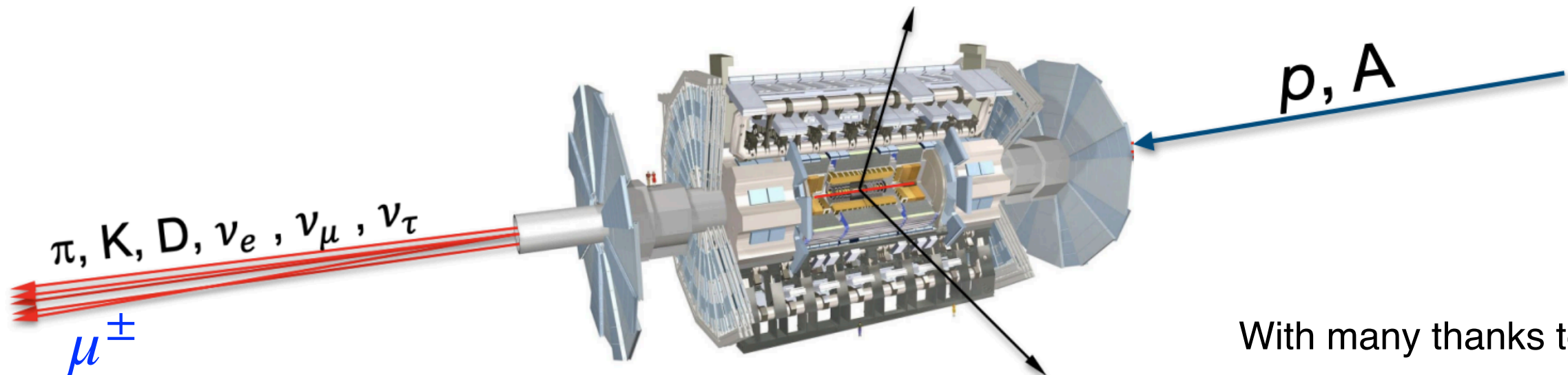


Kick-off meeting of the Nikhef FASER group

Lydia Brenner & Juan Rojo



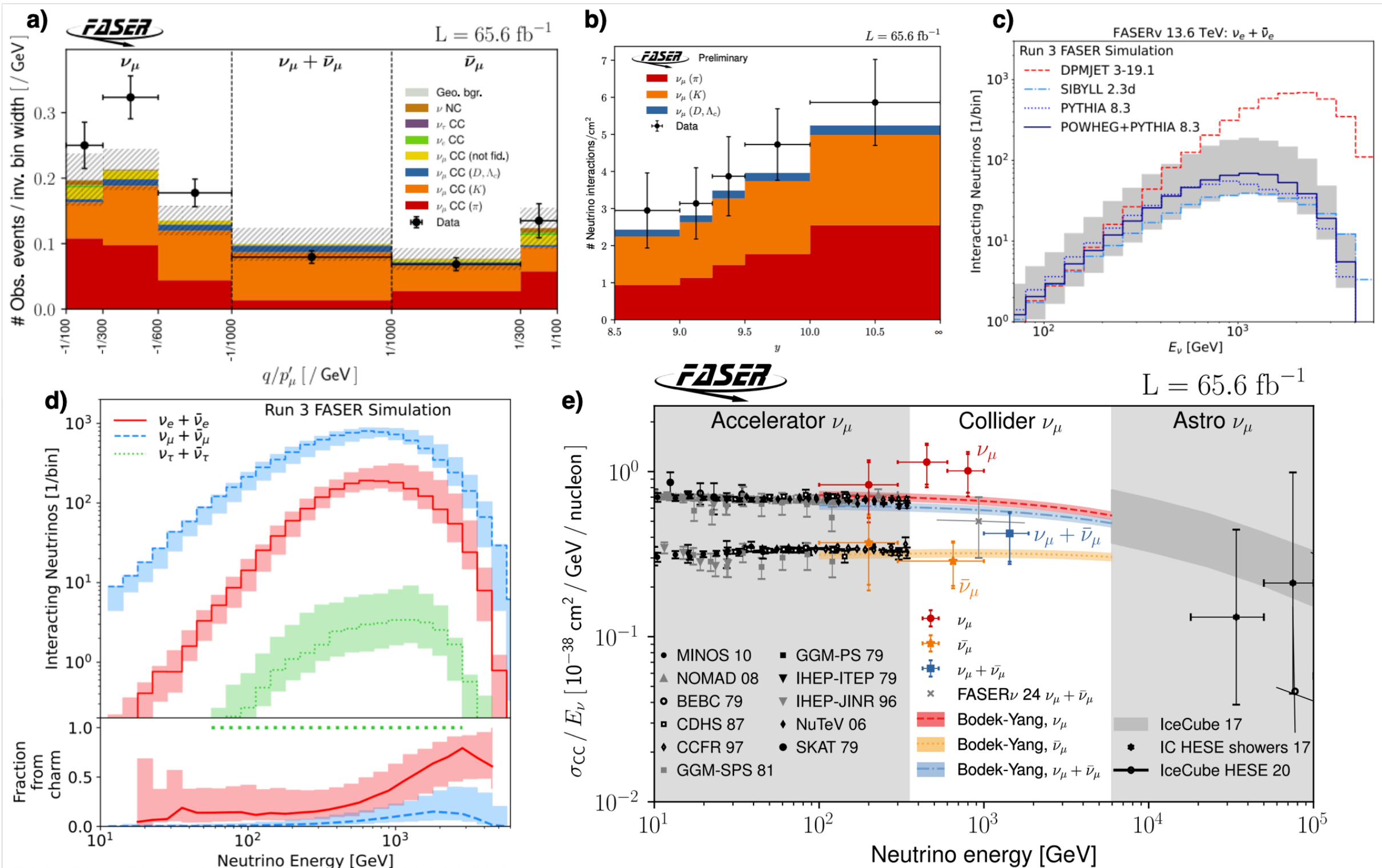
With many thanks to Felix
for joining our discussion!

