PRIN PROPOSAL:
SND@LHC UPGRADE TOWARDS HL-LHC

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on behalf of the proponent teams

Riunione Gruppo 1 - INFN Napoli
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RESEARCH PROJECT

- **TITLE:**

New physics, fundamental engineering and technological challenges in the emerging era of neutrino detectors at the Large Hadron Collider: feasibility study in view of an upgrade of the SND@LHC experiment for the high-luminosity LHC

- **DURATION:**

24 months

- **RESEARCH UNITS**

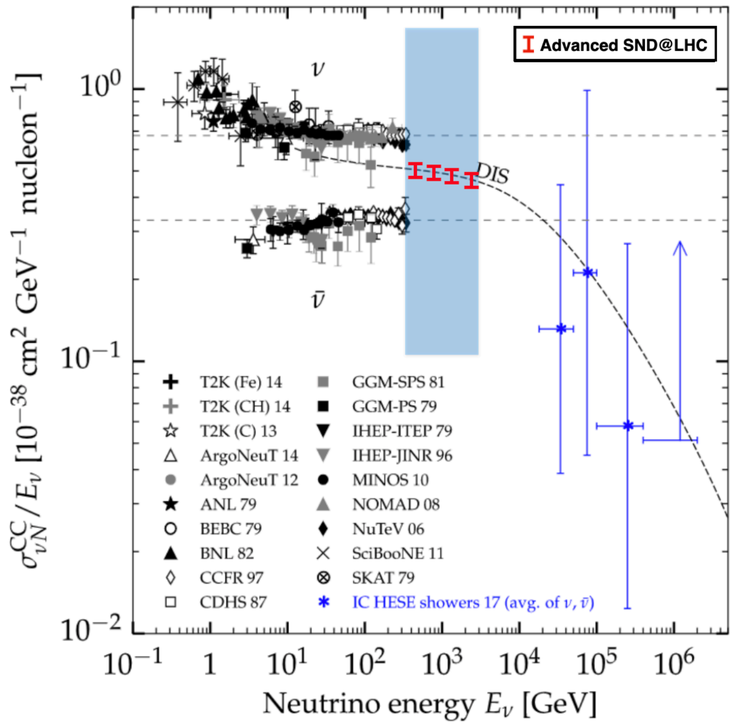
1) Università di Napoli “Federico II”- P.I. Prof. Giovanni De Lellis
2) Università di Napoli “Parthenope” - A.I. Prof. Massimiliano de Magistris
3) INFN - A.I. Dott. Gaetano Marco Dallavalle

