Low Energy Beam line at CERN SPS

Task 8.2 Report

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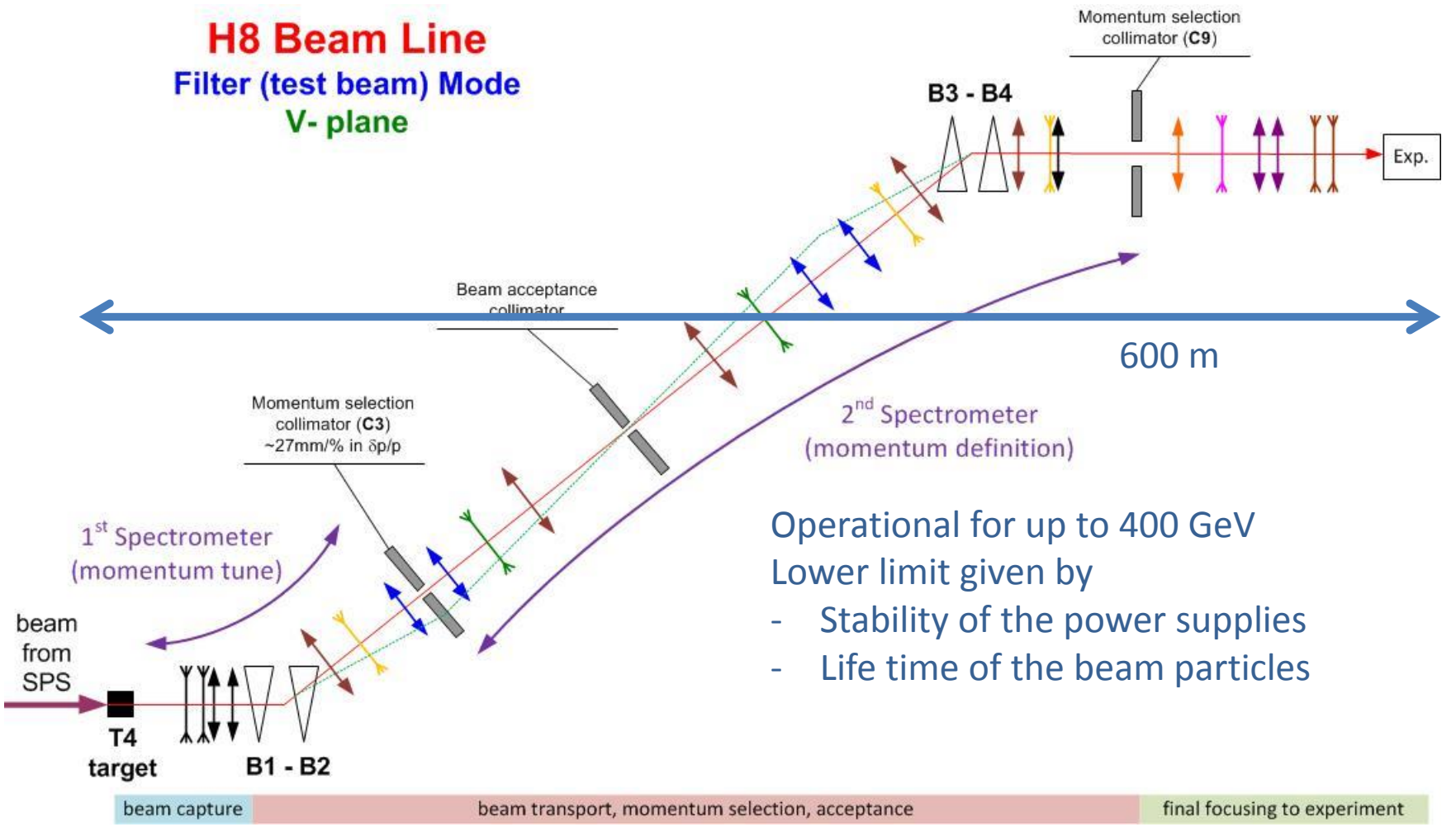
EN Engineering Department
CERN

