



Co-funded by the
European Union

The ESSnuSB Experiment

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The ESSnuSB Experiment



European Spallation Source Neutrino Super-Beam

- Future long-baseline neutrino experiment in Europe
- 5 MW proton beam
- 2.5 GeV proton energy
- 538 kt water Cerenkov detector



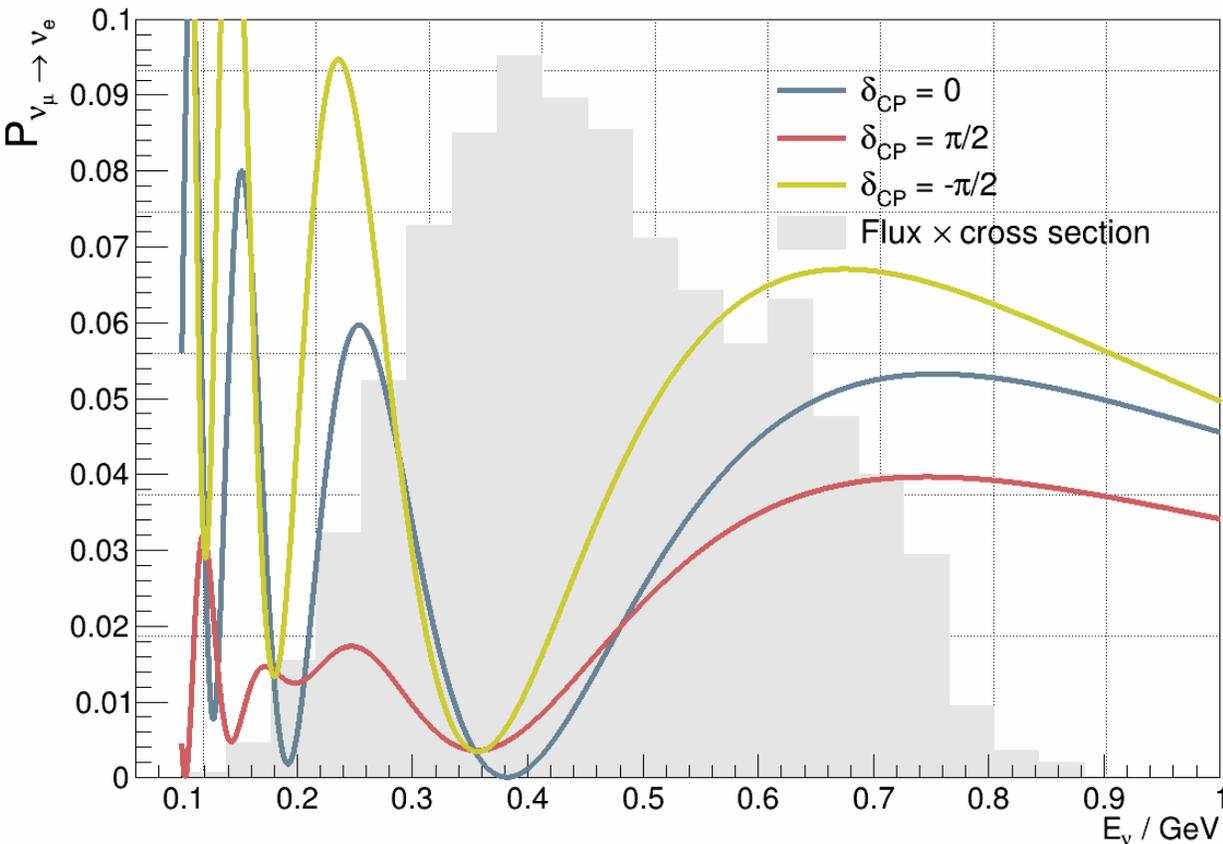
Collaboration annual meeting – Hamburg 2024

