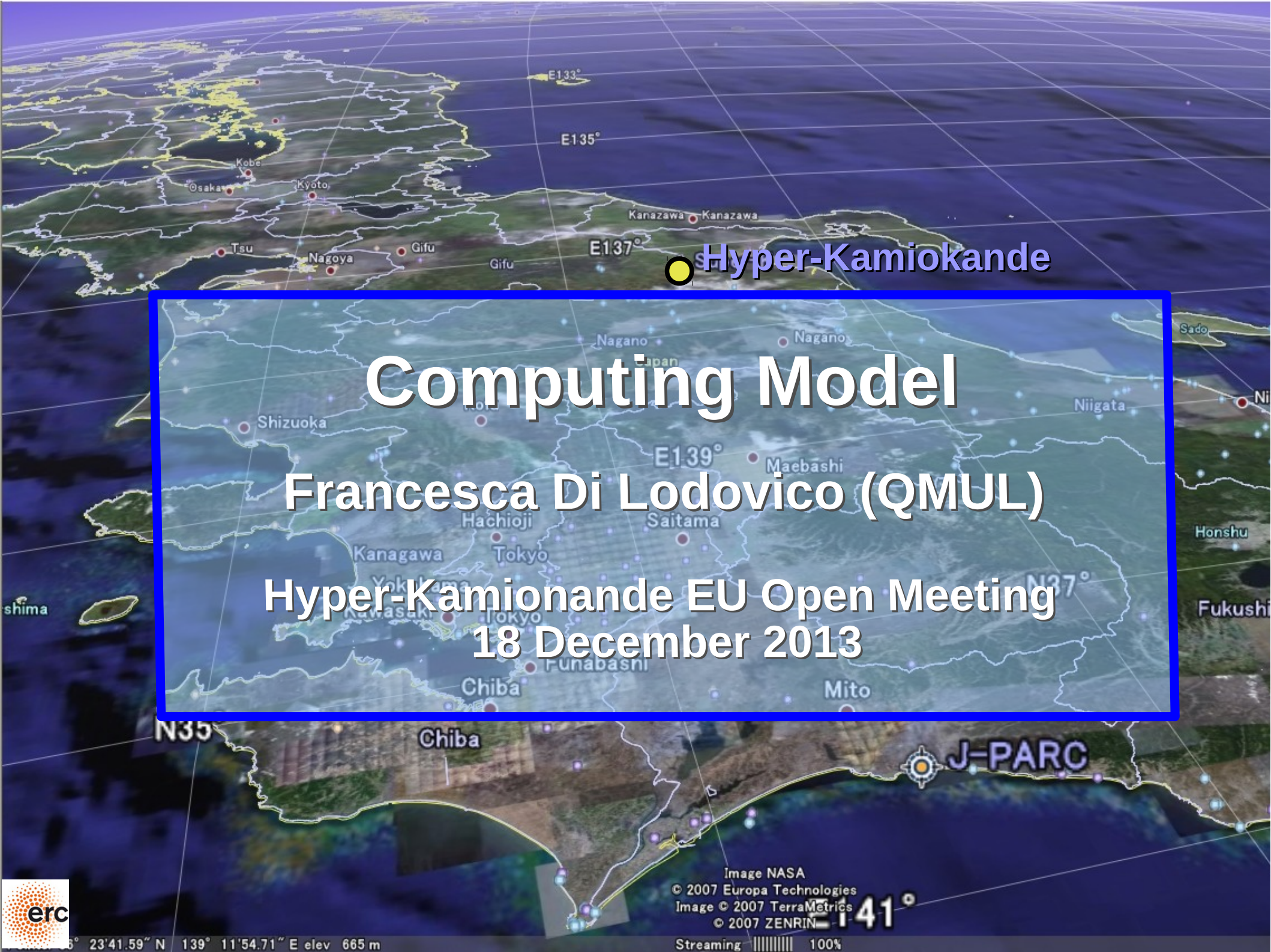
Hyper-Kamiokande
J-PARC
Computing Model
Francesca Di Lodovico (QMUL)
Hyper-Kamionande EU Open Meeting
18 December 2013
Image NASA
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Streaming 100%

Software Agreement with SK

Y.Suzuki@Super-K meeting on May 10th, 2013

Report

- Request from HK working group for an use of SK softaware and SK data in the HK software delopement work.
  - They asked to make a similar agreement between SK and T2K

Answer to the request

1) The SK Executive Committee feels that Hyper-Kamiokande is a natural extension of Super-Kamiokande, therefore, we should cooperate as much as possible.

2) We think that a HK working group will develop their own simulation code based on the 'real' HK geometry and other parameters since the HK detector size and shape are quite different from SK. As HK develops its own simulation code, then HK software becomes less dependent on SK software. We believe that HK should start their code development now.

3) Certainly, we agree that HK may adopt concepts of the SK software and if necessary to copy SK codes into HK codes freely. Once done, HK may modify the codes as they wish without reporting all the modifications back to SK. We would like to be informed of any modifications that could also improve the SK code.

4) SK software should not be used for any other purpose than for HK simulation and analysis software development.

