Summary

1. The T2K(Tokai to Kamioka) experiment has reached the construction phase.

2. Physics aims;
   1. 1-3 generation mixing to the level of 0.006
   2. 2-3 generation mixing to the level of 1% and Δm^2_{23} to 10%
   3. Sterile component search in $\nu\mu$ disappearance

3. The approved experiment;

   We have been approved to perform above research with neutrino beamline and 280m near detector and Super-Kamiokande which will be fully equiped

Maury's Long Baseline News

Long-Baseline news, October 2003

***** JPARC neutrinos setback**

Japanese Council for Science and Technology Policy, Cabinet Office (CSTP) recently evaluated the J-PARC neutrino project as a rank C project (the lowest priority in the four steps of evaluation, S, A, B, and C). C means "needs re-consideration." 3 reasons given: 1. A question remains whether suitable prior evaluation was made about the advance of the J-PARC second phase plan. (J-PARCnu had been classified as one of the J-PARC second phase projects.) 2. In view of the present severe financial situation of Japan, a question remains about whether a large amount of investment is justified only from a viewpoint as basic research. 3. Concerns if there exists a domestic similar plan or domestic facility where similar research can be conducted. - There was better news from a subsequent meeting of Koshiba & the panel. The chair of the panel stated that if a concrete plan for overcoming these difficulties is formulated, they'll reconsider.

Long-Baseline news, December 2003

***** JPARCnu approved again**

Reversing an earlier setback, the Japanese cabinet agreed in December to approve the neutrino program (JPARCnu) starting next fiscal year. The decision is based on the recommendation from the November review on J-PARC. The input from the International Advisory committee, which labeled the neutrino program the #1 priority, was very important. The final official decision will be made at the end of March at the House level. The total cost for the neutrino program is 16 billion Yen. Thus, the total budget for J-PARC is now increased from 135 billion Yen to 151 billion Yen. The first-year budget (JFY04) for neutrino is 0.6 billion Yen, and the total construction period is 5 years.

A bit of history…

- 2000: Initial review of J-PARC (at that time, JHF). JHF Phase-I recommended. Neutrino project classified into JHF Phase-II.
- Dec. 2000: JHF Phase-I funded as a 6-year project.
- June 2002: KEK submitted T2K funding request to MEXT.
- Aug. 2002: It did not go from MEXT to MOF.
- June 2003: KEK submitted T2K funding request to MEXT again.
- Aug. 2003: T2K funding request submitted from MEXT to MOF. At the same time, however, MEXT decided to extend the construction of J-PARC Phase I by 1 year.
- Oct. 17, 2003: CSTP announced the rating of T2K as a rank-C.
- Oct. 21, 2003: Professor Koshiba visited CSTP and protested against its eveluation of T2K. CSTP suggested him possible reevaluation of T2K if MEXT would properly review the progress of J-PARC project and inclusion of T2K into its Phase-I.
- Nov. 2003: MEXT set up a review committee for J-PARC Phase-I and T2K. The committee met 4 times and a report was submitted to CSTP on Nov. 27.
- Dec. 4, 2003: CSTP did not revise its rating on T2K, but decided to endorse funding to T2K.
- Dec. 20, 2003: MOF announced funding to T2K (6 Oku-Yen for JFY 2004).

Condition

- The budget will be finalized in March 2004 in the congress, but it is already certain that we will get 600M¥ as a first year budget of five-year construction project.
- The total budget will be 15,800M¥, which covers beam line and 280m detectors

‘Rough Cost Estimate’

Total	**159.6**
Civil construction	**83.5**
Instrumentation	**76.1**
Normal conducting magnets	6.9
Power supply	3.5
Superconducting magnets	12.8
Cryostats	8.9
Power supply	1.9
Cryogenics	9.7
Proton beam monitors	1.9
Vaccum system	0.5
Target system	0.7
Horn	1.5
Power supply	2.7
TS/Dump Fe shield	4.7
Decay pipe	3.0
Cooling water system	15.2
280m detector	0.5
Online/control	0.6
Etc	0.9

Unit:
Oku ¥
=10^8¥
~M$

Rough cost

	Real Estimate	Requested	Diff
Civil construction	83.5	83.5	
Beam line instrumentation	84	75.6	~8
280m detector	7.5	0.5	~7
Total	175	159.6	~15

1. **We need both contributions in beam line and 280m detector to start the run amount ~800M¥(beam line)~ 700M¥(min. detector)**

2. **We have to concentrate on <u>beam line and 280m detectors (see letter from KEK DG) for now</u>**
   - **Otherwise no beam or down grated beam**

   - **No endorsement as the collaboration for proposal for other components at this time**

   - **2 km need more studies, need consensus with whole collaboration and KEK, J-PARC directors to publicize any document about it**

Little more on cost

Neutrion facility	M$ [@109¥/$]	Oku¥
Global total	146.42	159.60
Civil total	76.63	83.53
Instrument total	69.79	76.07
Normal conducting magnets	9.60	10.47
Magnets	5.83	6.35
Power supply	2.75	3.00
Install	1.02	1.12
Vacuum system	0.43	0.47
Collimator	0.26	0.29
Superconducting magnets	21.68	23.63
Magnets	11.74	12.80
Cryostats	6.46	7.04
Install	1.74	1.90
Power supply	1.73	1.89
Cryogenics	8.94	9.74
Cold box	2.17	2.36
Compressor	0.87	0.95
Tanks	0.39	0.43
Distribution box	0.60	0.65
Transfer tube	1.28	1.40
End box/interconnect	1.47	1.60
Install	1.74	1.89
Control	0.43	0.47

Target system	0.61	0.67
Horns	3.82	4.16
Horns	0.83	0.90
maintenance system	0.37	0.40
bus bar	0.09	0.10
cooling system	0.09	0.10
Power supply	2.44	2.66
Concrete block	0.60	0.65
Decay pipe	2.75	3.00
TS/Dump Iron shield blocks	4.33	4.73
Control/DAQ/Interlock	0.57	0.62
Cooling water system	13.98	15.24
Neutrino detector	0.46	0.50