13 countries
23 Institutes

Horizon-2020 (2018 - 2022), 3 M€
Horizon-Europe (2023 - 2026), 3 M€



Probability and Flux

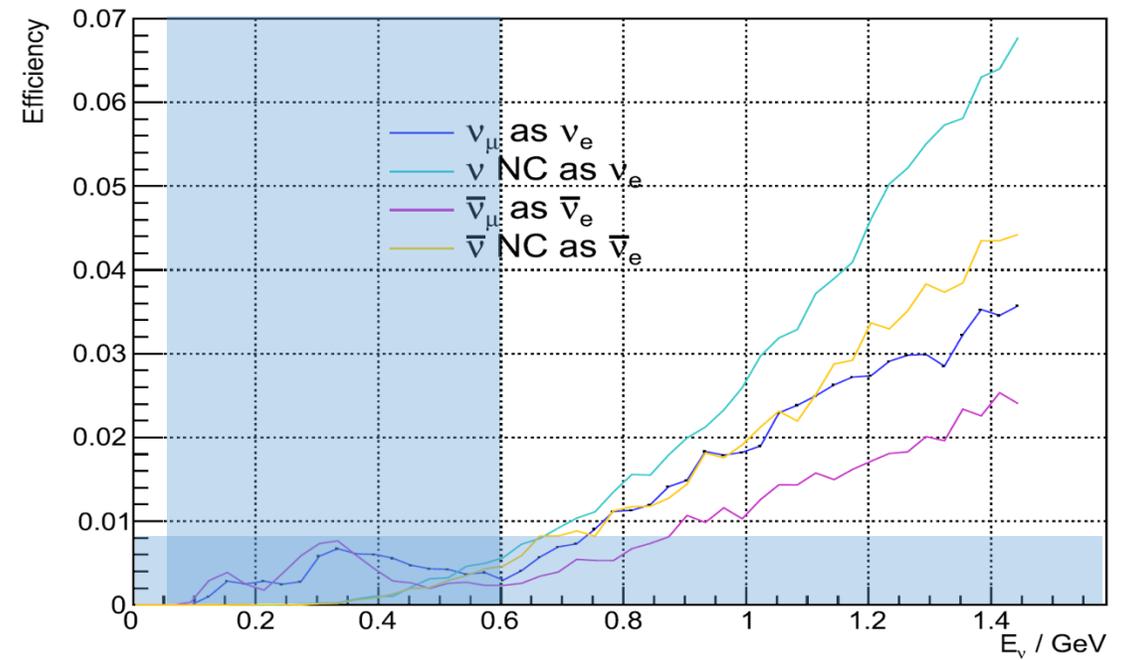
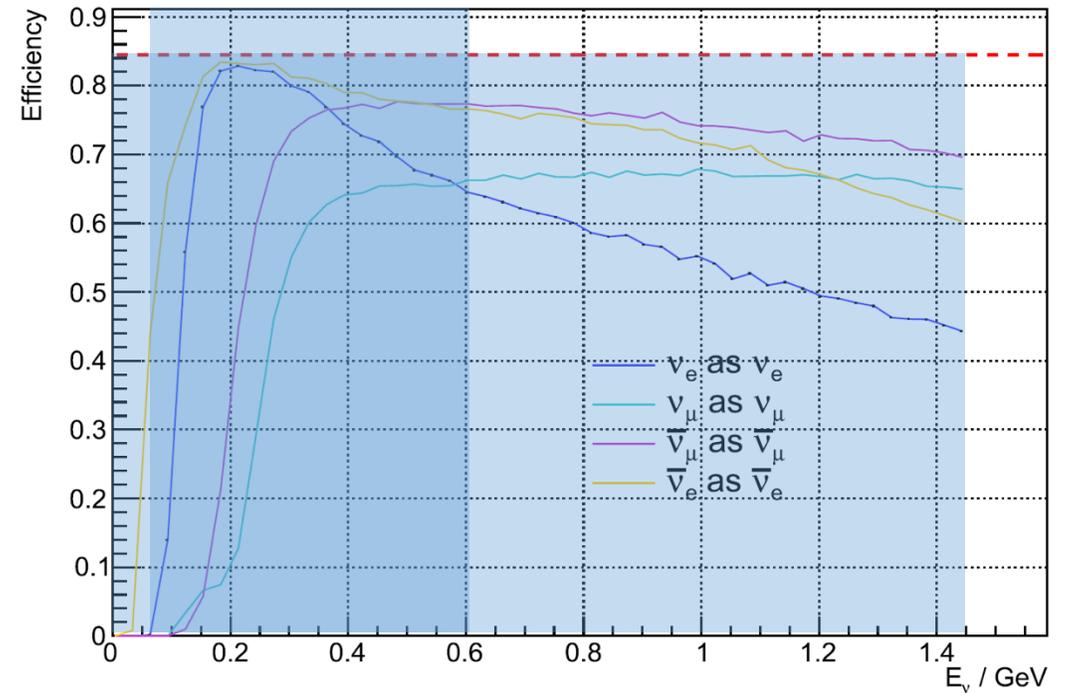


