The LEM experiment
Measurement of low energy spectrum at J-PARC on-axis neutrino beam

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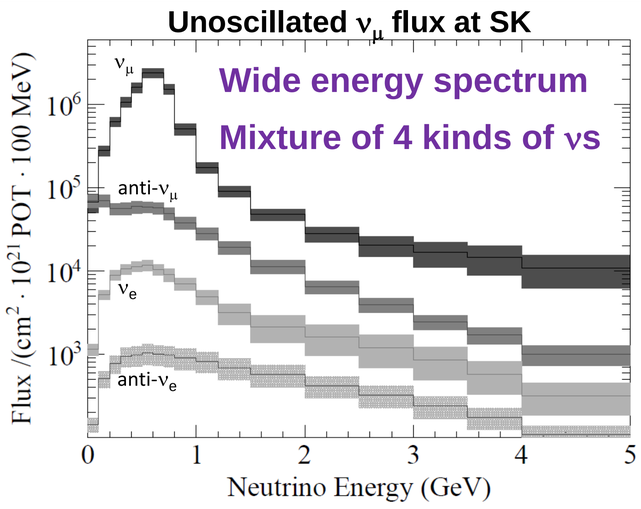
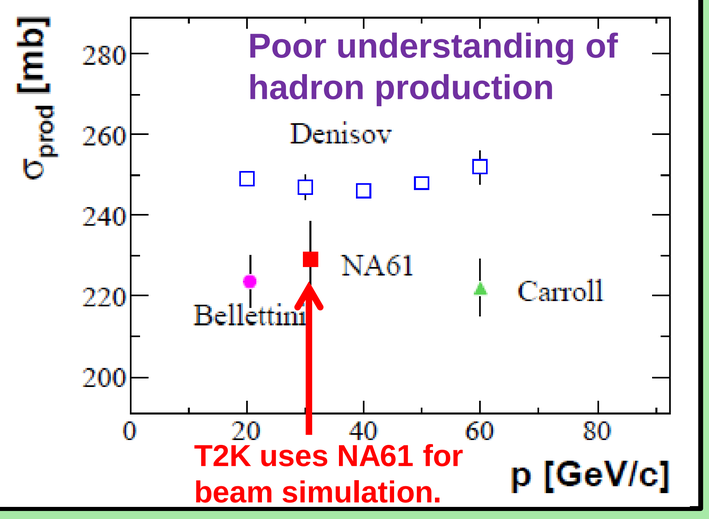
on behalf of the LEM collaboration

Neutrino beam plays significant roles on neutrino physics experiments. However …

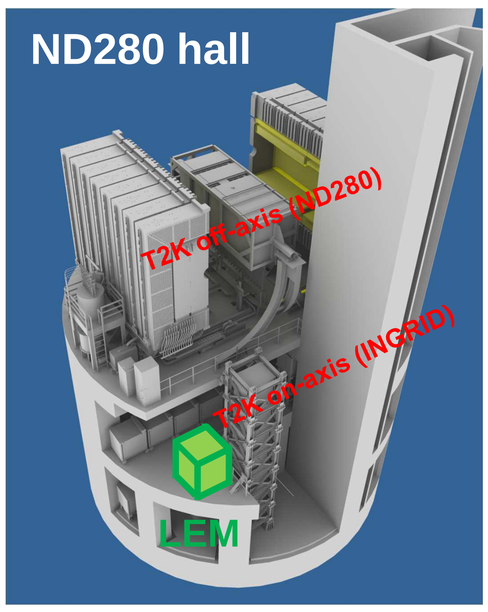
Beam quality is worse than that in colliders.
- Beam has divergence.
- Wide energy spectrum
- Mixture of 4 kinds of neutrinos