9th October 2025

Overview of FASER neutrino analyses

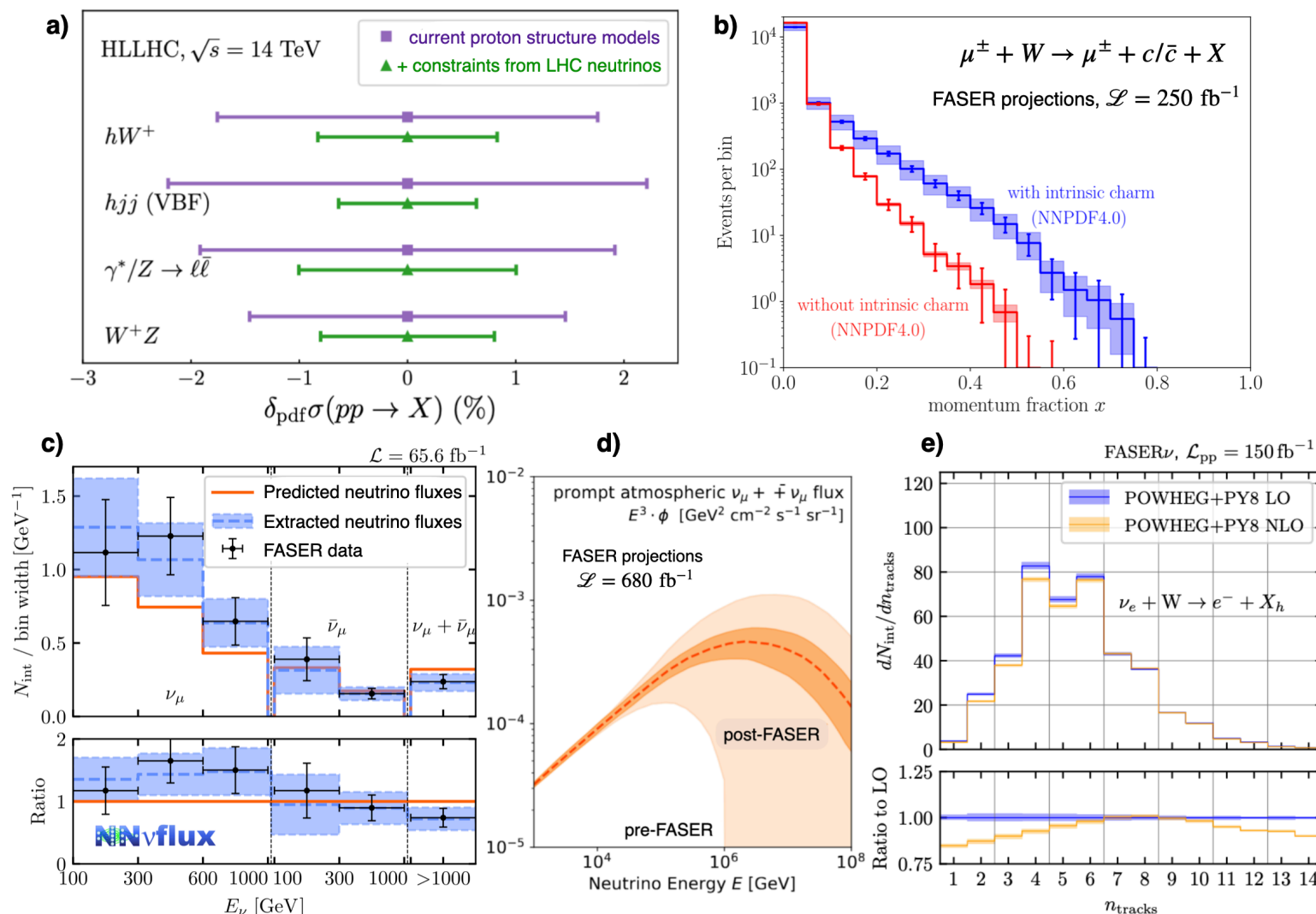
🔍 **Flux measurements** differential in energy and rapidity from electronic detector

