1. Hyper-K's status in Japan
2. Expected foreign contributions

Masato Shiozawa (UTokyo)

KEK-TRIUMF Scientific Symposium
December 14, 2017

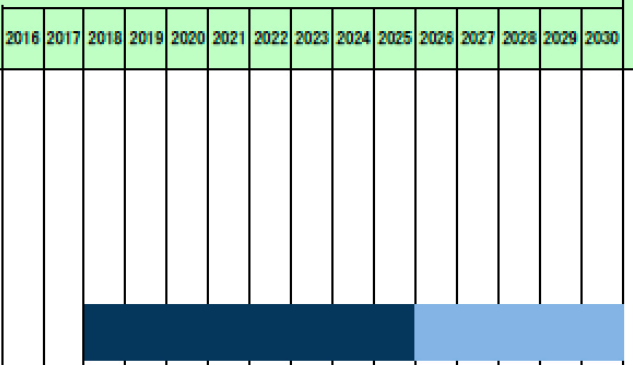
MEXT Roadmap 2017

- Fundamental Concepts for Promoting Large Scientific Research Projects -

http://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2017/10/18/1388523_002.pdf

- 7 projects are listed:
  Genome, HL-LHC, HK, SPICA, LiteBIRD, attosecond pulse laser, photon factory
- HK got highest evaluation result (a,a)
  5 projects got (a,a)
- We now become ready for budget request in Japan

Field	Category	Project name	Project overview	Implementing institute	Financial requirement (JPY 100 millions)	Project duration	Evaluation ①	Evaluation ②
Physics	Large facility plan	Nucleon Decay and Neutrino Oscillation Experiment with a Large Advanced Detector	Build the gigantic water Cherenkov detector Hyper-Kamiokande to succeed the Super-Kamiokande experiment. Conduct world-leading neutrino research in combination with the J-PARC accelerator neutrino beam and search for proton decay with unparalleled sensitivity.	The University of Tokyo Institute for Cosmic Ray Research and the High Energy Accelerator Research Organization Institute of Particle and Nuclear studies will lead the advancement of the project in conjunction with anticipated participation from both foreign and domestic universities and research organizations.	Total 1547 (Japan's share: 1393) Hyper-Kamiokande: Construction 675 (551), Operation 400 over 20 years J-PARC: Operation 400 over 10 years Other: Accelerator upgrades etc. 72 (42)	2018-2045: Geologic survey, construction, and operation of Hyper-Kamiokande 2026-2035: High-intensity operation of J-PARC (1.3MW)	a	a



Main outstanding points, etc.	Main tasks, points to keep in mind, etc.	Notes
● Originating from Japan's creative innovation, Hyper-Kamiokande is a flagship experiment that will not only maintain, but expand Japan's world-leading and internationally renown neutrino and nucleon decay physics research program. ● Preparations for the start of the project are already underway, including the formation of a framework in which more than 300 researchers from both within and outside of the implementing institutions will participate in the realization of the experiment.	● Due to its expansive scale and cost, the formation of a system of broad international cooperation to expand and deepen collaboration on the project is necessary. ● It is necessary to clarify the relationship between the project and existing large-scale projects at the implementing institutions and to develop more comprehensive and actionable plans to handle budgetary and personnel issues. (In particular, clarification of the project's relationship to Super-Kamiokande is desired.)	

What's next in Japan

- Draft budget by MoF in Dec., we need to wait until then for HK budget for next year
- Big projects in Japan sometimes get startup budget before construction start, e.g. Super-K
- Discussions with MEXT, MoF, Cabinet lead by Gonokami-san and Kajita-san
- UTokyo launched new organization to advance Hyper-K
- We are 'technically' ready to start construction