5) You mentioned the T2K-SK agreement as an example, but the situation of T2K is quite different from HK. T2K uses SK detector as a far detector, therefore, T2K definitely needs SK software and SK data, which is the reason we have made such an agreement. HK will not use the SK detector, so we do not need the same kind of agreement, as you have proposed.

6) SK will not form a group to have responsibility for maintaining analysis software of the SK detector for the HK group.

7) SK does not see any reason that the HK working group needs to use SK data for the HK software development. SK believes that HK needs only the MC generator, detector simulator and data analysis codes, which we are willing to provide, but not data.

SK Code in HK

SK code (at the moment)

Vector generator

Atmospheric ν: Honda flux + NEUT
Nucleon decay: ndecay_vc
Solar ν: vect_gen
T2K: Beam flux+NEUT

Ongoing work:
D. Hadley

Simulator:WCSim

Reconstruction: fiTQun (High E) Bonsai(LowE)
(Independent from SK library)

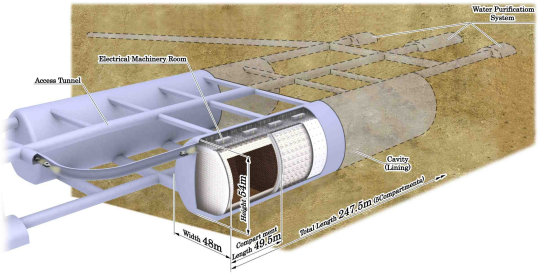
Analysis

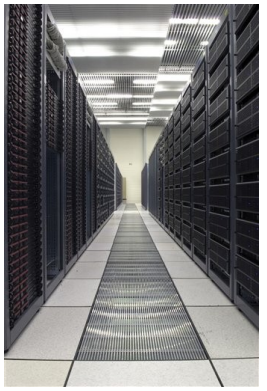
Atm.ν	Beam ν	Solar ν
OSC++	PROB++	SOLFIT, Spallation cut and related libraries

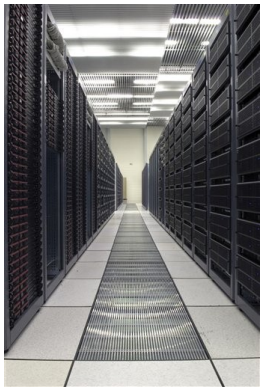
Computing Model

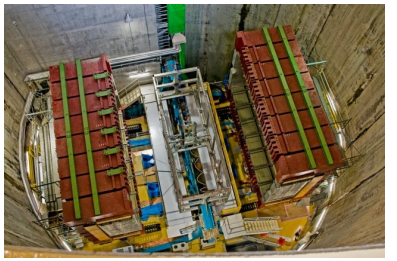
- Motivation:
  - Maximise throughput (processing and storage)
  - Minimise overhead (person-power, etc)
- Approach:
  - Take advantage of existing infrastructure
  - Adapt to new infrastructure if:
    - Has less overhead
    - Has more plentiful resources
    - Existing infrastructure is being phased out
  - Adapt/ develop tools to minimise overhead

Computing Model





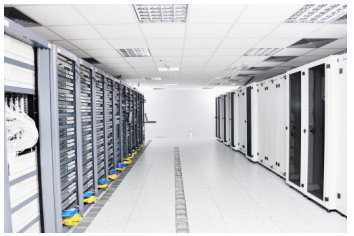


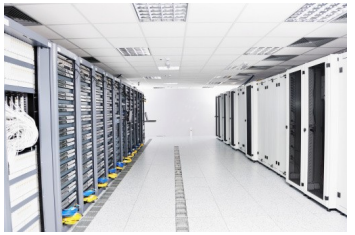


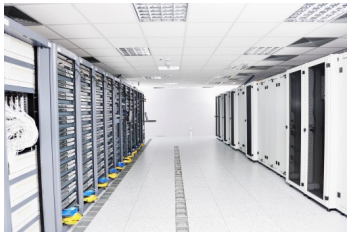
Tier 0
(raw, reco, calib store)

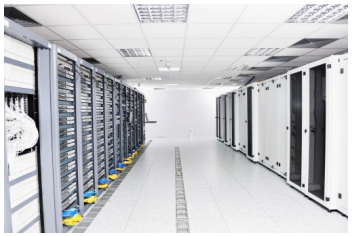
Tier 1
(reco, simu processing + store)

Tier 2
(physics processing)









Computing Model

- Model needs following features:
  - Distributable: easily make use of computing/storage in different locations
  - Adaptable: easily make use of new resources (e.g. new infrastructure, new storage, new computing)

Computing Model: Distributable

- Currently Grid technology used by T2K will be used by HK. HK VO: hyperk.org
  - In UK testing/making use of new features. E.g CVMFS (CernVM File System)
    - Only need to deploy s/w once, accessible from all grid nodes
  - Learn from T2K to reduce management overheads
- Have had some success with distributed data management (iRODS*) will be using it in HK
  - Has been used for some analyses and DQ in T2K
  - Simple to setup and use