🔍 **Cross-section measurements** differential in energy from electronic and emulsion detectors



State of the art

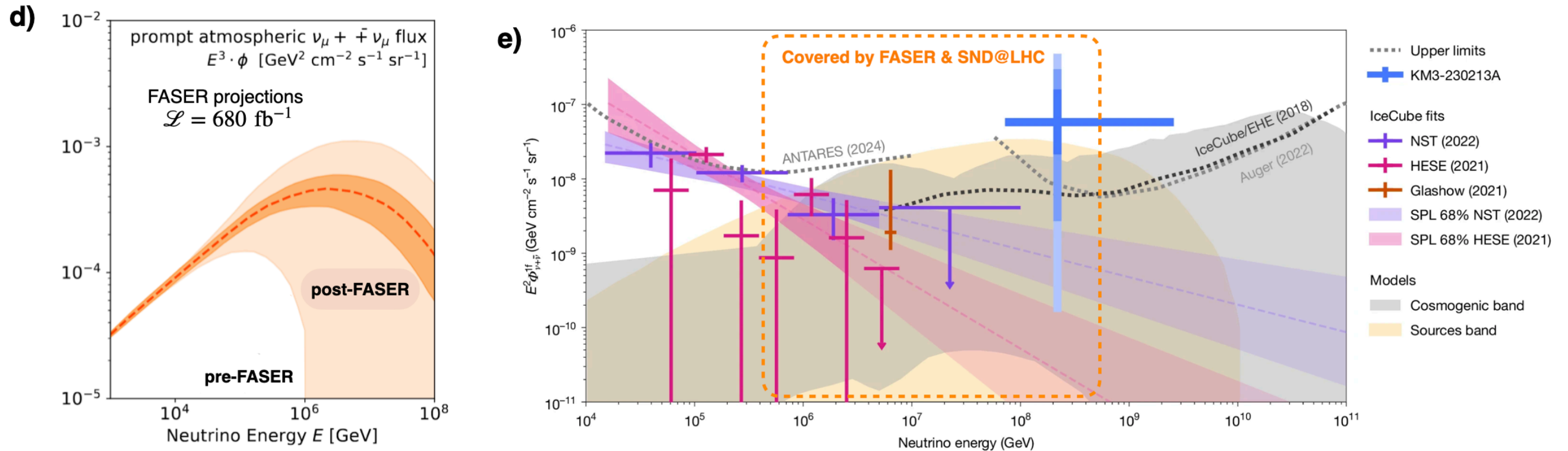
- Several results from the group and other colleagues provide the foundations for the next steps
- Demonstrated impact of **muon and neutrino DIS** for proton structure studies - but now the measurements and the corresponding interpretation need to be carried out
- Demonstrated potential of **flux measurements** to constrain small-x QCD, proton structure, and MC generators: now apply to high-stats measurements with the electronic and emulsion detectors
- Developed a NLO+LL **Monte Carlo generator** tailored to muon and neutrino DIS at FASER



Challenge now is moving from
projections to actual
interpretations of FASER data
based on global analyses

The Neutrino Telescope connection

It is also high time to study implications of FASER for UHE neutrino telescope measurements

