

# A fully active target for the PIONEER experiment

- **PIONEER** is the “successor” of PIENU/PEN/PiBeta experiments
  - <https://arxiv.org/abs/2203.01981>
- The goal is to **improve the precision of  $R_{e/\mu}$  and  $B(\pi^+ \rightarrow \pi^0 e^+ \nu)$**  by an order of magnitude
  - $R_{e/\mu}$  is the ratio of pion decay to electron/muon: precision measurement of **lepton flavor universality**
  - $B(\pi^+ \rightarrow \pi^0 e^+ \nu)$  is the cleanest measurement of  $V_{ud}$ : important to test **CKM matrix unitarity**
- PIONEER will take place at the Paul Scherrer Institut (PSI) cyclotron ring
- **The Goal of PIONEER is the separation of deposited energy spectra of  $\pi \rightarrow e \nu$  and  $\pi \rightarrow \mu \nu \rightarrow e \nu \nu$** 
  - Pions stop in an active target where they are tagged with energy and timing
  - Exiting positrons are tracked and the total energy is measured in a  $3\pi$  calorimeter
- **Two main detectors: Active TARget (ATAR) and  $25 X_0$  calorimeter**
  - **ATAR with fast timing and high segmentation allows to separate and tag  $\pi \rightarrow e \nu$  and  $\pi \rightarrow \mu \nu \rightarrow e \nu \nu$**  this reduces pileup and  $\pi \rightarrow e \nu$  energy tail
  - **Calorimeter with high energy resolution (liquid Xe or LSO crystals)** to reduce tail correction and pile-up uncertainties, plus improves uniformity
- In the poster a brief introduction to PIONEER is given, then a more detailed explanation of the ATAR and the chosen technology is shown.