Summary of possible contributions from abroad

	rough cost	time(JFY)	Comments
Normal conducting magnets			
Whole magnets	5~6M$	2007	Install start 2007 summer
Partial magnets	~2M$	2007~2008	Installation twice in 2007 and 2008
MIC magnets	~2M$	2007	Japanese MIC quality is high.
provide cheap magnets	(~1M$)	2007	by Japanese budget
Cooling water system	~5M$	2007	Must establish a way!!
Superconducting magnets			
Correction magnets	??		R&D going w/ BNL
Vaccum vessel(LHC)	22kCHFx32	2004	
Shield tray(LHC)	9kCHFx32	2004	
Connecting sleeve	2.5kGBPx30	2004	
Cryogenic system			
some tanks	0.2~0.4M$	2006	
cold box?	~2M$	2006	
Vaccum system			
Beam pipe(Ti?/Al?/SUS?)	~0.5M$	2006	
Vaccum pump	~0.1M$?	2006	
Gate/fast closing valve?	~0.1M$?	2006	
Collimator system/Plug	~0.3M$	2007	
Beam monitor?			
CT?	~0.1M$?	2007, 2008	
Share monitor?	~0.5M$	2007, 2008	
Cable?	~0.8M$	2007, 2008	
Target station			
remote maintenance system		2007	
remote crane system?	~1M$	2007	
alignment system?	??	2007	
Iron shield	~1M$	2007	DURATEK acitivated iron (~200$/ton)
Buffle/collimator	~0.1M$?	2007	cooling/monitoring,…
Beam window	~0.1M$?	2007	
Target irradiation test	??	2004	
Horn			
Transformer	2~3M$	2005?	first set
Power supply		2006~2007	
Beam dump			
whole system?	~2M$	2007~2008	incl. cooling design
Cupper shield	~1M$	2007~2008	
iron shield	~0.5M$	2007~2008	DURATEK?
Muon monitor			
Alternative monitor?	~0.5M$	2008	IC by Japan

- Not complete
- Providing examples of possible contributions

Important notes

- Maintenance
  - Spec. must be agreed by Japanese collaborators to enable maintenance in Japan.
- Schedule
  - Intn'l collaboration will take more time. To compete in time, schedule have to be carefully arranged.

Budget Request Profile for 5 Years

2004	8.04 Oku-Yen	(6 Oku-Yen approved)
2005	27.40	
2006	27.50	
2007	56.16	
2008	40.50	

total 159.6*

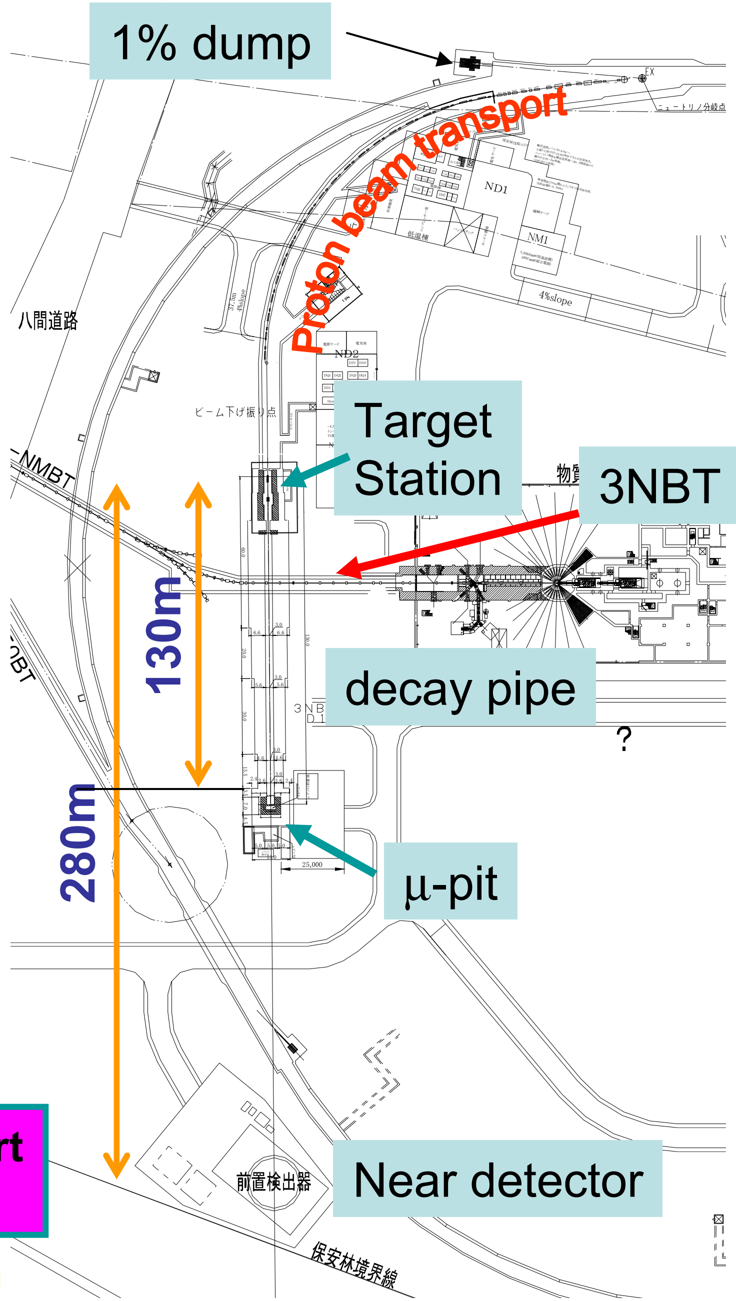
*does not include the 2km detector and its hall. Funding source for the 2km detector hall (～14 Oku-Yen) should be found later. No guarantee now.

