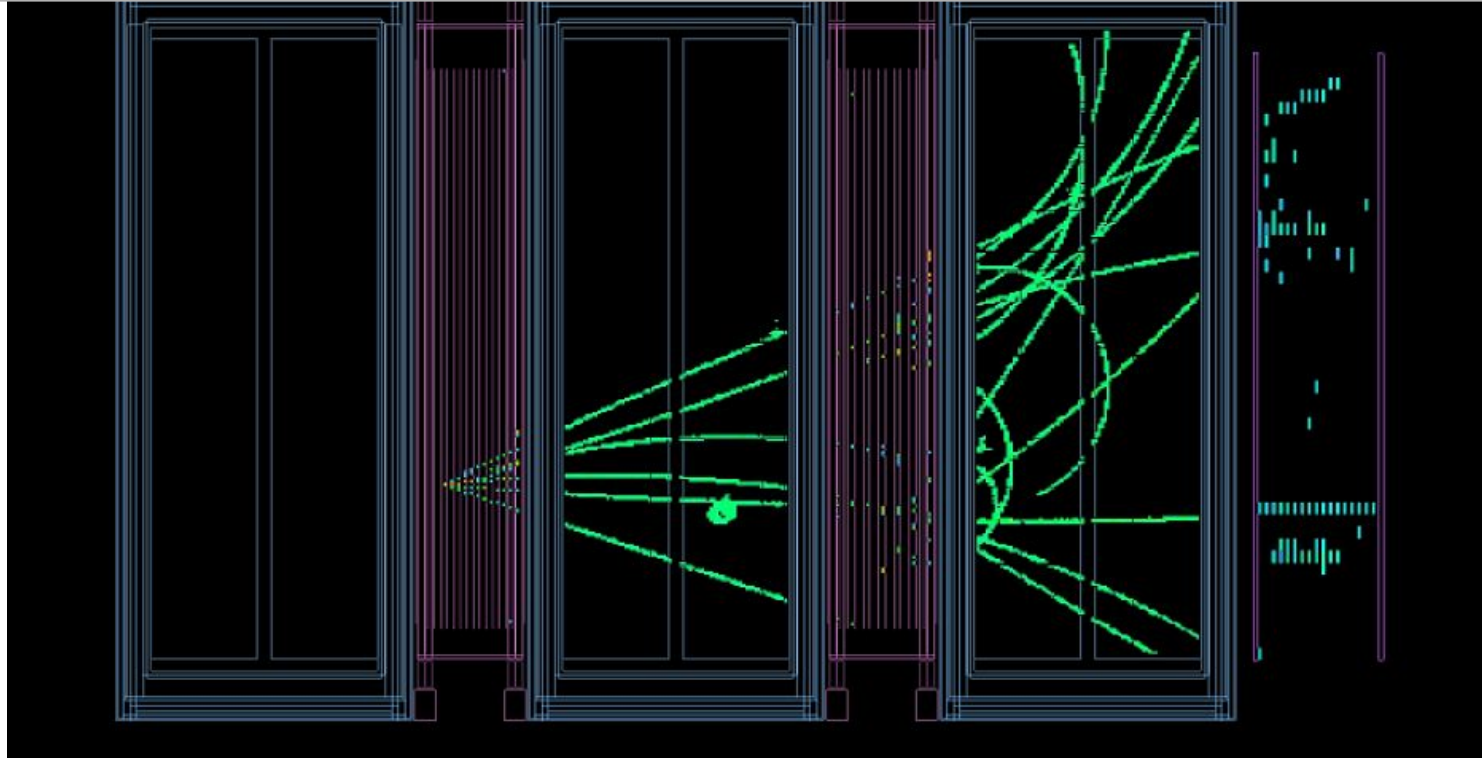


Introduction and goals of the workshop

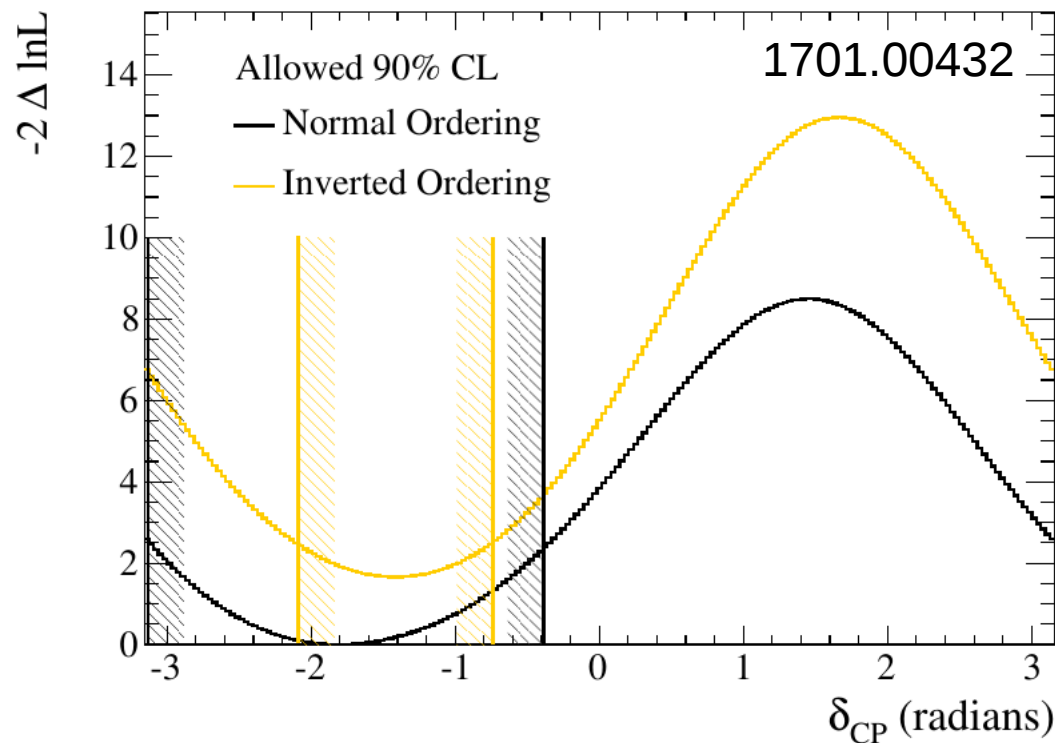
2nd Workshop on Neutrino Near Detectors based on Gas TPC



