

SND@LHC Physics

LIP Jornadas

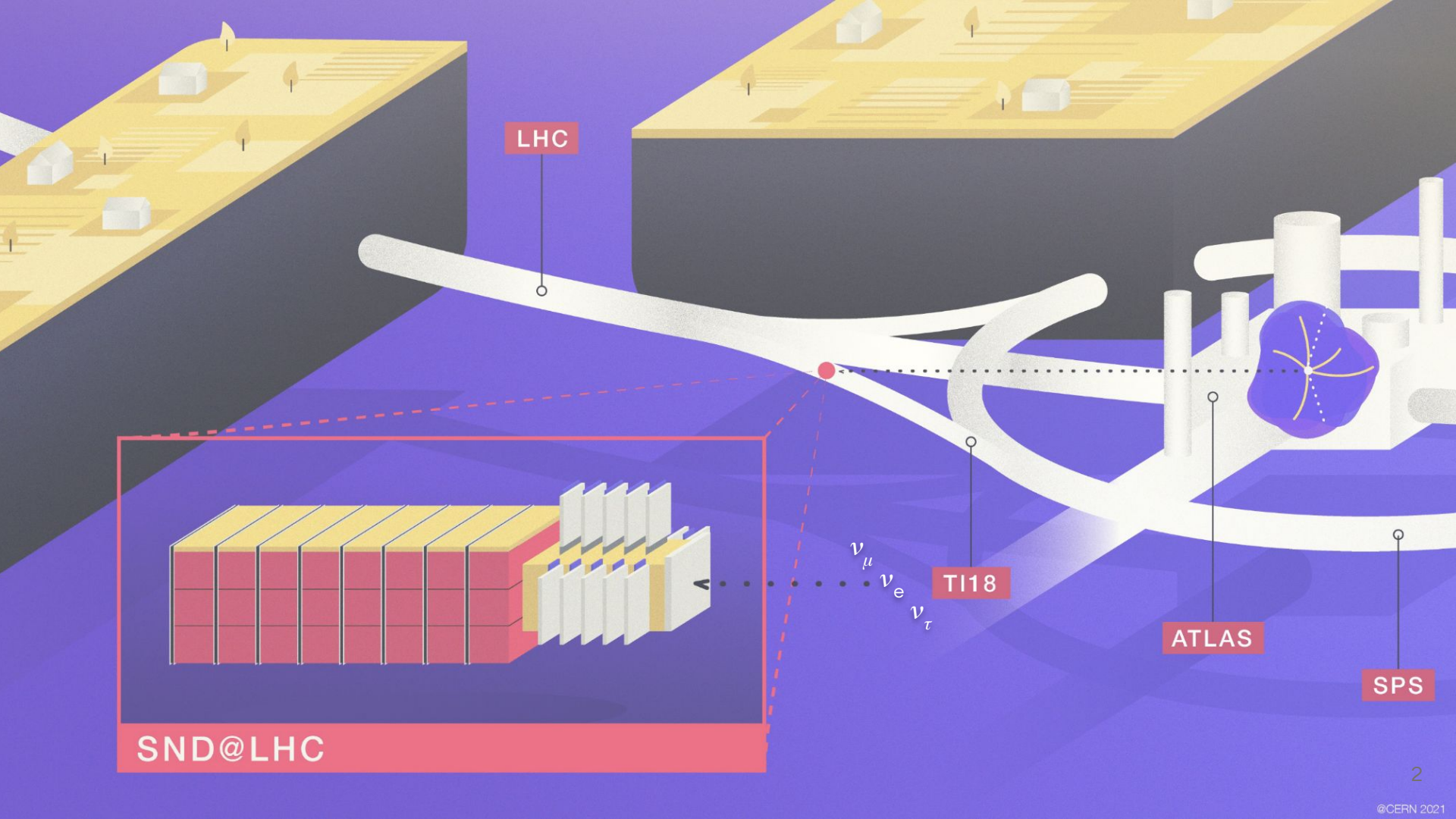
Braga

18 October 2024



LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

Cristóvão Vilela



Scattering and Neutrino Detector at the LHC

Veto system

2 (2022 – 2023) / 3 (2024 -) 1 cm thick scintillator planes.