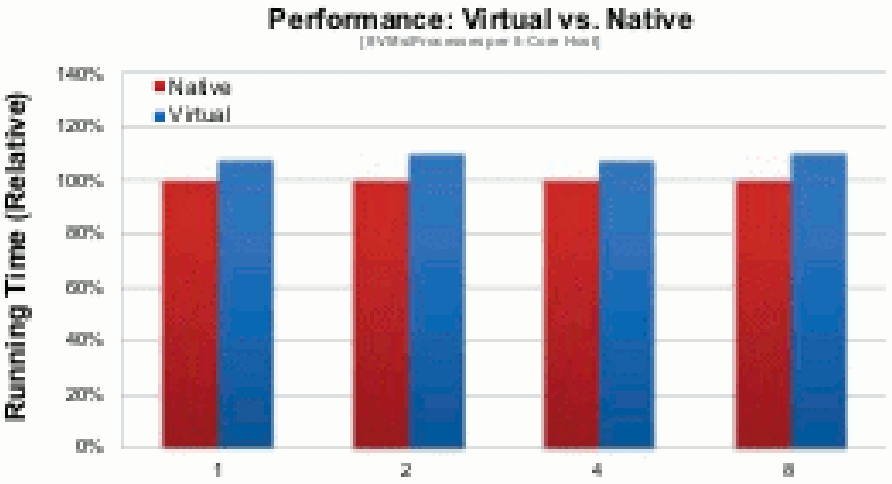
* no GRID certificate needed

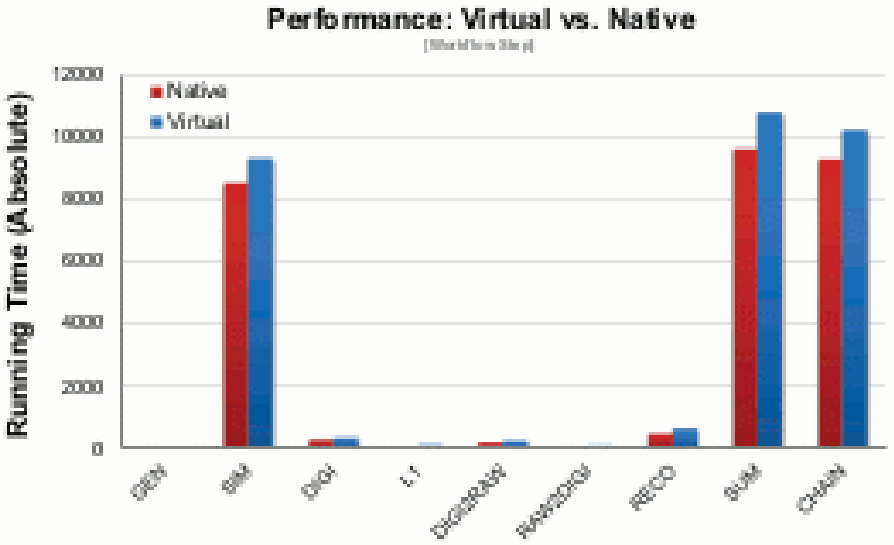
Computing Model: Adaptable

- Clouds and Grids allow virtual machines to be deployed and run
  - Clouds are very simular to Grids, but with a much thinner client (ie less to install on client-side).
- Currently testing Cloud system at KEK
  - Some fraction of production will be run on KEK cloud
  - Need to understand the impact of virtualisation (writing to external disk can slow jobs down)
- Will have discussion with GridPP people about cloud needs in UK. IRODS provides virtualisation of storage
- Clean API to storage virtualises iRODS (can replace without impacting user applications

Computing Model: Adaptable

Journal of Physics: Conference Series, Volume 331, Issue 6 (2011)



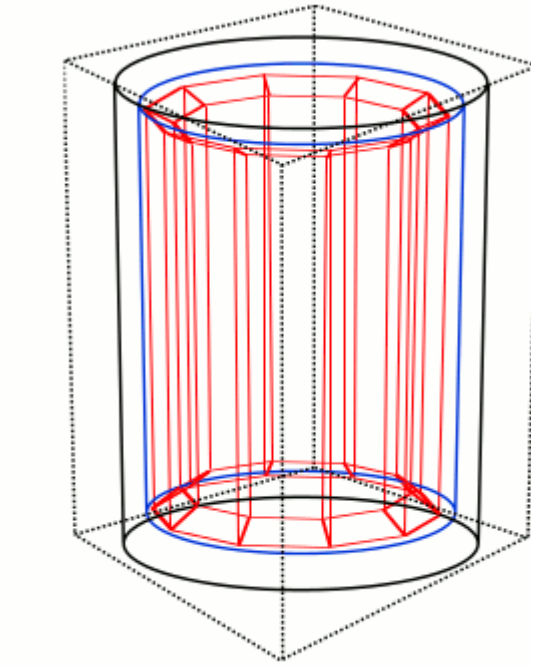


- Slight discrepancy between applications run native or virtual.
- Discrepancy can be larger if a lot of I/O to externally mounted filesystem.
- Have been recent improvements that now minimise the difference between native I/O and virtual (need to test).
- Possible the trade-off is acceptable if reduction in person-power.