Marco Zito
Irfu/SPP CEA Saclay

CERN March 20, 2017

T2K 2016: indications of CP violation



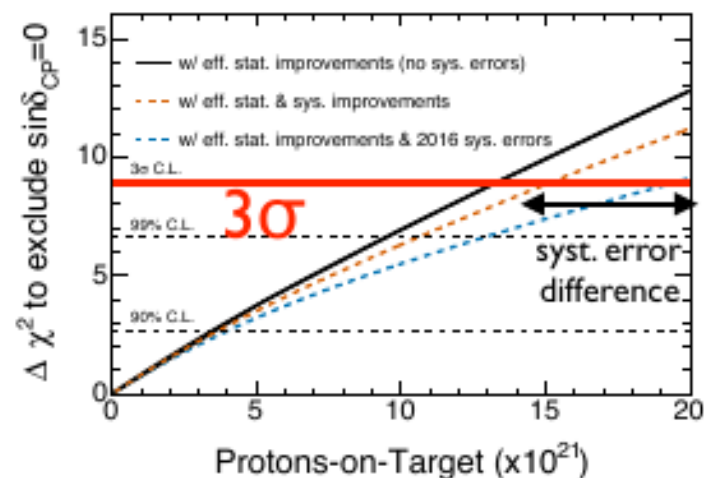
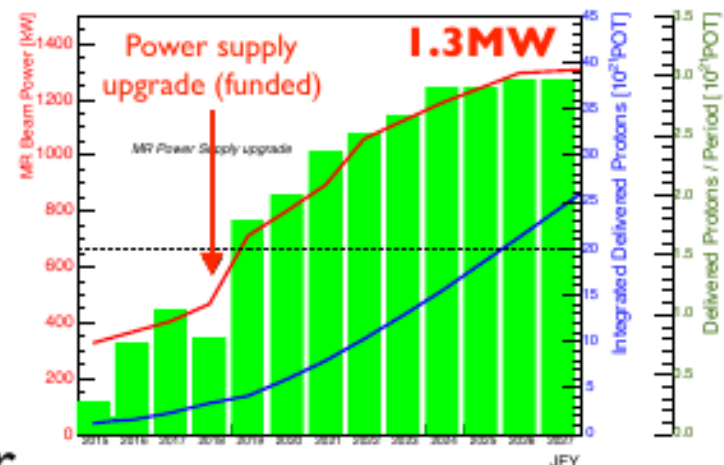
February 2017: new record for JPARC MR beam power, 475 kW

March 2017: T2K reaches 2×10^{21} POT

Stay tuned for new T2K results in Summer 2017!

T2K Phase II (T2K-II) and ND upgrade

- T2K-II extension proposal
(arXiv:1609.04111): got stage-I at PAC
- Aim for 3σ CPV sensitivity by 2026 by accumulating 2×10^{22} POT with upgraded J-PARC (1.3MW)
- Goal of systematics: 4% in total for number of ν_e (~ 400 evts expected)
→ ND measurement is a key!
- Upgrade of Near Detector (ND280) is under discussion inside T2K
- Target of installation date: ~ 2020
- New collaborators are WELCOME!



November 2016 Workshop

Tuesday 08 November 2016

Session 1: Introduction - 60-6-015 - Room Georges Charpak (Room F) (09:00-09:35)

time	[id]	title	presenter
09:00	[12]	Welcome	ELSEN, Eckhard
09:10	[13]	Goal of the workshop	BLONDEL, Alain ORGANISATION COMMITTEE
09:20	[14]	The Neutrino Platform	NESSI, Marzio

Session 2: The T2K Near detector: Lessons Learned - 60-6-015 - Room Georges Charpak (Room F) (09:35-10:15)

time	[id]	title	presenter
09:35	[15]	T2K near detector performance and limits	GIGANTI, Claudio
09:55	[16]	The T2K ND TPC	RADICIONI, Emilio

Session 3: Near Detector Challenges for Long Baseline Projects - 60-6-015 - Room Georges Charpak (Room F) (10:45-12:05)

time	[id]	title	presenter
10:45	[17]	T2K - HyperK	HARTZ, Mark
11:05	[19]	DUNE	KABOTH, Asher
11:25	[20]	Neutrino cross-sections	BOLOGNESI, Sara
11:45	[21]	Theoretical challenges	SOBCZIK, Jan

Session 4: The T2K Near Detector Upgrade - 60-6-015 - Room Georges Charpak (Room F) (13:30-15:00)

time	[id]	title	presenter
13:30	[22]	The T2K Near Detector Upgrade	YOKOYAMA, Masashi
13:50	[23]	The new TPCs	ZITO, Marco
14:10	[24]	Active targets	QUILAIN, Benjamin
14:30	[25]	Quantitative assessment of upgraded performances	SGALABERNA, Davide

Session 5: TPC H/W - 60-6-015 - Room Georges Charpak (Room F) (15:20-18:30)

time	[id]	title	presenter
15:20	[26]	First look at TPC field cage and mechanical constraints	CADOUX, Frank Raphael SGALABERNA, Davide

