Hyper-Kamiokande for new RISE Call

Francesca Di Lodovico

JENNIFER Consortium General Meeting
October 6, 2017

Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Future Expectations for Hyper-K

Revised project proposed to the Science Council of Japan and MEXT:

- Early realization of first tank, physics potential, cost optimization.

Important Milestone achieved:

- Hyper-K is listed in the MEXT roadmap

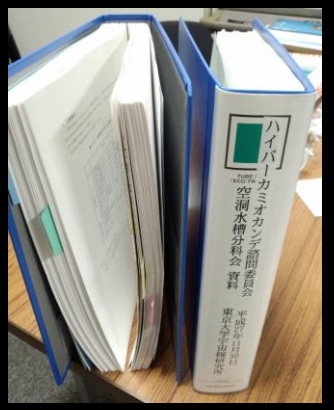
New Organization will be launched by the University of Tokyo to promote Hyper-K

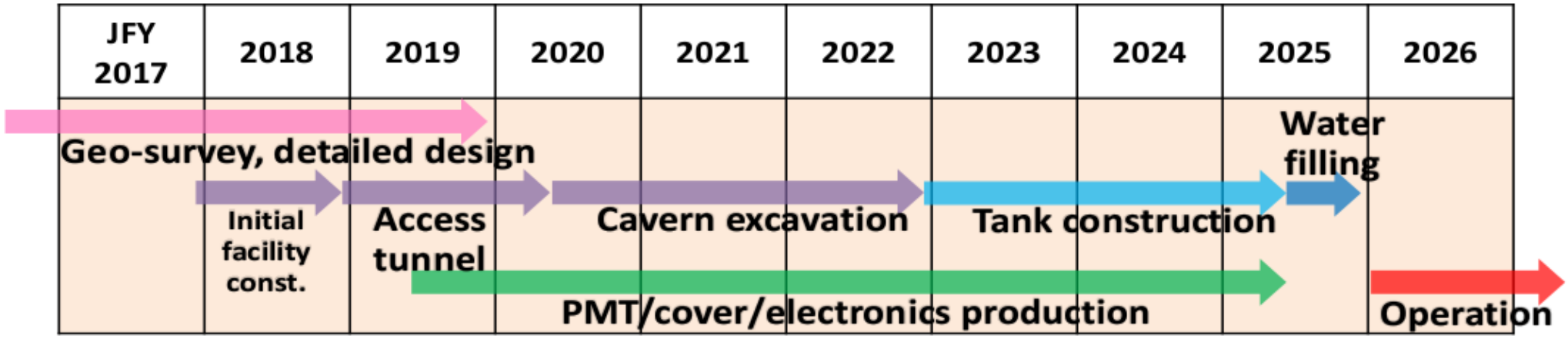
- Inauguration on Nov 8.

Transition from Hyper-K proto-collaboration to collaboration under-way.

Construction

- Assuming the next JENNIFER grant will run from April 2019 to March 2023 (4 years), we will start to build the Hyper-K experiment.
- Also the E61 experiment may be built in parallel according to the current timeline.
  - E61 timescale is close to the HK timescale
  - ND280 may be further upgraded in >2025
- The next step is to move from the current R&D phase to design and construction.
  - Close collaboration w/ KEK, J-PARC, ICRR
  - Longer secondments.





Outline

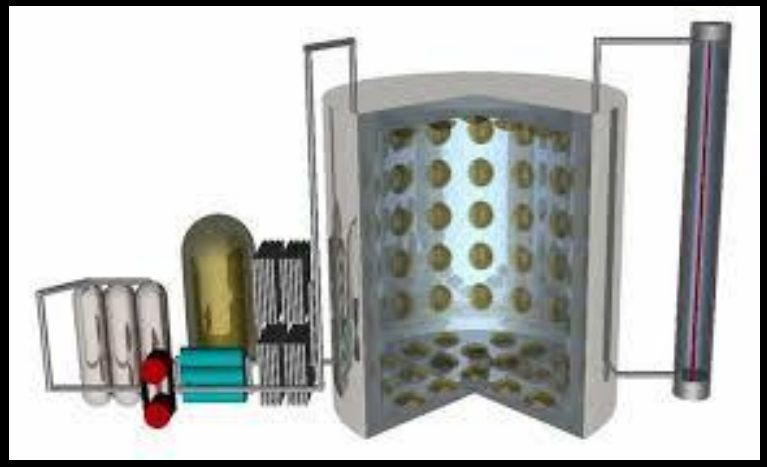
- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Synergies between WC Detectors