Neutrino beam facility Overview

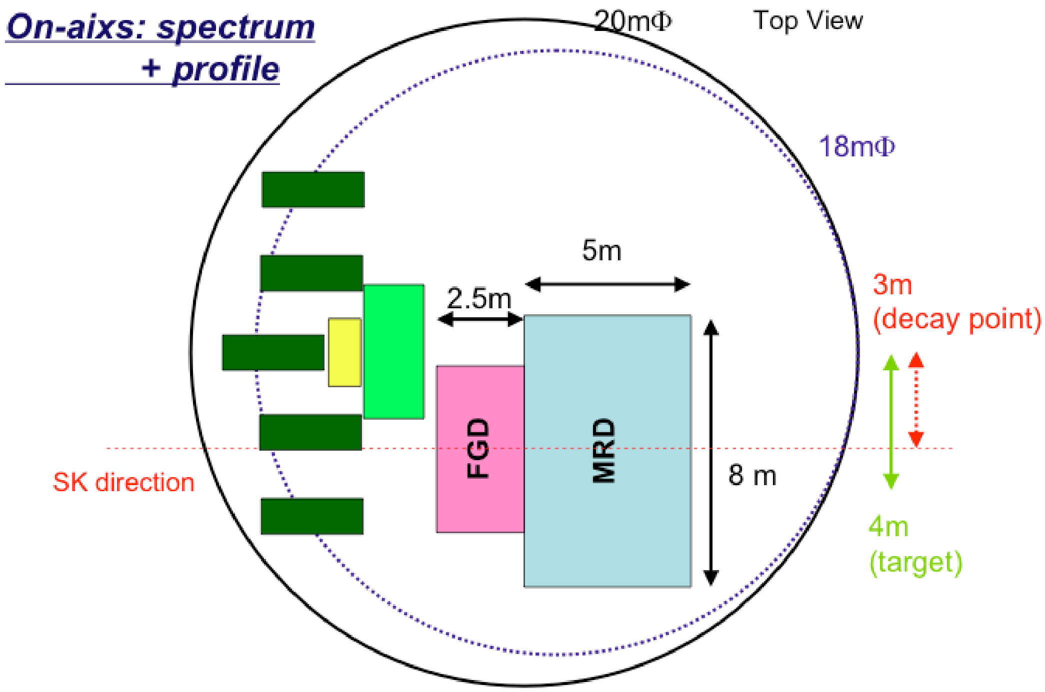
Components

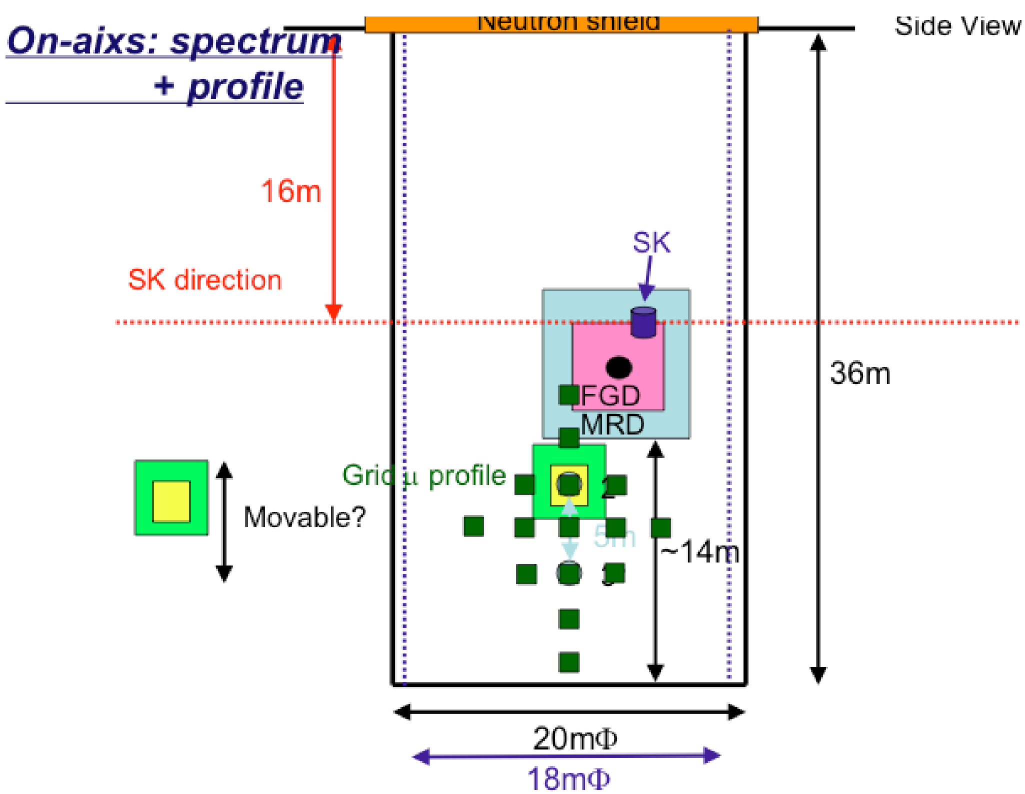
- Primary proton beam line
  - Normal conducting magnets
  - Superconducting magnets (Ogitsu)
  - Proton beam monitors (Iwasaki)
  - Vacuum system
  - Collimators/beam plug
- Target station (Yamada)
  - Target (Hayato)
  - Horn (Ichikawa)
  - Remote handling system
- Decay pipe
- Beam dump
- muon monitors (Kameda)

Technical Design&Development (Status) Report
http://jnusrv01.kek.jp/jnu/nu-TAC/



ND280m hall and a sample config.





Detector Technologies

Water Čerenkov detector

Good for detecting particles below 1GeV

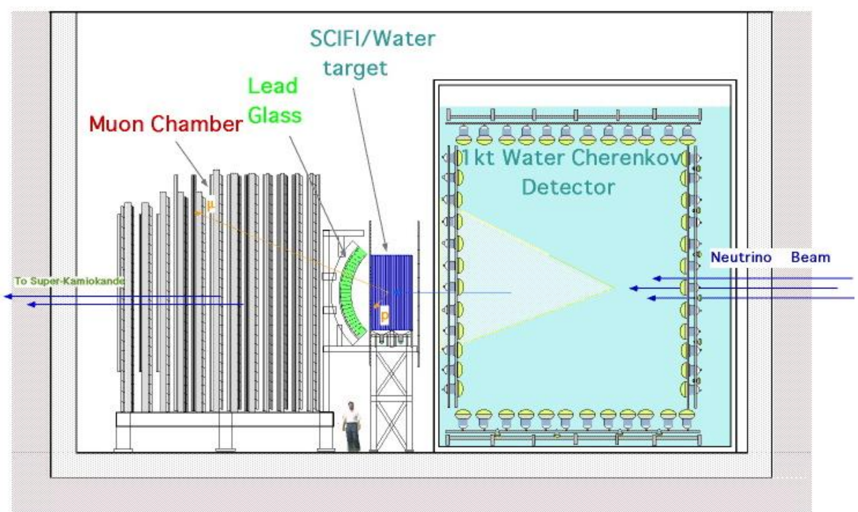
Miss low velocity particles (low energy π and p)

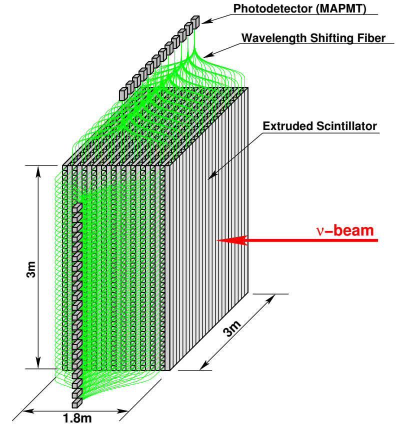
Fine grained calorimeter

Good PID and vertex reconstruction

[Magnetized] iron calorimeter

Good for high energy μ detection





- $\nu_\mu n \to \mu^- p$ (QE) measurement
  - Proton tag (full reconst.) ⇒ non-QE/QE ratio
  - Surrounding μ range detector
- $\nu_e n \to e^- p$ (QE) measurement
  - EM calorimeter section required
- $\nu_\mu N \to \nu_\mu N \pi^0$ (NC) measurement

