

Panjab University – StrawTube Efforts and Flux Studies

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Group Members

- Vipin Bhatnagar
- Sushil Singh Chauhan
- Riya Gaba (PhD Student)

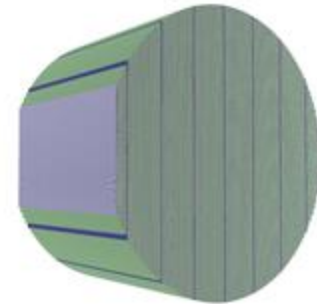
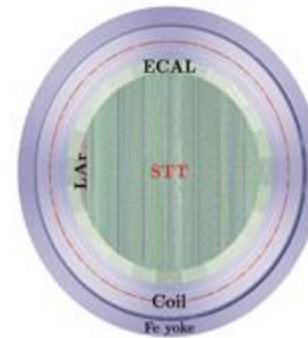
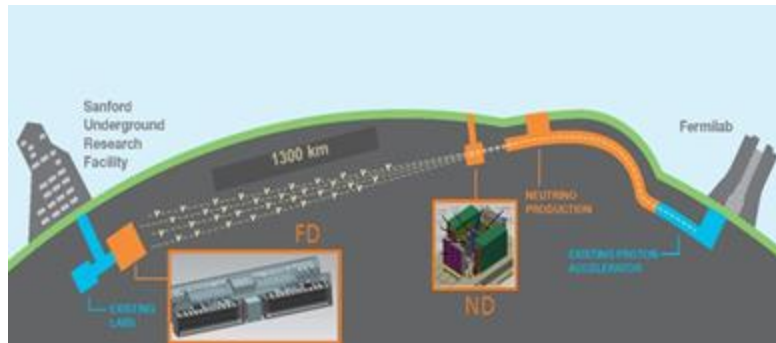
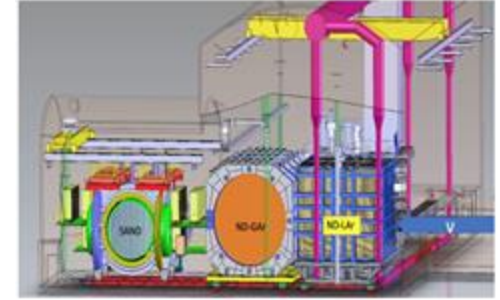
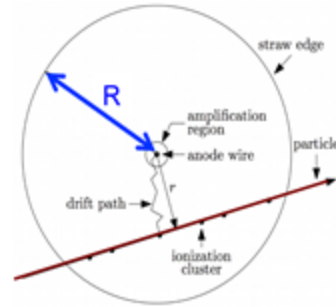
- Already Contributing to NOvA
 - Prachi Sharma (PhD Thesis submitted)
 - Bhumika Mehta (Finalizing work)
 - Remote Operations Center (ROC) established at Panjab University
- Participating in the CMS Experiment
 - Hardware contributions – Outer Hadronic Calorimeter, RPC (Muon), GEM (Muon)
 - Well Equipped assembly, fabrication and characterization labs/setup

Straw Tube Trackers - SAND

Gas filled cylindrical drift chambers, tube acting as cathode and thin wire stretched along its axis acting as anode

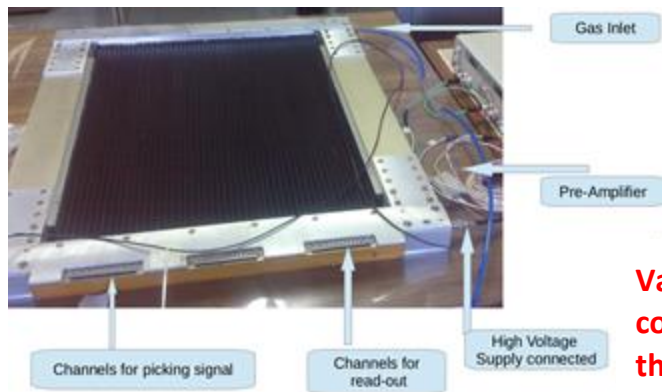
It is instrumented to:

- Separate neutrino and antineutrino events
- Identify primary leptons
- Measure energy of all the charged and neutral particles coming from the neutrino interaction vertex
- Low mass, Excellent resolution, adaptable and customizable



Green: polypropylene (CH_2) targets (4.7 t FV),
Blue: graphite (C) targets (504 kg FV)

Strawtube Test Chamber (JINR) – R&D



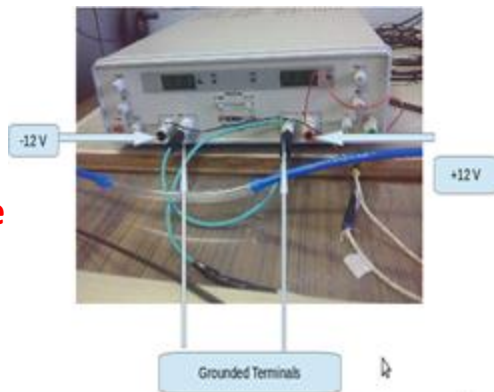
Various connections to the chamber



Complete Set-up

Inner diameter: 9.53mm
Thickness : 80 microns
No. of straws : 48
Gas Mixture : Ar/Co2 (80/20%)
Anode wire : Gold plated tungsten of 30 micron