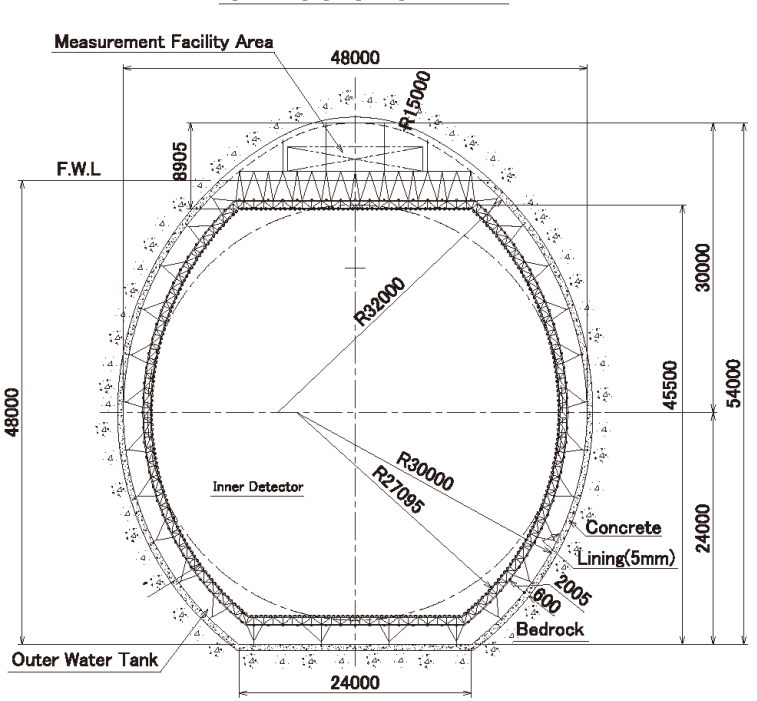
Computing Model Components: WCSim (Simulation Code)

- WCSim is a flexibile Geant4-based simulation of a water-Cherenkov detector with top and side photo-multiplier tubes.
- Developed by Duke University: https://wiki.bnl.gov/dusel/index.php/WCSim
- Implemented Hyper-Kamiokande “egg-shape” geometry (WCSim default: cylinder shape).

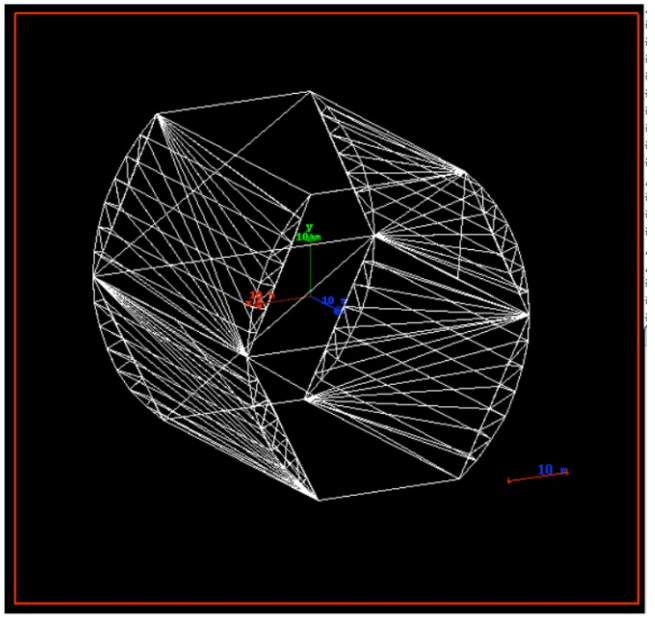
Nominal Cylindrical Geometry



Hyper-K “egg-shape”



Implementation of Hyper-K “egg-shape”