Target, vertex detector and ECal

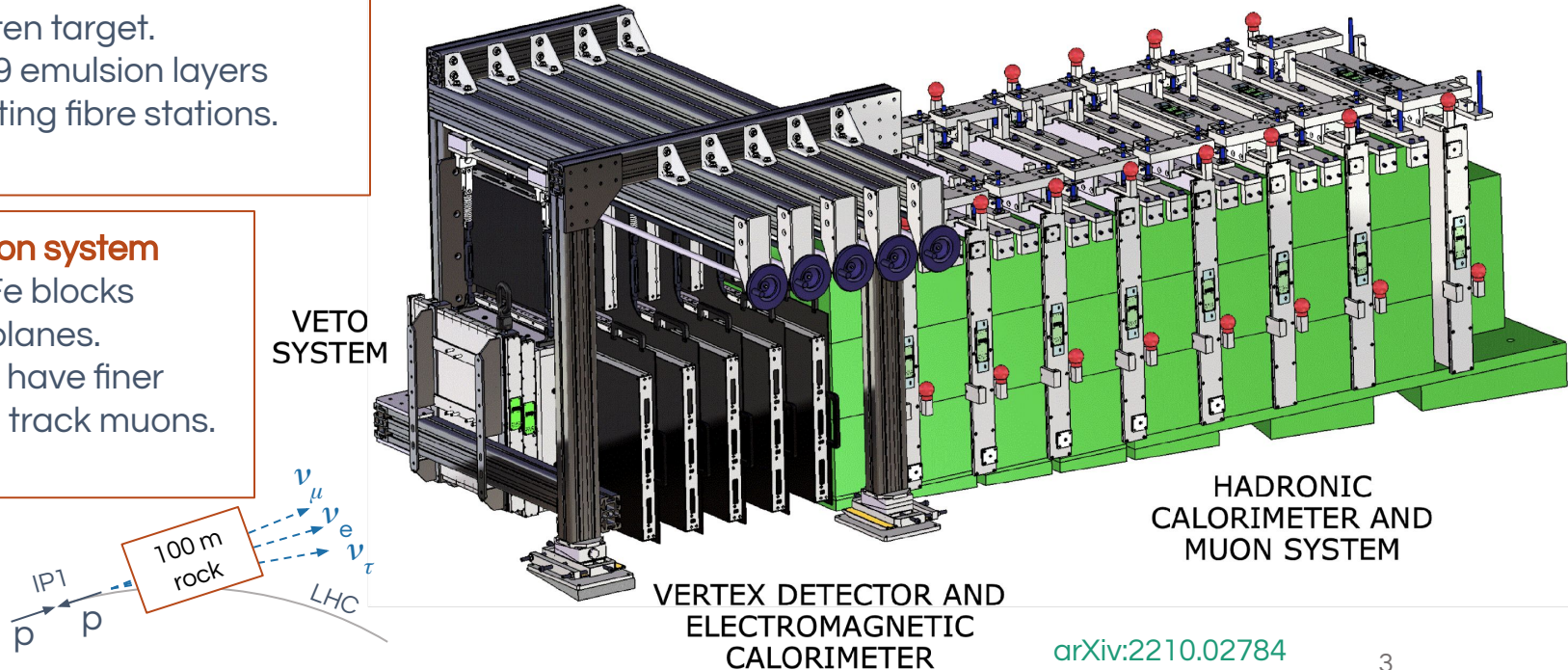
830 kg tungsten target.
Five walls x 59 emulsion layers
+ five scintillating fibre stations.
 $84 X_0$, $3 \lambda_{\text{int}}$

HCal and muon system

Eight 20 cm Fe blocks
+ scintillator planes.
Last 3 planes have finer
granularity to track muons.
 $9.5 \lambda_{\text{int}}$