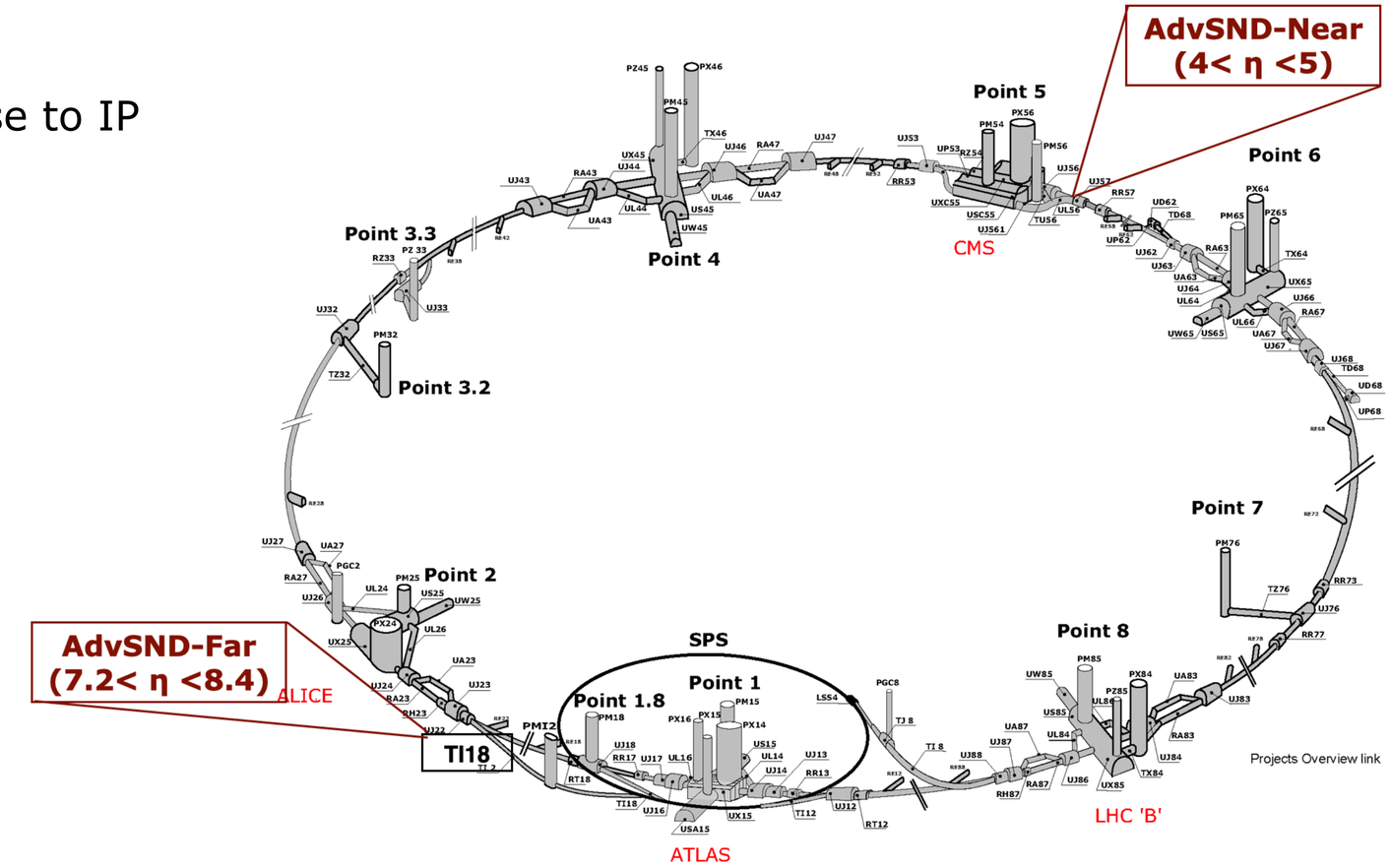
ADVANCED SND@LHC

- Upgrade of SND@LHC in view of an extended run during Run 4:
  - Extension of the physics case
  - New technologies and detector layout
  - Two detectors
    - **AdvSND-Far** (7.2<η<8.4)

      Possible locations: TI18
    - **AdvSND-Near** (4<η<5)

      Possible locations: existing caverns close to IP



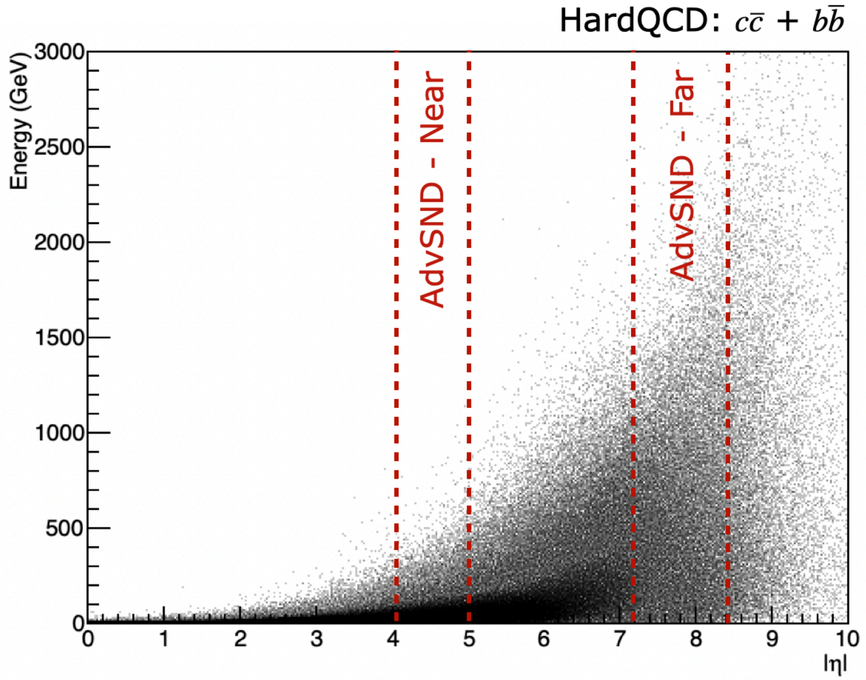


ADVANCED SND@LHC

- Upgrade of the detector in view of an extended run during Run 4:
- **Two** off-axis forward detectors:

