

Overview of the photodetector development

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@ The 2nd open Hyper-K meeting

Task of the Hyper-K photodetector (PD) WG

- Develop the photodetector assemblies which meet the required performance and cost for the Hyper-K detector
 - Photodetectors are the key component of a water Cherenkov detector.
 - The fraction of the photodetector cost is significant ($\sim 1/3$ of the total construction cost in the current estimation).

Hyper-K photodetectors in the baseline design (LOI)

□ Inner detector

- 99,000 20-inch ϕ PMTs
- 20% photo-coverage (= SK-II)
- Hamamatsu R3600 PMTs (used in SK)
 - Known to satisfy basic requirements
 - Operated for more than 15 years in SK. Long-term stability are well understood.
- Acrylic and FRP protective cases.

□ Outer detector

- 25,000 8-inch ϕ PMTs

Many options ...

□ Sensors

- HPD, PMT w/ box-line dynodes, PMT w/ venetian blind dynodes, ...
- High QE, Normal QE
- 20-inch, 12-inch, 8-inch, ...

□ Light collection

- No light collectors, WLS plates, Winston cones, ...

□ Protective cases

- All acrylic, Acrylic+Stainless, ...
- w/ passive magnetic shielding (such as mu-metal wire cages) ?

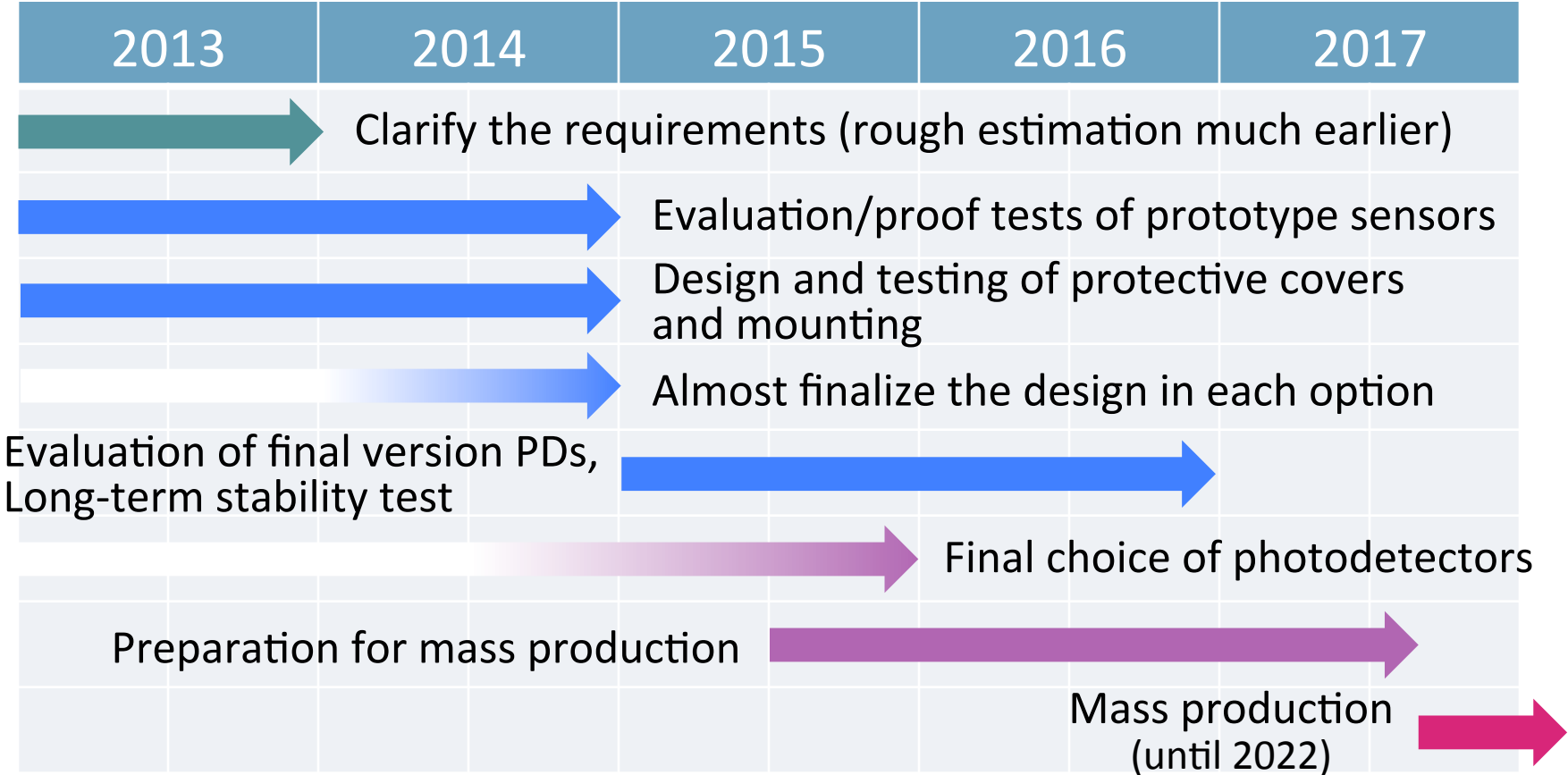
Should be chosen primarily by physics requirements.

Cost, quality control in mass production, and production/assembly period are also important for the choice.

Requirements for Hyper-K photodetectors

- We don't have an accurate grasp of all requirements yet.
- Specification of 20-inch PMT (R3600) must be a reference.
 - QE : 22% @ $\lambda=390\text{nm}$
 - Gain : 10^7
 - Dark rate : 4.5kHz @0.25p.e. threshold
 - Transit time spread : 2.2nsec (1σ) for 1p.e. signals
 - Pressure tolerance : 6kg/cm²
- Requirements should depend on physics targets and Hyper-K configuration (number of compartments, Gd, ...).
- We first have to clarify the requirements for each photodetector option
 - Possibly based on Hyper-K simulation studies.

Rough schedule



Under discussion

To do (in near future)

First,

- Make a task list
- Make more detailed near/mid-term plan
 - Check plans of each PD R&D group for a coherent work.
(We may be able to evaluate each option using the EGADS tank.)

Then,

- Allocate (and search for) manpower for each task
- Start clarification of the requirements

Documentation

- We will have some events in near future.
 - January 14th and 15th : 2nd open Hyper-K meeting
 - February 8th : Science Council of Japan Symposium
 - Add Hyper-K as a real proposal to the master plan of large research projects in Japan to establish its priority as current/future project

- It's good time to make a document on our R&D status and plans.

- First version (in English) by the end of February.

- As for studies not specifically for Hyper-K, we may need description on possible applications to Hyper-K in addition to references to your papers/documents.

Talks in this session

- HPD development Nishimura (ICRR)
- A new design of large area MCP-PMT for the next generation neutrino experiment Heng (IHEP)
- Update on Photomultiplier Evaluation and Development in the U.S. Svoboda (UC Davis)
- Photo-detector development for maximizing the overall photon detection efficiency Retiere (TRIUMF)

Supplement

Sub-WG members (24 persons)

- Nakayama^C
- Nishimura^C
- Konaka
- Smy
- Nakaya
- Yokoyama
- Suda
- Huang
- Ikeda
- Hirota
- Kudenko
- Haga
- Ling
- Iijima
- Kametani
- Retiere
- Mine
- Tateishi
- Itow
- De Perio
- Kuze
- Maricic
- Svoboda
- Bergevin