

LEMMA

Low **E**Mittance **M**uon **A**ccelerator

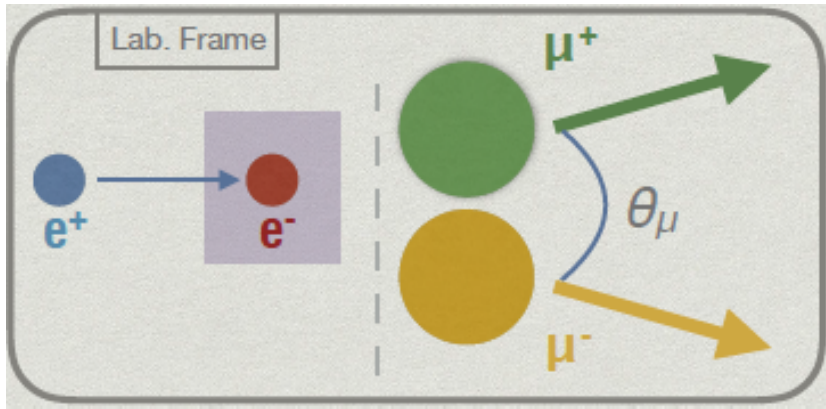
July 26th – August 2nd 2017

BEAM TEST END REPORT

Mattia Soldani
for the LEMMA team

GOALS OF LEMMA

Novel approach: **direct μ -pair production from $e^+e^- \rightarrow \mu^+\mu^-$** just