15:40	[27]	TPC Gas system	GUIDA, Roberto
16:00	[28]	MPGD for TPC/HPTPC	Dr. GIOMATARIS, Ioanis
16:20	[32]	Calibration	STEINMANN, Jochen
16:40	[29]	Electronics based on the T2K TPC design	CALVET, Denis
16:55	[31]	Electronics ideas from Poland	ZIEMBICKI, Marcin
17:10	[30]	Recent developments based on ILC TPC Electronics	OSKARSSON, Anders
17:25	[50]	The Quad: a general purpose modular readout system for TPCs	VAN DER GRAAF, Harry
17:40	[33]	Scintillators for T0/TOF	KUDENKO, Yury

Workshop on Neutrino Near Detectors based on gas TPCs

8-9 November 2016

Task Force report

- “Deliverable” defined in the charge of TF
- ~60 page document summarizing extensive work done past year
- Thanks to great effort of all of you!
- Released as TN-303
- Expect collaboration discussion this week

T2K-TN-303

ND280 Upgrade Task Force report

S. Blunck, A. Blondel, S. Bolognesi, C. Giganti, A. Izmaylov, Y. Kudenko, T. Ovsyannikova, B. Quilain, M. Rayner, D. Sgalaberna, M. Yokoyama, M. Zito

Abstract

The T2K experiment established the $\nu_\mu \rightarrow \nu_e$ appearance with only 10% of the original beam request of 7.8×10^{21} 30 GeV protons on target (p.o.t.); It has presently collected the equivalent in anti-neutrino mode. In view of the J-PARC program of upgrades of the beam intensity, the T2K-II proposal requires to run up to 20×10^{21} p.o.t., i.e. an increase of the exposure by more than a factor 10. The Hyper-K proposal consists in a further increase by a factor 10 of the far detector mass. Facing the potential increase of statistics by two orders of magnitude, it is of great importance to undertake a vigorous program of near detector upgrades, with the aim of reducing the statistical and systematic uncertainties at the appropriate level of 3-4% or less on the prediction of the $\nu_\mu \rightarrow \nu_e$ and $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ appearance signals in the far detector for a given set of oscillation parameters. A dedicated task force was created in October 2015 with the mission to propose such a program for the magnetic near detector of the T2K experiment (ND280). This report presents a baseline proposal, which achieves a much better uniformity of acceptance as function of polar angle, by reconfiguring the geometry with active targets of the WAGASCI type, disposed along plane including both the beam direction and the magnetic field. New TPCs cover the large angles and time-of-flight detectors allow rejection of out of fiducial volume events. First results of performance are given.

<http://www.t2k.org/docs/technotes/303/tn303-v1.0>

Expression of Interest (EOI) SPSC-EOI-15

- Decision taken at the November workshop
- Signed by 190 people
- Submitted to SPSC early January
- First contact with referees and questions received
- Next SPSC April 4-5

Expression of Interest for the January 2017 SPSC

Near Detectors based on gas TPCs for neutrino long baseline experiments¹

R. Hamacher-Baumann, L. Koch, T. Rademacher, S. Roth, J. Steinmann
RWTH Aachen University, III. Physikalisches Institut, Aachen, Germany

V. Bararot, M.G. Catanesi, R.A. Infanti, L. Magaletti, E. Radicioni
INFN and Dipartimento Interateneo di Fisica, Bari, Italy

S. Bordon, M. Caporini Garrido, A. De Roeck, R. Gluza, B. Mandelli,
D. Mladenov, M. Nessi, F. Rezzati
CERN, Geneva, Switzerland

Z. Liptak, J. Lopez, A. Martin, K. Nagai, E. D. Zimmerman
University of Colorado at Boulder, Department of Physics, Boulder, Colorado, U.S.A.

T. Hayato, M. Ikeda, M. Nakahata, Y. Nakajima, Y. Nishimura
University of Tokyo, Institute for Cosmic Ray Research, Kamioka Obs., Kamioka, Japan

M. Antonova, A. Izmaylov, A. Kostin, M. Khabibulin, A. Khatjantsev, Y. Kudenko,
A. Melnikov, O. Mineev, T. Ovsianikova, S. Suvorov, N. Yershov
Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russia

F. Sanchez, M. Cavali-Sforza, T. Lutz, B. Bouguelin, M. Leylan
Institut de Física d'Altes Energies (IFAE), The Barcelona Institute of Science and
Technology, Campus UAB, Bellaterra (Barcelona) Spain

J. Arney, R.J. Dunne, P. Jonsson, R.P. Litchfield, W. Ma, L. Pickering,
M. A. Uchida, Y. Uchida, M.D. Warko, C.V.C. What
Imperial College, London, United Kingdom

C. Gronner, M. Hertz, M. Vagstad
Kavli Institute for the Physics and Mathematics of the Universe (WPI), University of Tokyo,
Kashiwa, Chiba, Japan

S. Bolognesi, D. Calvet, R. Colas, A. Delbart, S. Emery, F. Giazarini, M.
Lamoureux, M. Martini, E. Mazzucato, G. Vassero, M. Zito
IPN, CEA Saclay, Gif-sur-Yvette, France

¹ Corresponding authors: Alain Blondel (alain.blondel@cern.ch), Marco Zito
(marco.zito@cea.fr)