  Two shower track separation required

Role of the near detectors

Predict signal and background spectra in the far detector

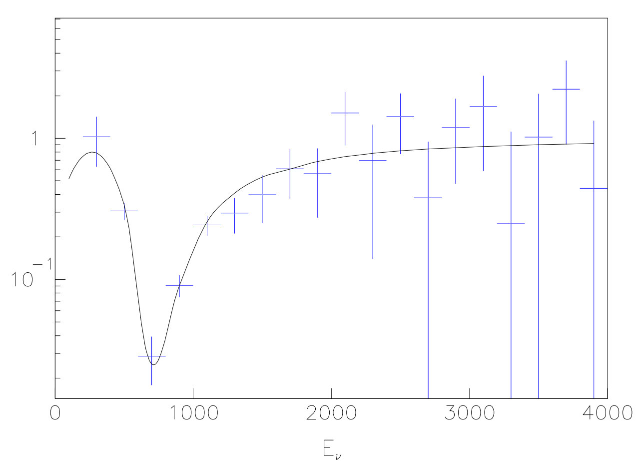
1. ν_μ disappearance
   - **Signal:** ν_μ QE (quasi-elastic) $\nu_\mu n \to \mu^- p$
   - **Background:**

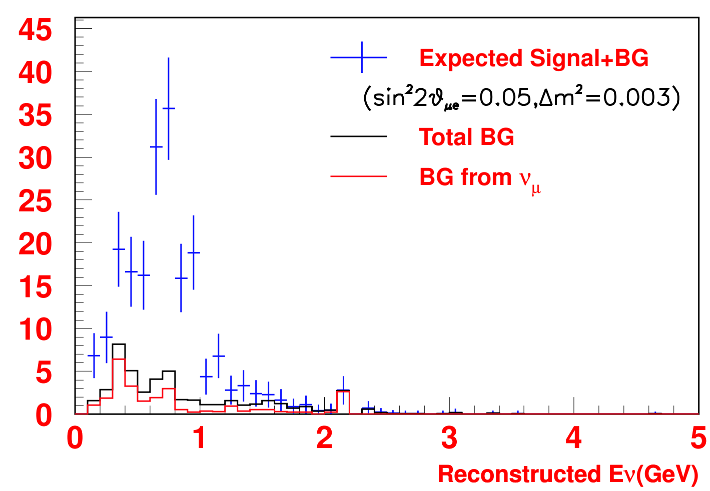
     ν_μ inelastic $\nu_\mu n \to \mu^- p\pi \sim 3.5\%$

     E_ν resolution smearing $\sim 3.5\%$
2. ν_e appearance
   - **Signal:** ν_e QE $\nu_e n \to e^- p$
   - **Background:**

     ν_μ NC and CC $\nu_\mu N \to \pi^0 N \sim 0.4\%$

     ν_e beam contamination $\sim 0.4\%$





Challenges

- Control of systematics uncertainties, the key for discovery

  "Rare" $\nu_\mu \rightarrow \nu_e$ appearance signal

  "Weak" signature of the neutrino signal:

  Observable = (Flux) × (Cross section) × (det.eff)

  Redundancies required to study systematics

- Far/near ratio to be understood

  The pion decay vertex is a "line source" at 280m

  Solid angle & off-axisness depend on π decay pos.

  $\Rightarrow$ neutrino energy spectrum and flux changes.