above production threshold ($\sqrt{s}=212\text{MeV}$), by using a beam of $\sim 45\text{ GeV } e^+$ on a thin target [arXiv:1509.04454]



$$E(e^+) \sim 45\text{ GeV} \rightarrow E(\mu^{+/-}) \sim 22\text{ GeV}$$

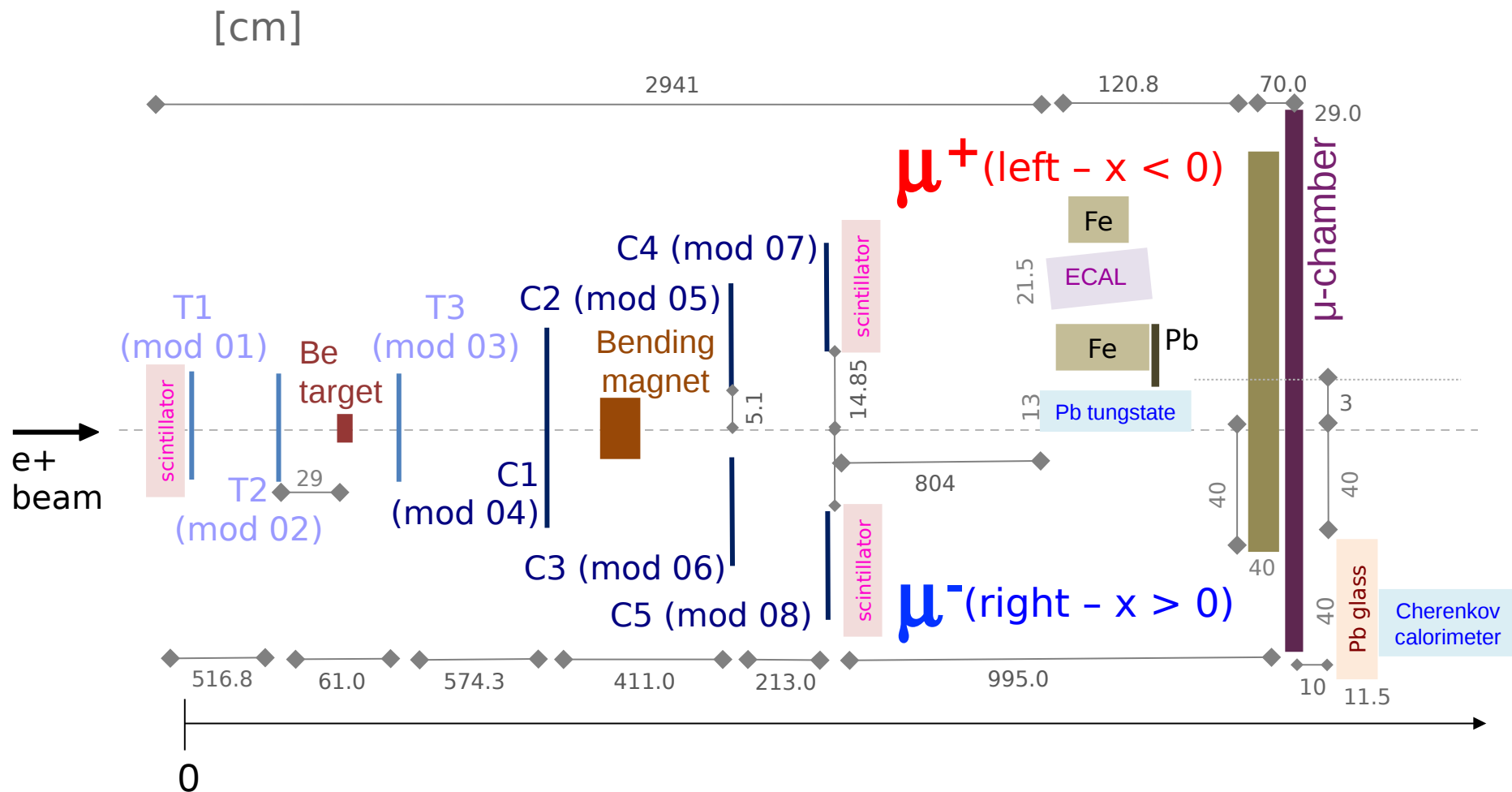
Features:

- Minimal muon energy spread
- Very small emittance can be obtained
- Low background
- Reduced losses from muon decays

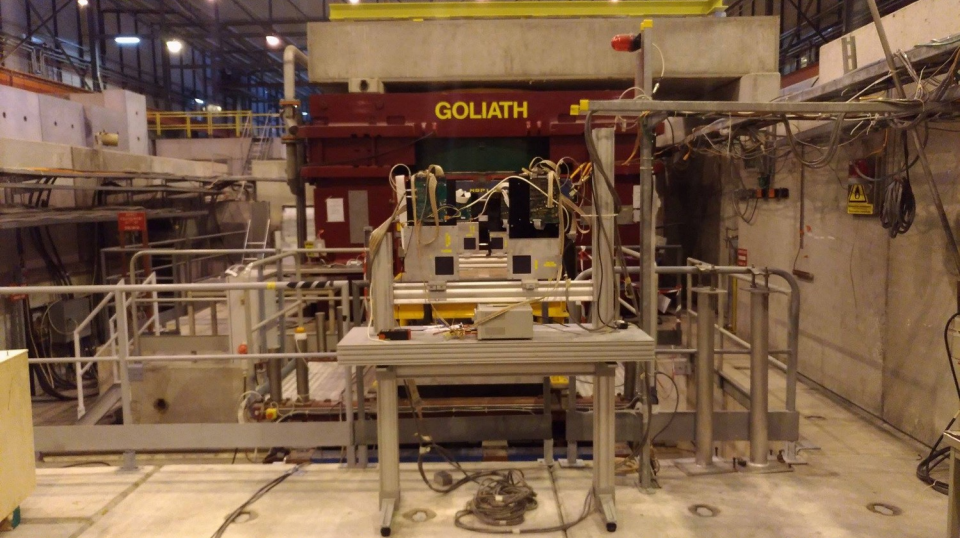
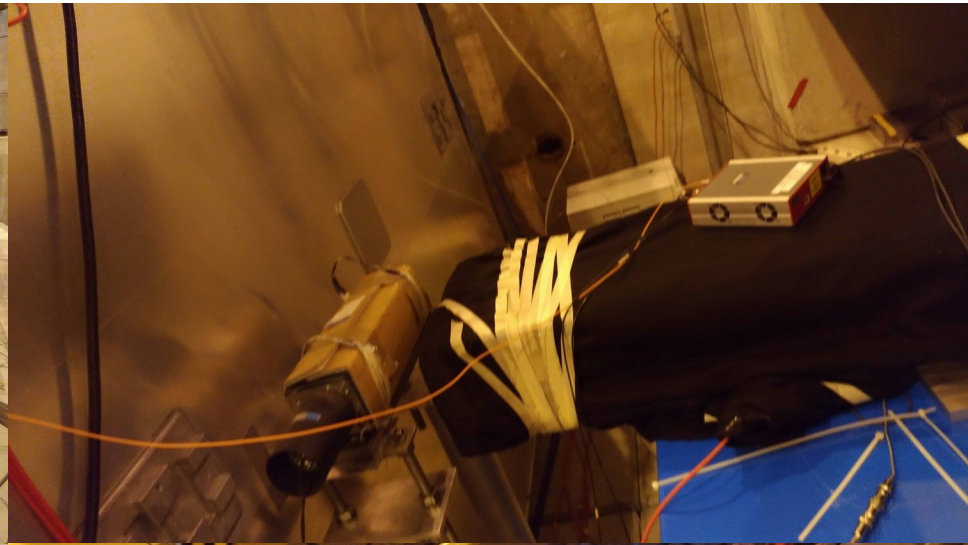
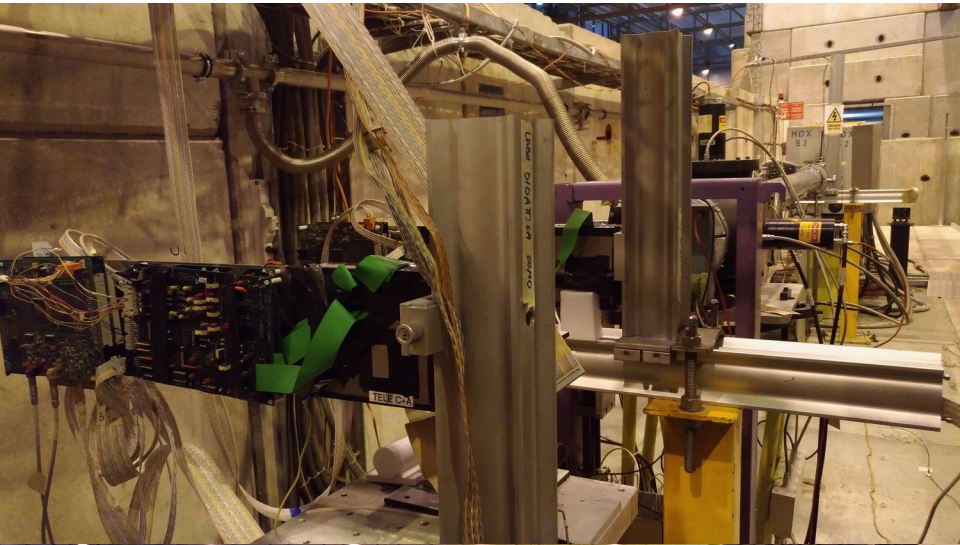
GOALS OF THE 2017 BEAM TEST

- Measure momentum and emittance of outgoing pair $\rightarrow \mu^+\mu^-$ *tracking*
- Measure **production cross section** and other properties of the production process