- The work on Hyper-K detector also includes the work on Super-K, EGADS and E61.
- We will be testing, commissioning and building new prototypes.
- Very close collaboration with KEK/J-PARC and ICRR

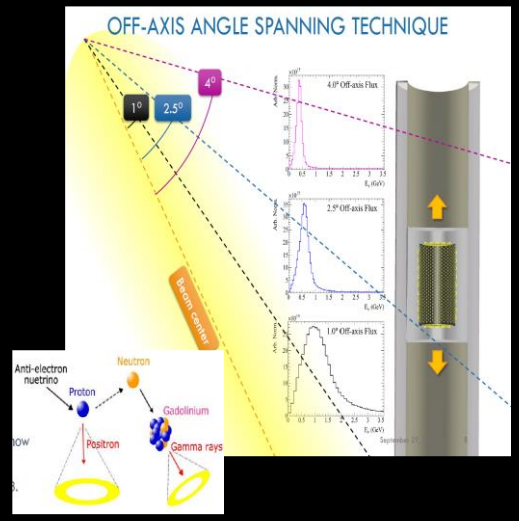
Super-Kamioka (~50kton), Kamioka

- **Calibration → deploying prototype in SK-Gd, neutron calib.**
- Gadolinium → testing samples in Spain/UK/Italy.



EGADS (~200t), Kamioka

- **Calibration → neutron calib.**
- **Gadolinium → Gd concentration**
- Software



E61 prototype

- **PMTs**
- **ToolDAQ**
- **Calibration**
- **Software**

Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Computing, Software,Physics

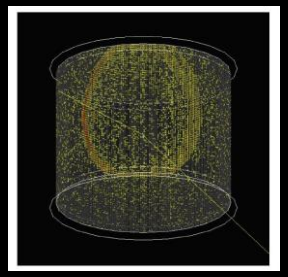
Production (Grid, SciNET, other resources)