Existing High Energy Beam Line



Operational for up to 400 GeV
Lower limit given by
- Stability of the power supplies
- Life time of the beam particles

Requirements

- Tasks 8.2: provide the test beam infrastructure at CERN and Frascati
- For testing neutrino detector technologies

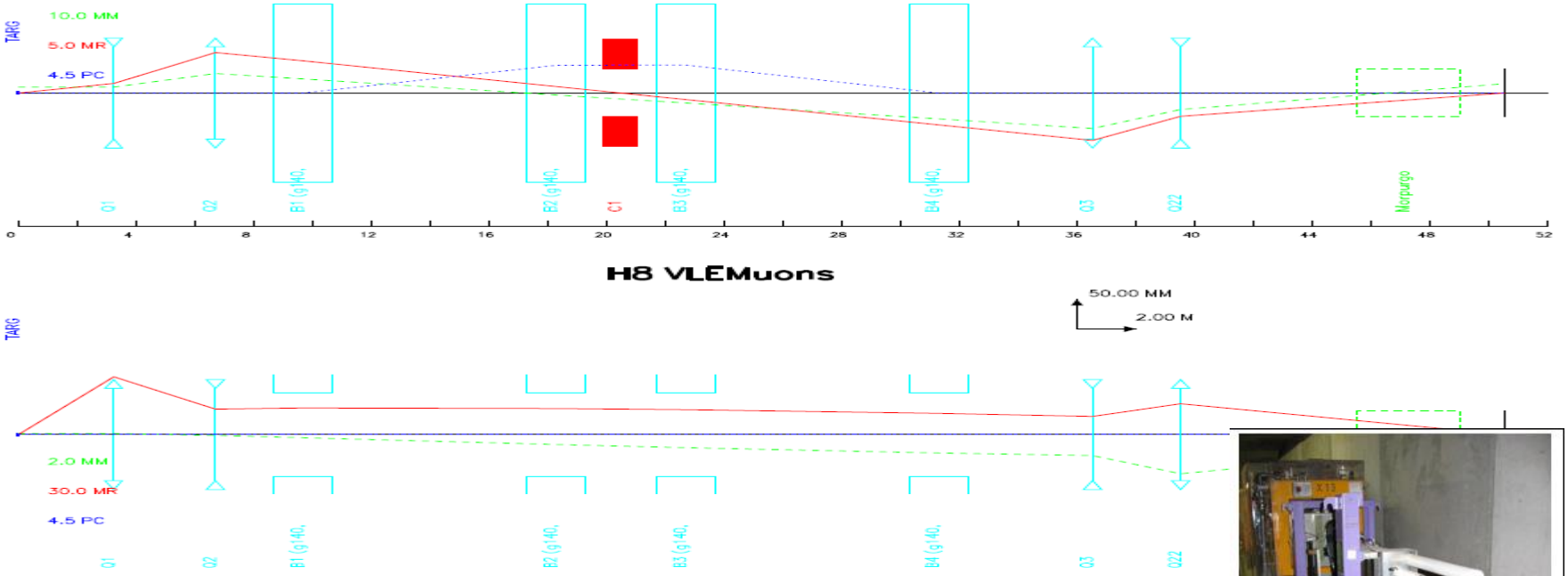
Requirements defined in http://cdsweb.cern.ch/record/1430746/files/AIDA-MS27.pdf

- Pions/protons, electrons and muons (both polarities)
- Extend the lower energy range down to 0.5 GeV
  - So far reaching 10 GeV
- Particle rates 1-2 kHz
- Magnetic field at the detector test location
- Including infrastructure like cryogenics

Design study performed by I. Efthymiopoulos and M. Turner
looking into the specific case of H8 - but not limited to