EXPERIMENTAL SETUP



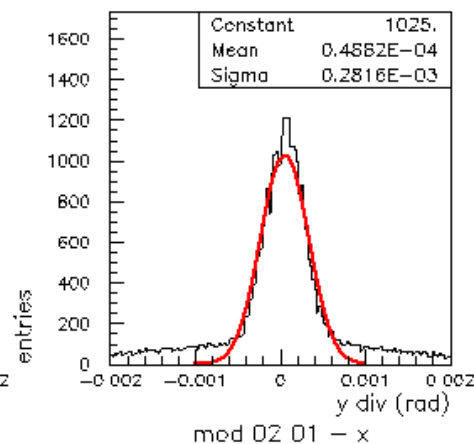
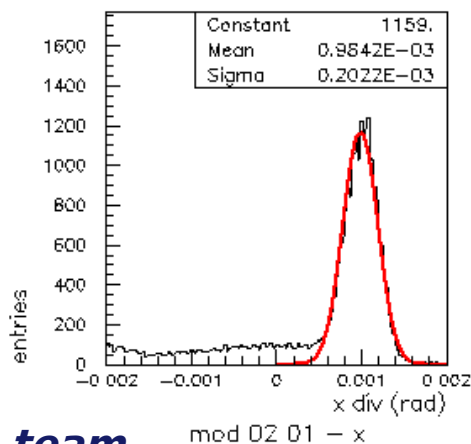
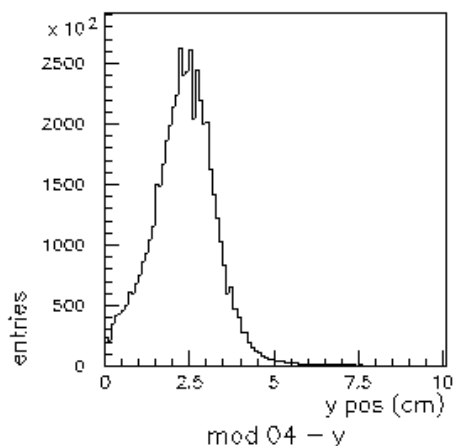
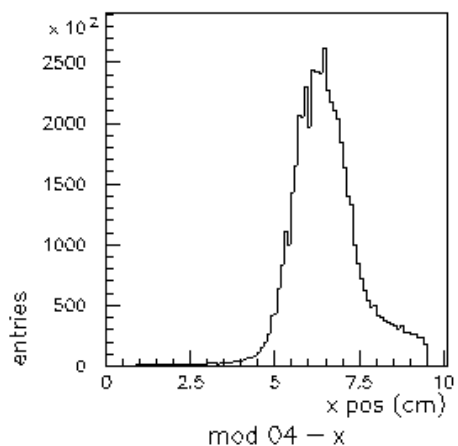
EXPERIMENTAL SETUP



***Mattia Soldani for the LEMMA team
CERN PS/SPS User Meeting, August 3rd 2017***

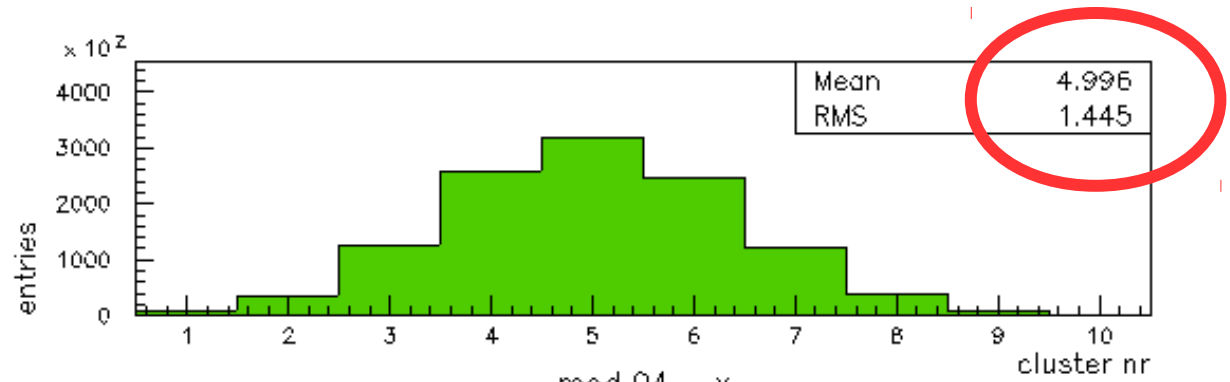
INCIDENT BEAM IN THE SILICON DETECTORS

- Tracking systems installation on July 26th (Wed)
- Completion of the setup with calorimeters on July 28th (Fri)
- Very high intensity e^+ beam ($\sim 4\text{-}5 \times 10^6$ spill⁻¹ - great job by Nikos!) from July 29th (Sat)