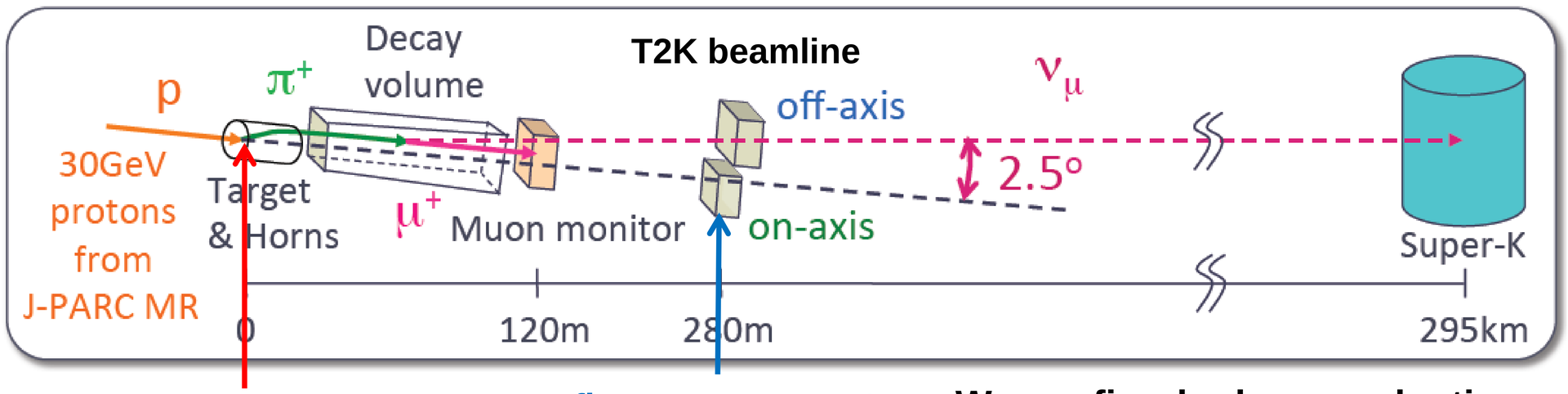
More understandings for flux are needed.
- Poor understanding of hadron productions
- Poor understanding of ν interaction cross sections





We installed new detector, LEM (Low Energy Module), at the ND280 hall for further understanding of J-PARC ν-beam.





We confirm hadron production from ν flux measurement.

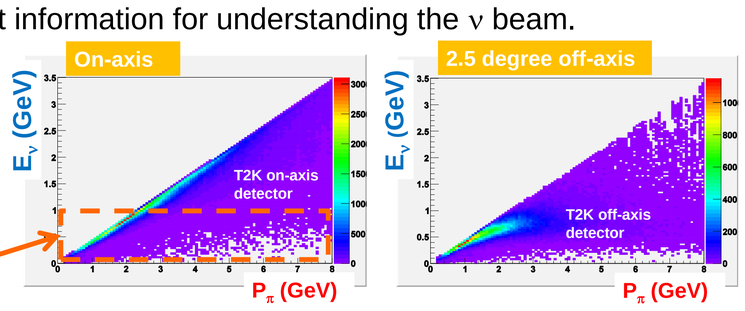
Why on-axis and E_ν<1GeV?

There is good correlation between **ν energy** and **hadron momentum** in on-axis direction.
Measurement in on-axis is important information for understanding the ν beam.

No energy spectrum measurement
in the on-axis of J-PARC ν-beam

No sensitivity in E_ν<1GeV region
by T2K on-axis detector

LEM takes care of this part.



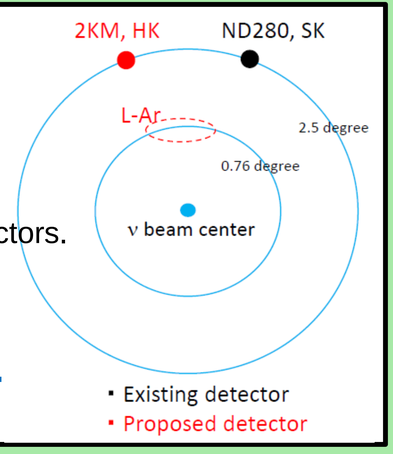
Many sided understanding of ν beam,
itself, is necessary for future experiments.

T2K is OK! They measures ν flux before and after oscillation.
ND280 (before osc.) ⇒ SK (after osc.)

There is no measurement for the direction to the proposed detectors.
- Hyper-Kamiokande, 2KM
- Liquid-Ar TPC (Okino-shima)

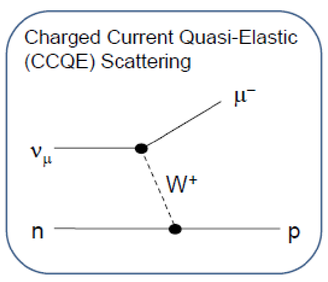
Sensitivity study depends on beam simulations.