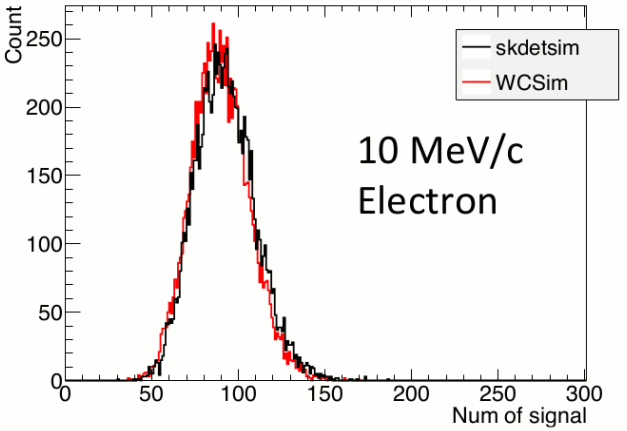
WCSim Validation

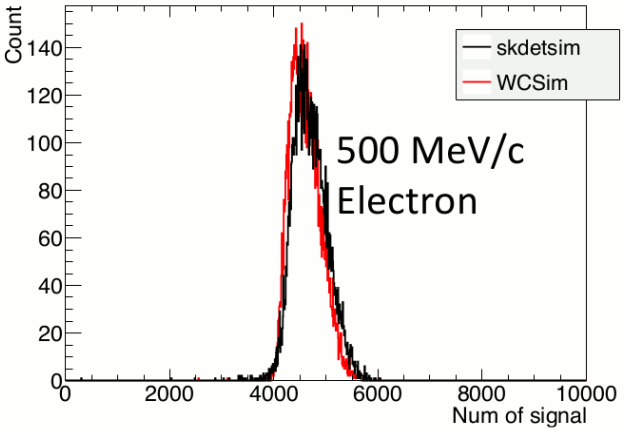
Y. Okajima

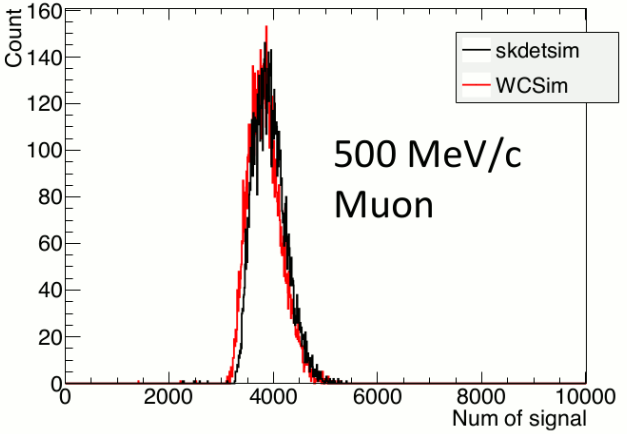
Comparison between WCSim and SKDetSim

Software	WCSim, SKDetSim
Detector	Super-Kamiokande
Coverage	40%
Particle origin	Uniform in fiducial volume of the detector
Direction	Isotropic direction

Fiducial volume: The region at a distance of 2 [m] or more from the inner detector's wall







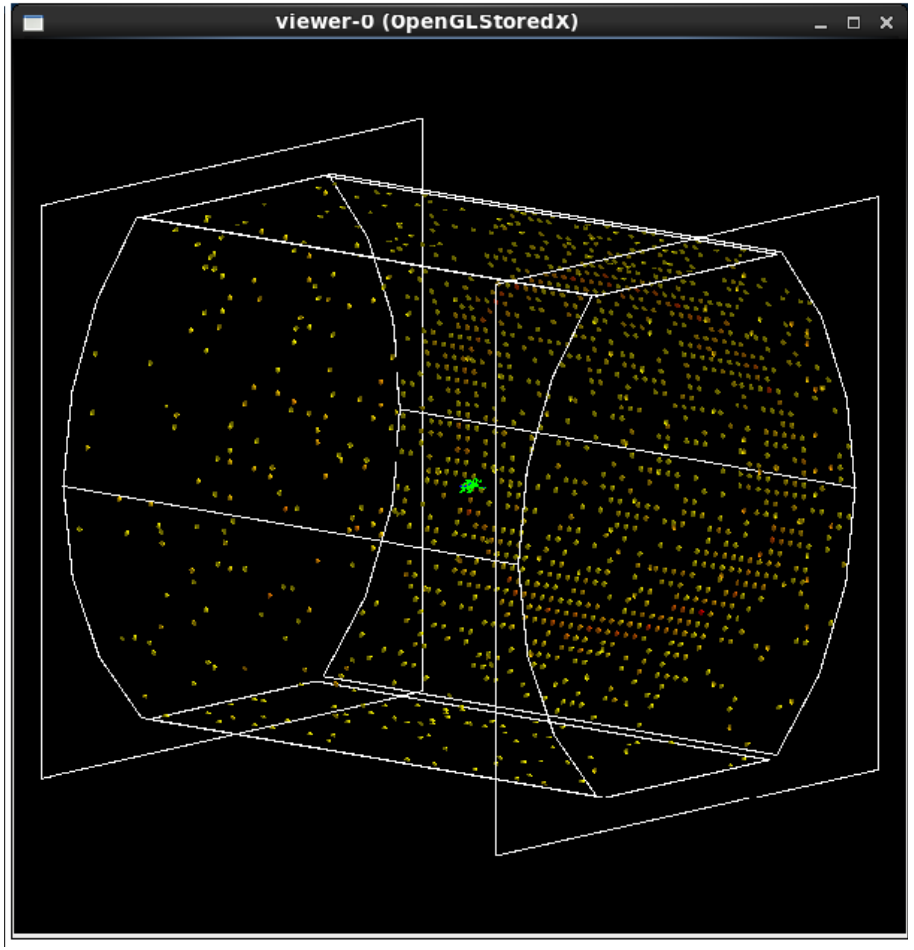
Fitted by asymmetric Gaussian and Compared the Number of PE on the peak

(Difference of peaks)/(SKDetSim peak)

