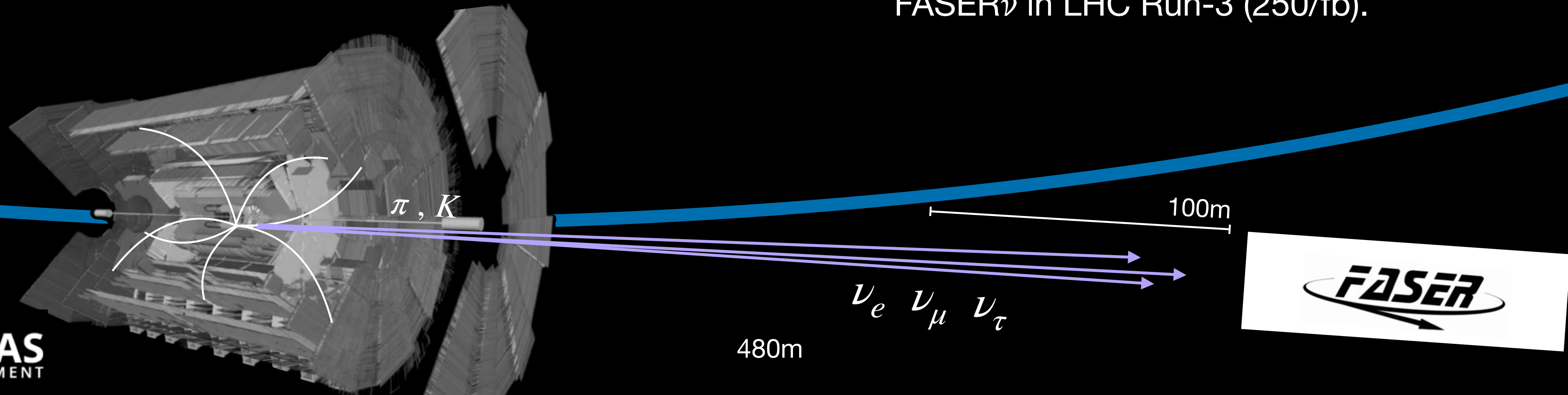


Large Hadron Collider

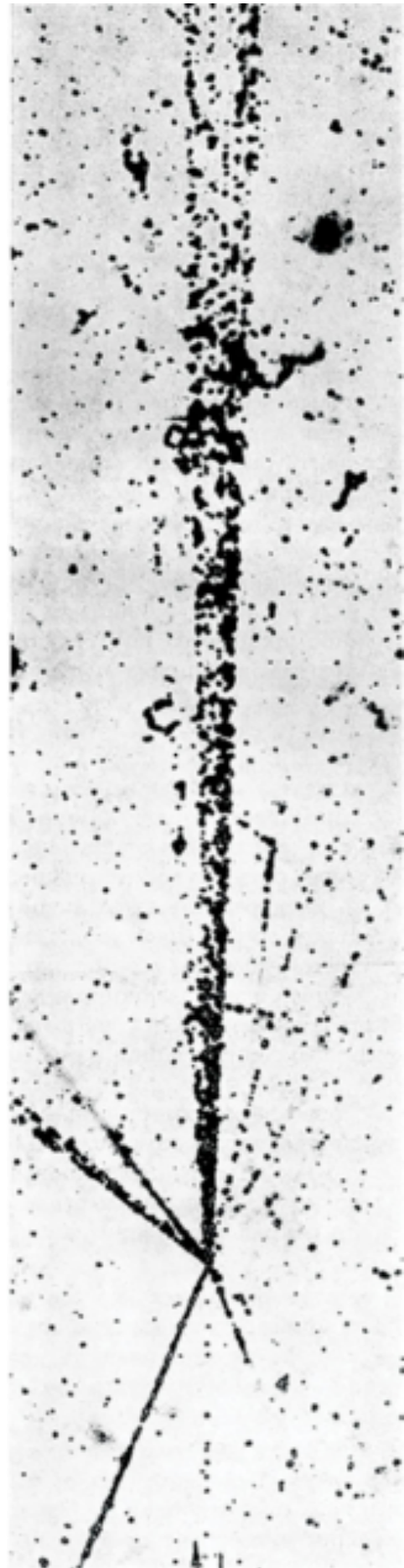
Neutrino production at LHC

- 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 (TI12 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, luminosity increase by a factor of 5.
 - ▶ *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.