Beamline Concept

- Secondary beam in the energy range of 20-80 GeV (depending on particle type and tertiary energy)



- Create a tertiary beam closer to the detector
  - Introducing an additional production target
- Install dedicated spectrometer

Beamline Optimisation

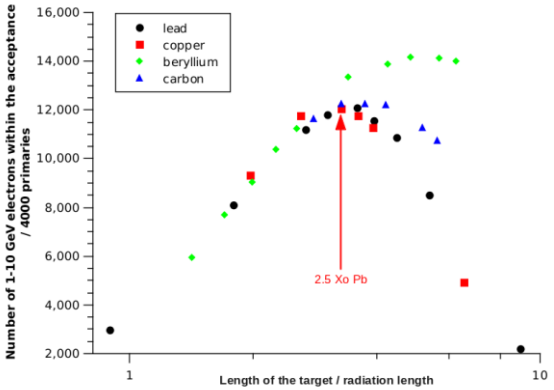
Studying systematically
- target material and length
- Beamline layout: on-/off-axis

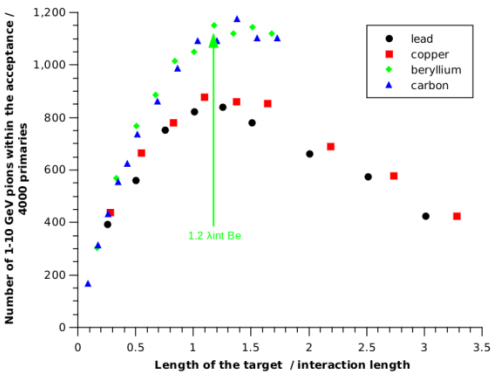
flux estimates of the cases for
- Electron
- Pion/proton
- Muon

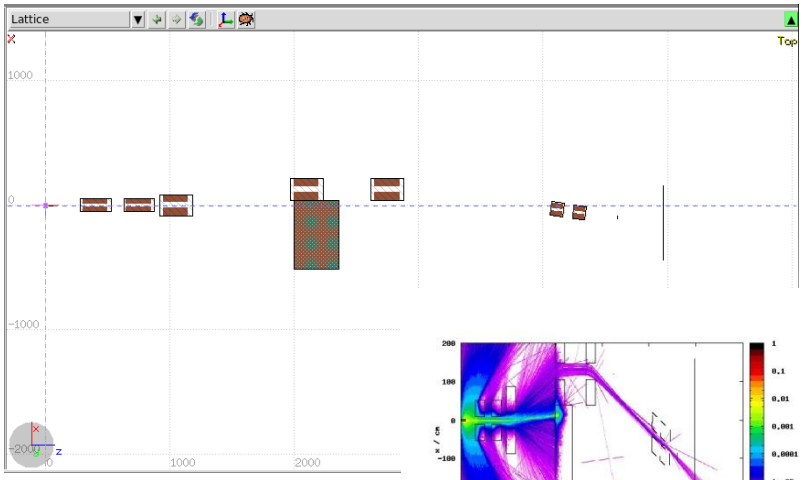
- and background

Charge sign to be chosen on the spot

Studying the different cases using several simulation tools (turtle, halo, FLUKA)