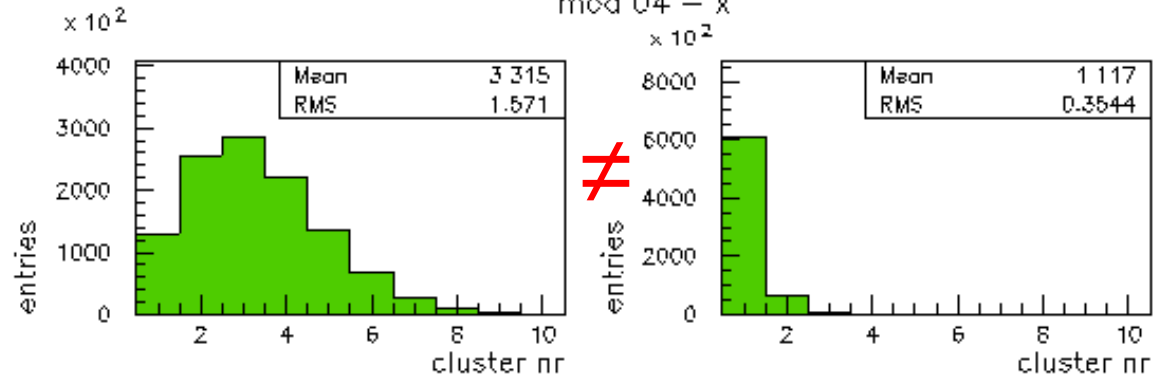


HIGH MULTIPLICITY IN THE SILICON DETECTORS

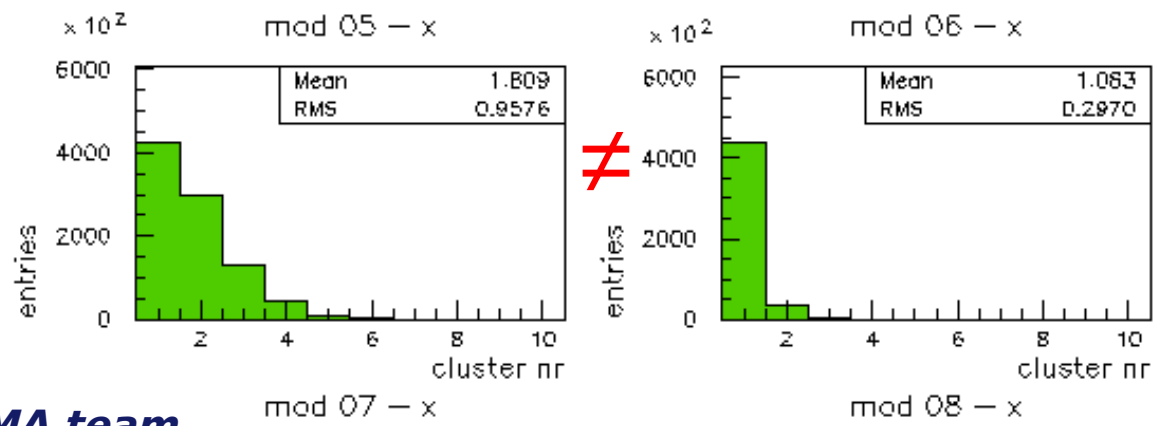
Condition on the beam axis, downstream with respect to the target