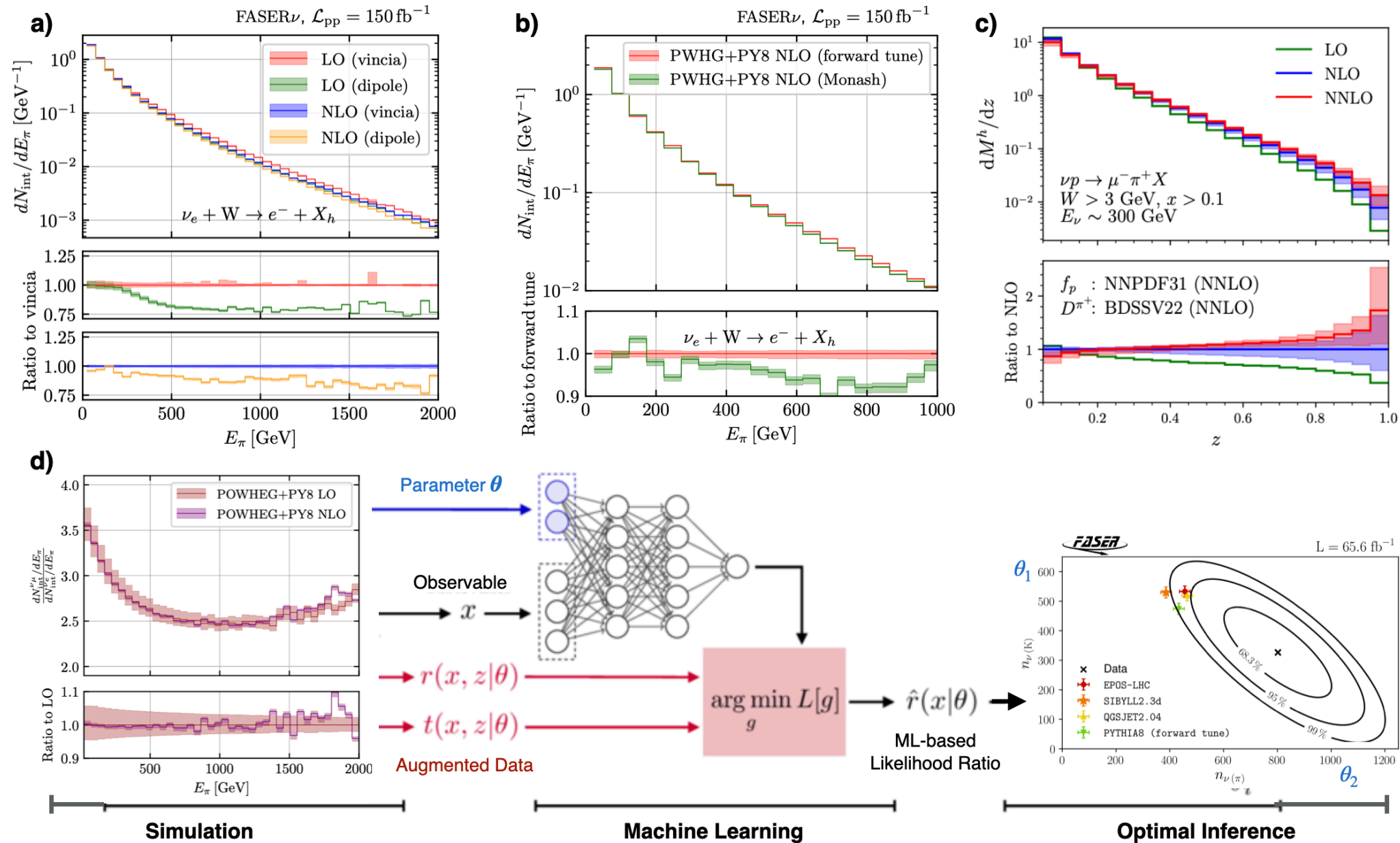


Study implications of POWHEG simulations for **UHE neutrino DIS up to 100 PeV**, compare with simulation tools adopted by KM3NET and IceCube

Revisit calculation of the **prompt neutrino fluxes** at the light of FASER, study implications for neutrino telescopes

Need close collaboration with experimental colleagues in the interpretation of the FASER data

Progress in DIS modelling



- Integrate POWHEG in FASER pipeline, systematic benchmark with GENIE and other generators
- Benchmark with **NNLO analytical calculations of SIDIS**, study FASER potential to constrain light and heavy **fragmentation functions**
- Design **detector-level multivariate observables** at FASER with NSBI to achieve optimal sensitivity

List of possible projects (random order)

- 📌 Contribute to muon DIS measurement (simulations, theory interpretation, guidance)
- 📌 Ditto for neutrino DIS (goal: first measurement of neutrino structure functions at TeV energies)
- 📌 POWHEG simulations of final states with 100 PeV neutrinos
- 📌 Revisiting prompt neutrino flux calculations at the light of what FASER can provide
- 📌 ML-based observables at FASER for optimal sensitivity
- 📌 Benchmark POWHEG with GENIE and other MC DIS generators
- 📌 Compare POWHEG with NNLO SIDIS, quantify potential to constrain fragmentation functions
- 📌 Include muon and neutrino DIS data into NNPDF fits, study implications for HL-LHC
- 📌 Study in more detail the potential of muon DIS for PDF constraints, including to break down possible degeneracies with new physics signals
- 📌 Improve our modelling of systematic uncertainties in our projections
- 📌 Better generators of forward charm production (with charm in initial state, eventually move to NNLO)
- 📌 Consider the constraints also from SND@LHC
- 📌 Extend our NNnuFlux determination to the case of double differential ($E, \text{rapidity}$) measurements

To discuss today

- 👤 List possible projects, try to prioritise, distribute person power
- 👤 Align our theory-based activities with the priorities of FASER and its timeline to release new data
- 👤 Discuss what will be we doing as stand-alone theory activities and what will we be doing as members of the FASER collaboration
- 👤 Schedule for next meetings