Simulation (WCSim) – US + other countries developing code

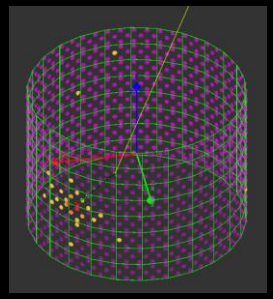
Reconstruction (fiTQun) – Canada, US

Analysis far/second/near/ intermediate detectors - everyone

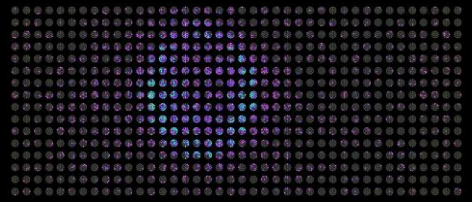
WCSim µ1GeV

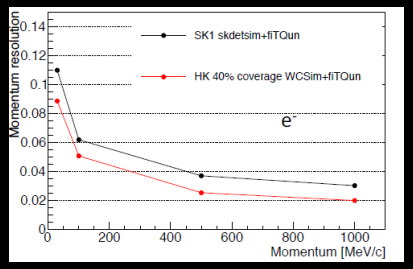


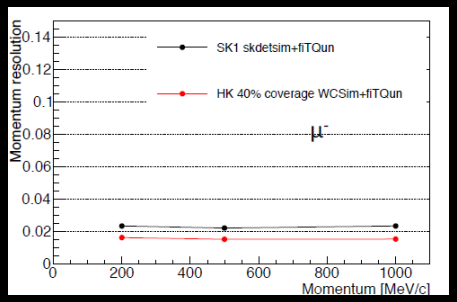
WCSim OD event



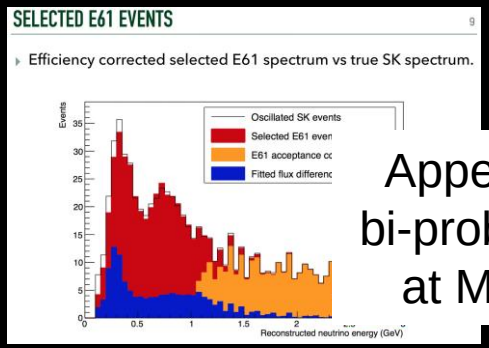
WCSim mPMTs



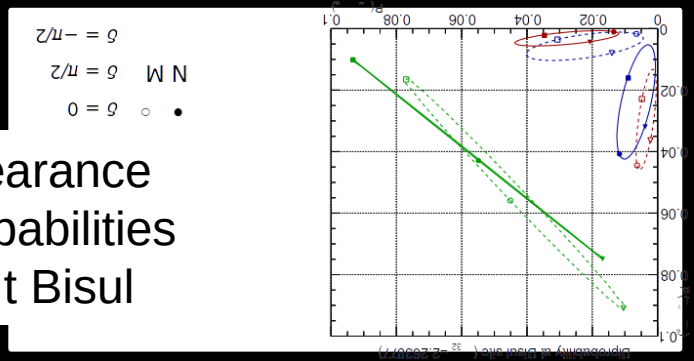




FitQun momentum resolution



Appearance bi-probabilities at Mt Bisul



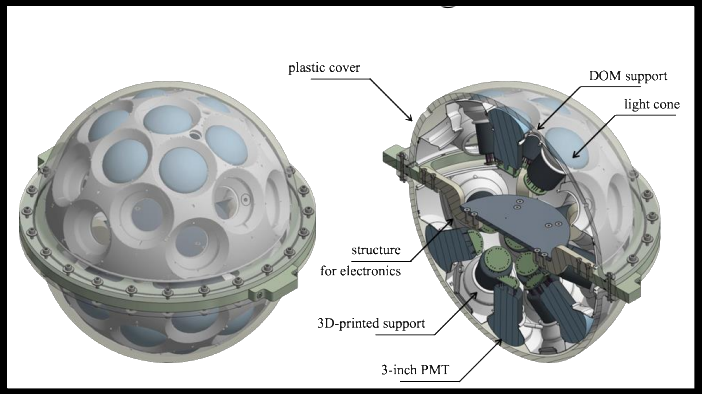
- For the future call we will need to write the code for the new detectors and make simulation studies.

Outline

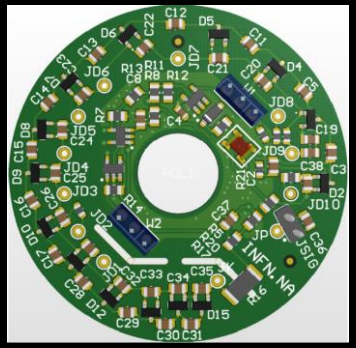
- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

PMTs

- During the next period of the JENNIFER-2 grant, HK we will develop mPMTs and OD (new original ideas for WC detector)