Dual Voltage Supply



Pre-Amplifier



Voltage Supply

Anode Wire Tension Test

- Gold plated tungsten wire of 20 micron thickness and density of 19.22g/cc with a specific resistance of $0.092\Omega\text{-mm}^2/\text{m}$
- Tension in the wire was measured with a Sonometer setup. Resonant frequencies were observed for a particular mass and the masses were increased gradually.
- The length of wire between two bridges is 75 cm.
- Plan is to follow the Max/Min Current measuring technique at resonance for tension measurement in coming days



Mass (g)	I Harmonic (Hz)	II Harmonic (Hz)	III Harmonic (Hz)
20	124	250	376
30	145	299	450
40	162	326	491
50	188	372	559
60	201	411	614

Observed values

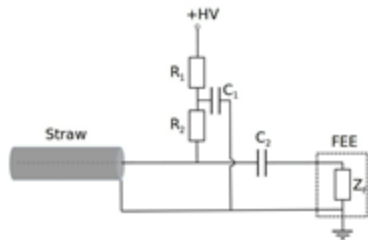
Mass(g)	Frequency(Hz)
20	120
30	147
40	169
50	189
60	204

Calculated values using the formula
 $F = 17.67/2\pi l \sqrt{m/d}$

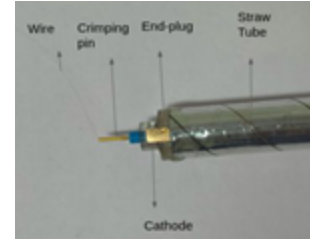
Tension Measurement Results

Test Assembly with 10mm

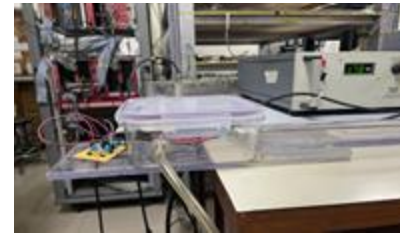
- 9.53 mm inner diameter and a length of 181cm
- Gold-plated tungsten wire is used as anode of diameter 20 micron
- One spacer is inserted in the middle of tube
- Wire is crimped with crimping pin after giving a tension of 46 g which is glued to end cap
- For readout, we have used the following circuit



- $R_1 = 10\text{k}\Omega$ and $C_1 = 1\text{nF}$, used as a low pass filter
- $R_2 = 1\text{M}\Omega$ limiting the short circuit current to 2 mA at 2000 V, and $C_2 = 0.3\text{nF}$
- **Arrival time** of the signal determines the drift radius
- The **charge collected** is proportional to energy loss



Assembled straw



New Straws Received



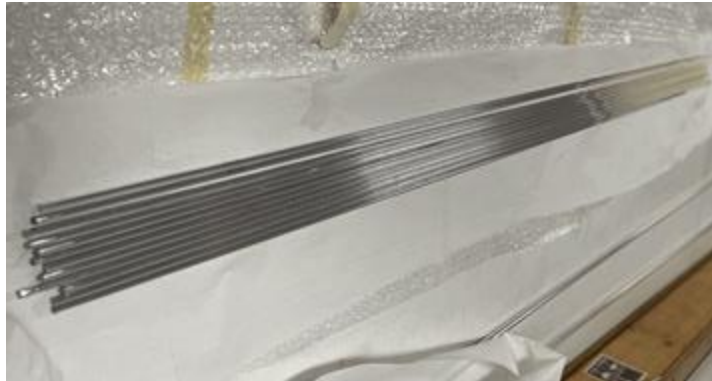
End plug



Spacer



End plug with
crimping pin inserted



5 mm
straws

- We received 12 straws of approximate length 1.2 - 1.3m.
- Single channel preamplifier is available along with gas mixing units (Ar/Co₂)
- Diameter of straws : 5mm

(Thanks to USC – Roberto)

Flux Studies (ongoing)

- Supernova Neutrinos
 - Different flux predicting models compared (with MSW effect) – DUNE, Hyper-K, JUNO (PhD Student - Riya)
- Beam Flux Uncertainties – PPFX used by MINERvA, NOvA and DUNE
 - Using the same procedure as used in NOvA – Studies extended to DUNE: MIPP, NA49, NA61
 - Results are promising and presented in the DUNE Beam group meeting (PhD Student – Bhumika)

STT - Development

- 1.2m scale STT prototype assembled at CERN and Beam tests are done
- Full scale 3.7m STT prototype to be assembled
- Need for Straw production center (max 700Km of Straws needed!)

- Look forward to contribute to these efforts

Thank you