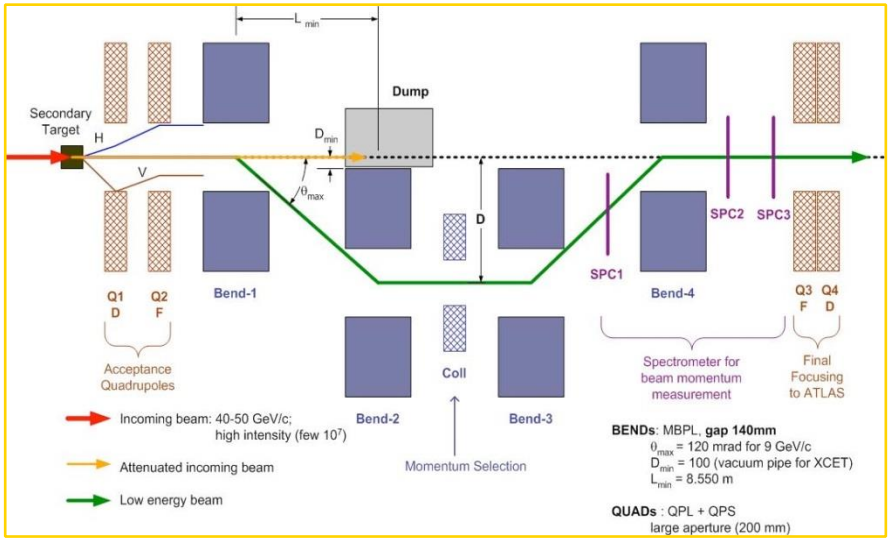


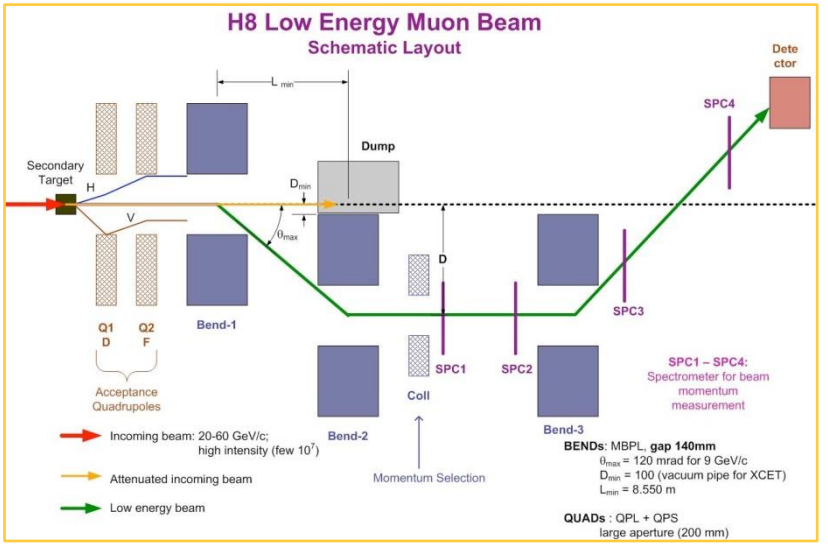


Layout Options

- **Four-bends layout**
  - similar to the one used for the ATLAS&CMS calorimeters in the past
  - compatible with detectors installed inside the large Morpurgo magnet
  - suffers from large background from the direct secondary beam

- **Three-bends layout**
  - reduces the background from the direct secondary beam – essential for ν-detectors ?
  - less straightforward to install detectors in inside the Morpurgo magnet