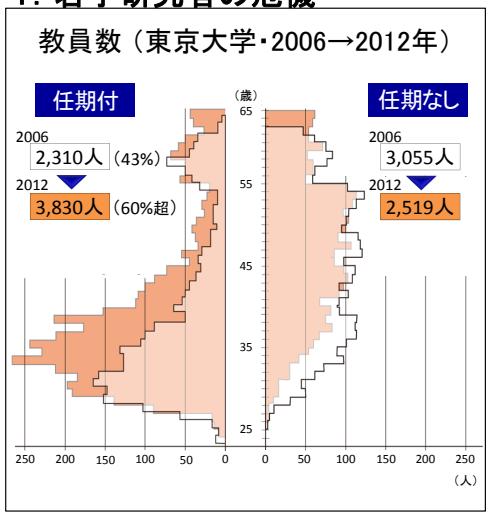
Gonokami-san's slide in future investment council in the Cabinet (2017.5.12)

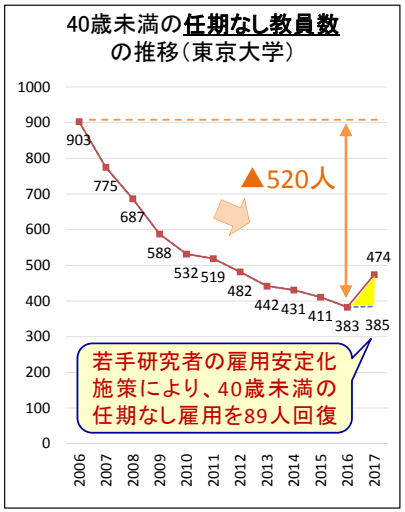
Sankei news (2017.11.17)