Statement by T2K

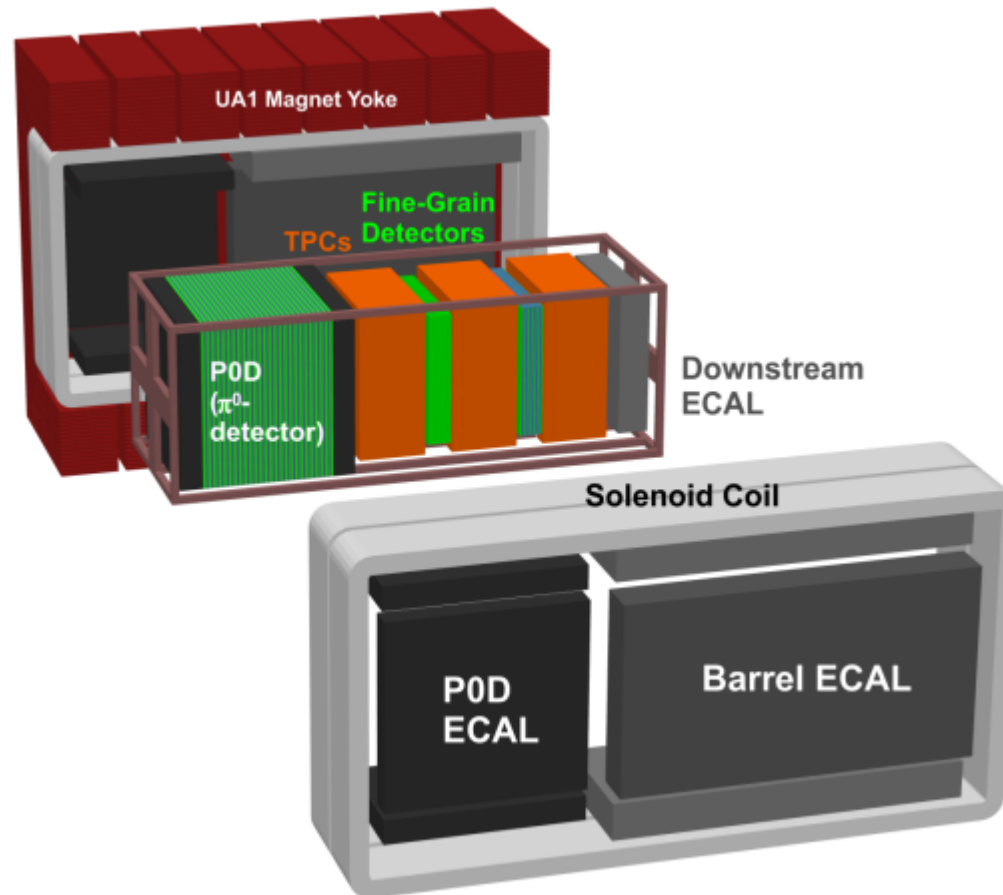
- On February 11, 2017, the T2K Collaboration launched its Near Detector Upgrade project. The upgrade is targeted at reducing systematic errors in T2K's search for CP violation in the neutrino sector. The current conceptual design will be developed into a technical design, leading to a full proposal, by the end of 2017. The collaboration aims to install the upgraded near detector around 2020, to fully benefit from the foreseen increase of the J-PARC MR beam power.

One project, two goals

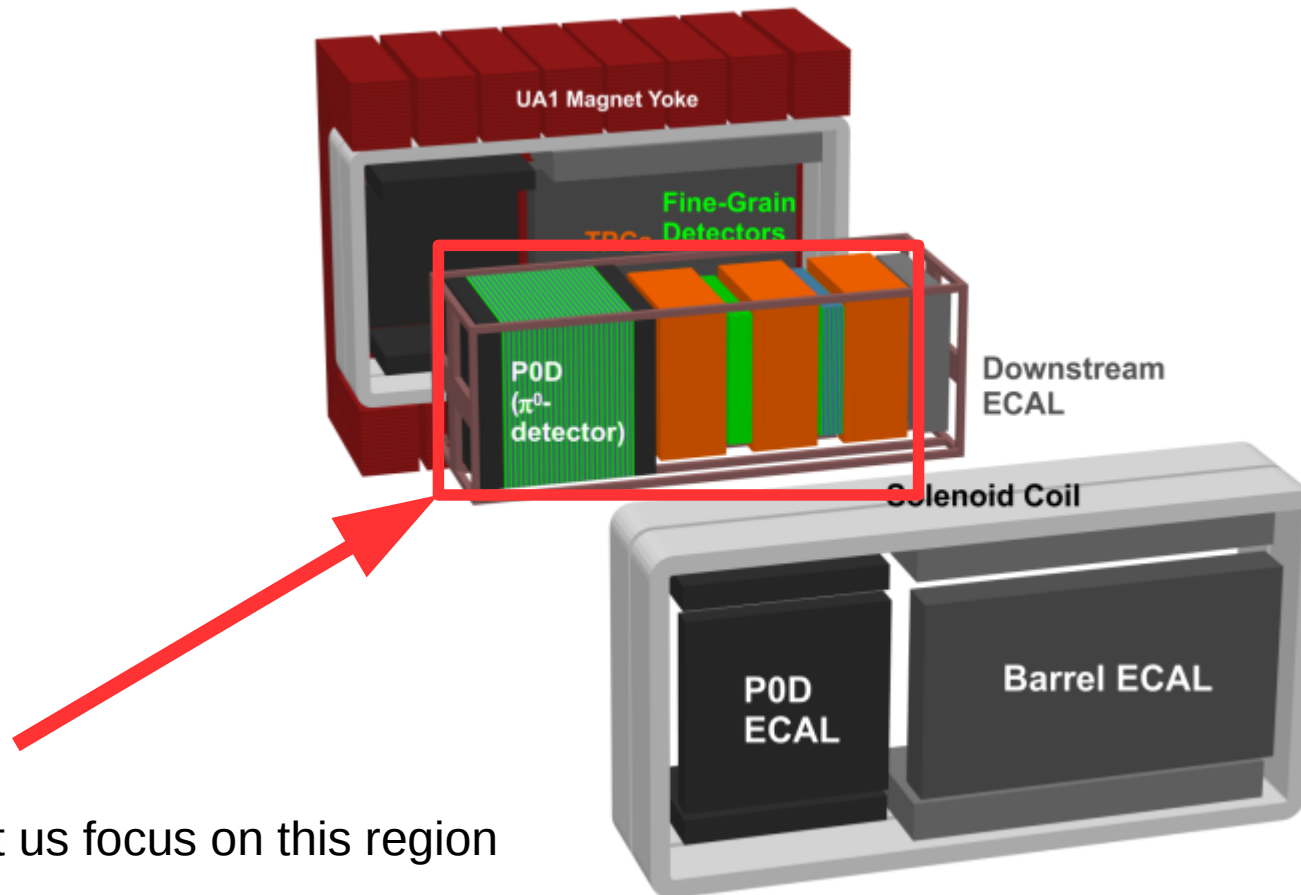
- Study, optimize, design and build an upgrade of the ND280 near detector capable of improved and model-independent precision below $\sim 4\%$ in line with T2K-II physics needs
- Study, optimize, design a High Pressure TPC that could serve as base for a detector aimed at exploring the details of neutrino interactions. Demonstrate the concept with prototypes on a test beam.