  Neutrinos (ν_e) from K's and μ's have different far/near

  Redundant measurements to pin down the systematics

  Hadron production model/measurement

  Near detector at the the SK direction

  Detectors at locations other than the SK direction

  The 2km detector

- Cross sections to be measured

  Detection efficiency of near and far detectors are different

  Flux, cross section, and detection eff. to be untangled

  Far detector cannot see low energy π, μ, and p

  Oscillation modifies E_ν spectrum for CC at SK

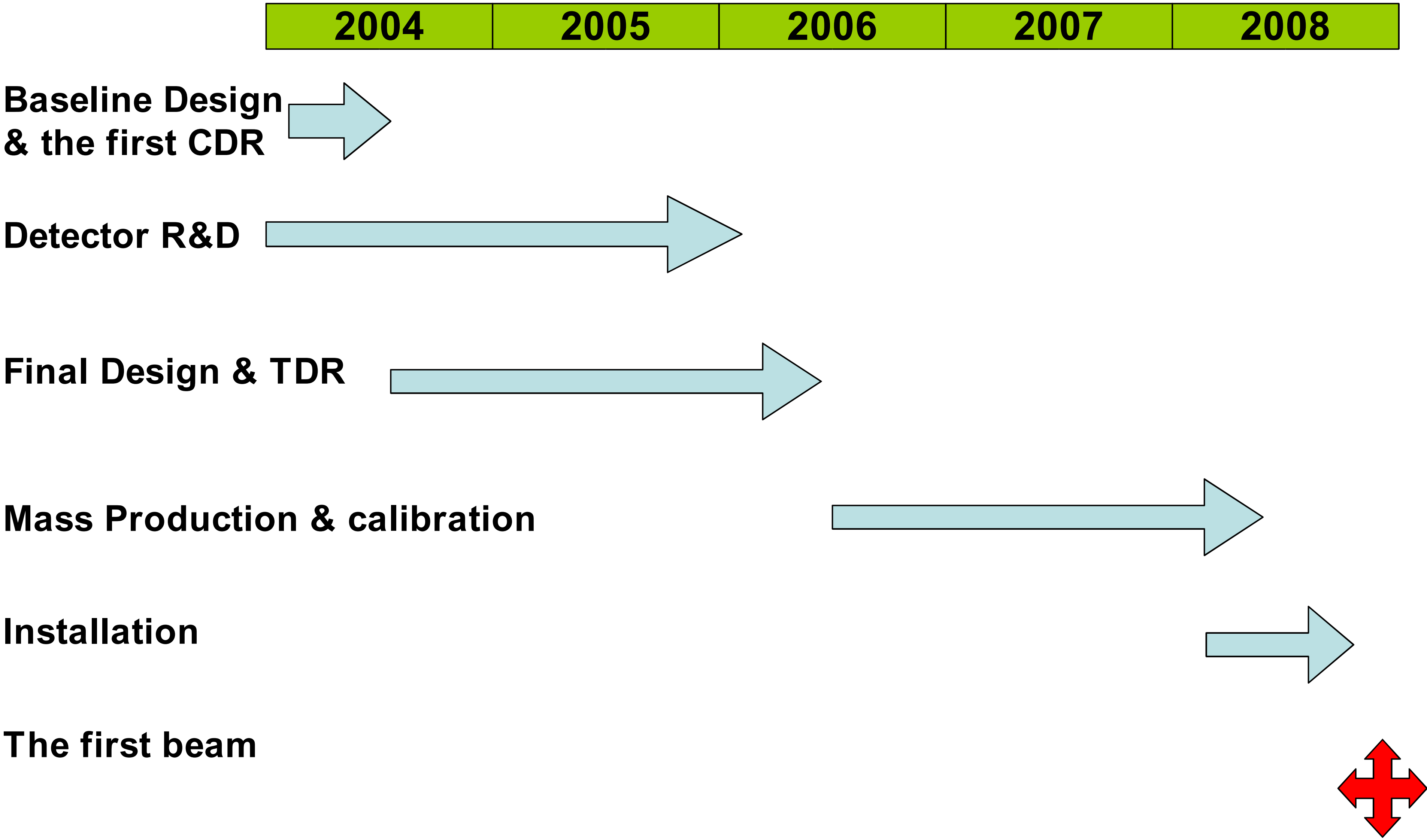
  Pion absorption in the final state

  Redundant information in fine grained calorimeter

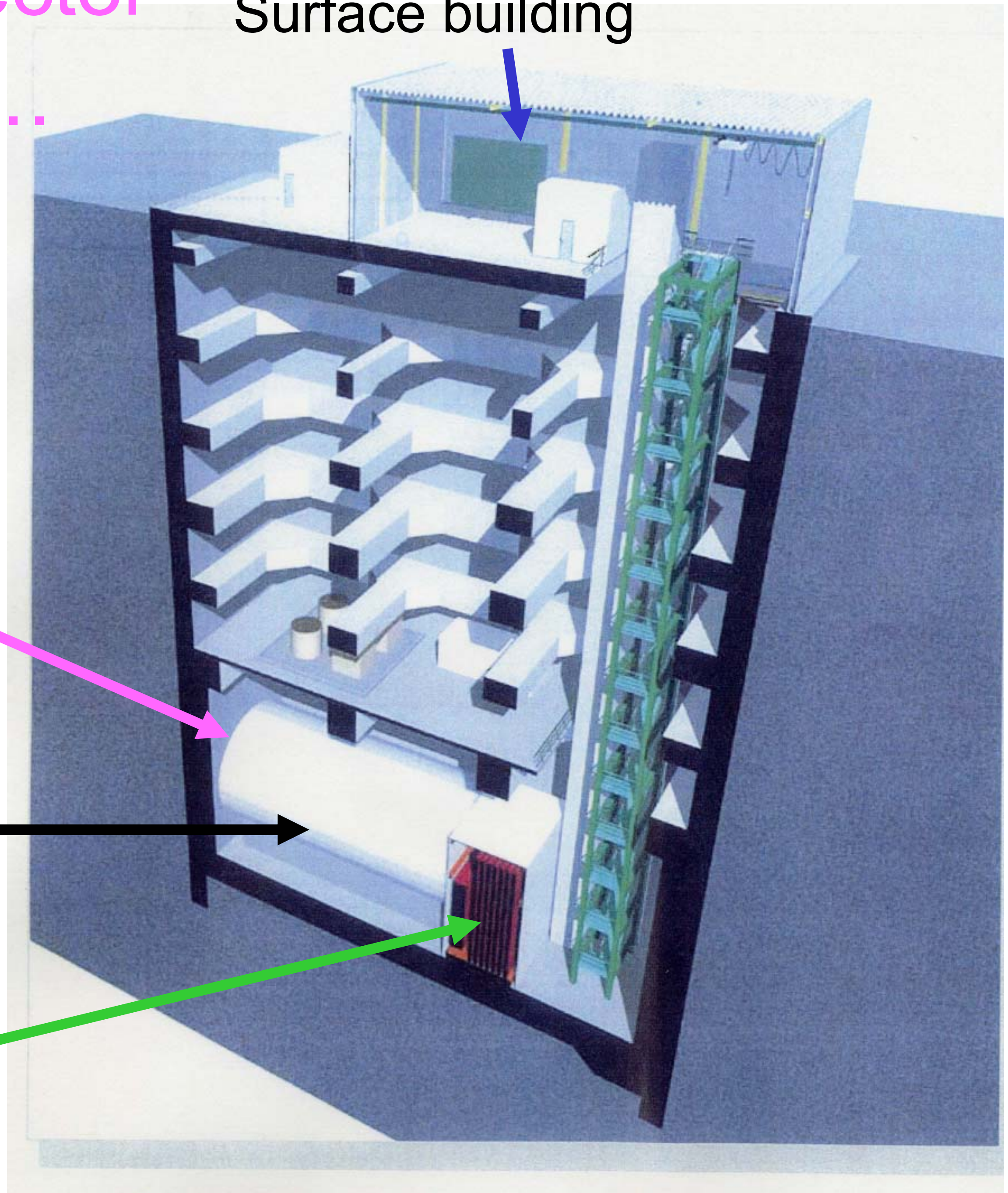
Cost

- The experimental hall will be constructed by Japanese money (¥700M $\Rightarrow$~$7M)
- The cost of the detectors will be ¥500~10,00 M (~$5~10M.).