基礎科学力の危機

資料４－２
平成２９年５月１２日
未来投資会議
東京大学総長 五神 真

1. 若手研究者の危機



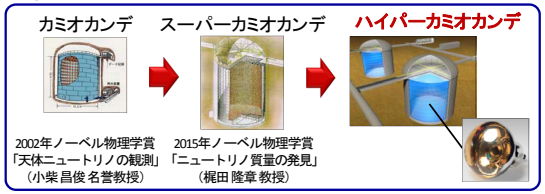


大学の"経営"における先行投資判断の重要性

2. 基礎科学に対し集中投資を行う枠組みの不在

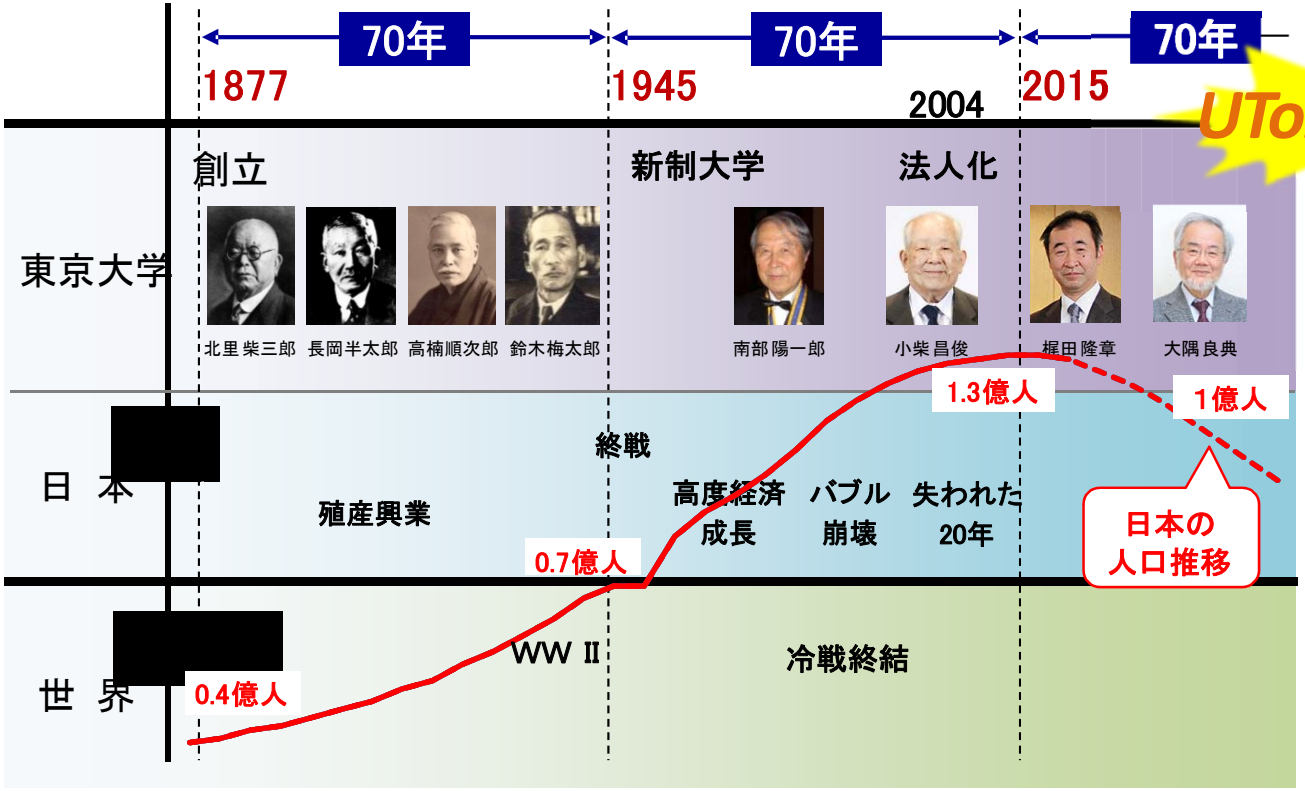
優秀な若手を惹きつけるため、国際求心力の回復が急務。

大規模国際共同研究施設の整備など、基礎科学振興戦略のグランドデザインが必要。



Gonokami-san's slide in the financial system council in MoF (2017.10.4)

Univ. of Tokyo 140 years
東京大学140年



UTokyo 3.0

SUSTAINABLE DEVELOPMENT GOALS

2030年に向けて世界が合意した「持続可能な開発目標」です

社会・経済を駆動させる新たな仕組みが必要

・学部学生	14,116人
・大学院学生	13,419人
（修士・専門職	7,600人）
（博士	5,819人）
・教員数	3,931人
特任研究員	903人（外数）
・職員数	3,934人
・収入予算額	2,608億円
（運営費交付金	805億円）
（授業料等	184億円）
（附属病院等	459億円）他
・土地面積	326k㎡

※ 国土総面積の約1000分の1

1877.4 創立
1886.3 帝国大学に改組
1897.6 東京帝国大学に改称
1947.9 東京大学（新制）に改称
2004.4 国立大学法人 東京大学

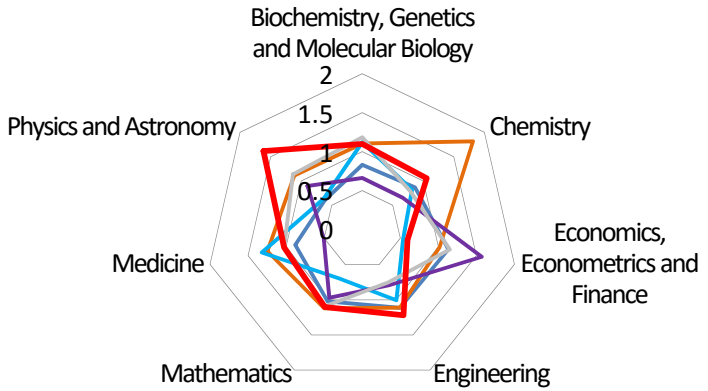
・学部卒業者数 276,803人
（1876-2015の140年間）
・課程博士授与者数 33,003人
（1957-2015年度の59年間）

3

Gonokami-san's slide in the financial system council in MoF (2017.10.4)

Basic Science
国際ステータスに寄与する基礎科学力

海外大学との分野別論文数比較（2015年）※6大学の平均を1とした場合



National University of Singapore
Seoul National University
University of Cambridge
Peking University
University of California at Berkeley
University of Tokyo

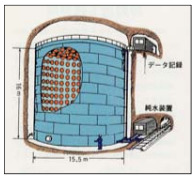
SciVal　データ取得日：2017/05/8
Documents Type: Articles, reviews and conference papers

