Water-Cherenkov Test Experiment (WCTE) and beam test of July 2023.

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Introduction

The Water-Cherenkov Test Experiment (WCTE) is a **prototype water Cherenkov detector** which will be placed in the T9 beam area at CERN, operated with a low momentum (200-1200 MeV/c) flux of $\pi^{\pm}$, $\mu^{\pm}$, $e^{\pm}$ and p^{+}.

The main purpose of this experiment is to prove the new technologies that are being developed for the next-generation water-Cherenkov experiments, along with properly modeling the detector response and studying physical processes such as **Cherenkov light profile produced by secondary particles, charged pion hadronic scattering or secondary neutron production and tagging**. One of the main goals of the test beam is to experimentally test the e/γ **separation**, as simulations are promising.

Data taking period with WCTE is scheduled for 2024, therefore the collaboration is working towards the start of the detector assembly. First mPMT production assembly ongoing.

WCTE design

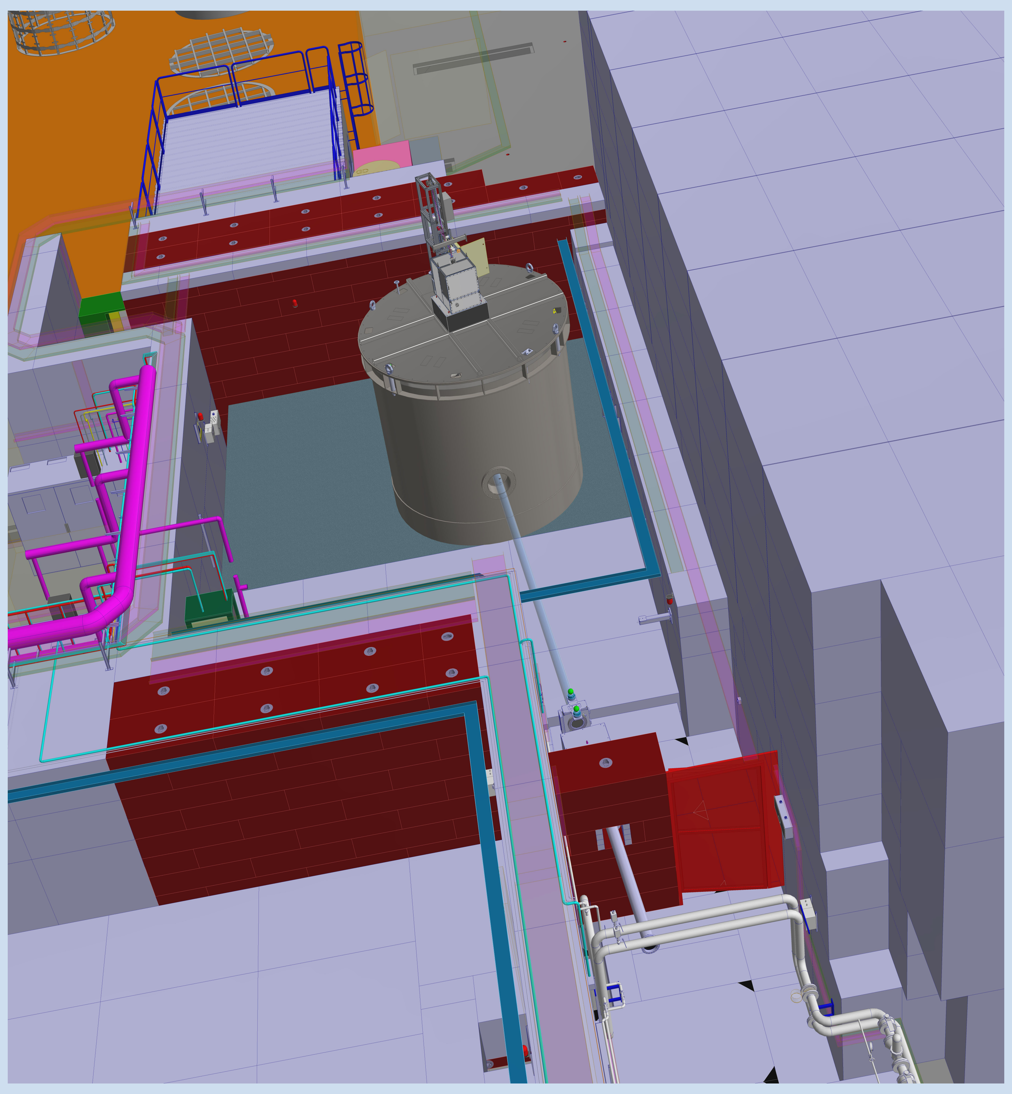

Fig.1: 3D model of the T9 area at CERN.

It will consist of a tank of 3.8m diameter and 3.5m height, leading to a 40 ton tank filled with ultra pure water and in a second phase, also with gadolinium (Gd) loaded to enhance neutron tagging. A stainless steel 304 support structure instrumented with 102 multi-photomultipliers (mPMTs), each of them with 19 PMTs, will be lifted into the tank after assembly.