We identified synergies and strong overlaps in the interests expressed by the participating groups. Associating the two projects will strengthen the collaboration.

T2K Near Detector ND280

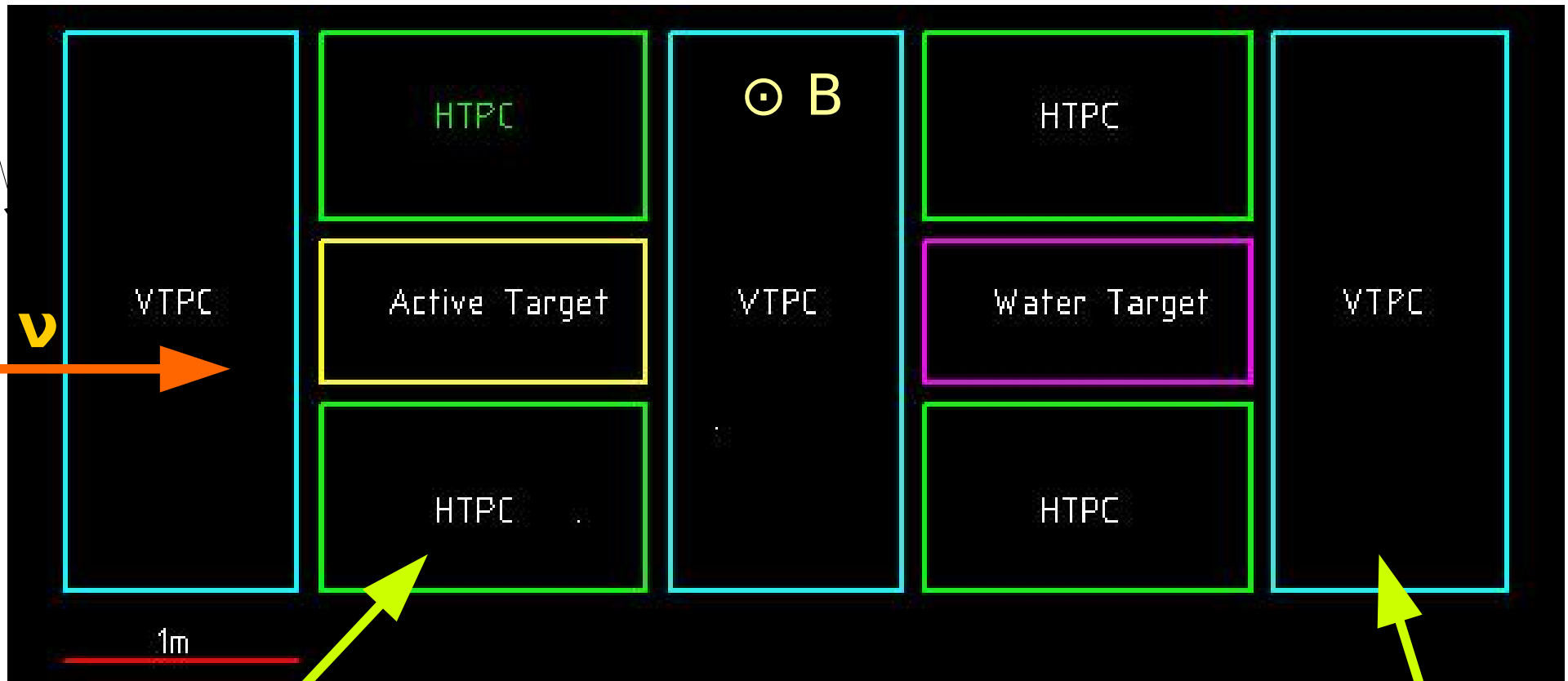


T2K Near Detector ND280



The baseline design for the upgraded ND280