東京大学の強み：
物理学・天文学分野
工学分野の論文数も比較的多い

ハイパーカミオカンデ（600億円事業）

- ✓ 青写真は完成したが予算の仕組みがない
- ✓ 人と技術が中国・米国に流出する危険

カミオカンデ（3千トン／1983～1996）

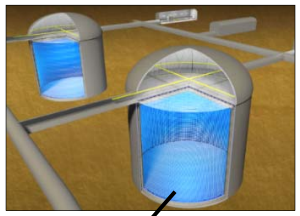


2002年ノーベル物理学賞
「天体ニュートリノの観測」
（小柴昌俊名誉教授）

スーパーカミオカンデ（5万トン／1996～）

2015年ノーベル物理学賞
「ニュートリノ質量の発見」
（梶田隆章教授）

ハイパーカミオカンデ（26万トン）



21世紀、ノーベル賞を受賞した日本人は16名に上る（敬称略）

物理学賞	化学賞	生理学・医学賞
小柴 昌俊	野依 良治	山中 伸弥
南部 陽一郎	田中 耕一	大村 智
小林 誠	下村 脩	大隅 良典
益川 敏英	根岸 英一	
赤﨑 勇	鈴木 章	
天野 浩		
中村 修二		
梶田 隆章		

Kajita-san's slide in the meeting w/ MEXT top-level members (2017.9.27)

Broad International Cooperation

多方面にわたる国際協力体制の構築の検討

各国の取り組み

UK
- ✓ 英国：9/20米国計画への£65Mの投資合意, Hyper-K R&D grant(£2.5M), Pre-construction grant(£2.5M), 2018夏にHK建設費申請予定（日本での承認が条件）

Canada
- ✓ カナダ：T2KとHKを合わせて1.3~1.5MUSD/年（20-30% for Hyper-K）, 日本（T2K,HK）の明確な見通しがなければ国として米国計画への方針転換の可能性 *Withdrawal from T2K/HK unless clear future prospect*

Italy
- ✓ イタリア：米国計画への投資（現状：200-300Kユーロ/年,加速器に5-10MUSD）,Hyper-K R&D grant(現状：40Kユーロ＋旅費). Hyper-K本格参加には追加の予算申請が必要. ただしDUNEと競合.

France
- ✓ フランス：T2K前置検出器アップグレードに貢献中,米国計画と日本計画の選択を来年予定

Korea
- ✓ 韓国：Hyper-K R&D (150KUSD)