280 m Schedule

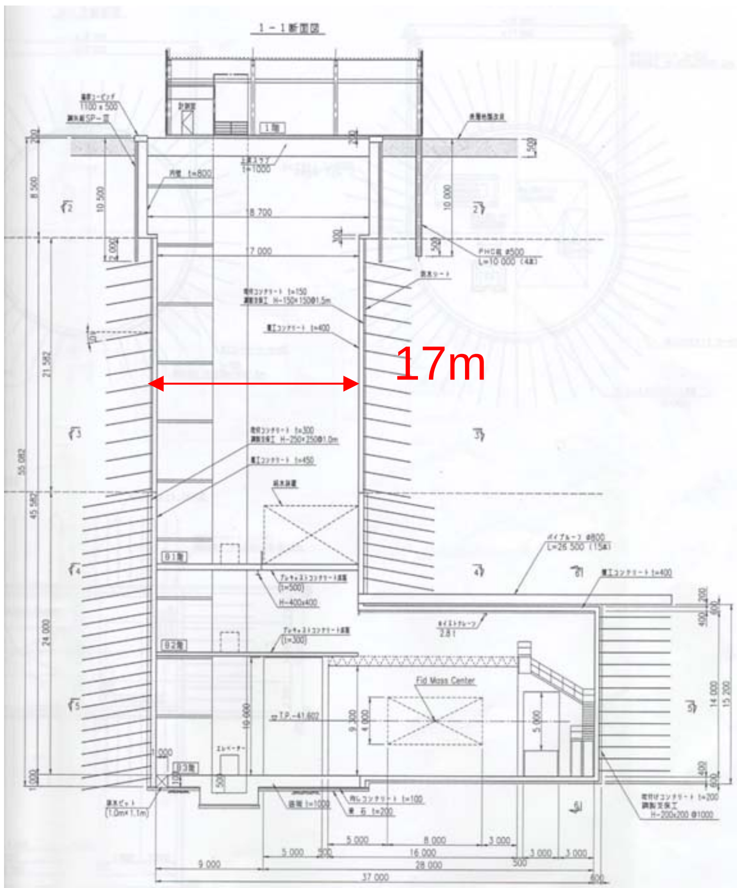


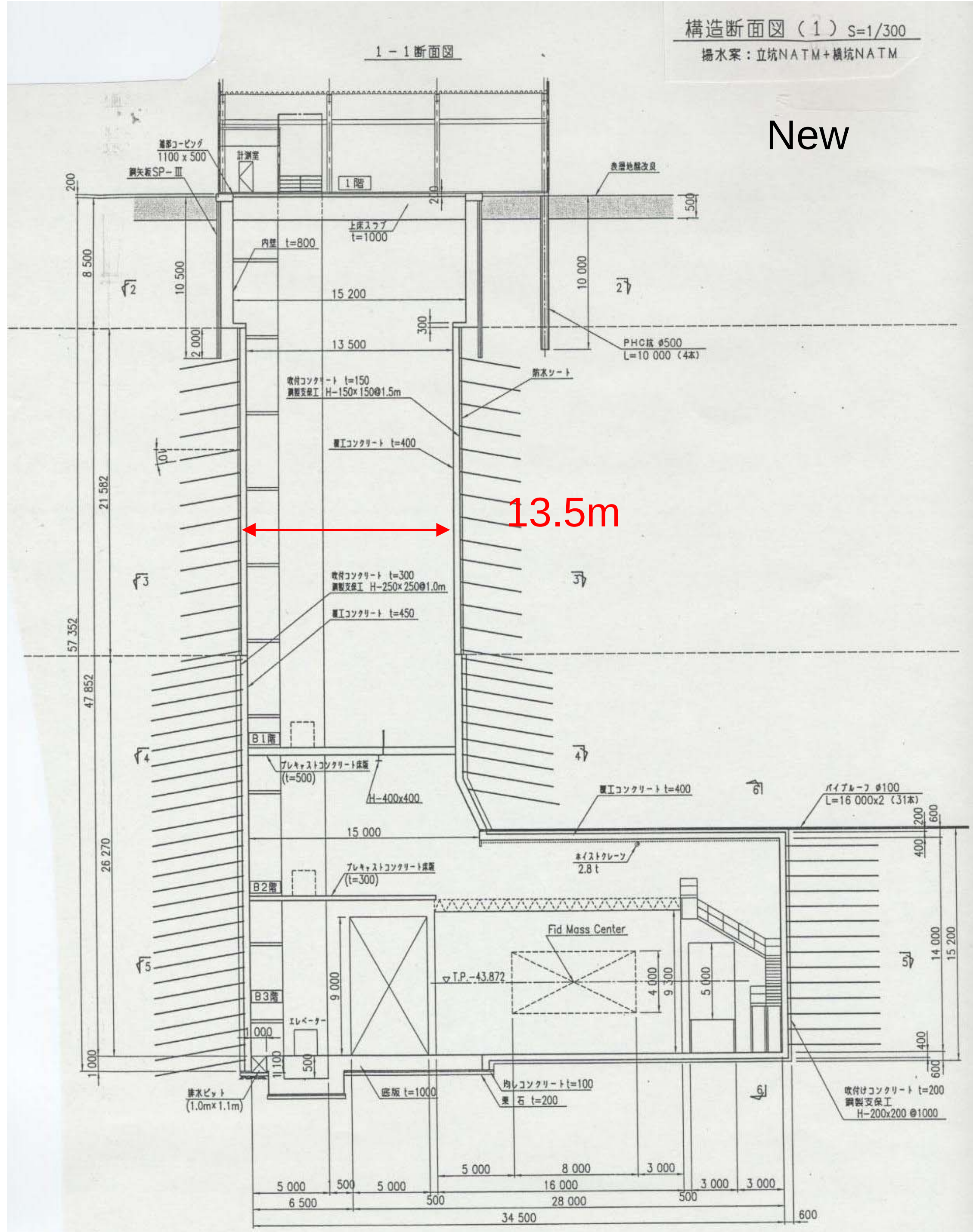
The 2 km detector should look like….



New design

Old





2km Cost estimates

Unit: 10^8 yen

	Old	New
Under ground hall	14.030	11.600
Surface building	0.475	0.483
Utilities (lift, electric power distribution…)	1.195	1.195
Tax (5%)	0.750	0.664
Total	16.486	13.942

Possibile Schedula per il gruppo italiano

- 10 marzo: open meeting a Roma
- Fine marzo: presentazione in commissione II
- Giugno: richiesta di apertura di sigla (T2K R&D)
- Fine agosto: meeting in Giappone, possibile inizio di definizione dei rivelatori e degli impegni
- Fine anno: T2K proposal
- Giugno 2005: proposta completa di esperimento alla Commissione II

Areas of competence and interest

Uni Ge: neutrino group has participated in neutrino factory R&D (horn, HARP and MICE)
ATLAS/CDF AMS groups expert in silicon detectors
ATLAS group in Liquid argon (electronics)
Member of k2k via harp