All this inside the EM calorimeter and the UA1 magnet

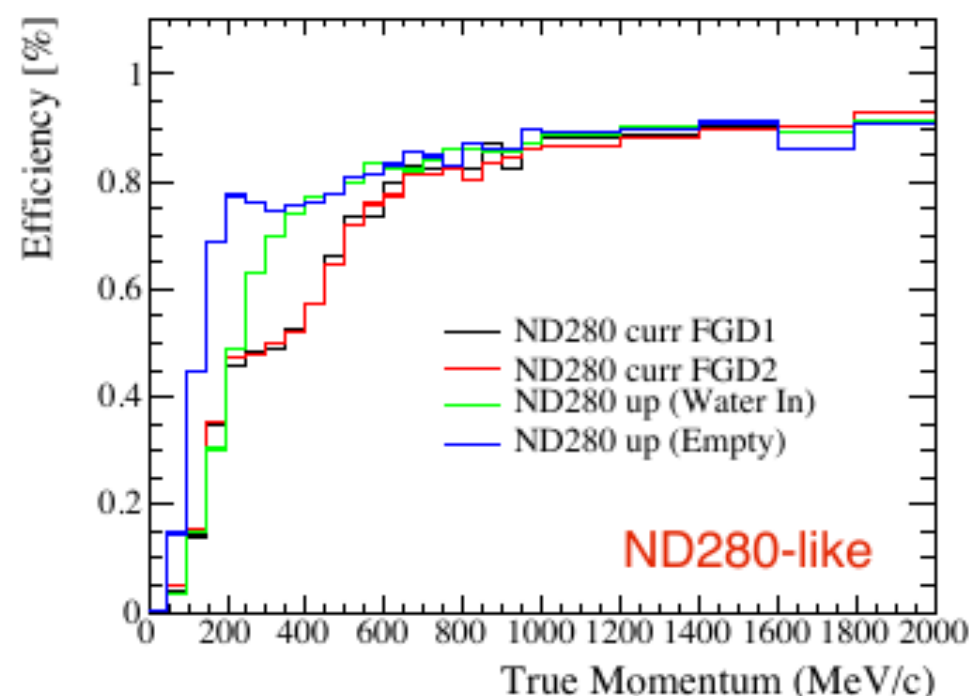
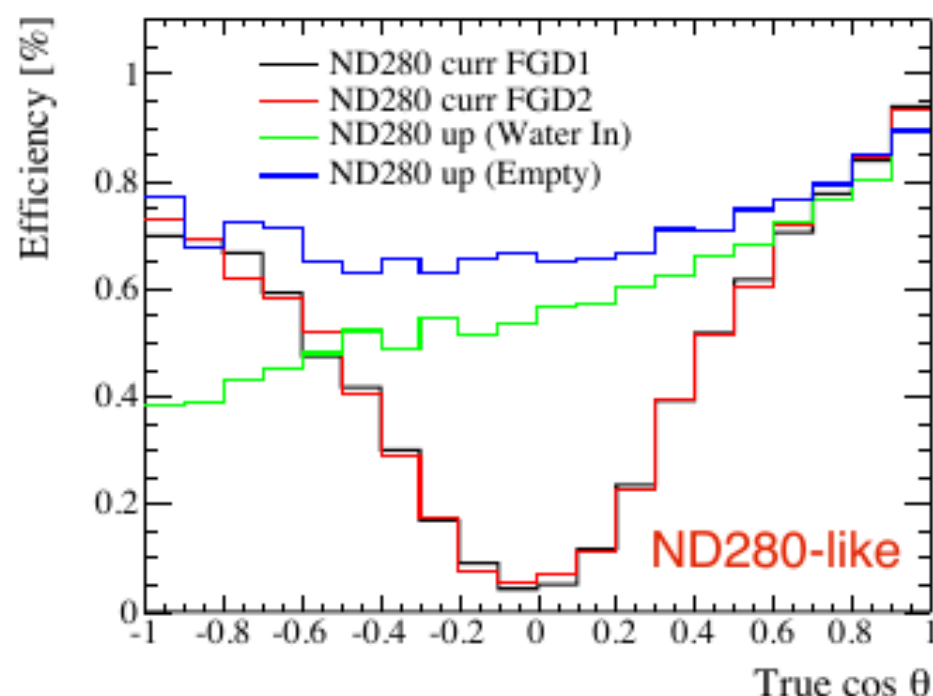


New Horizontal TPC

Existing VTPC

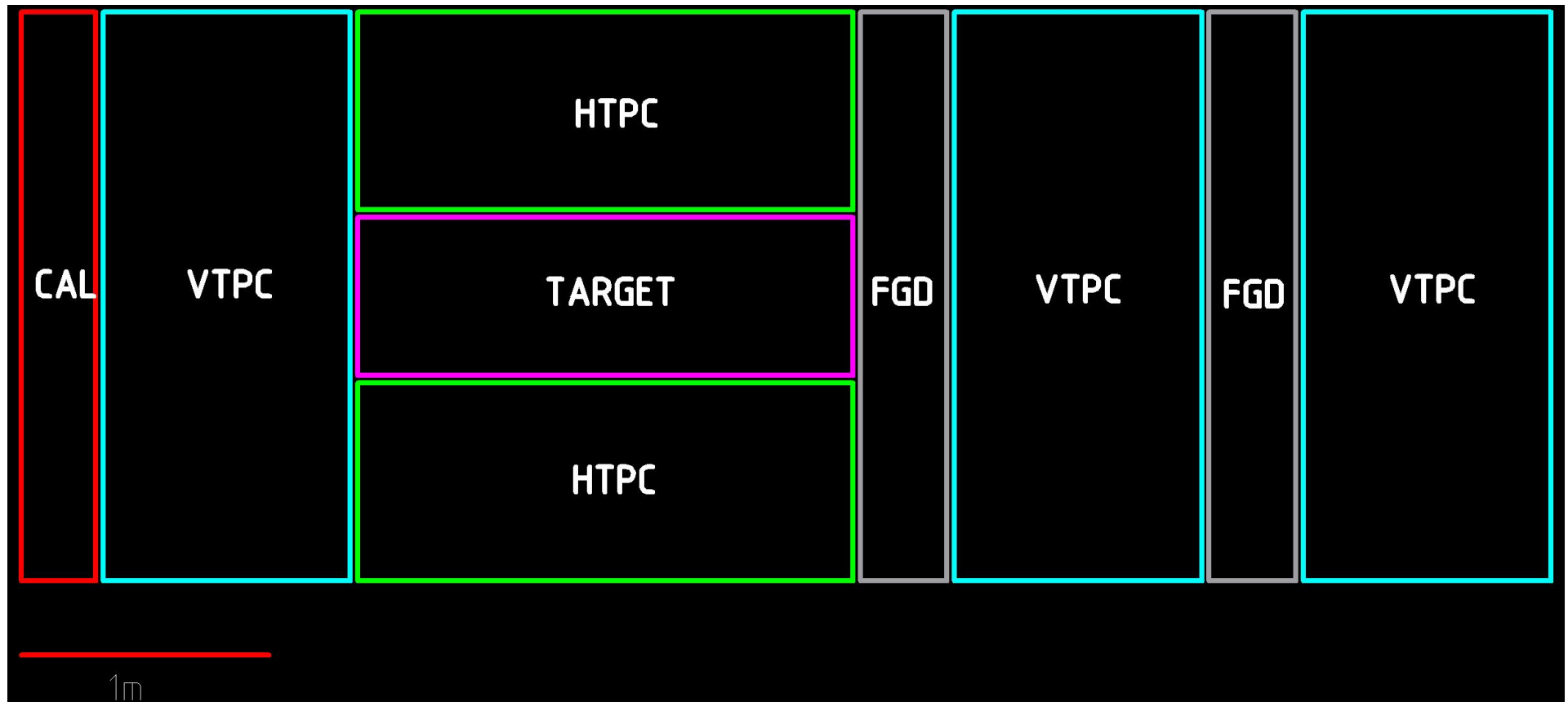
We plan to surround the TPC by scintillator planes for T0 and TOF determination.