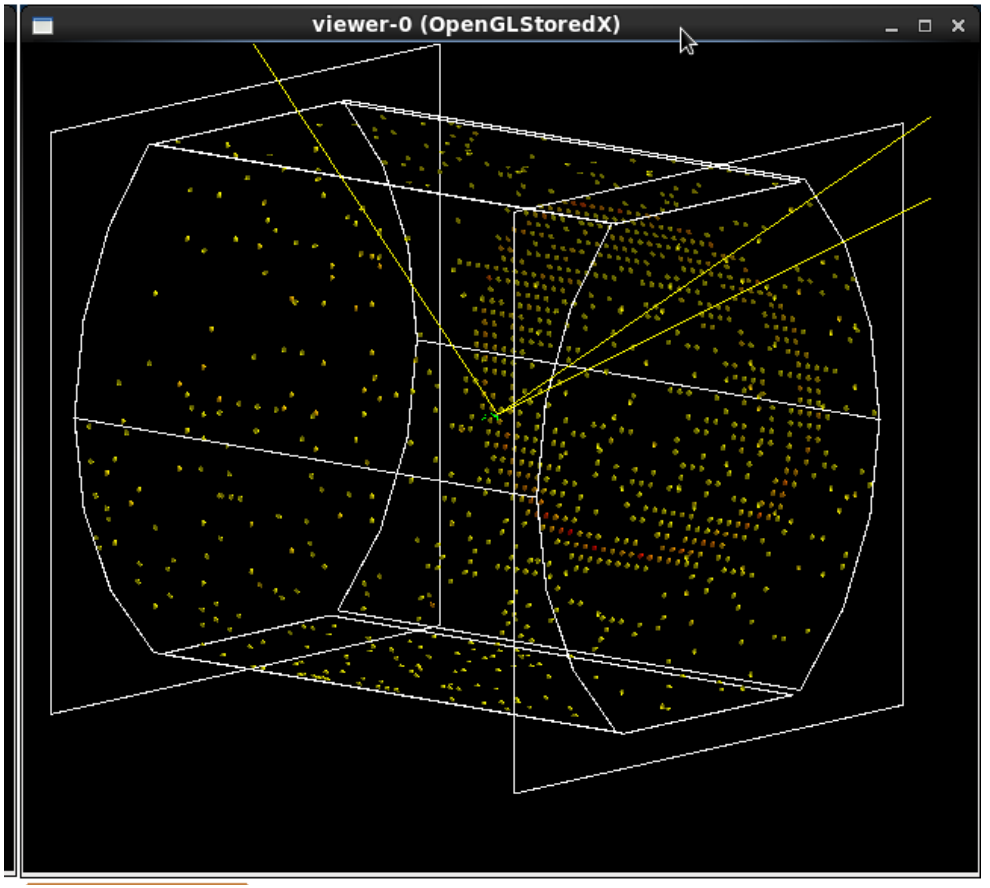
10MeV e^-	1.51±0.73%
500MeV e^-	2.53±0.27%
500MeV μ^-	1.63±0.39%

WCSim and SKDetSim output agree well,
Validity of WCSim output was confirmed.

WCSim Event Displays



600 Mev/c electron



600 MeV/c muons

Ongoing work on the event display for WCSim and fiTQun (A. Finch)

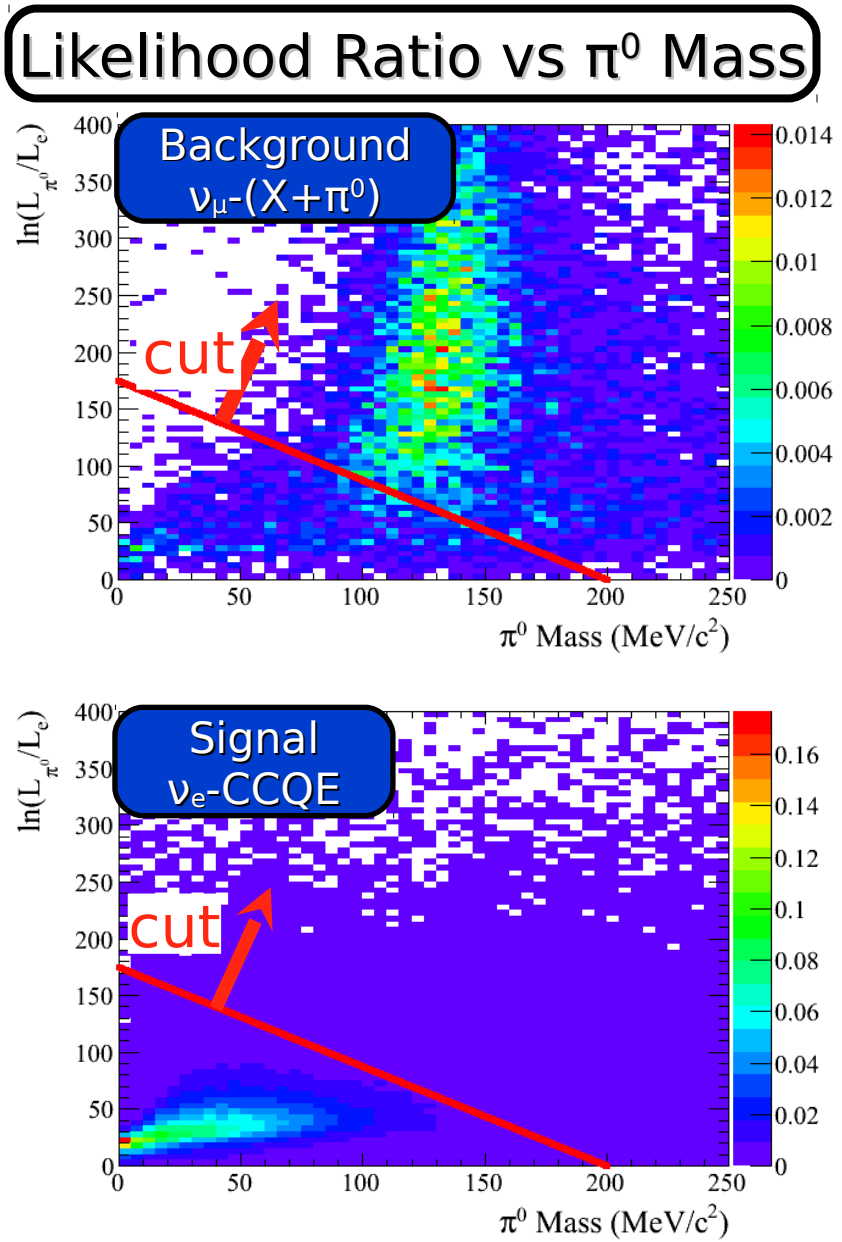
Computing Model Components: fiTQun (Reconstruction) Canada