- **Main goal:** Determination of leptonic CP phase
- Unlike other experiments (T2HK and DUNE), we probe Second oscillation maximum
- CP sensitivity is 3 times higher at the second maximum

Detector

Detector Performance

- Detector efficiency for correctly identifying neutrinos $> 85\%$.
- Flavour misidentification probability $< 1\%$.

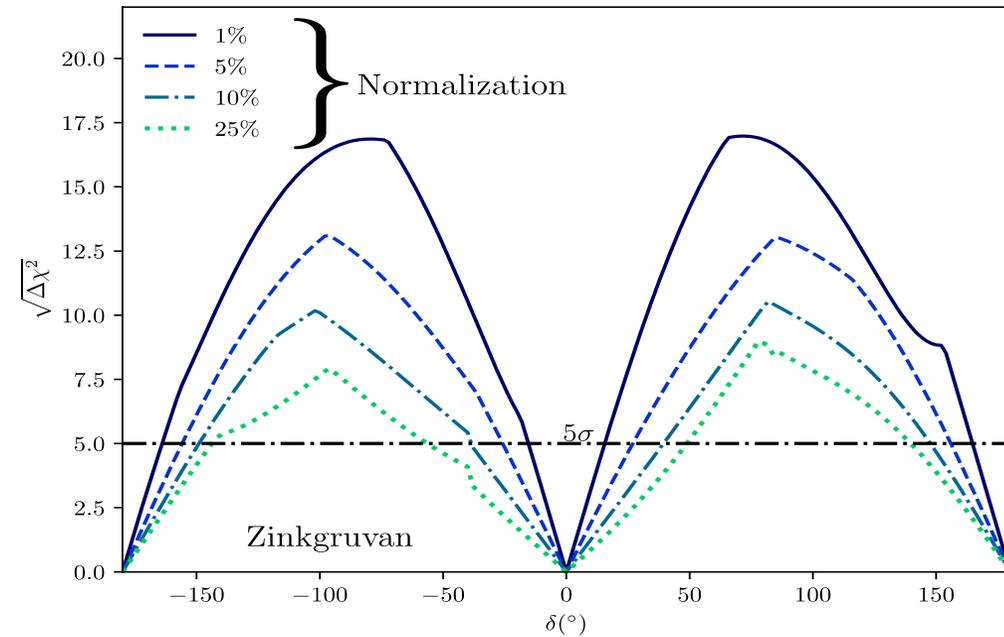
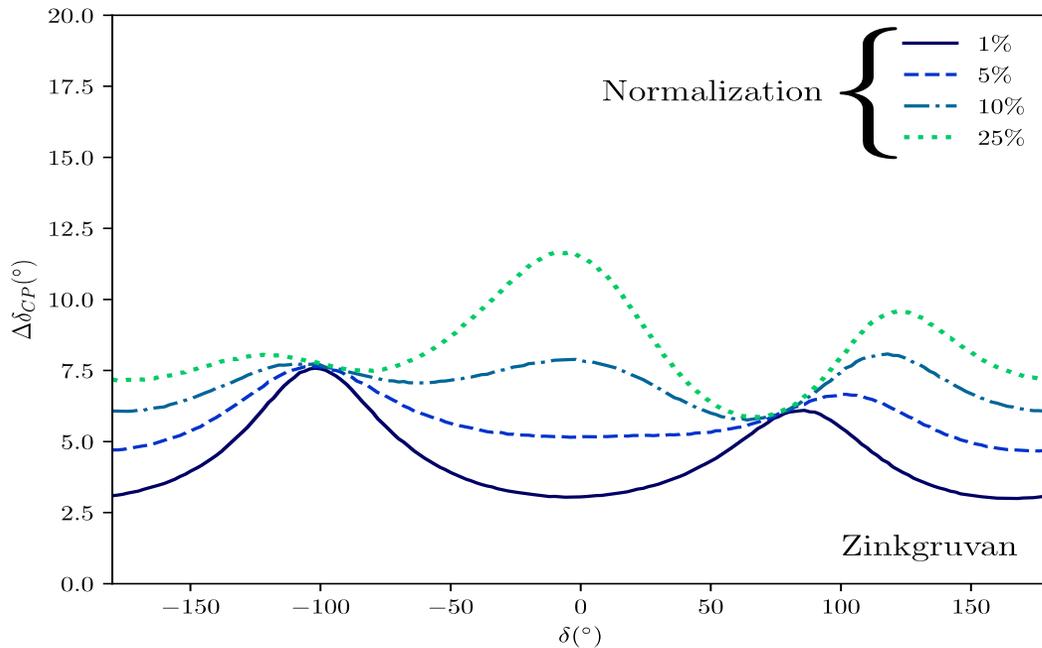