Off-axis : $7.2 < \eta < 8.4$

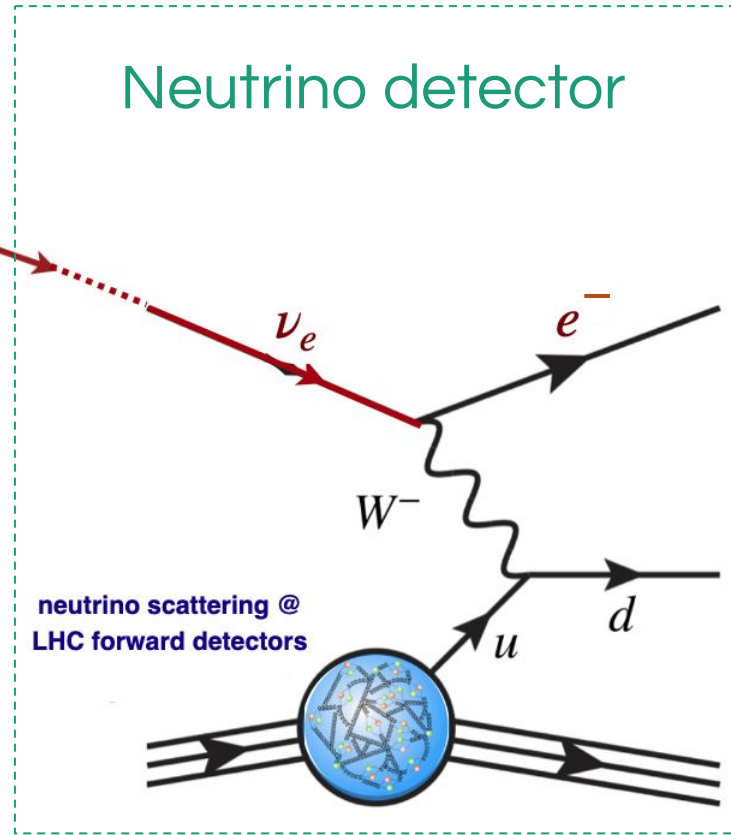
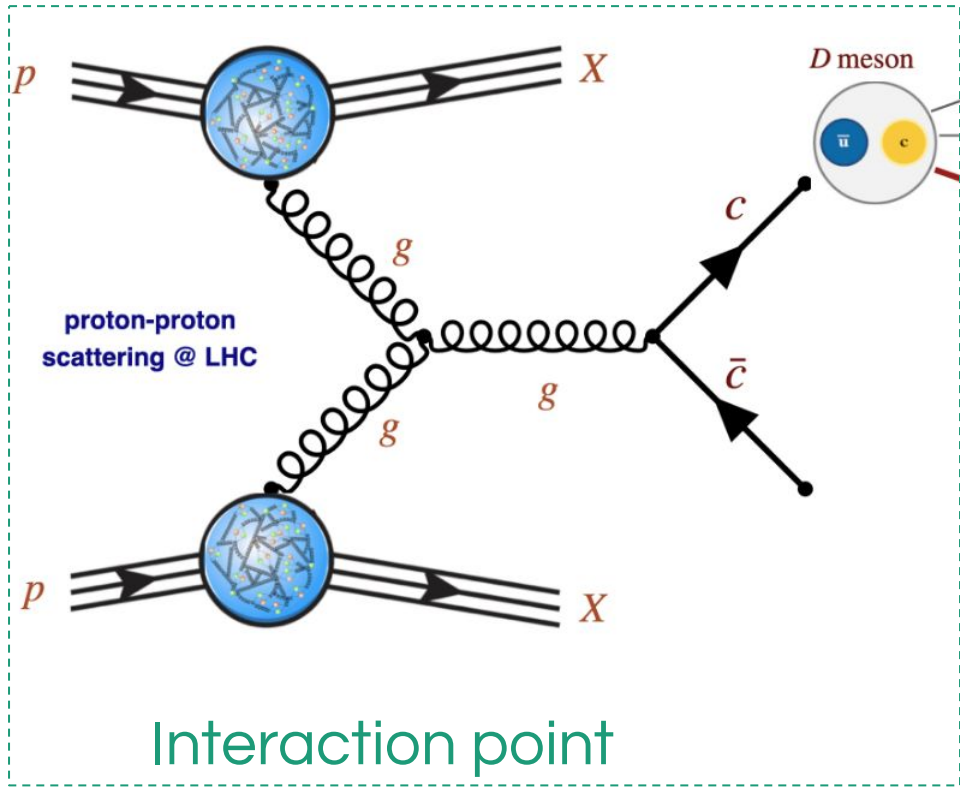
Enhances the flux with charm origin.