- **AdvSND-Near:** $4<\eta<5$
  - Overlap with LHCb pseudo-rapidity coverage
  - Reduction of systematic uncertainties
  - Neutrino cross-section measurement
  - charm measurements in the region of interest for prompt ν fluxes

- **AdvSND-Far**: $7.2<\eta<8.4$
  - Acceptance similar to SND@LHC
  - Charm production measurements
  - Lepton flavour universality



ADVANCED SND@LHC: Detector layout

1) Target region:

- Vertex identification and electromagnetic calorimeter
- Thin sensitive layers interleaved with Tungsten plates
- Replace emulsions with compact electronic trackers to cope with high intensity muon rates

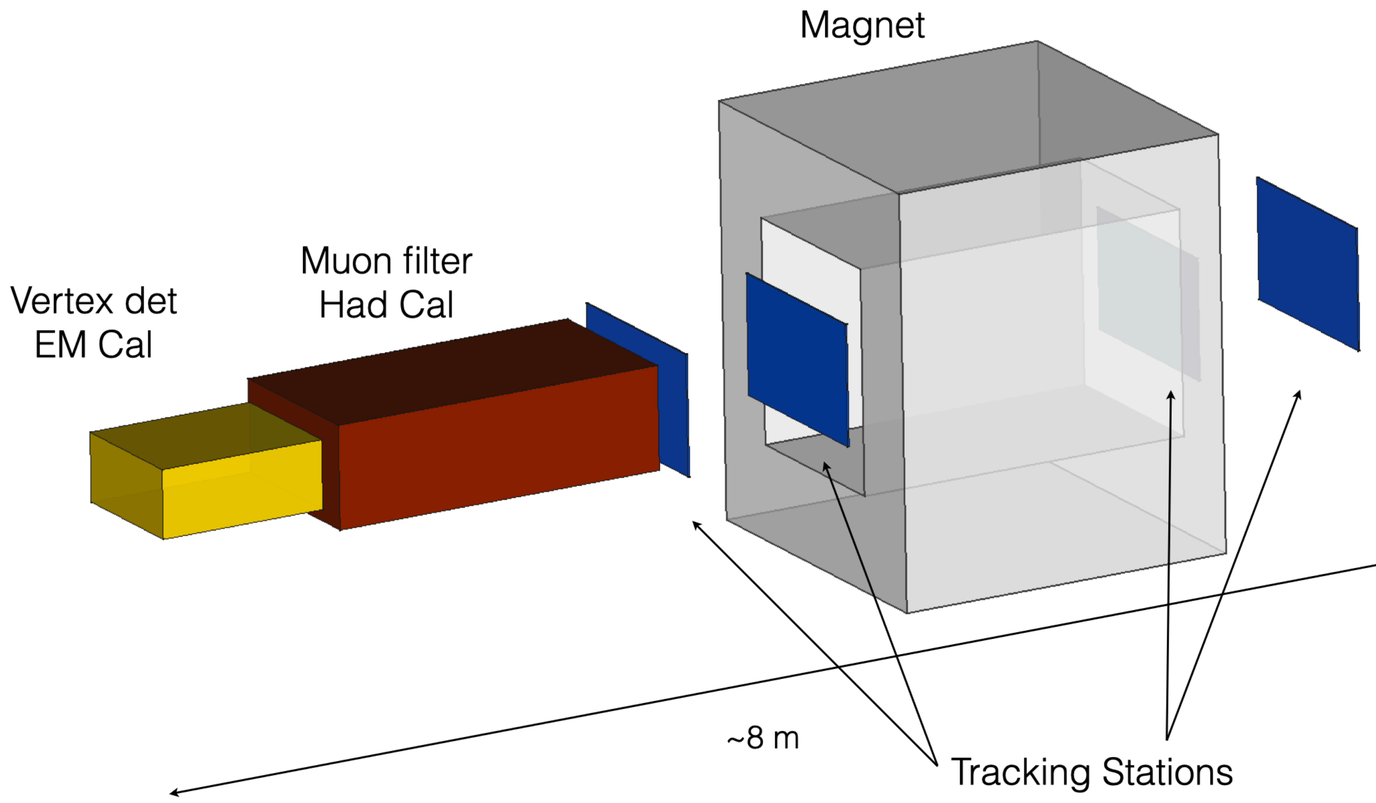
2) Muon ID system and hadronic calorimeter

