

# T2K collaboration

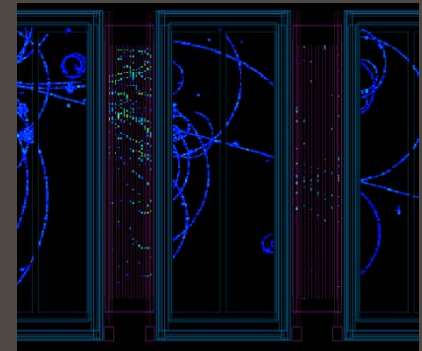
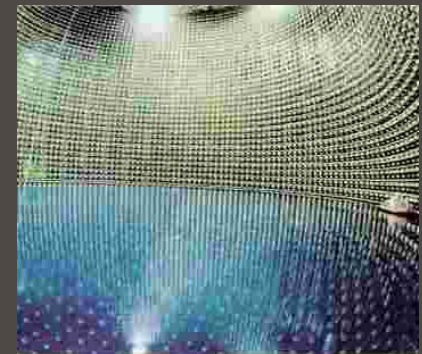
ICFA Neutrino mini workshop , Jan28-29<sup>th</sup> 2014

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Senior Emeritus researcher

Accelerating Science for Canada  
Un accélérateur de la démarche scientifique canadienne

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Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada



# Early history

- JHF review 1999
- - Recommended inclusion of a neutrino program as part of JHF. KEK director ( Y Totsuka) pushes this idea.
  - JHF Nu initial proto proposal discussions initiated ( several workshops held in Japan and abroad)

J-PARC formed to merge KEK project ( JHF) and JAEA ( JEARI then) project ( Spallation Neutron source)

-International partners joining the pre proposal discussions

2004: LOI approved , neutrino program funded in Japan

This was the trigger for the international partners to seek funding and make commitments

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# T2K concepts

- New ideas beyond K2K:
  - Off Axis beam
  - Superconducting beam transport
  - Near detectors (On and Off axis)
  - 2Km detector
- Frozen in a TDR document

# ND280 concepts

- Major commitment by Europe/CERN to contribute the refurbished UA1 magnet:
- New SiPM detector technology ( Russia and Japan)
  - These developments changed the concept of the near detector dramatically:
    - Tracker system with TPC and FGD
    - Micromegas read out
    - POD
    - ECAL
    - SMRD

# 2km detector

- Need for an intermediate detector debated for two years
- Baseline design didn't include it
- Left aside in favor of a ND280 system to measure cross sections and constraint near far extrapolation.

# Proto collaboration (2004-2006)

- Interim Board of Representatives ( sort of constitutional assembly to draft a formal agreement and make decisions in the interim)
- Each country to negotiate their commitments with their respective funding agencies)

# T2K collaboration 1<sup>st</sup> picture 2004



# Formal Collaboration

- International Collaboration Agreement (2006)
- Agreement with the SK collaboration on the conditions for using SK detector data.
- MOU's with KEK ( if required) on commitments
- CERN NA61 Carbon target hadron production measurement
- Negotiations on Operational issues ( housing, access, safety, administrative support, import of components,...)
- International Finance Oversight Panel (2007)



# The T2K Collaboration



~500 members, 62 institutes, 12 countries

## Canada

TRIUMF  
U. Alberta  
U. B. Columbia  
U. Regina  
U. Toronto  
U. Victoria  
York U.

## Italy

INFN, U. Roma  
INFN, U. Napoli  
INFN, U. Padova  
INFN, U. Bari

## Japan

Hiroshima U.  
ICRR Kamioka  
ICRR RCCN  
KEK  
Kobe U.  
Kyoto U.  
Miyagi U. Edu.  
Osaka City U.  
U. Tokyo

## France

CEA Saclay  
IPN Lyon  
LLR E. Poly.  
LPNHE Paris

## Germany

U. Aachen

## Poland

A. Soltan, Warsaw  
H.Niewodniczanski,  
Cracow  
T. U. Warsaw  
U. Silesia, Katowice  
U. Warsaw  
U. Wroclaw

## Russia

INR

## S. Korea

N. U. Chonnam  
U. Dongshin  
U. Sejong  
N. U. Seoul  
U. Sungkyunkwan

## Spain

IFIC, Valencia  
U. A. Barcelona

## Switzerland

U. Bern  
U. Geneva  
ETH Zurich

## United Kingdom

Imperial C. London  
Queen Mary U. L.  
Lancaster U.  
Liverpool U.  
Oxford U.  
Sheffield U.  
Warwick U.