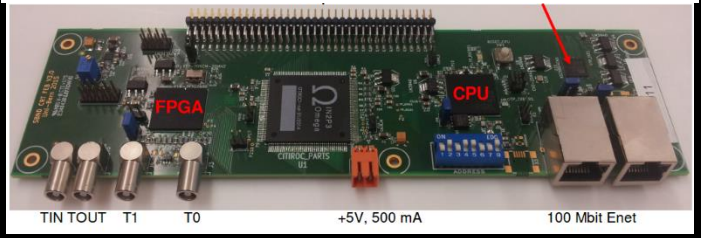


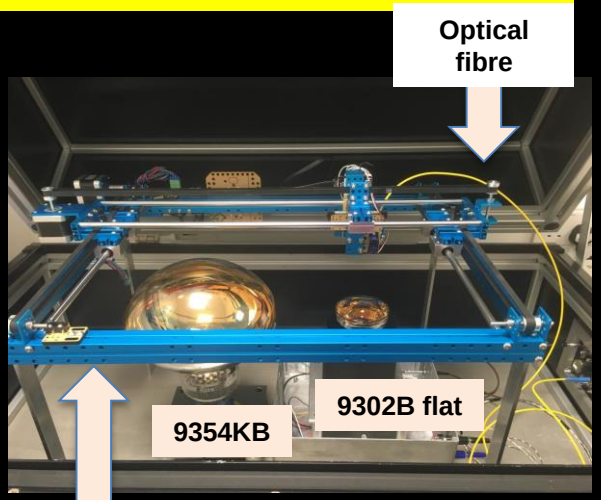
Some electronic options under studies

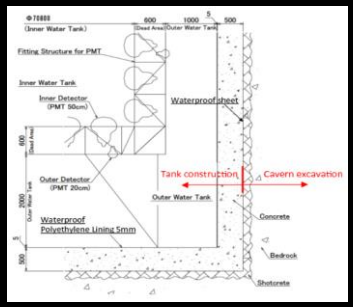


HV base

Voltage multiplier circuit - Petiroc





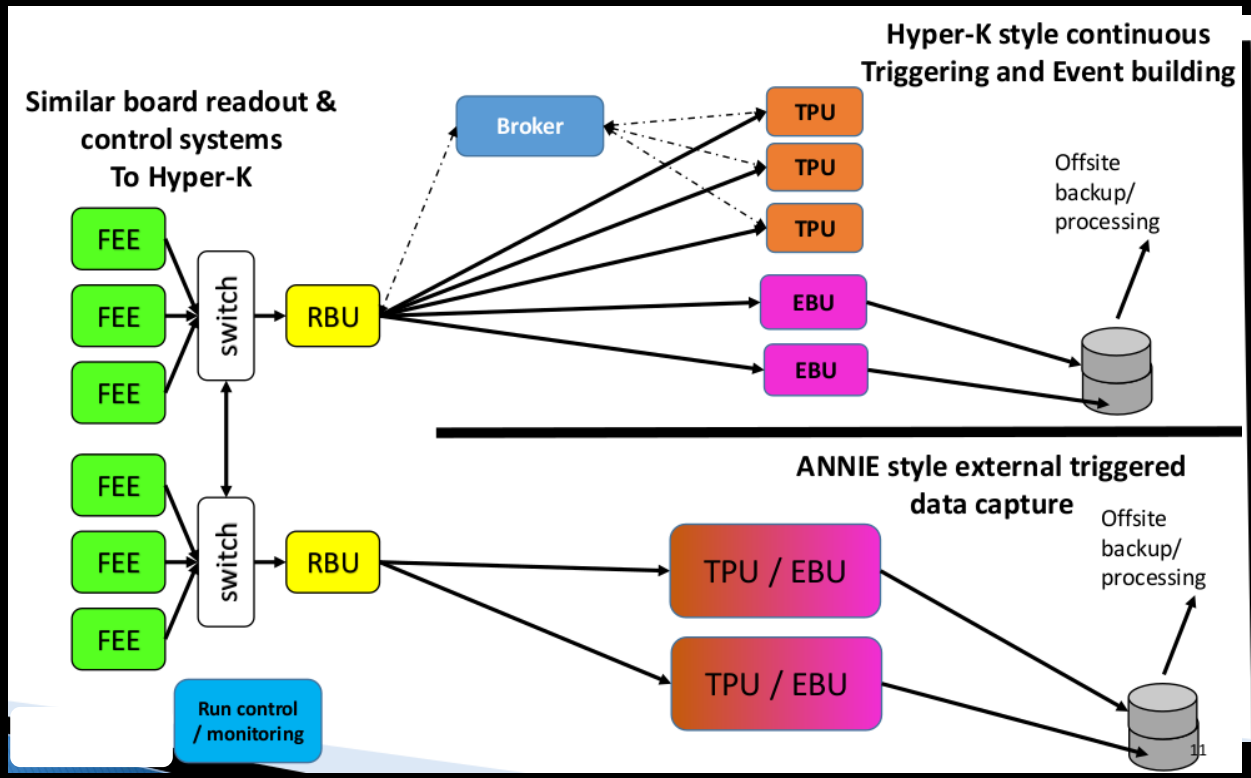


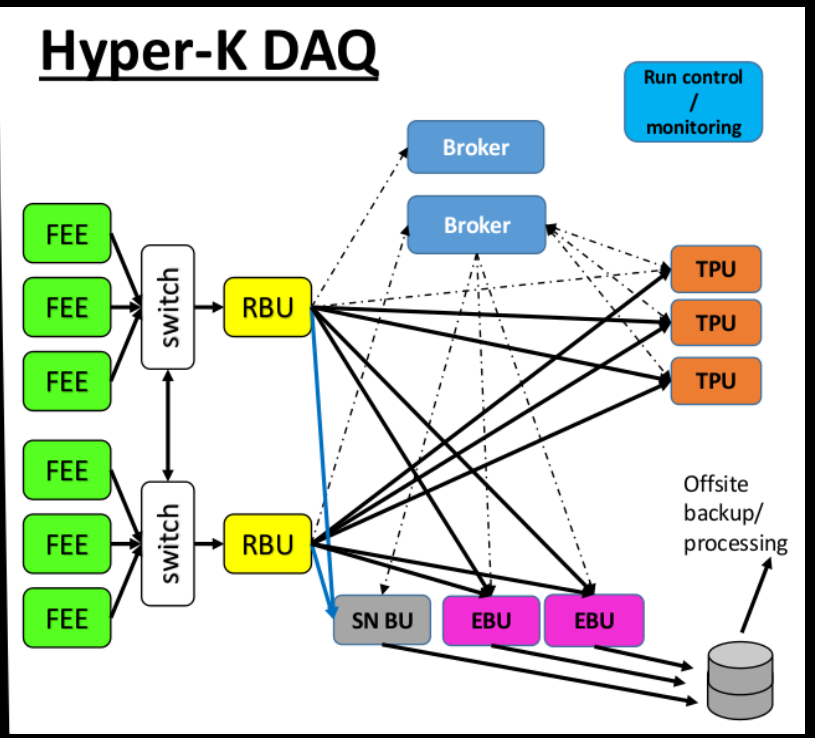
Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Hyper-K DAQ

During the next period of the JENNIFER-2 grant, we will design the DAQ for E61 and HK (too many unknown now for a final design). New home-built DAQ





DAQ for HK/E61ongoing.
