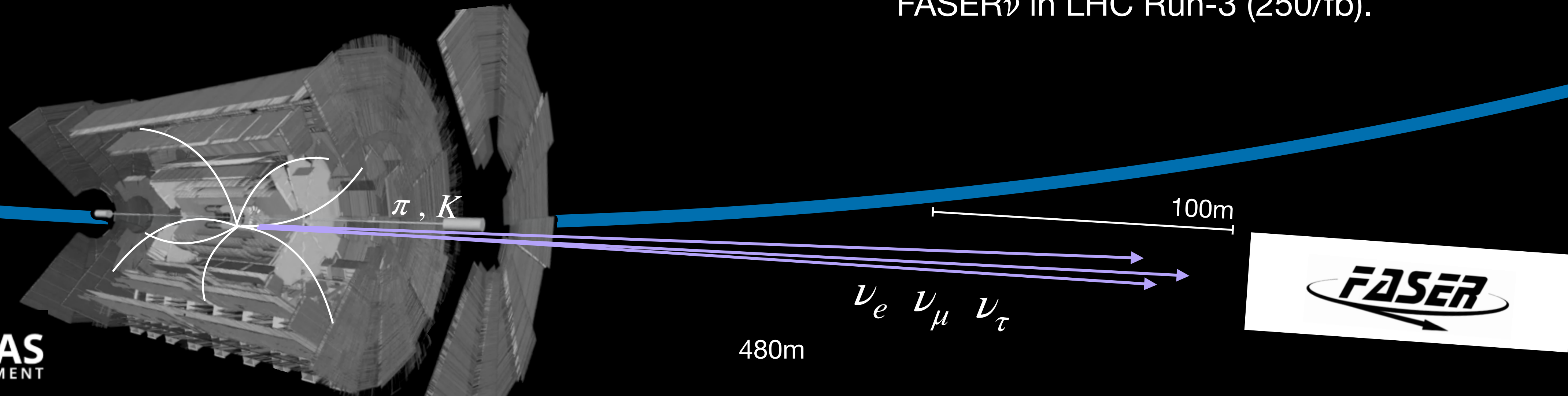


# Large Hadron Collider

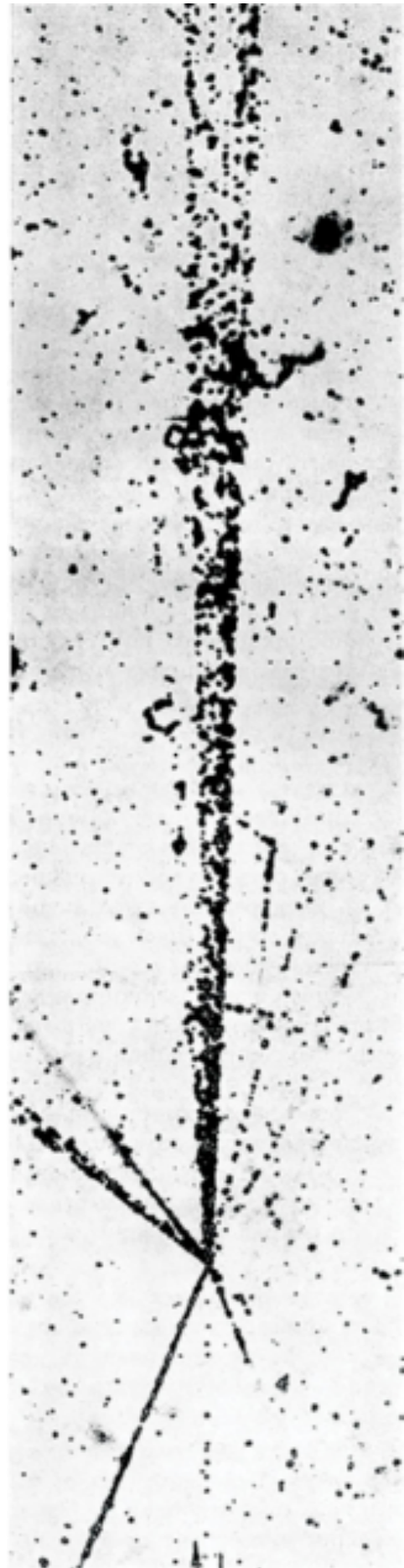
## Neutrino production at LHC

- 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 $\nu$  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.