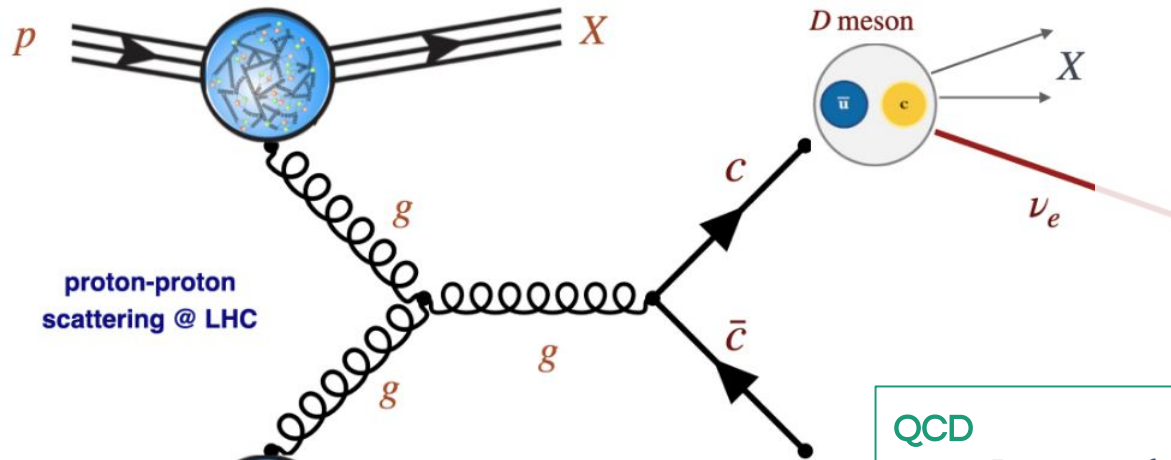


SNDITRON 5.H

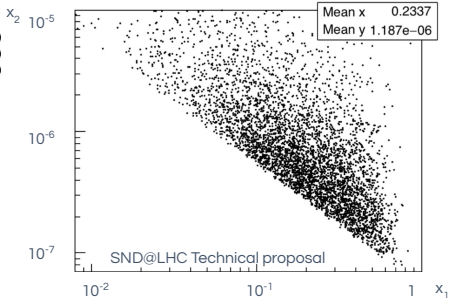
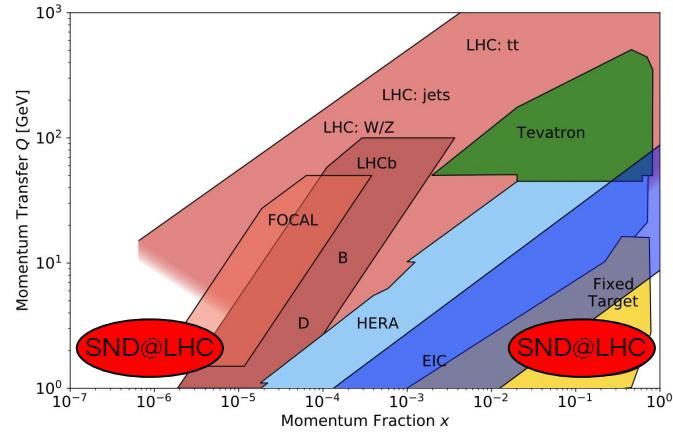
Hadron collider neutrino physics