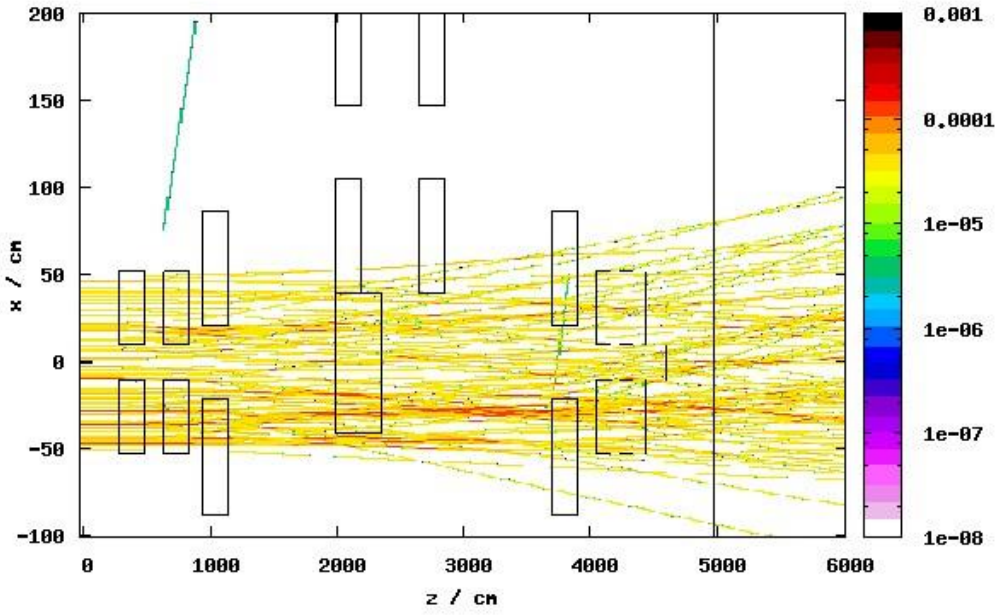


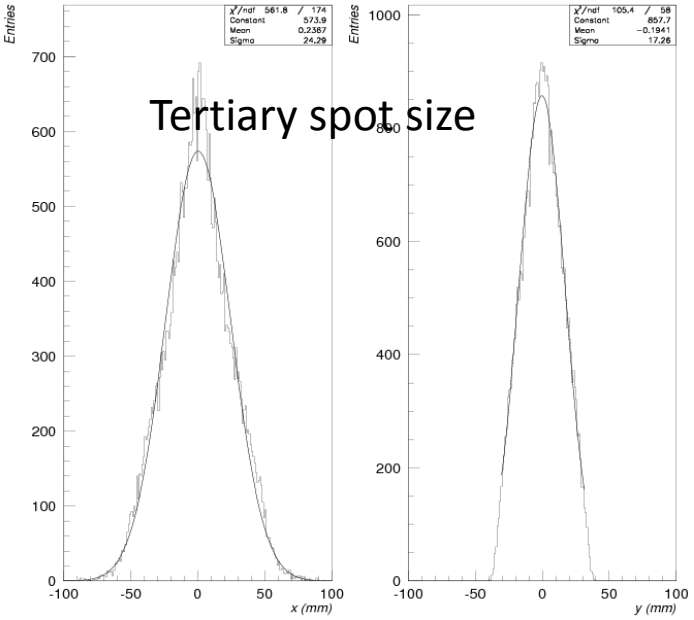


Pion+proton performance

- Consider background from muons
  - At secondary (high) and tertiary energies

Secondary muons

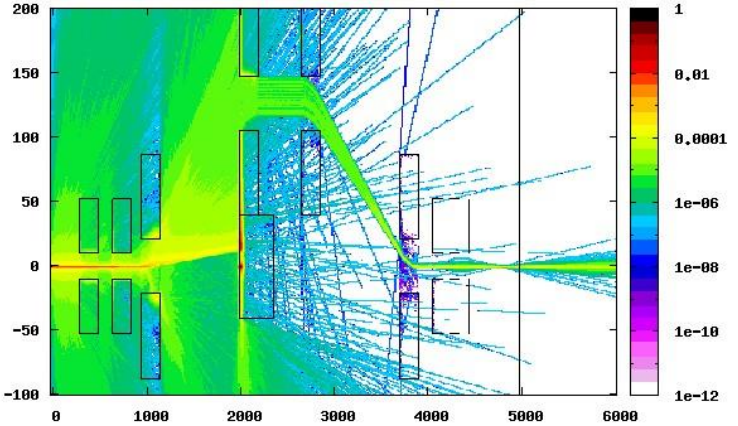