In order to construct full DAQ solution we need more information about:

- Final FEE hardware specification and capabilities
- Trigger type (continuous or external)
- Event rates

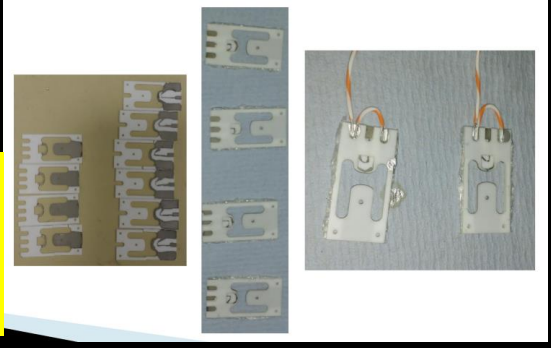
	Rate of events	No. Hits / 0.3ms
Beam Neutrinos	0.41 Hz	2861
Cosmic Muons	13.1 kHz	34600
Neutron Cosmic Spallation	78.5 Hz	1.3
N Sand events	0.22 Hz	7.9
Mu Sand Events	0.08 Hz	286.1
Dark noise	20.0 MHz	9230
Bi214 PMT	129.1 KHz	627
Tl208 PMT	13.3 kHz	52
K40 PMT	447 kHz	175
Bi214 water	942 Hz	9.5
Total		**47866**