- 10 interaction lengths

3) Magnetic spectrometer

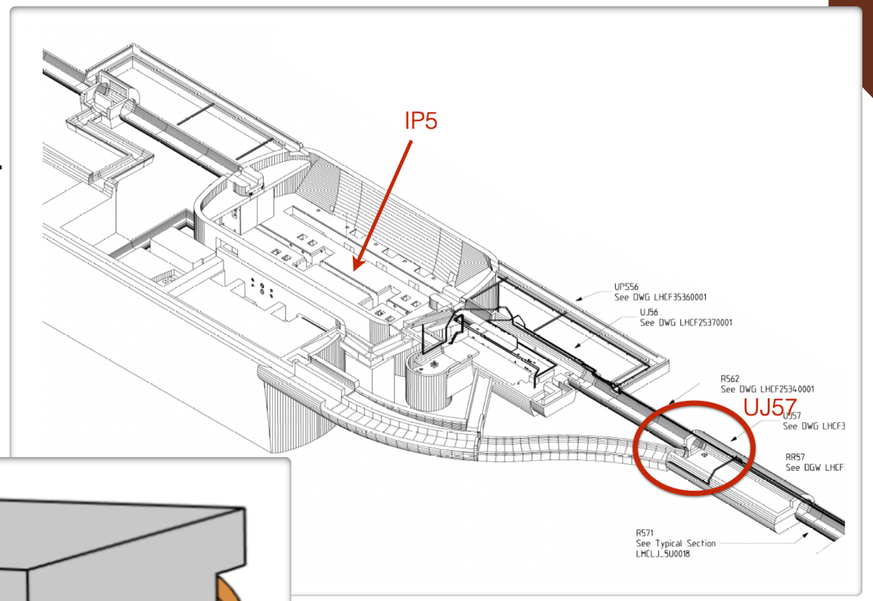
- measure charge of the muon
  (ν_μ/anti-ν_μ, ν_τ/anti-ν_τ in the $\tau \longrightarrow \mu$ channel)
- 2 tracking stations, each made of 2 planes
- Magnet: 1 Tesla over 2 meters

	AdvSND - NEAR	AdvSND - FAR
η	[4.0, 5.0]	[7.2,8.4]
mass (ton)	5	5
surface (cm^2)	120×120	100×40
distance (m)	55	630

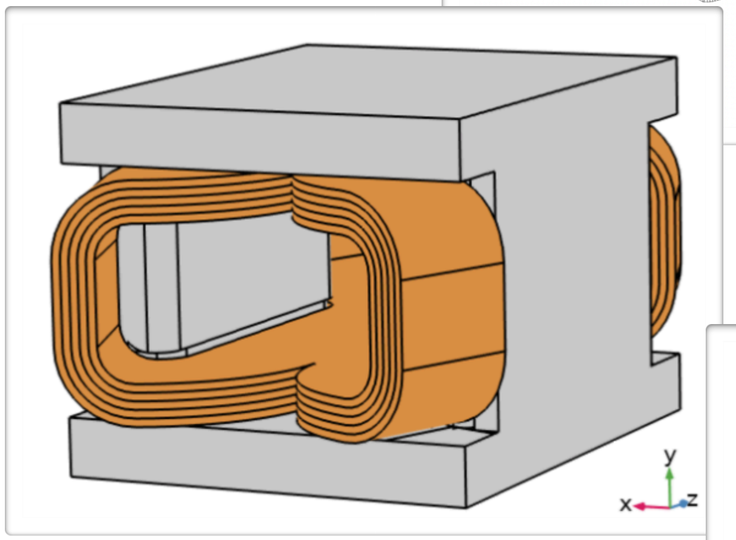


RESEARCH PROJECT

1) WORK PACKAGE I: Identification of the site for the NEAR detector
- Angular acceptance: $4<\eta<5$
- Distance from the IP<100 m
- Suitable radioactivity levels
- MC simulations
- In situ measurements



2) WORK PACKAGE II: Magnet design
- Layout optimization
- Maximize aperture, minimize civil engineering
- Study of superconductive option
- Physics performance evaluations



3) WORK PACKAGE III: Vertex detector design
- Identify the tracking technology to replace emulsions
- Optimization of layout
- Design of a prototype module