Quantum chromodynamics



proton-proton scattering @ LHC

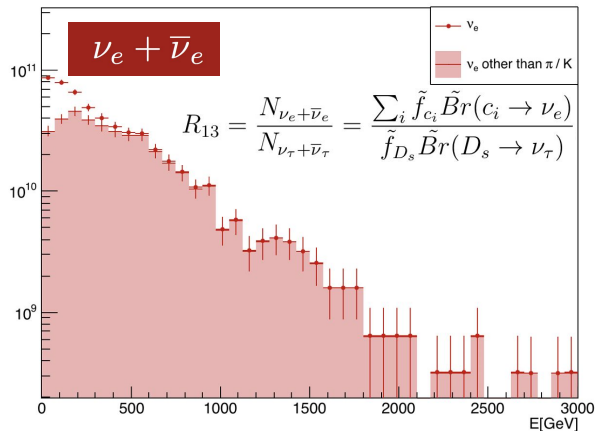


QCD

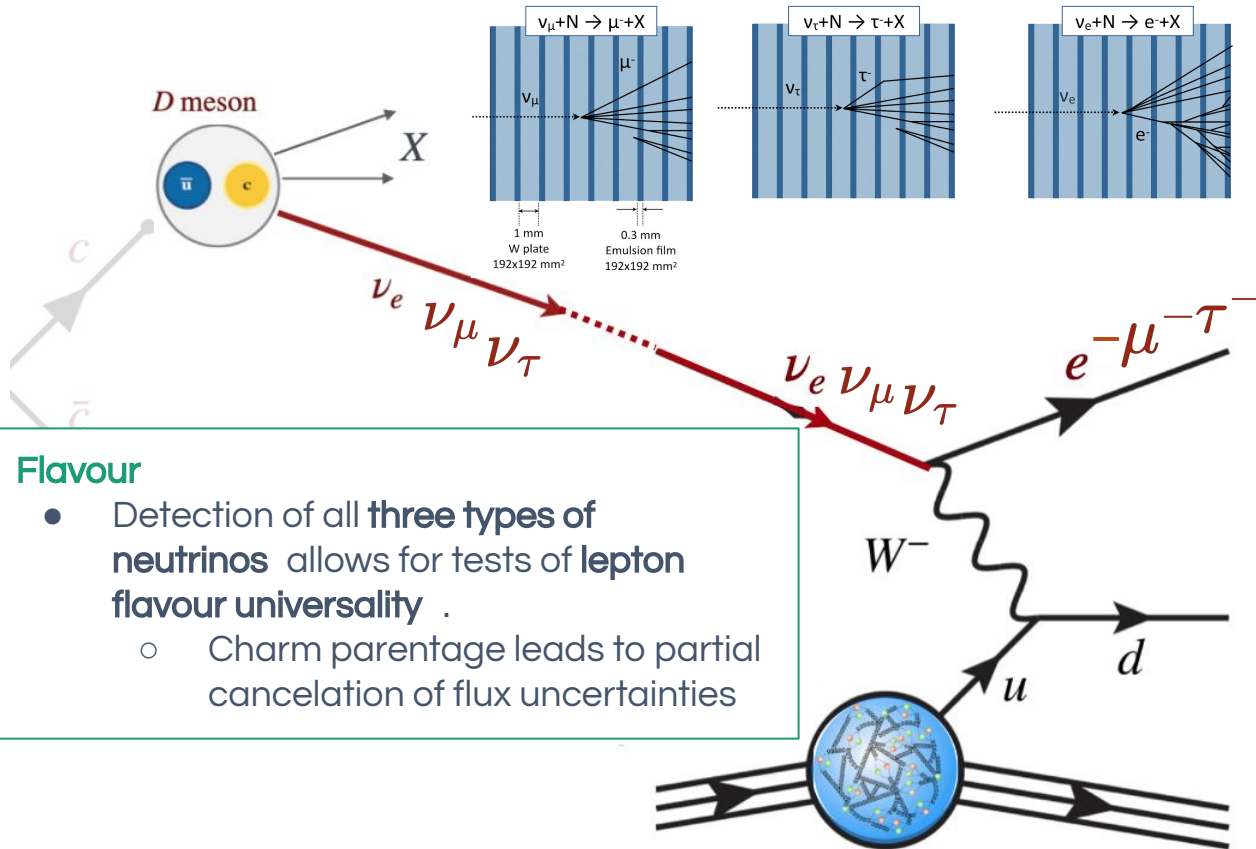
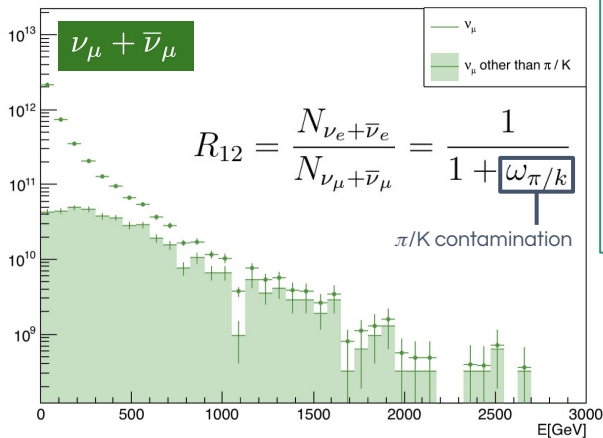
- Decays of **charm** hadrons contribute significantly to the neutrino flux in SND@LHC.
- ⇒ Measure **forward charm production** with ν_e s.
- ⇒ Constrain **gluon PDF** at very **small x** .