Outline

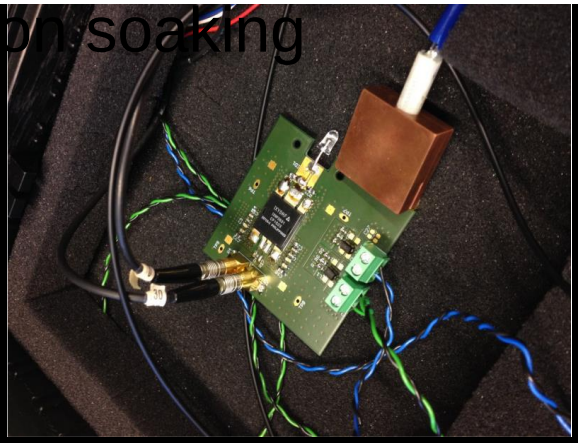
- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Calibration

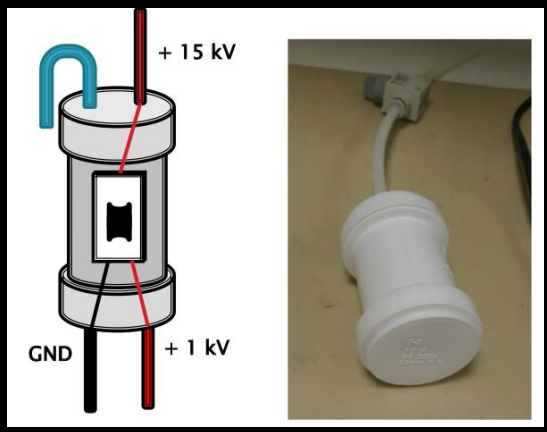
During the next period, we will finalize the design and test the different calibrations. All new ideas.



A UK prototype will be tested at Super-K. Already ongoing tests on soaking

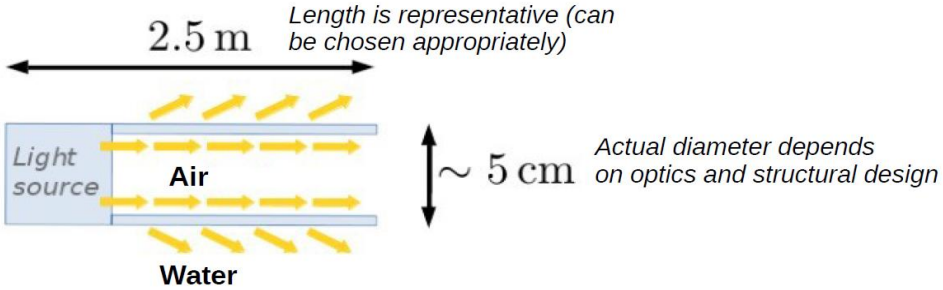


Wide angle optical diffuser. Compressed PMMA pellets meets performance.



Neutristor (compact neutron source) - prototypes being built and tested.

Latest version of LED pulser. Improved performance and stability compared to first version.