ND280 upgrade performance



- Horizontal targets and new TPCs can measure very well the high angle region both for Water-in and Water-out WAGASCI targets
- At $\cos \theta \sim 0$ the efficiency is improved to $>50\%$ for water-in, $\sim 70\%$ for water-out
- Also momentum threshold is lower with the new configuration

A possible alternate configuration



Provide ~4t of instrumented target with excellent acceptance both for forward/backward and high angle tracks.
Minimize reshuffling of detectors. Concentrate on upstream part. Keep most of the current ND280 tracker untouched.

Events after selection ($/10^{20}$ POT)

configuration	Tgt/FGD 1	Tgt/FGD 2	Tgt (for alt.)
current	4569.87	4382.75	-
ref.	6432.4	2192.47	-
alt. Target(60cm)→TPC	4682.57	4525.35	9826.74
alt. Target(40cm)→TPC	4663.51	4646.57	7157.74
alt. TPC→Target(60cm)	4696.01	4474.61	9291.15
alt. TPC→Target(40cm)	4718.36	4466.33	6993.41

- Similar total number of events for current and upgrade reference configuration ($\sim 1000+1000$ kg against $\sim 1450+450$ kg)
- More events in alternative thanks to the new target in addition to the existing FGDs

Main detector sub-systems

- TPC
 - Field cage
 - Other mechanical structures (end plates, MM support, FE cooling and support)
 - Micromegas
 - Electronics
 - Gas system
- TOF
- Scintillator target(s)
- (ECAL completion – or preshower – in the upstream region)
- HPTPC prototype

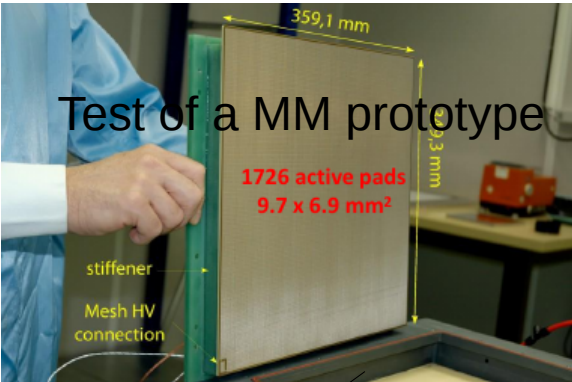
Preliminary EOI-15 Work Packages and Contact persons