Lepton flavour universality

Neutrinos in SND@LHC acceptance

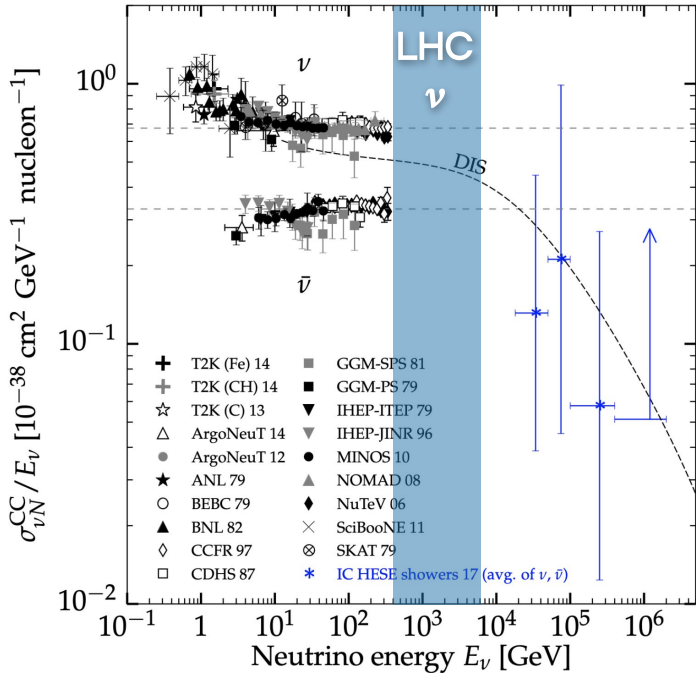


Neutrinos in SND@LHC acceptance



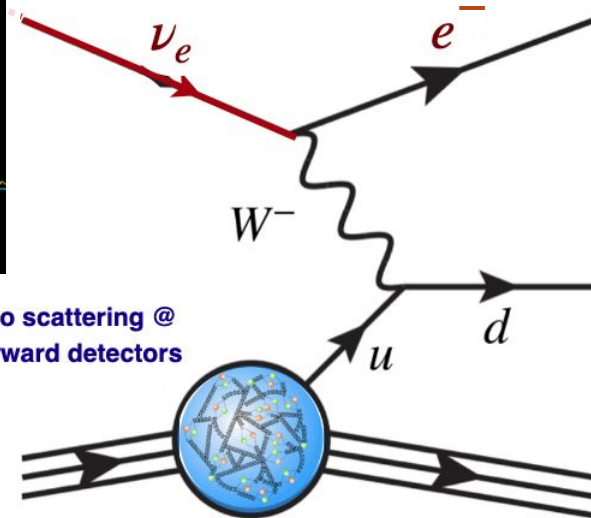
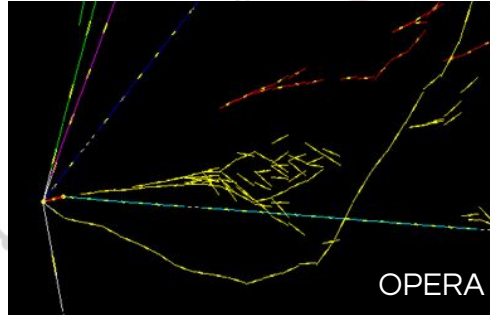
Neutrino interactions

PRL 122 041101 (2019)

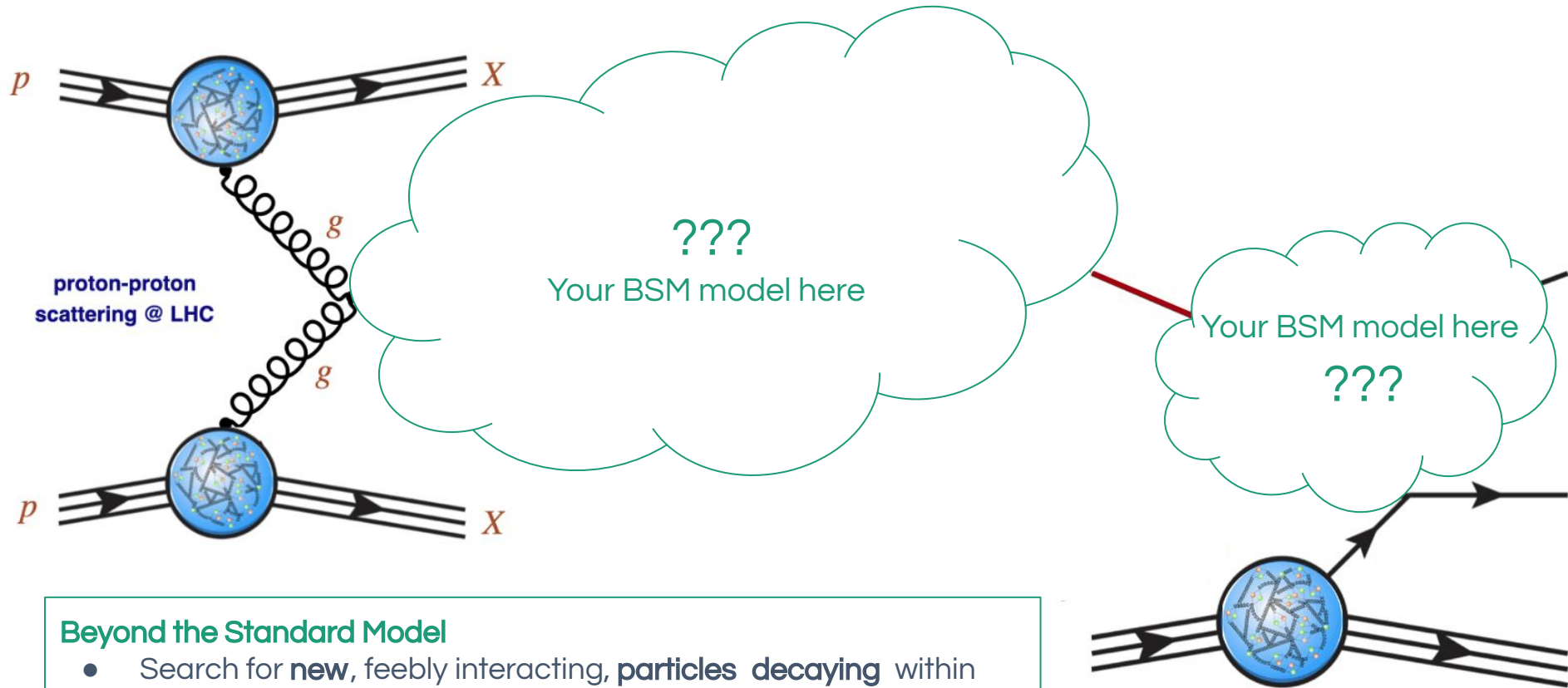


Neutrino interactions

- Measure ν interactions in unexplored \sim TeV energy range.
- Large yield of ν_{τ} will likely double existing data.
 - About 20 events observed by DONuT and OPERA.