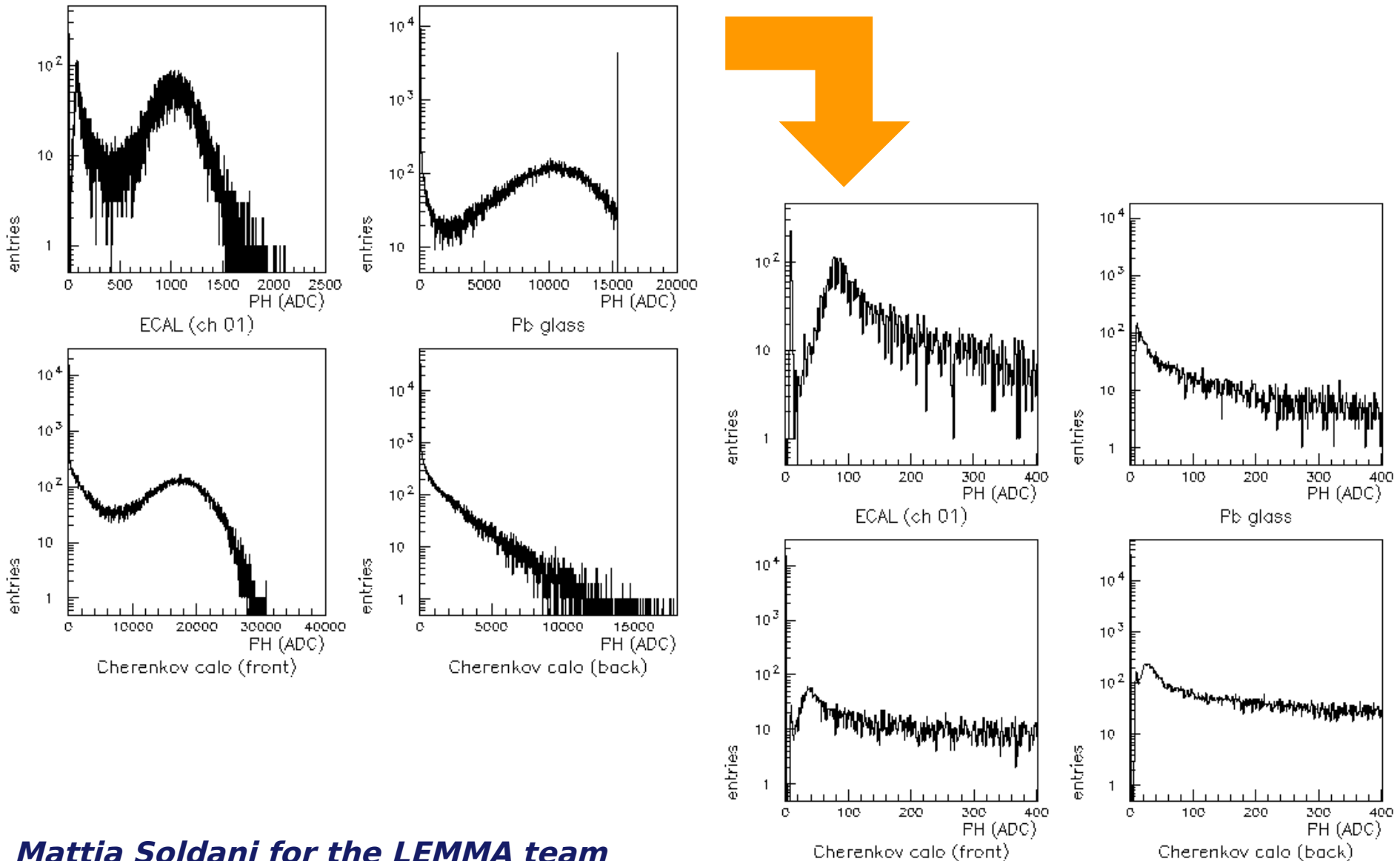
Condition at the innermost couple of silicon strip detectors after the magnet