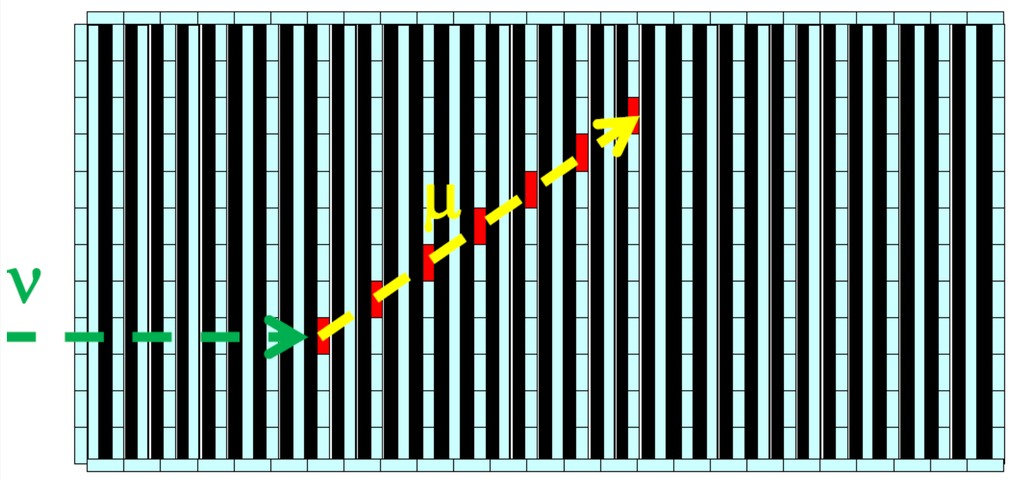
We measure energy spectrum at on-axis and <1GeV.
Target accuracy is ~10 %.



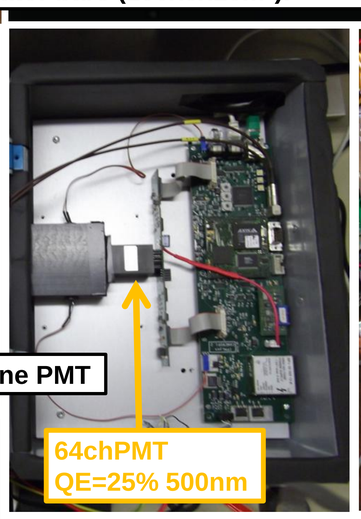
Sandwich calorimeter type module

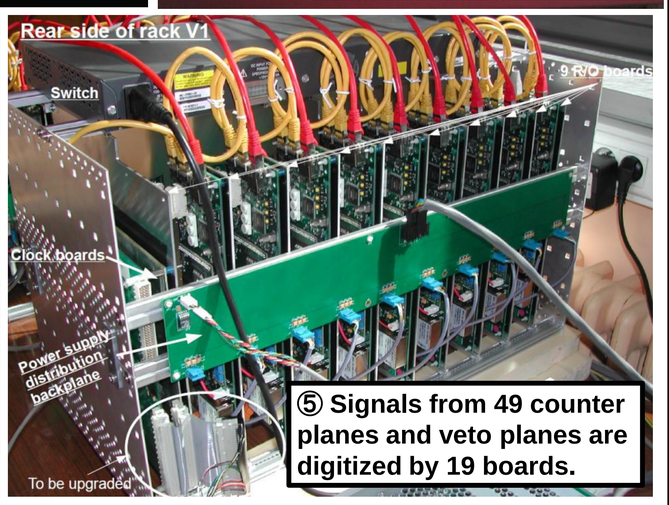
1cm thickness iron target
1cm thickness scintillator, counter plane
- 100x100cm^2 size
- Optically segmented (x or y directions)
- Muon tracking from hit positions





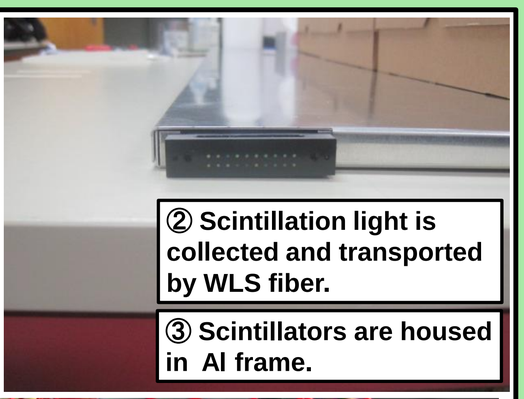
④ 3 planes are connected to one PMT





⑤ Signals from 49 counter planes and veto planes are digitized by 19 boards.

① Counter plane is made by aligning 20 scintillator bars (100x5x1cm^3).



② Scintillation light is collected and transported by WLS fiber.

③ Scintillators are housed in Al frame.

⑥ Detector is assembled at ICRR.

⑦ Installation is finished.

⑧ Control monitor is prepared on the ground floor.

DAQ board
- PMT mounted
- 2 FPGA (ADC)
- Power suply
- Calibration LED
- Controlled via ether-net

Installation is finished and we are waiting for ν beam.

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