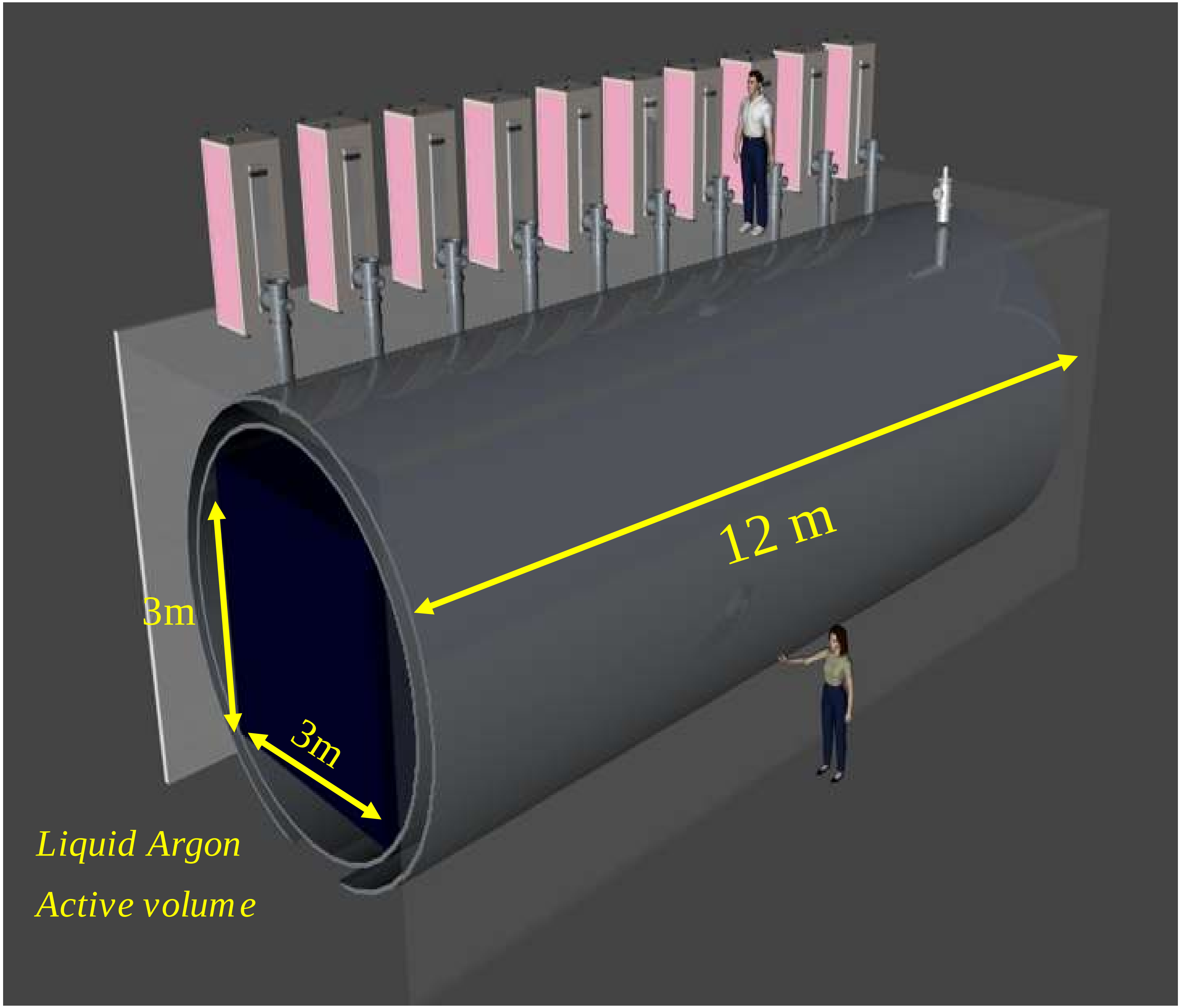
Possible contribution (manpower permitting, this is still a small group!) in beam and horns.

ETHZ neutrino group is in ICARUS (Liquid argon TPC)
and has expertise in neutrino experiments (NOMAD), beam calculations

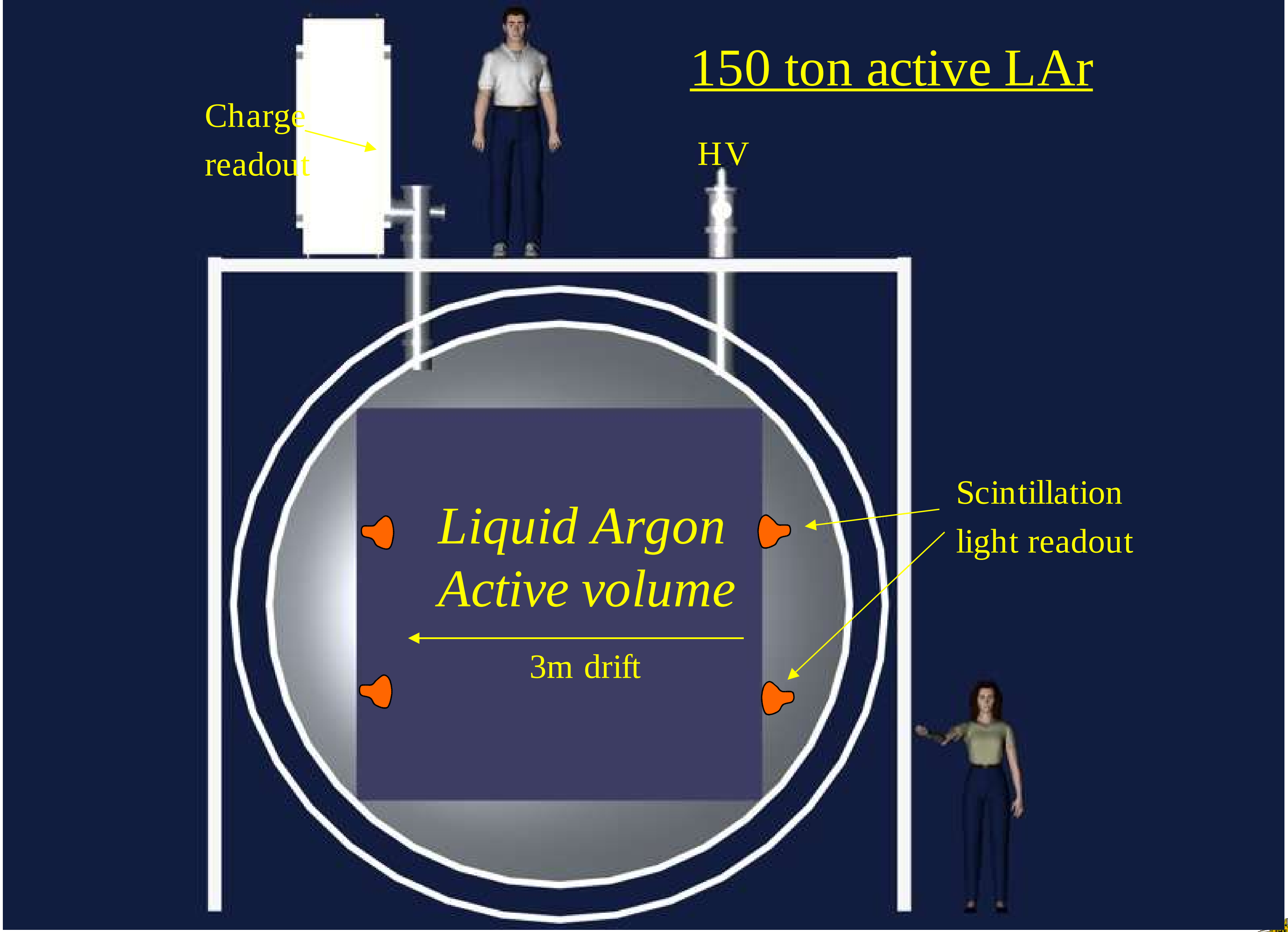
PSI has 600 MeV proton beam of > 1 MW (CW)
(windows, graphite target, rad. handling etc…)
a direct contact from accelerator group of KEK to that lab is probably most effective process