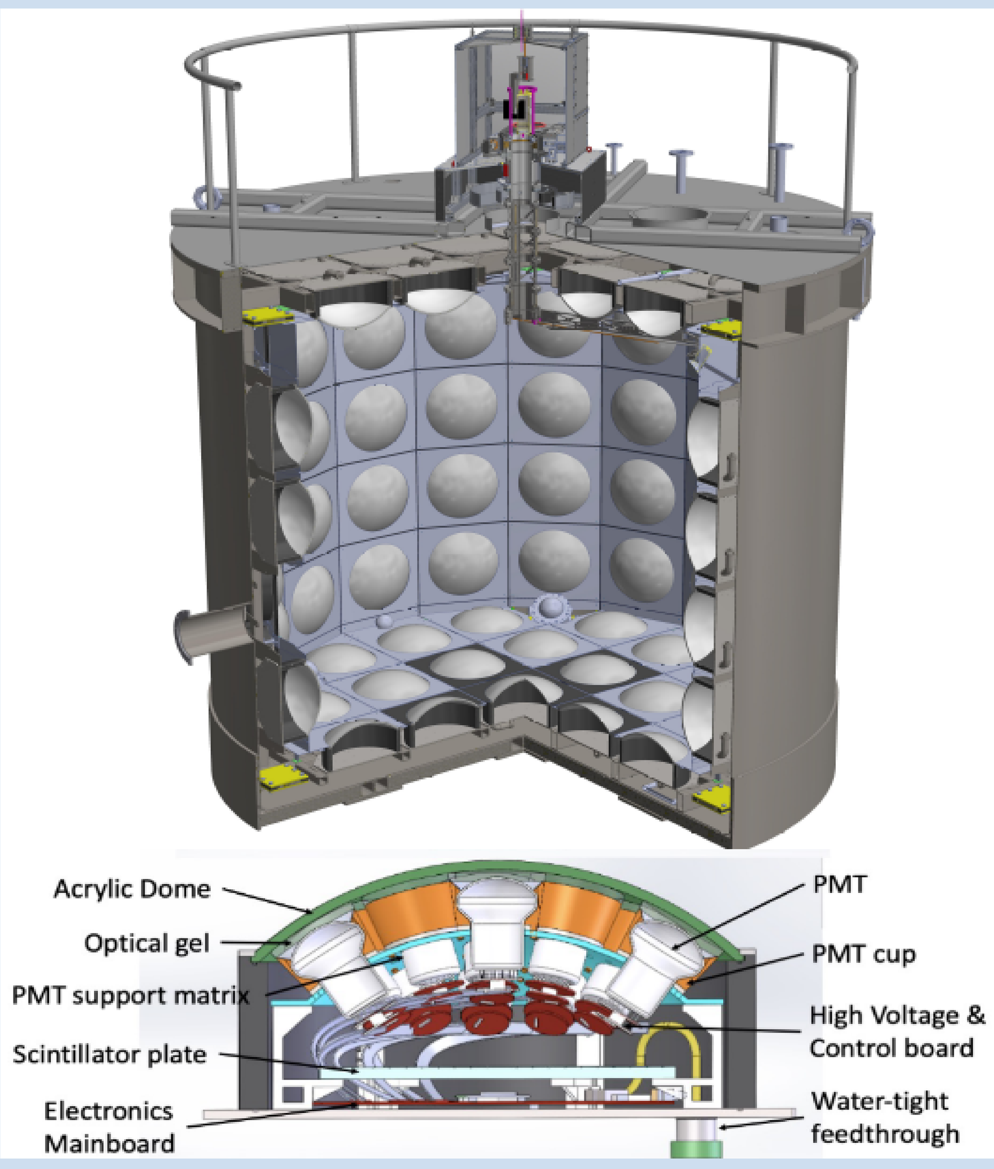

Fig.2: Detector cross section with rails surrounding the top of the tank for safe calibration work, and schematic view of multi-PMT

HyperK project

The Hyper-Kamiokande (HyperK) project is the next-generation, large scale water-Cherenkov experiment focused on ν studies. Highlight its far detector (~295km from the beam) and the Intermediate Water Cherenkov Detector (IWCD), ~1km downstream from the beam production point; both of them will **benefit from the WCTE results**.

