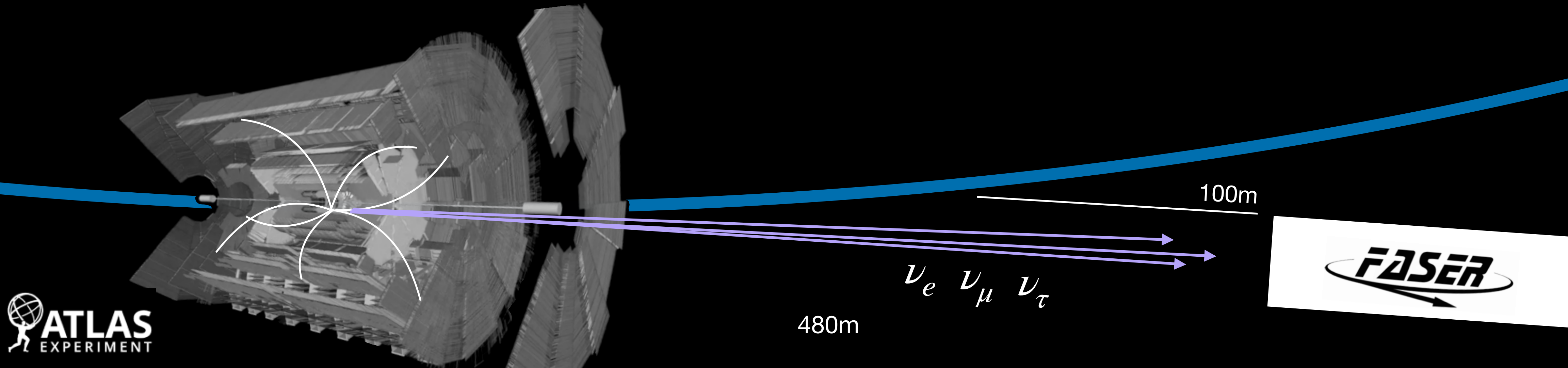


Large Hadron Collider

Neutrino production at LHC

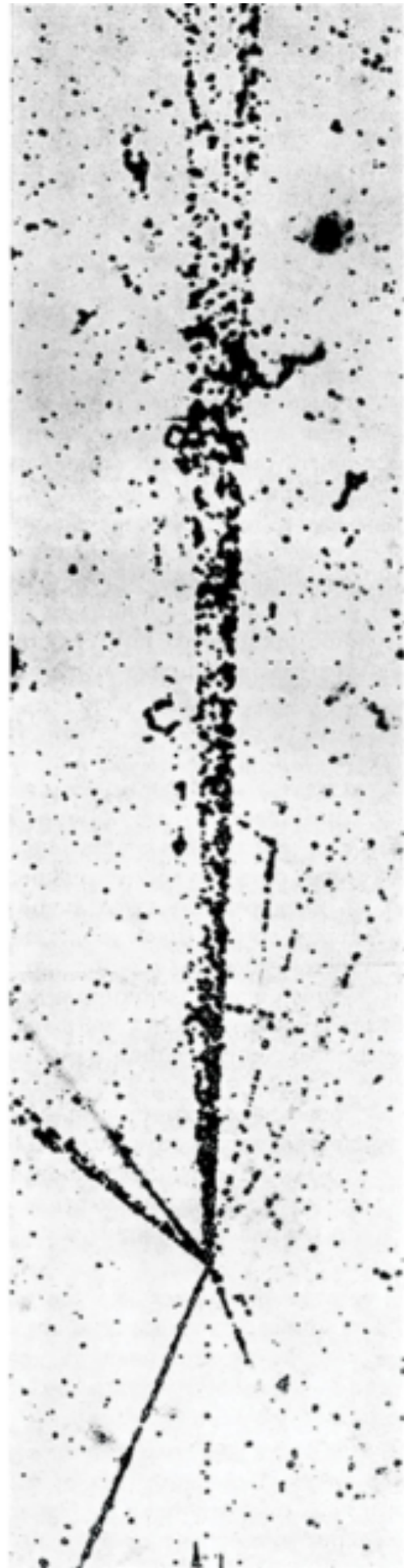
- Unstable hadrons travel forward and **decay** almost instantly, producing **collimated beam** of neutrinos → **FASER** detector

- FASER detector 480 meters downstream** from the collision point, perfectly aligned with the beam (T112 service tunnel).
- Shielding:** 100 meters of rock and concrete filter out all particles except neutrinos and very high-energy muon.
- Expecting $\sim 1700 \nu_e$, $\sim 8500 \nu_\mu$ and $\sim 30 \nu_\tau$ charged current (CC) neutrino interactions in FASER ν in LHC Run-3 (250/fb)



ForwArd Search ExpeRiment

From Run 3 to the High-Luminosity Challenge



- **The FASER detector in Run 3:**
 - commissioned during 2021 and started physics data taking in 2022
 - *core technology:* emulsion detectors → unmatched precision for tracking particle interactions. ($x \sim 300\text{nm}$, $\theta \sim 0.07 \text{ mrad}$)
- **The Coming Data Flood (LHC Run 4):**
 - High-Luminosity LHC, collision rate increases by a factor of 5.
 - Massive surge in neutrino events: expected $\sim 30,000$ neutrino interactions.
- **The Technology Limit: Why We Must Upgrade:**
 - The emulsion detector saturates ($30\text{-}50 \text{ fb}^{-1}$) and would need constant replacement: Not feasible.