Will be studied: **a liquid argon TPC as 280 m or 2km detector**

A. Rubbia presented preliminary ideas at the 'JHF-EU' meeting



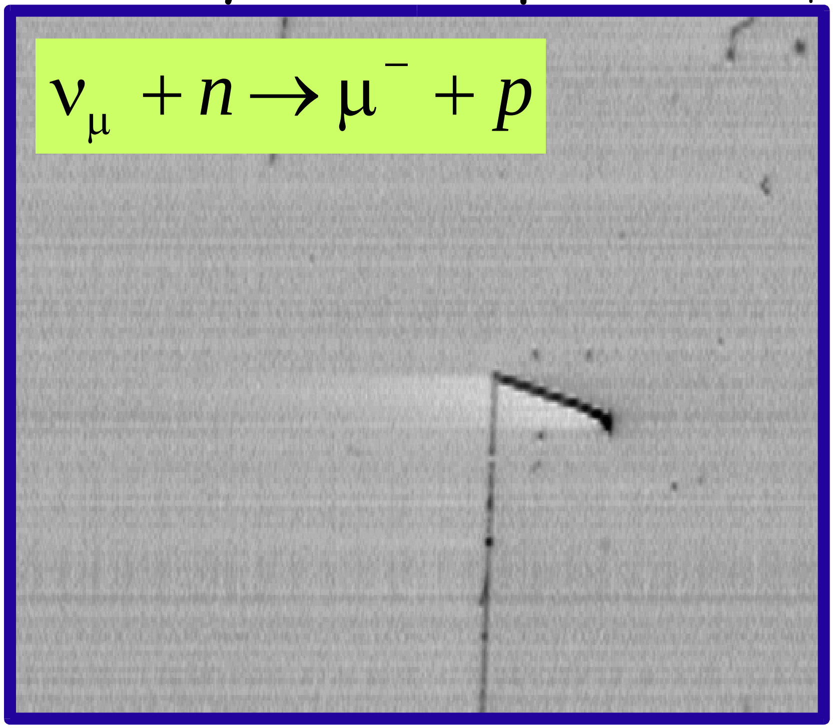
André Rubbia, JHF-Europe, November, 2003

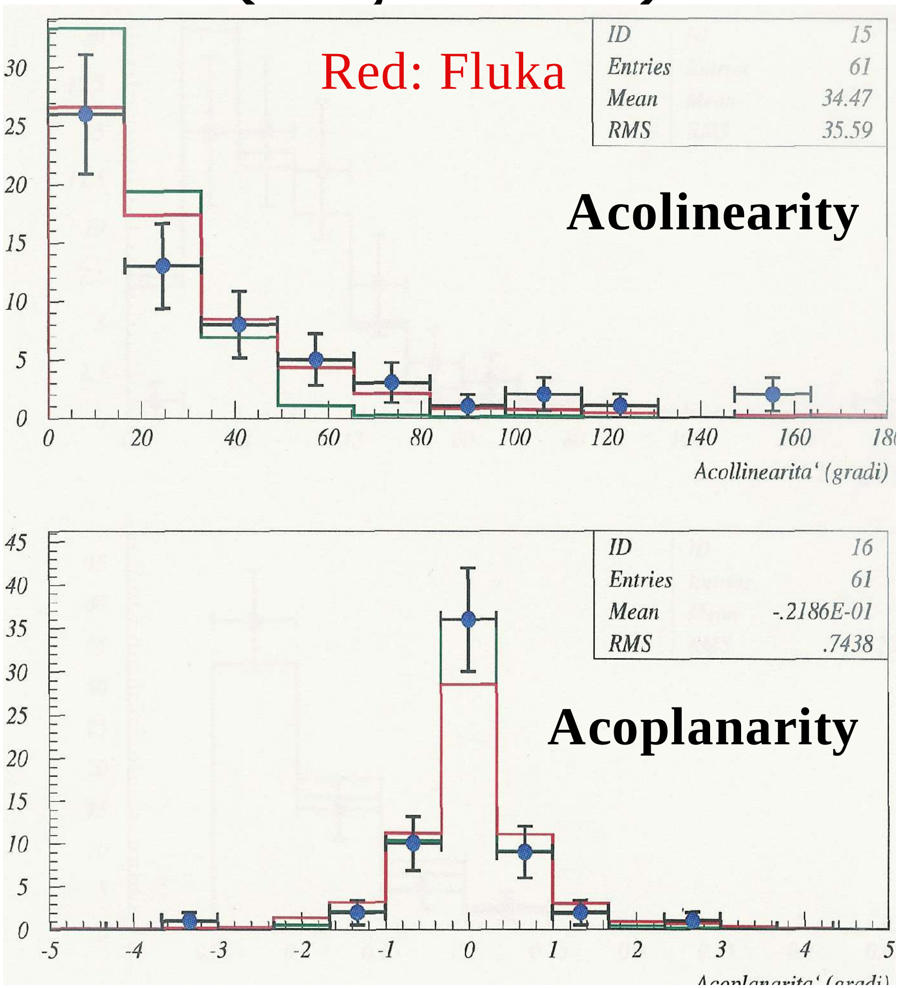


NB: the transverse size is largely determined by the Interaction Length in Argon.

exposed to CERN WANF

- Selection of pure lepton-proton final state with exactly one proton T_P>50 MeV (range > 2 cm) and any number protons T_P<





André Rubbia, JHF-Europe, November, 2003

B. Boschetti's thesis (Milano, 1998)

Liquid Argon: What next ?

- Encourage/discourage?
  - Yes/no
- Choose better location (280 vs 2800 m)
  - Define physics goal
  - Maybe timescale
- Start technical work
  - Dewar design
  - Purification design
  - Chamber design
  - Infrastructure
  - Cave interface
- Physics study
  - overlap between water and LAr detectors in terms of physics (Ice slabs inside the L-Arg?)
- Actual work
  - Where to build it?
- What is the "legal" way to proceed?

André Rubbia, JHF-Europe, November, 2003