Beam test of July 2023

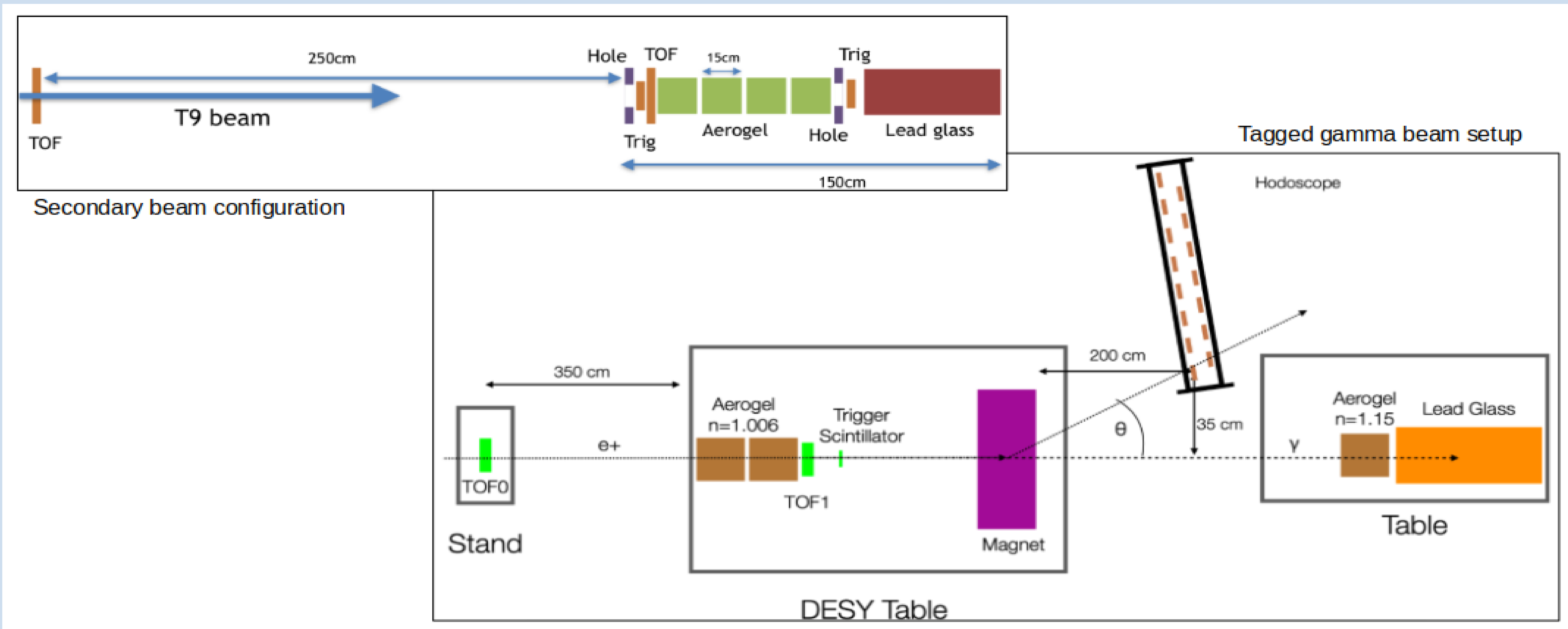

Fig.3: Two different configurations were tested during beam test 2023.

Beam tests in order to **determine the proper configuration** and to **study the response that would occur in the real experiment**. Main goals: test of the beam monitors (aerogel Cherenkov counters (ACTs), TOF, trigger and hole counters), beam survey of the sub-GeV e, μ, π, p beam and test of a new tagged γ beam equipment.

Comissioning and data analysis

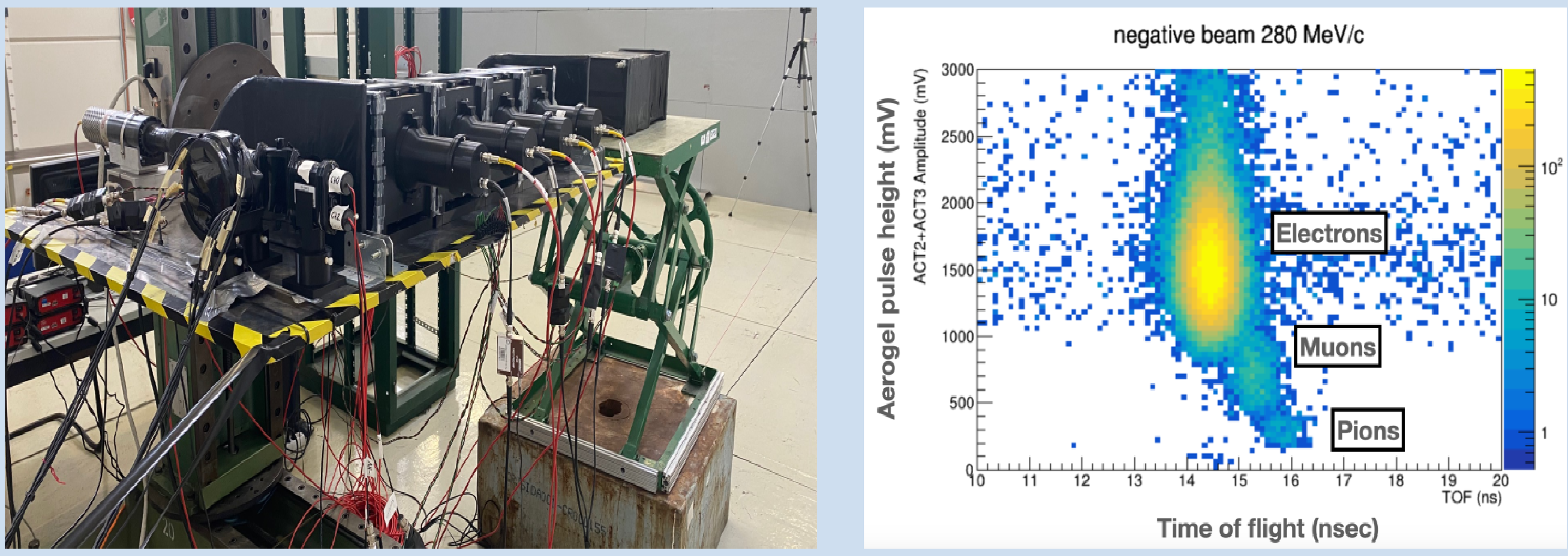

Fig.4: secondary beam setup (sub-GeV beam survey) for π/μ separation.