Management: MZ and Masashi Yokoyama,
Contact with CERN: Alain Blondel

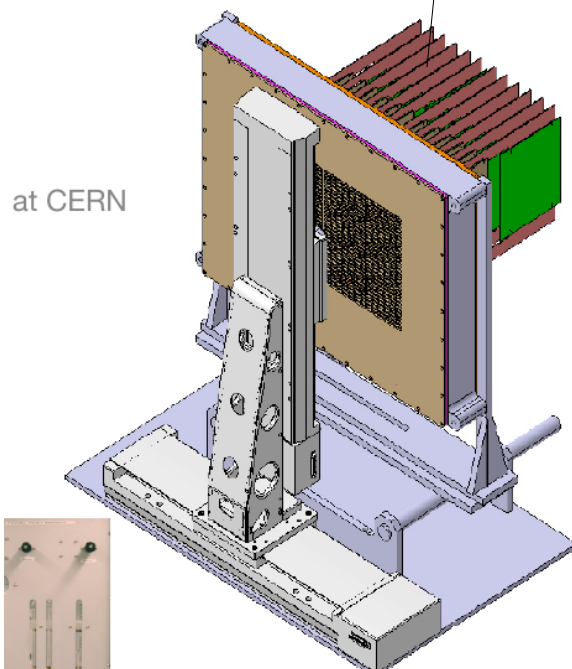
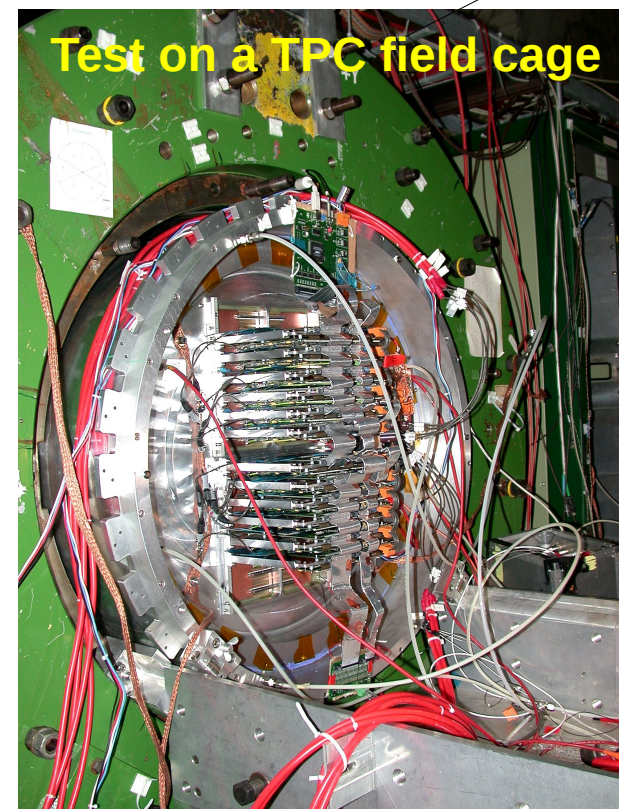
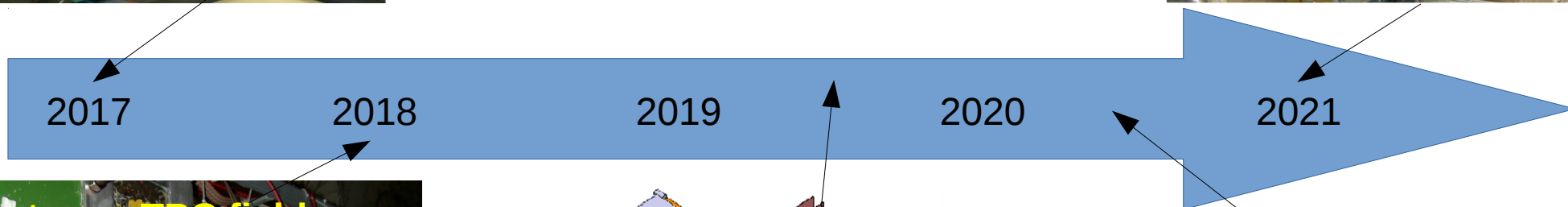
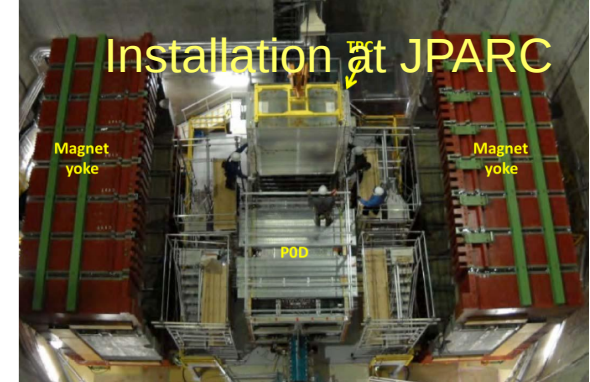
- WP1 Mechanical design and integration (Marcela Batkiewicz, Davide Sgalaberna)
- WP2 TPC field cage and gas vessel (Gabriella Catanesi, Emilio Radicioni)
- WP3 TPC Readout technology (Alain Delbart, CERN)
- WP4 TPC electronics and DAQ (Denis Calvet, Andrzej Rychter)
- WP5 Scintillator-based trackers (Japan+LLR)
- WP6 TOF system (Yury Kudenko)
- WP7 Gas system and calibration (Blair Jamieson, CERN)
- WP8 Test beam measurements (Federico Sanchez, Stefania Bordoni)
- WP9 High Pressure TPC (Asher Kaboth, Morgan Wascko)
- WP9 Simulation and optimization studies (Davide Sgalaberna)
- WP10 Physics studies (Sara Bolognesi, Claudio Giganti)
- WP11 DAQ (Giles Barr)
- WP12 Software (Yoshi Uchida)

Timeline

- To benefit from the MR upgrade the upgraded detector should be installed around 2020 (data taking until ~2026)
- The installation must happen during the Summer shutdown to limit the downtime
- It seems reasonable to aim for the 2021 Summer shutdown as the target for the installation of the upgraded detector
- The schedule needs to be prepared taking into account the technical and budgetary constraints for the various detectors however a preliminary version could look like this
- **2017**: pursue optimization studies, define preferred configuration, finalize WP structure and responsibilities, prepare and submit proposal for SPSC
- **2018** Prototype of TPC (field cage, micromegas) in a testbeam. Define the detector options (granularity etc). Prepare for production. NB similar milestones for the other detectors
- **2019-2020** Production, integration at CERN. System test (cosmics?).
- **2021** Shipment to Japan, installation, commissioning.



Milestones



Validation and calibration
of all MM modules



NB Each WP should define realistic milestones as part of the project planning

Goals of this workshop

- Define the scope of each WP
- Provide input towards definition of the proposal
- Prepare overall plan for the prototyping and the construction and the tests
- Identify and define requests to CERN as required by the SPSC referees (a first draft exists thanks to Alain Blondel and will be circulated and discussed here)
- There will be a EOI-15 PI meeting tomorrow morning (08:00-09:00) in the Theory Auditorium