German
- ✓ ドイツ：新規参加希望。日本でのプロジェクト承認が条件。

➔ 日本での予算化が急務　*Urgency of funding in Japan*

41

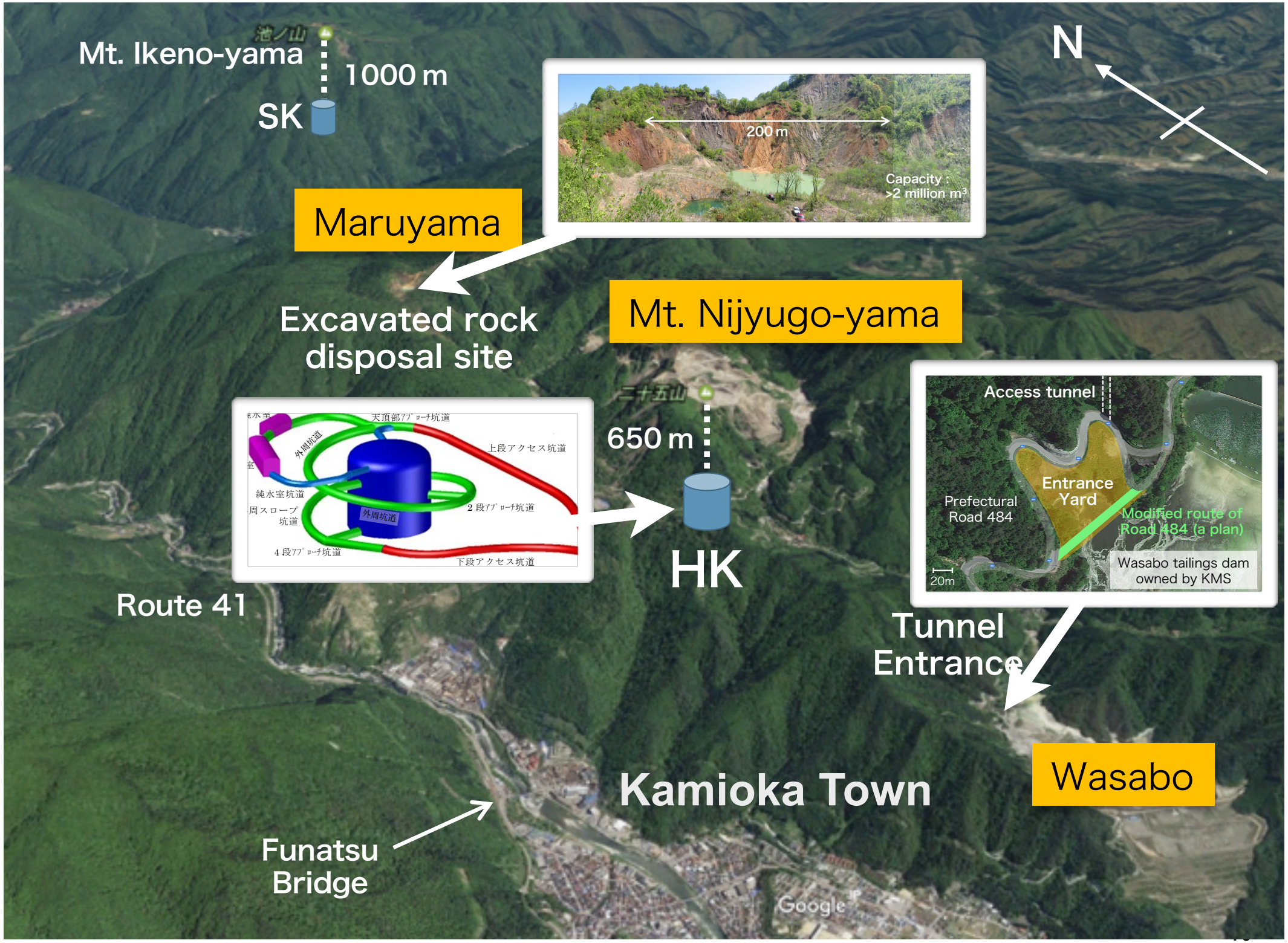
New organization

✓ (2017.10) **UTokyo launched "Next-generation Neutrino Science Organization (NNSO)"**

✓ Collaboration btw ICRR, IPMU, and School of Science to advance Hyper-K

✓Director T. Kajita, HP: http://nnso.jp

Nov. 8th, 2017 Inaugural ceremony


Mt. Ikeno-yama
池ノ山
1000 m
SK
N
200 m
Capacity :
>2 million m³
Maruyama
Excavated rock
disposal site
Mt. Nijyugo-yama
二十五山
650 m
HK
Route 41
天頂部ｱﾌﾟﾛｰﾁ坑道
外周坑道
上段アクセス坑道
純水室坑道
周スロープ
坑道
2 段ｱﾌﾟﾛｰﾁ坑道
4 段ｱﾌﾟﾛｰﾁ坑道
下段アクセス坑道
Access tunnel
Entrance
Yard
Prefectural
Road 484
Modified route of
Road 484 (a plan)
Wasabo tailings dam
owned by KMS
20m
Tunnel
Entrance
Wasabo
Kamioka Town
Funatsu
Bridge
Google

