catch the escaping muons
- Magnetize the detector for charge identification
- Dimensions of the MRD, size and downstream, being optimized

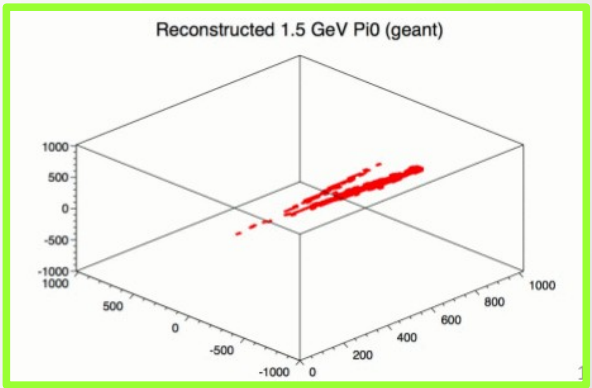


Photosensors

- Standard PMTs/HPDs and LAPPDs.
- Optimal configuration being investigated.
- LAPPDs should help reconstruction due to good timing and spatial resolution.





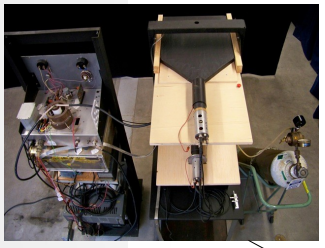


T.Xin, I. Anghel, M. Wetstein, M. Sanchez

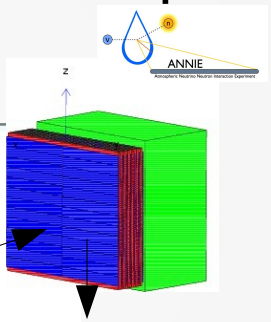
Synergie with ANNIE

Similarities have been very helpful for software development so far.

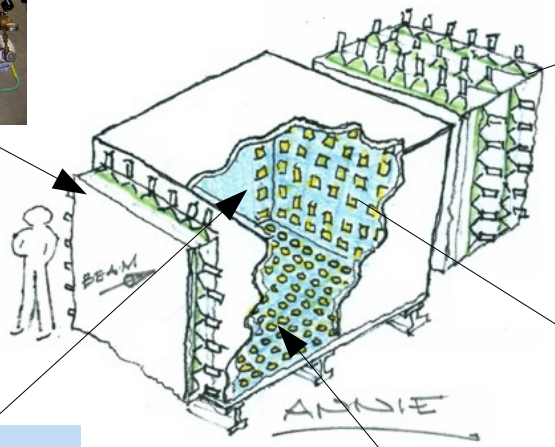
ANNIE is directly involved in the LAPPD development and should be the first experiment using them.



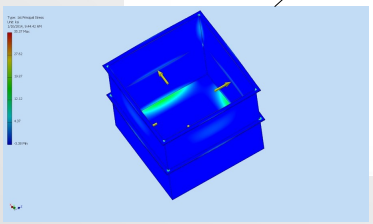
Front Anti-Coincidence Counter



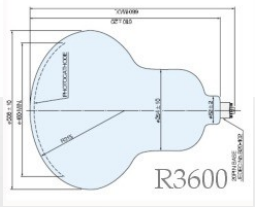
Muon Range Detector



LAPPDs



Gd-loaded water volume



Conventional PMTs

Breath of Physics

- Main goal of the detector is to provide a 'background-free' signal for oscillation analysis.
- Several other important analyses can be addressed:
  - SN analysis, thanks to the Gd-doping.
  - Proton-decay background analysis.
  - Xsection measurements
  - Sterile neutrinos
  - ...

Status of the Code

Working on developing the simulation and soon the reconstruction for this detector.
Results shown today use:
- NEUT, Genie vector files (D. Hadley) and 2km flux (M.Hartz)
- simulation code WchSandBox by Matt Wetstein (hk-wchsandbox in HK release) and contributions from TITUS (Dave, Francesca, Matthew, Dave). MRD code being developed (M. Rayner)
- reconstruction for high energy rings based on Shimpei's fiTQun tables
- analysis developed by the TITUS team

Under way and Planned

Three main area of work:

- Software Development
  - Several studies planned to develop a simulation and reconstruction adapted for TITUS. Initial work focused on the simulation.
  - Create common software for tank and MRD.
- Detector Optimization
  - Re-optimize the detector, both the global shape of the tank and the MRD and the photosensor configuration.
- Analysis
  - Selection with captured neutrons
  - Sensitivity studies
  - Non-oscillation analysis (π^0 and xsection measurements, SN, sterile neutrinos, proton decay background etc)

Summary

- TITUS: new original detector for reaching „background-free“ signal and charge separation at 2km to minimize beam differences with Hyper-K (can work at other distances)
- Characteristics: new original use of Gd-neutron tagging (useful for SN too and to help in possible development of a Gd-doped Hyper-K) and MRD.
- Preliminary initial results show improved purity for CCQE in ν-mode (at least 37% → 63%) and $\bar{\nu}$-mode (at least 55% →82%).