- Event reconstruction application for Water Cerenkov detectors.
- Developed in MinibooNE and T2K
- Can read WCSim ROOT files
- Likelihood analysis to reconstruct events
- Work on separating code from dependency on SK code
- Continual work to improve speed of reconstruction
- Recent work on:
  - Improvement of the scattered light
  - Interface with WCSim

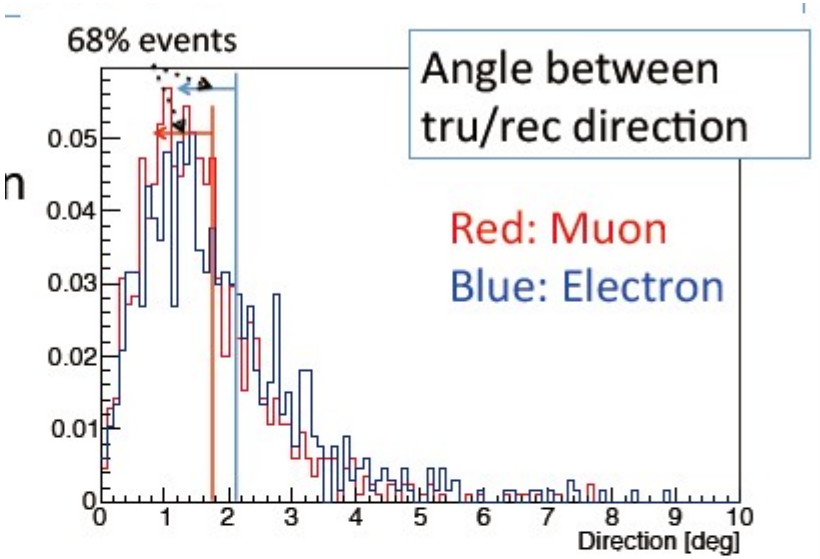
Computing Model Components: fiTQun (Reconstruction)

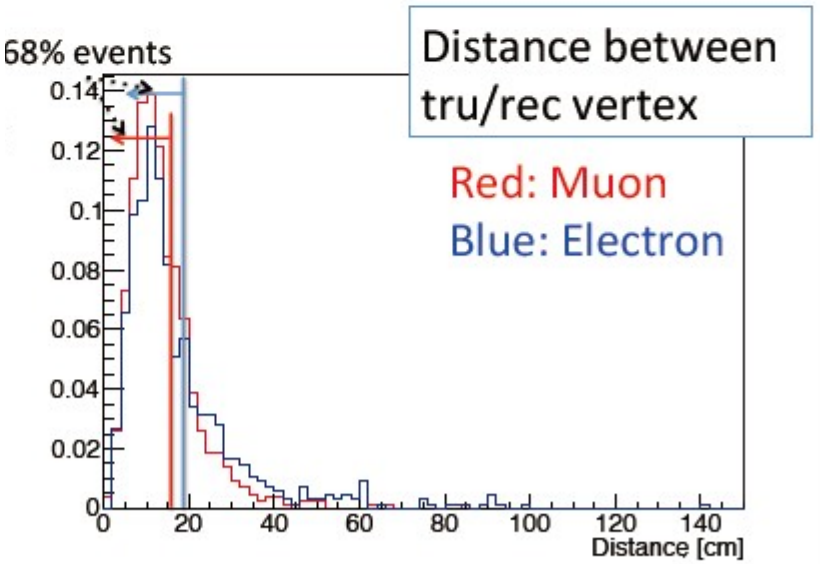
From T2K:

- fiTQun can also use the best-fit **likelihood ratio** to distinguish e- from π^0
  - Even if 2nd photon is identified, it may be on the tail of the π^0 mass resolution
  - In this case, the 2-ring likelihood will still be preferred
- 2D cut **removes 70% more π^0 background** than POLFit for the same signal efficiency



Reconstruction performance





NOTE
WCSim: 500 MeV/c e,μ
Skdetsim: <1000 MeV/c,random

	WC sim		skdetsim	
	e	μ	e	μ
Ang. Resolution(deg)	2.1	1.8	2.6	1.8
VTX resolution(cm)	18	15	20	18

Comparable results.