Condition at the outermost couple of silicon strip detectors after the magnet

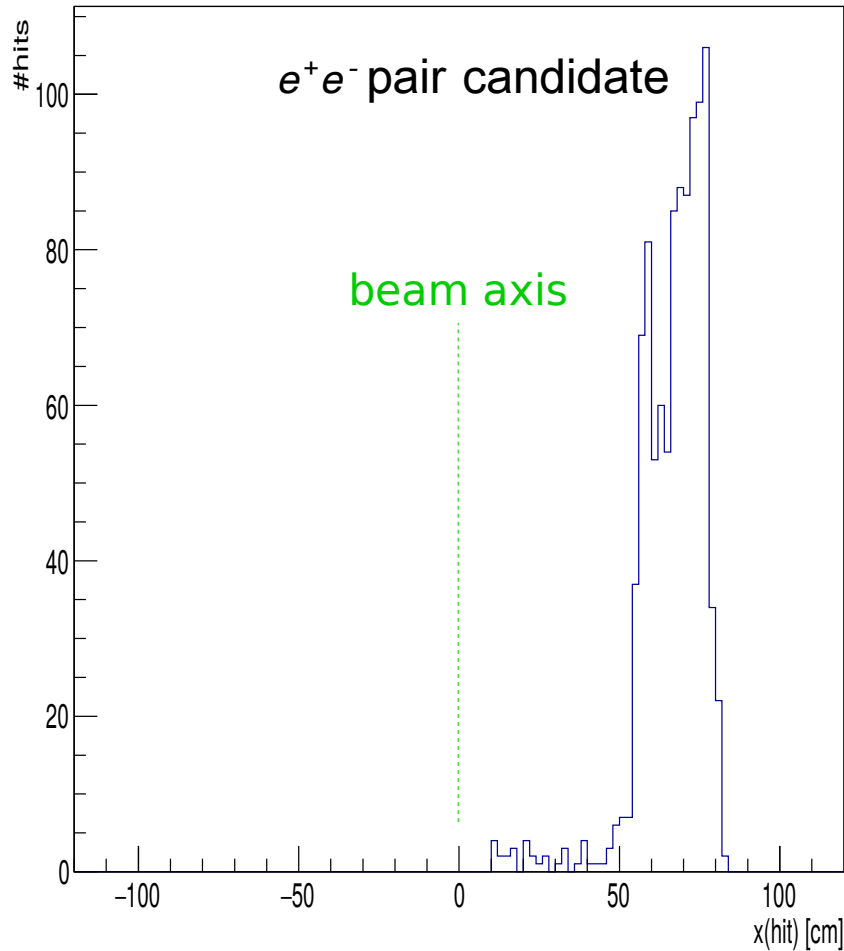


PULSE HEIGHT IN THE CALORIMETERS

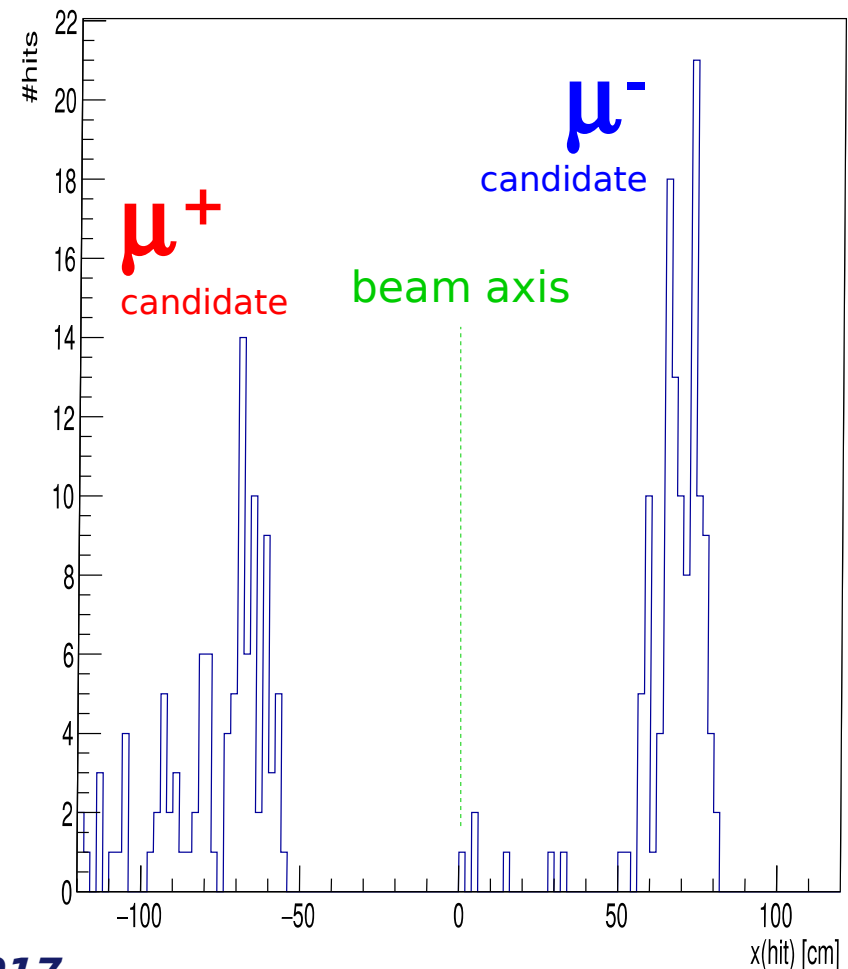


CANDIDATE EVENTS IN THE μ -CHAMBER...