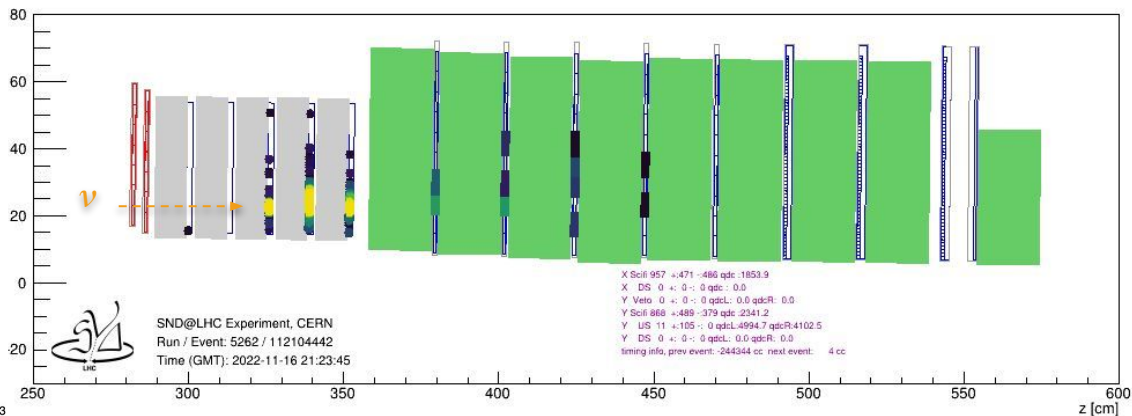
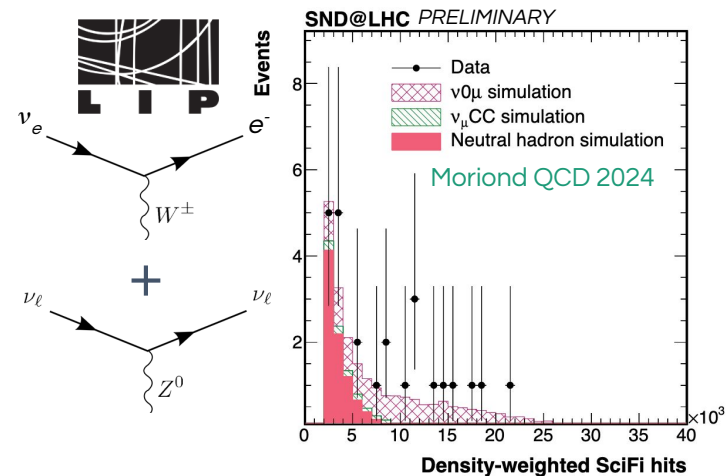
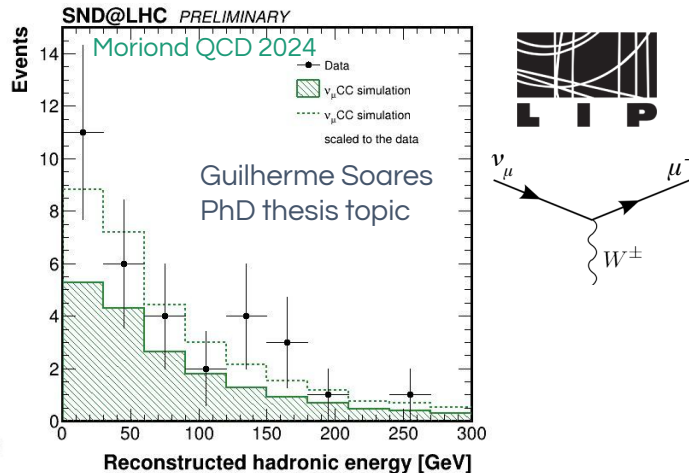
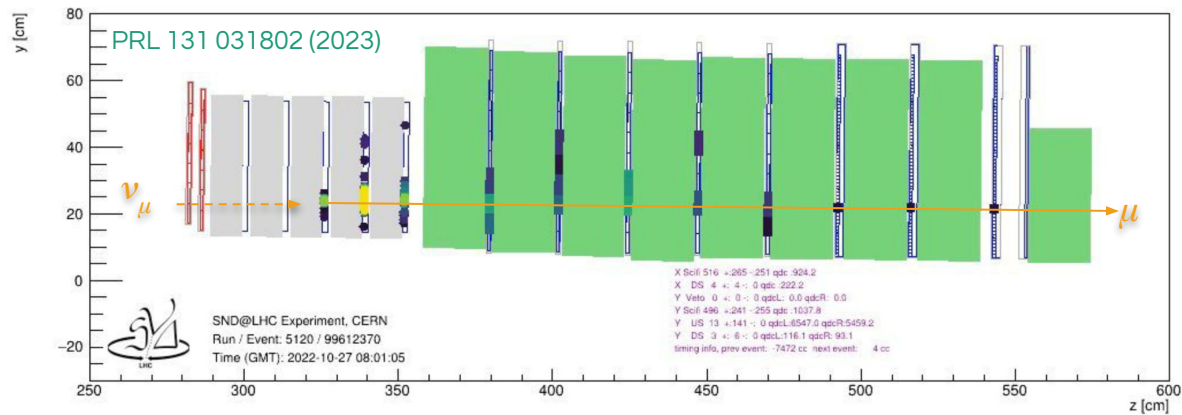
Beyond the Standard Model