e, μ, π, p **beam setup:** since we already know the beam energy and the mass of each particle, we know their velocity, i.e. their TOF. Also we can estimate the light production of each particle in the ACTs, therefore we compare with experimental data and identify different particles of the beam.

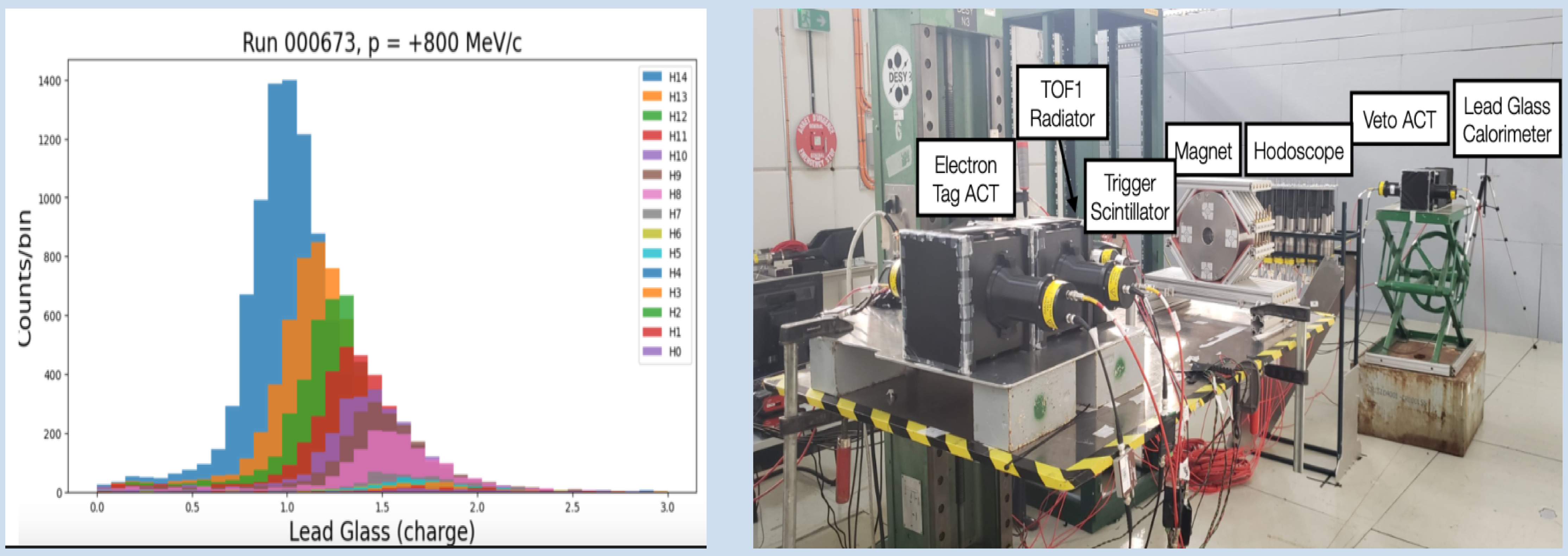

Fig.5: Tagged photon beam configuration for γ counts in the Pb glass in coincidence with positrons in the hodoscope.

Tagged photon beam setup: based on the energy of the positrons that hit the hodoscope (we can calculate this energy due to the hit position in the hodoscope), we can estimate the energy of the bremsstrahlung gammas that hit the lead glass. The ability to tag incoming gammas of known energy will allow for positron/gamma separation studies.