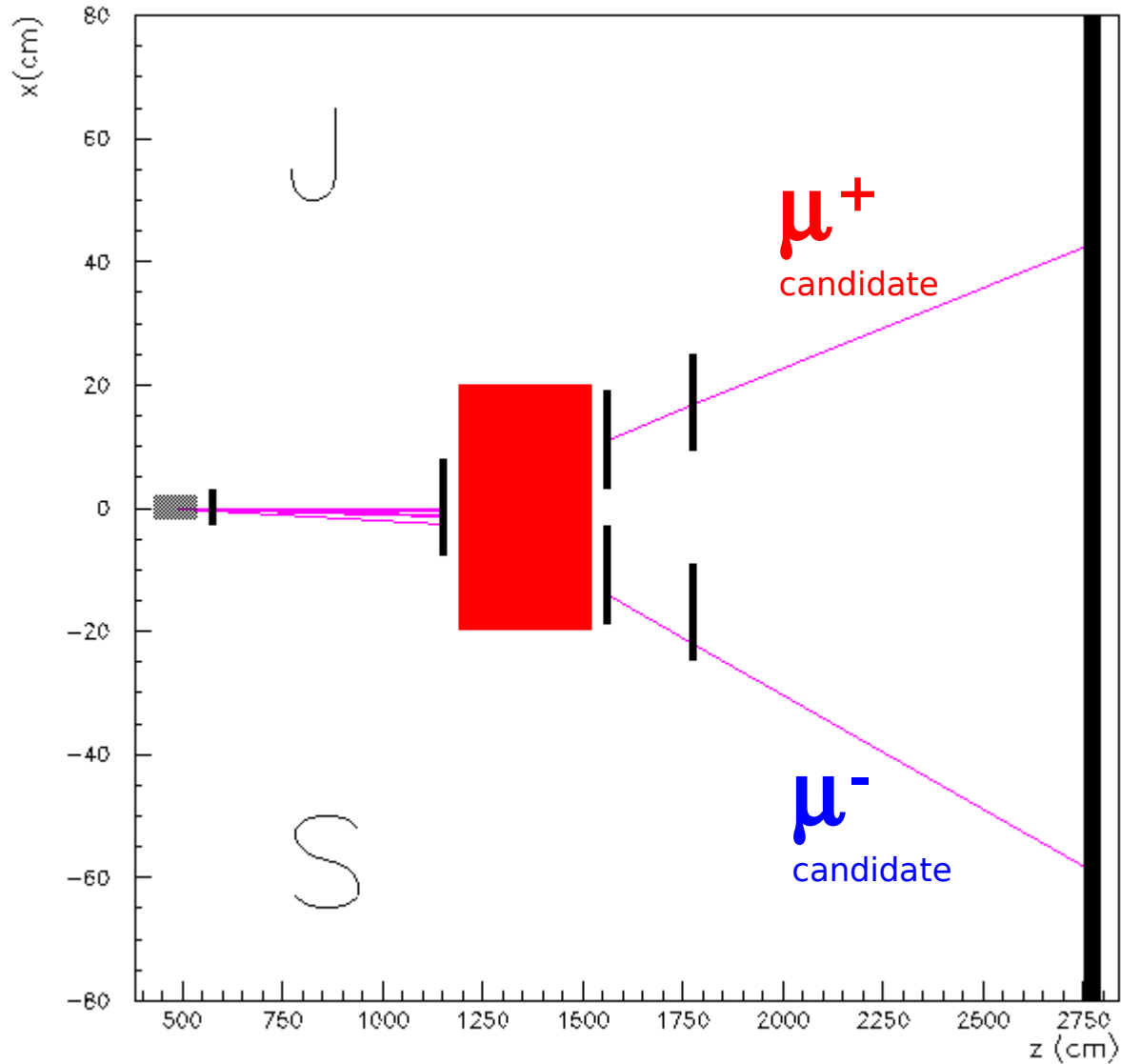
chamber hits in events with one right track only



mu-chamber hits in left-right side coincidences



...AND IN THE SILICON DETECTORS



SUMMARY

The reaction $e^+e^- \rightarrow \mu^+\mu^-$ near the production threshold has been studied with a 45 GeV e^+ beam on a Be target and with a complex setup; this will lead to the extraction of the kinematic features and of the production rate of the $\mu^+\mu^-$ pair. This was the first experimental test for a positron induced low emittance muon beam.

ACKNOWLEDGEMENTS

We would like to thank many people and groups that helped us:

- the SPS coordinator and staff for supporting us before and during the beam test;
- Nikos Charitonidis for providing a beam with the required features;
- Nikos, Marcel, and the TE/MSD group for providing us the magnetic field map of the MBPL magnet;
- Benoit Cure and the surveyors team for the geometry measurements;
- CMS and the PHOTAG/AXIAL team for kindly providing us some of their instruments.

Thank you!