STFC/RAL

STFC/Daresbury

## USA

Boston U.  
B.N.L.  
Colorado S. U.  
Duke U.  
Louisiana S. U.  
Stony Brook U.  
U. C. Irvine  
U. Colorado  
U. Pittsburgh  
U. Rochester  
U. Washington

# Organisation

- Collaboration General Assembly (CGA)
- Spokesperson and International co-spokesperson
- Executive Committee (EC)
- International Board of Representatives (IBR) ( Legislative body appointed by institutions)
  - Election process. Authorship requirements. Membership approval. WG and committees memberships , ICA modifications,..
- International Finance Oversight Panel (IFOP)
- Membership commitments via MOU's with KEK
- Science extraction working groups
- Operation coordination/ shifts assignments/
- Publication/ speakers board

# Construction phase (Beamline)

- Japan contributed a fixed capital amount for the neutrino beamline ( 160M\$) as supplementary budget for J-PARC ( approved 2004)
- Foreign partners were asked to help find the missing part.
  - Production target ( UK)
  - Superconducting magnets, 2<sup>nd</sup> Horn, GPS system (USA)
  - OTR, Beam window and target remote handling station and manipulators, (Canada)
  - Primary beam monitors ( Korea)
- **Note : Problem with long term commitments regarding maintenance and operation of supplied components**

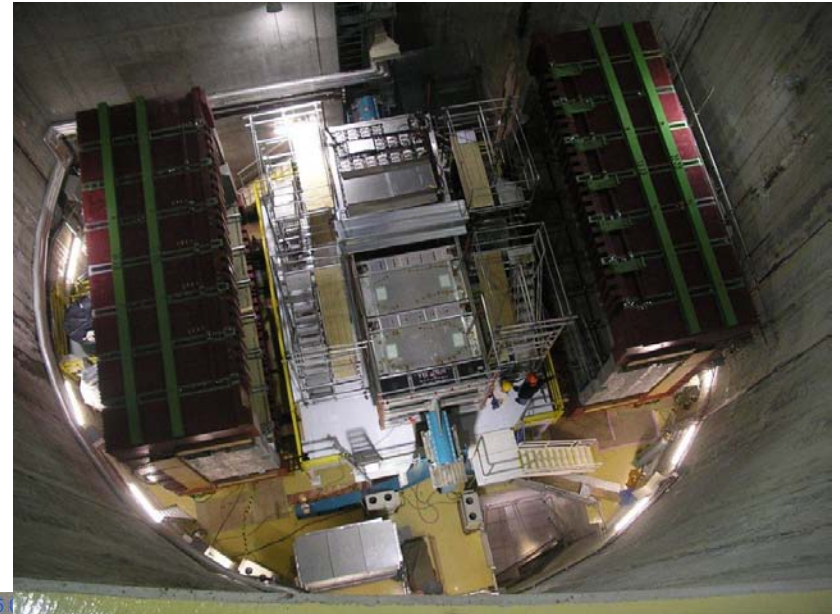
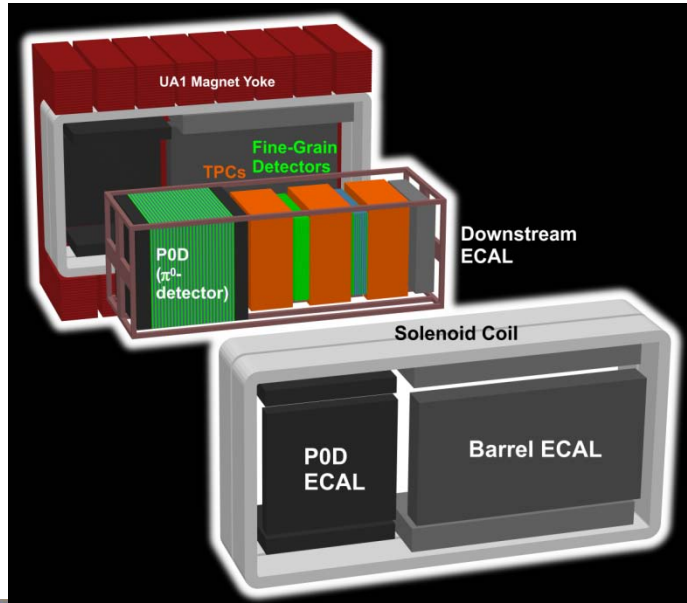
# Construction phase (Near detectors)

- Civil Infrastructure provided by Japan(KEK)
- On Axis detectors ( Japan grants in Aid, France)
- Off Axis detectors (Mainly non Japanese )
  
- Total cost beamline + ND280detector:
  - Japan:                   \$155M
  - Partners:               \$37.5M + UA1 magnet donation
    - Estimated at \$12.5M capital and \$25M manpower