Sensitivity to δ_{CP}

$$P(\bar{\nu}_\mu \rightarrow \bar{\nu}_e) = s_{23}^2 \sin^2 2\theta_{13} \left(\frac{\Delta_{31}}{\tilde{B}_\mp} \right)^2 \sin^2 \left(\frac{\tilde{B}_\mp L}{2} \right) + c_{23}^2 \sin^2 2\theta_{12} \left(\frac{\Delta_{21}}{A} \right)^2 \sin^2 \left(\frac{AL}{2} \right) + \tilde{J} \frac{\Delta_{21}}{A} \frac{\Delta_{31}}{\tilde{B}_\mp} \sin \left(\frac{AL}{2} \right) \sin \left(\frac{\tilde{B}_\mp L}{2} \right) \cos \left(\frac{\Delta_{31}L}{2} \pm \delta \right),$$

12 sigma sensitivity to discover CP violation for maximal values

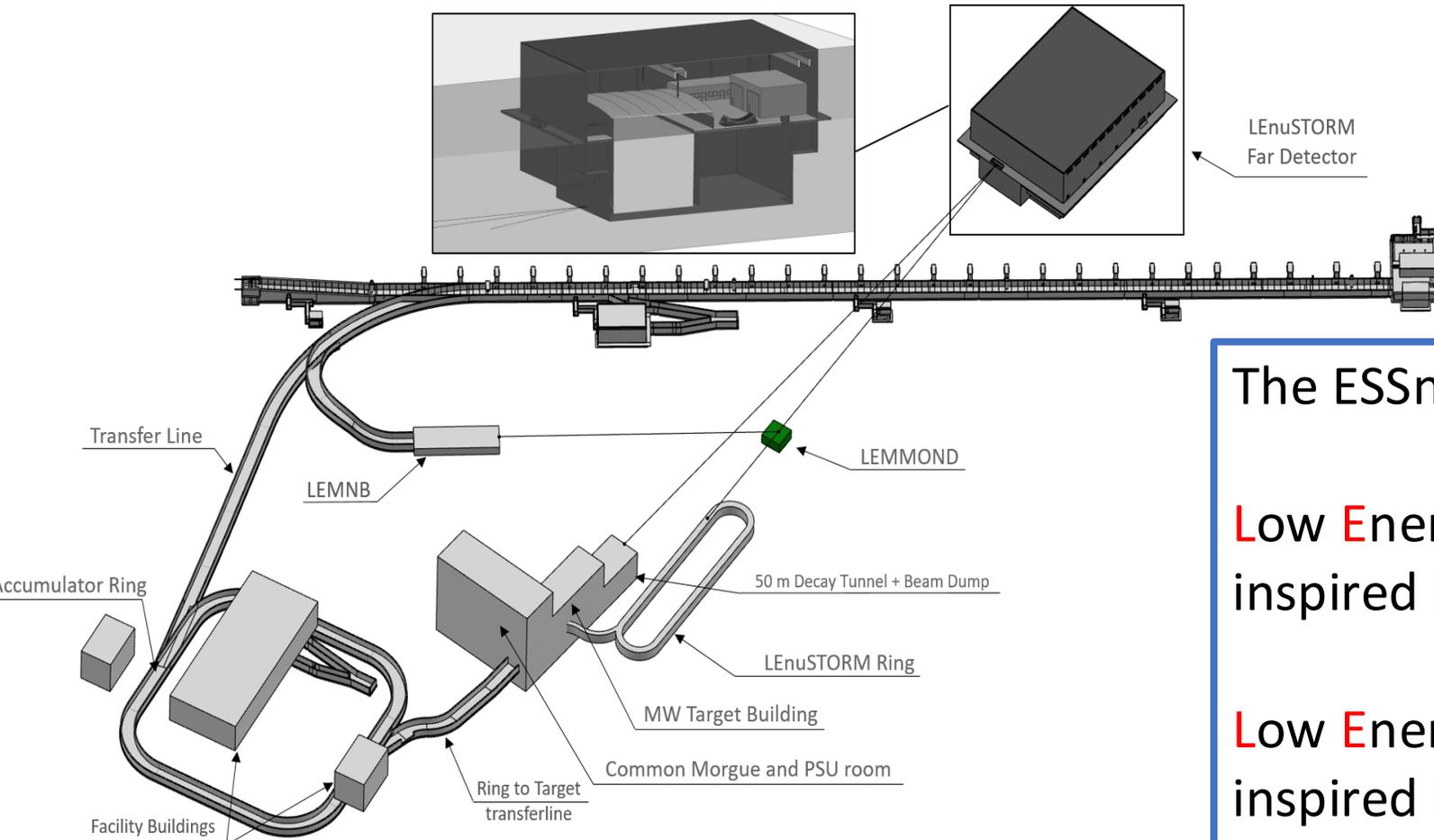
Will measure δ_{CP} with less than 8° precision for all values



Other physics programs

- **New physics beyond 3 flavour**: sterile neutrino, neutrino decay, quantum decoherence, long-range force etc
- **Atmospheric neutrino**: Larger detector volume and higher flux due to proximity of north pole
- **Solar neutrino**: Larger detector volume and less atmospheric muon induced background due to higher overburden
- **Supernova neutrino**: Larger detector volume
- **Proton decay**: Larger detector volume