Computing Model: Management

Towards the first Hyper-Kamiokande software release

- Code management is an important component of model.
- Using Git system (http://git-scm.com/) to manage code
  - Git is a distributed code management system
  - Each user has a complete copy of the repository (clone)
  - Can check into local repository clone to manage locally changes and push to remote repository to 'publish' changes to others.
- Each package has its own git repository
- Git repository at QMUL
  - Please let me know if you need a new package
  - Registered users can make a local copy of package repository

Computing Model: Management

- All git Hyper-K packages prefixed by hk-... Current we have:
  - hk-clhep, hk-eventdisplay, hk-fitqun, hk-geant4, hk-hyperk, hk-new, hk-root, hk-WCSim
- Third party code (such as WCSim, ROOT, Geant etc) have a copy in Git repository
- Once all the package are finalized we will announce the first HK release
- hk-hyperk package is a manager package containing build scripts
  - You should be able to just check-out this package (look on the HK wiki for instructions – see next page)
  - Package script will check out other packages and build code
  - Capable of building stand-alone WCSim and fiTQun complete with own local ROOT, Geant4

Computing Model: Management

As a by-product of the Grid VO (Virtual Organization), we have a domain hyperk.org.

Two web sites:

Public web site: http://www.hyperk.org/ (not official yet)

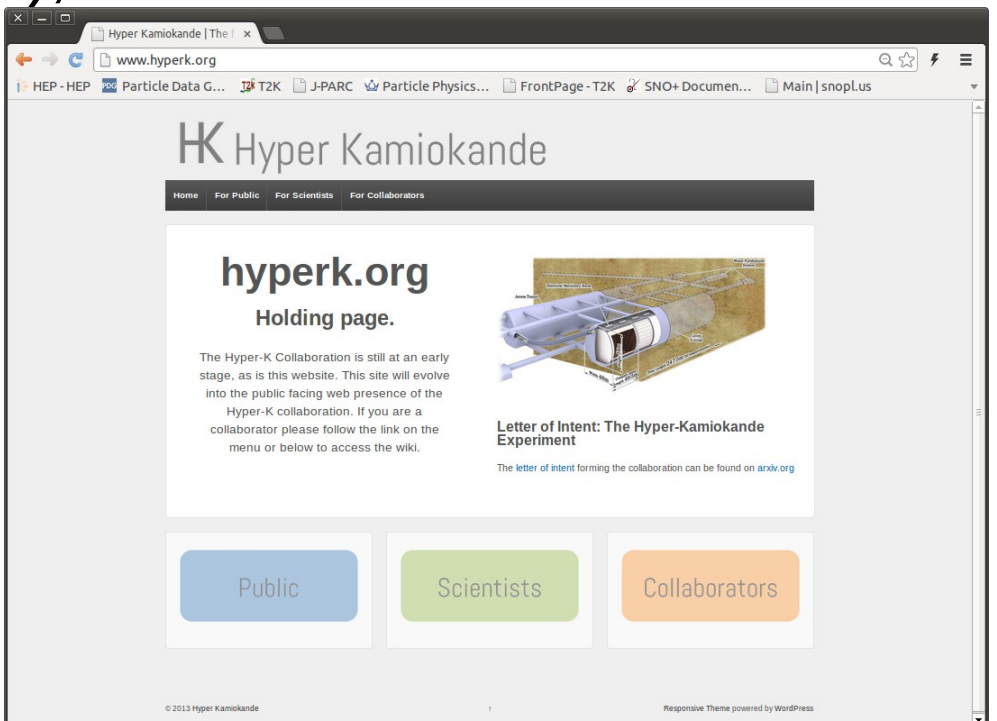
Working wiki web site: http://wiki.hyperk.org

Instructions on how to download the HK release!

Automatic registration for T2K and SK members (once we are given a list of names and emails), otherwise it will need to be approved once you register.

For questions on registration email Alex Owen (r.a.owen@qmul.ac.uk).

Ongoing work on all the three web sites to set them up. Current test version of the public web site:



Computing Milestones

- Test MC production using Grid infrastructure
  - Will test CVMFS and will test chain (incl writing data to iRODS and bookkeeping)
- Test MC mini-production with Cloud infrastructure
  - Will test performance, stability and chain
- Test MC production with hybrid system

Computing

- Plenty of work to do:
  - Improving simulation/reconstruction (more detailed detectory geometry and response)
  - Developing production tools (to manage production, bookkeeping etc)
- A zero version of the HK release is available →
  - Final version expected in ~January
  - Simulated events should be included in the LoI
- If you have an interest in more information on computing tasks to work on please contact me.