# ND280 contributions

- Civil engineering and construction (Japan)
- UA1 magnet ( Switzerland)
- Magnet power supply ( France)
- Magnet moving system ( Germany)
- TPC ( Canada-France-Spain-Switzerland) (Germany and Italy)
- FGD ( Canada-Kyoto)
- ECAL (UK)
- POD( USA)
- SMRD( USA,Russia,Poland)
- SLOW control (Canada)
- Services ( Shared)
- DAQ (UK), Online monitoring ( Shared)
- Tier 0 ( Japan), Tier 1(UK-CANADA)
- Simulation ( Spain and others)

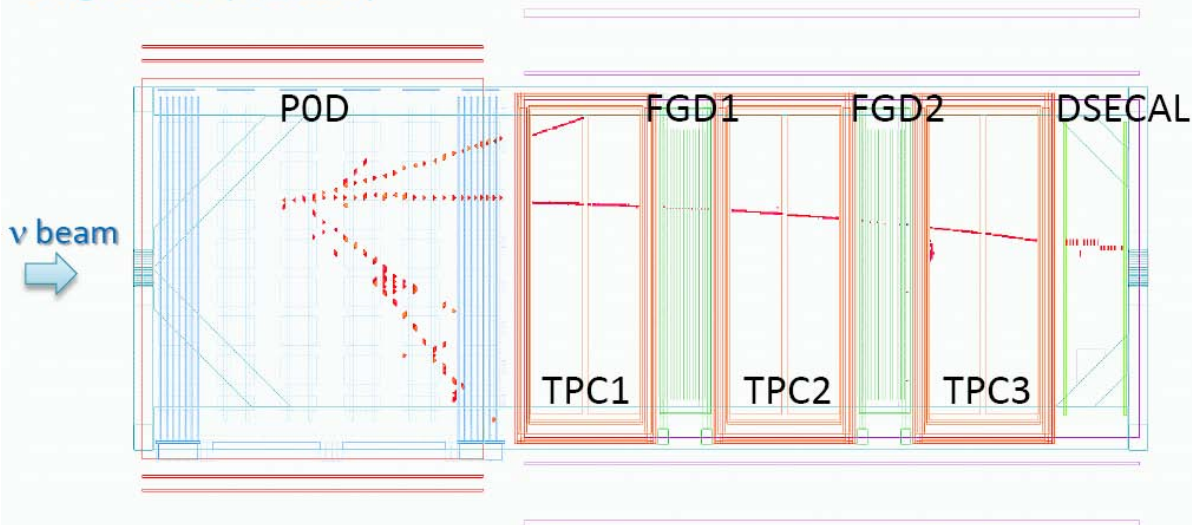
# OFF axis detectors



Event number : 1609 | Particle : 63 | Run number : 2953 | Split : 7295 | SubRun number : INVALID | Time : Fri 2010-02-05 01:57:00 JST

Magnet on (0.188 T)

01:57 JST, Feb. 5, 2010



Event display for beam event  
During Magnet test operation.

# Early challenges

- Interfaces with Japanese contractors
- Interfacing between sub-projects
- Infrastructure projects
- Overall installation Coordination
- **Safety/liability issues**
- Construction common fund for unfunded items
- Operating common fund for ND280 detector

# Time table

- 2002 J-PARC construction approval
- 2004 T2K beamline approved in Japan (Phase 1b)
- 2006 ND280: International commitments
- 2008 First operation of J-PARC's RCS
- 2009 First beam at J-PARC Main Ring
- 2009 ND280/ neutrino Beamline completed
- 2010 First data taking
- 2011 First observation of “large”  $\theta_{13}$
- 2013 Evidence ( $7.5 \sigma$ ) of electron appearance