ESSnuSB+ setup: Cross-section measurement



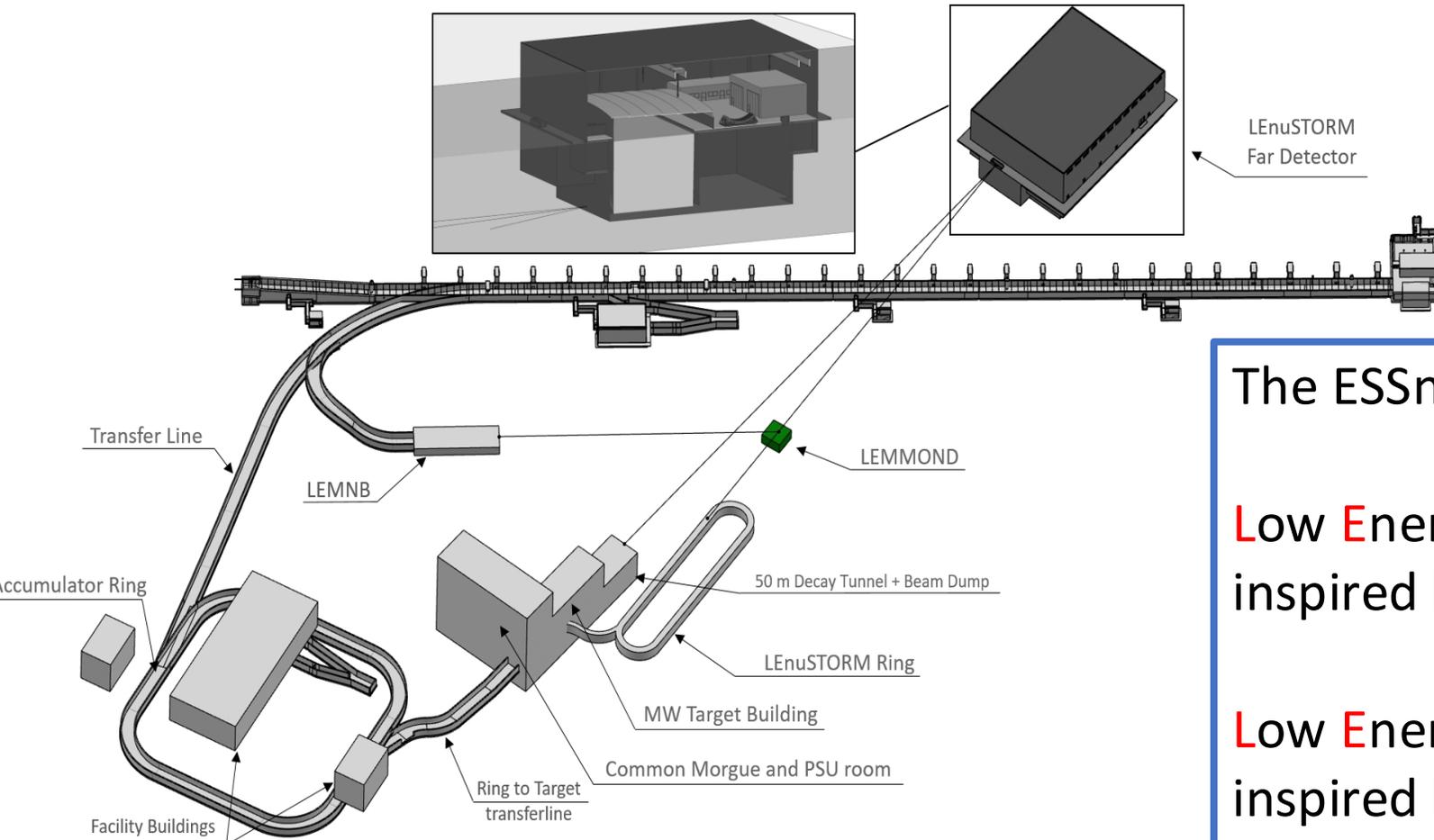
The ESSnuSB+ setup will have:

Low Energy Monitored Beam (LEMNB) inspired by the ENUBET experiment and

Low Energy nuSTORM (LEnuSTORM) inspired by the original nuSTORM idea

For cross section measurement at the near detector **LEMMOND**

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Thank You