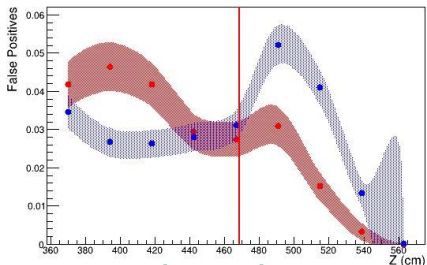
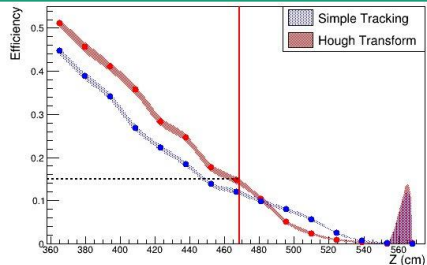
Beyond the Standard Model

- Search for **new**, feebly interacting, **particles decaying** within the detector or **scattering** off the target.

SND@LHC first neutrino measurements



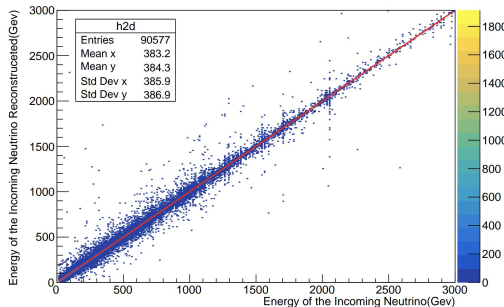
Student analyses at LIP



B. Semião [Undergraduate/Internship]

Identification of ν_{μ} interactions in the HCal

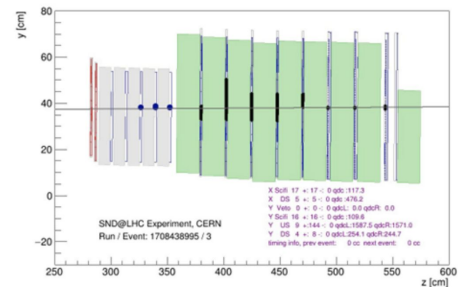
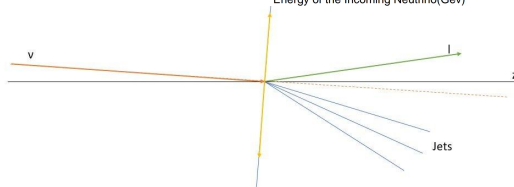
LIP-STUDENTS-23-29



P. Teigão [Undergraduate]

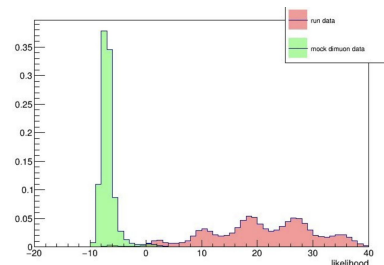
ν_{μ} energy reconstruction via transverse momentum balance

LIP-STUDENTS-23-30



H. Santos [Master]

Search for FIP decays to muon pairs



A. Mendonça and T. Barlerin [Undergraduate/Internship]

Measurement of the muon flux at the LHC with LIP's sRPC detector

$$\Phi = \frac{N}{L * A * eff}$$

$$\Phi \sim 7.66 * 10^4 / cm^2 / fb^{-1}$$