LOGO

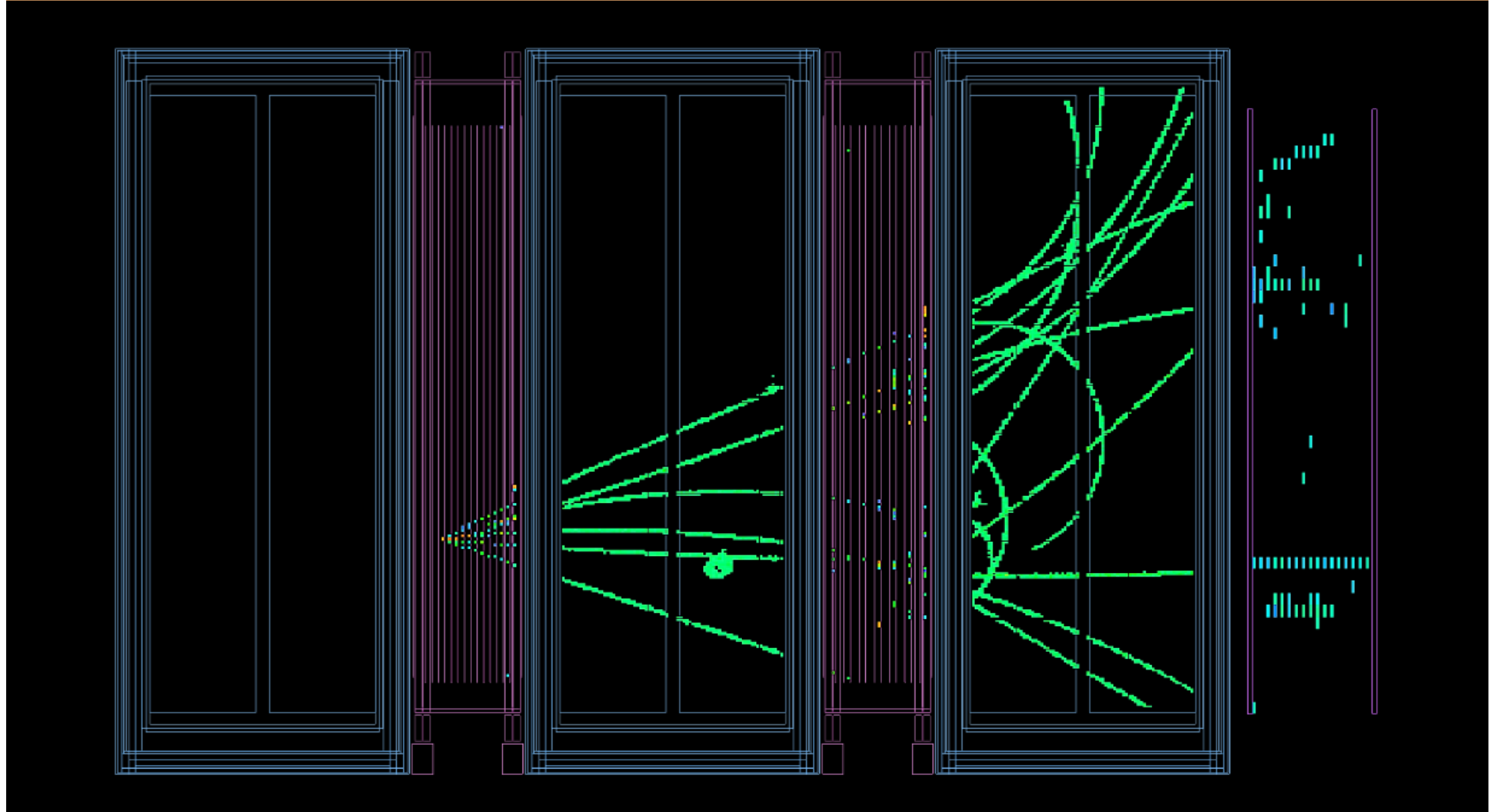


# Physics phase

- Analysis coordination
- Distributed computing and software support
- Analysis working groups
- Approval of results
- Approval of talks
- Approval of publications
- Interaction with PAC, IAC, MEXT

# PHYSICS phase

Event number : 110284 | Partition : 63 | Run number : 4200 | Spill : 0 | SubRun number : 25 | Time : Mon 2010-03-22 14:06:35 JST | Trigger: Beam Spill



# User environment

- User support
- Access to J-PARC within JAEA
- Computing environment within JAEA
- Academic environment
- Housing
- Transportation
- Few long term stays. Experts commuting
- Extensive video based meetings ( time zones issues)

# J-PARC international office

- J-PARC responded to the challenges faced by the international members by developing a user office to manage many of the administrative chores, building and managing new accommodations, providing offices and working with the village of Tokai to open up relations etc. and improve environment.
- J-PARC instituted a regular seminar series and social activities for long term residents ( students/post docs)
- KEK moved some of their support services and personnel to a Tokai campus .
- T2K hired a bilingual secretary on common funds
- JSPS has been generous in providing visitor support

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- 2011 First observation of “large”  $\theta_{13}$
- 2013 Evidence ( $7.5 \sigma$ ) of electron appearance
- 2017 beam power to 750Kw

# Concluding remarks

- T2K is the largest collaboration (450) dominated by non-japanese participants (380) in Japan
- J-PARC is a dual head laboratory on JAEA campus with no infrastructure of its own while T2K is a KEK sponsored experiment.
- Tokaimura was a “japanese village”
- Foreign physicists work in english , JAEA not (For ex cannot take beamline shifts unless fluent in Japanese, emergency announcement in Japanese only,...)
- Through a tremendous effort, our Japanese colleagues have made us welcomed, operationally effective and comfortable .
- We owed them a success story and ...
- **that is what T2K is.**
- We have come a long way in such a short time,

# Thank you! Merci!

## Questions?

TRIUMF: Alberta | British Columbia | Calgary  
 | Carleton | Guelph | Manitoba |  
 McGill | McMaster | Montréal | Northern  
 British Columbia | Queen's | Regina |  
 Saint Mary's | Simon Fraser | Toronto |  
 Victoria | Winnipeg | York