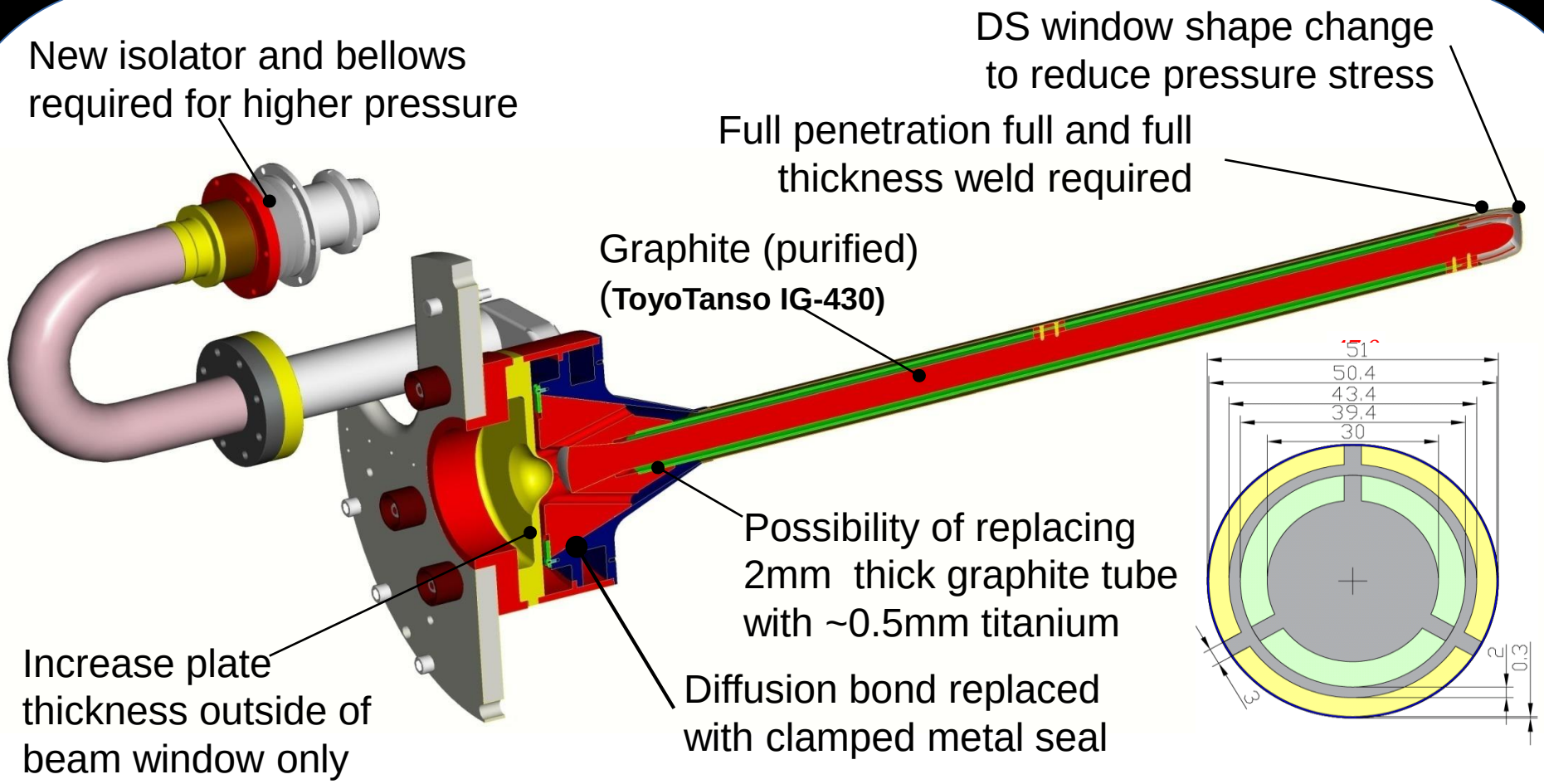


Pseudo-muon light source

Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Currently foreseen design modifications for 1.3MW operation



NOTE: Beam windows and outer tube 0.5mm Titanium

During the next period of the JENNIFER-2 grant, we will design a working target and build the prototype.

Outline

- The Hyper-K project prospects and timeline
- WC-based R&D
  - Physics and Software
  - Photosensors
  - DAQ
  - Calibration
- Beam R&D
  - Target
- Conclusions

Conclusions

- Hyper-Kamiokande is a next general multi-purpose detector.
- Hyper-K and E61 will move to the construction phase
  - Water Cherenkov Detector:
    - Physics/Software
    - PMTs
    - DAQ
    - Calibration
  - Beam upgrade:
    - Beam