Toward the start of excavation

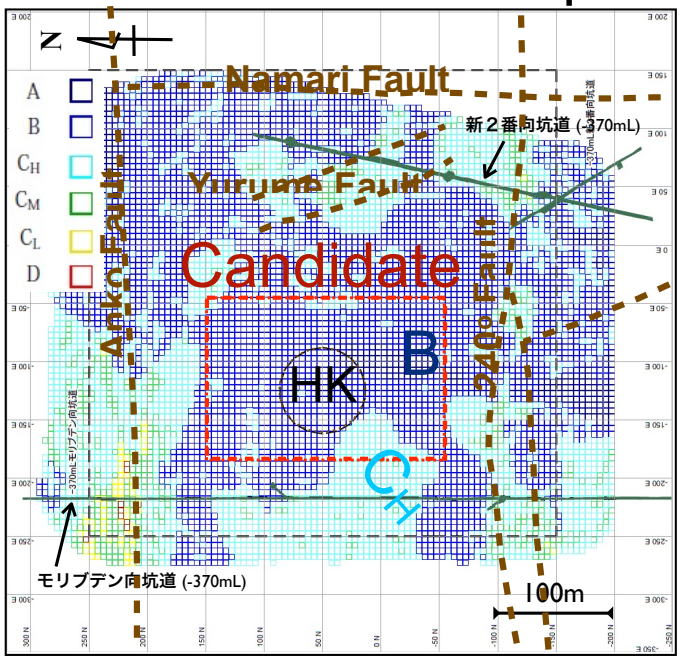
✓ Identified the candidate position with excellent rock without any discontinuities

✓By 3-dimensional seismic tomography and seismic reflection imaging

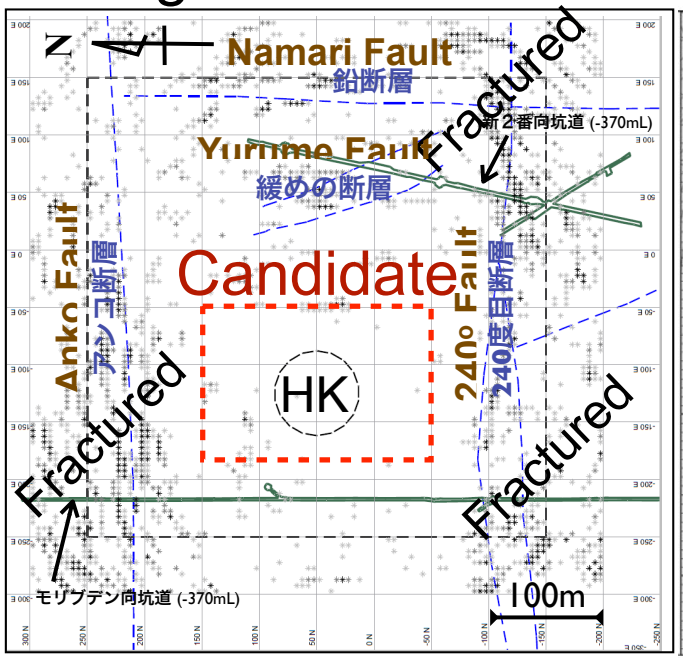
✓ Preparation for access tunnel excavation is going on

✓Environmental assess, Negotiations w/ local governments, electric company, mine company

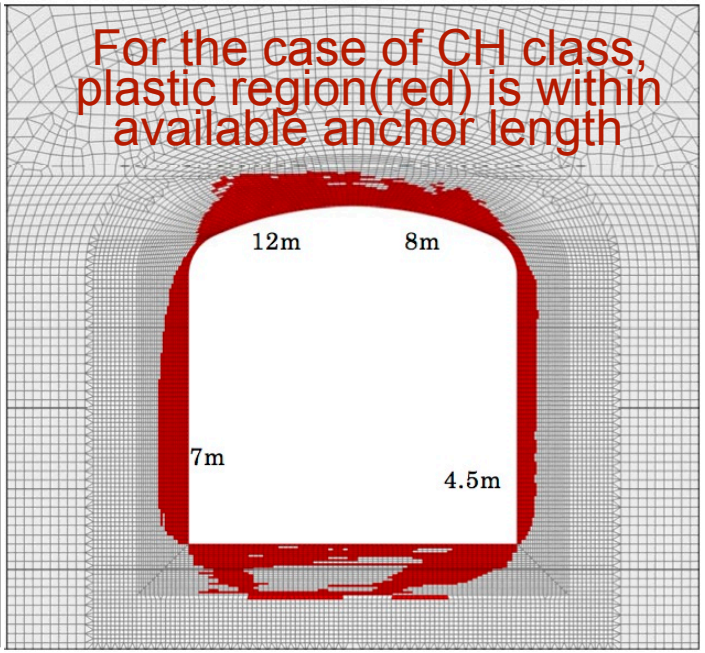
3D rock-class map



Geological discontinuities



Cavern stability analysis



(2017.8)HK Advisory Committee review report:

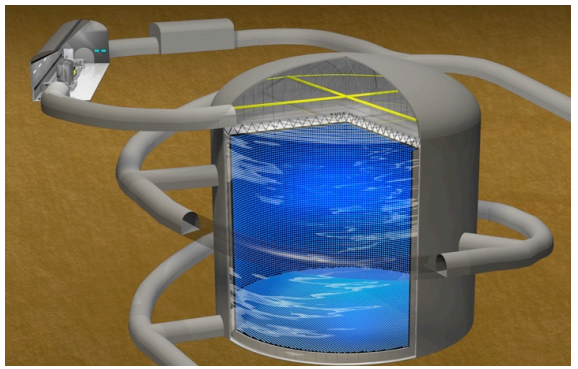
The level of the feasibility of cavern and water tank construction is now satisfactory.

1. Hyper-K's status in Japan
2. Expected foreign contributions

Hyper-K project:

Nucleon Decay and Neutrino Oscillation Experiment with a Large Advanced Detector

- **World-leading detector(s)** for nucleon-decay and ν-detection by state-of-the-art water Cherenkov technique



- **MW-class high-power J-PARC ν beam** and **near detector system**

- **Global project** by **international participations**

aiming to address profound questions such as

- Particle & Force Unification
- Origin of tiny ν mass, large mixing, and CP violation
- ν's role in nature, and more

International contributions

- I would like to require that every participating countries contributes to the far detector
  - to realize full HK physics sensitivities
  - to realize a single collaboration for beam and non-beam physics

- Foreign contributions to the J-PARC upgrade will also be appreciated

- Foreign contributions to the near detector system
  - Necessary to understand J-PARC beam and cross sections
  - Need to clarify required specification and our proposal for the near detector system (ND280 and intermediate detectors).

Far detector

- Priority to early realization of single-tank
  - Fid. mass 190 kton, an order of mag. larger than Super-K, Light yield: ~2 x Super-K
  - Construction start in JFY2018, operation from JFY2026
- UTokyo leads the Hyper-K, KEK leads J-PARC
- International organization
  - design/construction/operation/physics by international cooperation
  - Japan takes responsibility of the detector cavern&tank, the half of inner detector PMTs, J-PARC upgrade, and facility for the near detector system
- International participation contributes to ID/OD photo-detection system, DAQ, calibration etc and ND system

Photo-detection system

- Outer detector
  - Active veto for non-beam physics (solar ν, supernova ν, atmospheric ν, proton decay)
- Inner detector
  - Aiming at ~2 x Super-K Light yield by 40% photo-coverage w/ double-efficiency PMTs
    - Extension of solar ν observation to the region where transition from vacuum to MSW happens
    - Better energy resolution for first observation of Hep ν
    - Supernova relic neutrino measurement (neutron tagging for signal detection and background rejection)
    - higher detection efficiency for prompt $\gamma\&K \rightarrow \pi^+\pi^0$ in proton decay into νK^+
    - proton decay background rejection (neutron tagging)

Future

- I appreciate Canadian group's leadership in Hyper-K R&D which was/will be certainly essential to realize/ enhance the project.
- Plan to start internal review to make a comprehensive detector design
  - Combine Japanese&International photo-detection system to define design of ID, OD, and dead-region between
  - Consistent support structure
  - Design of light/Radon separation
  - Overall design of DAQ electronics and readout etc
  - Evaluation of detector performance to meet the physics goals
  - Budget request plan in each countries
  - etc etc