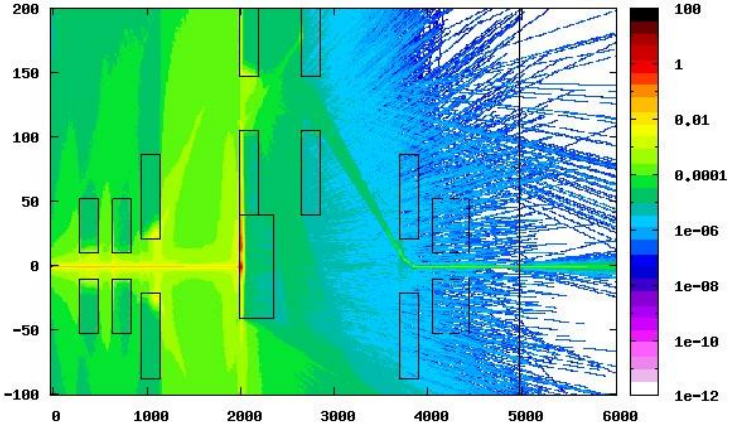
Electron performance

- Secondary electron beam
- On 2 cm lead target
- Large photon background

Electrons only

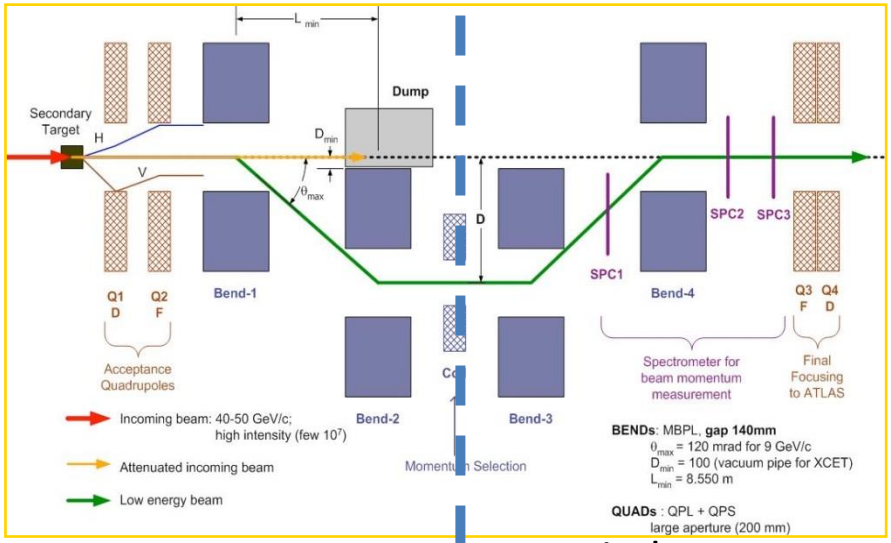


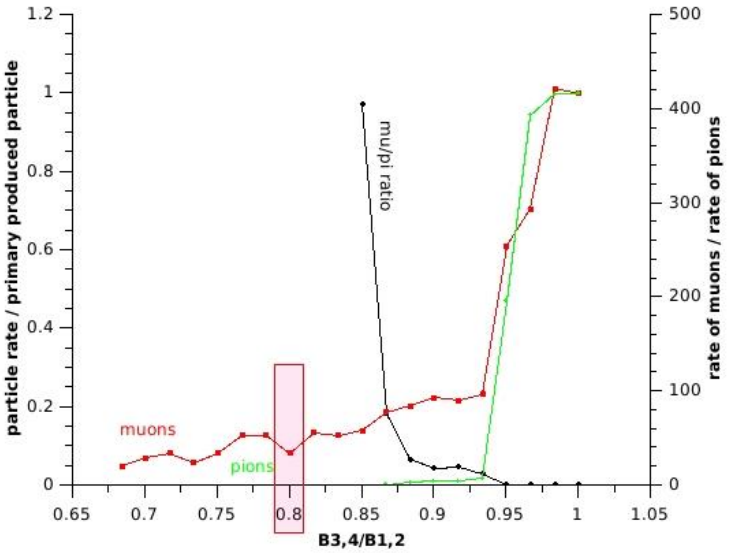
Including photons/positrons



Muon performance

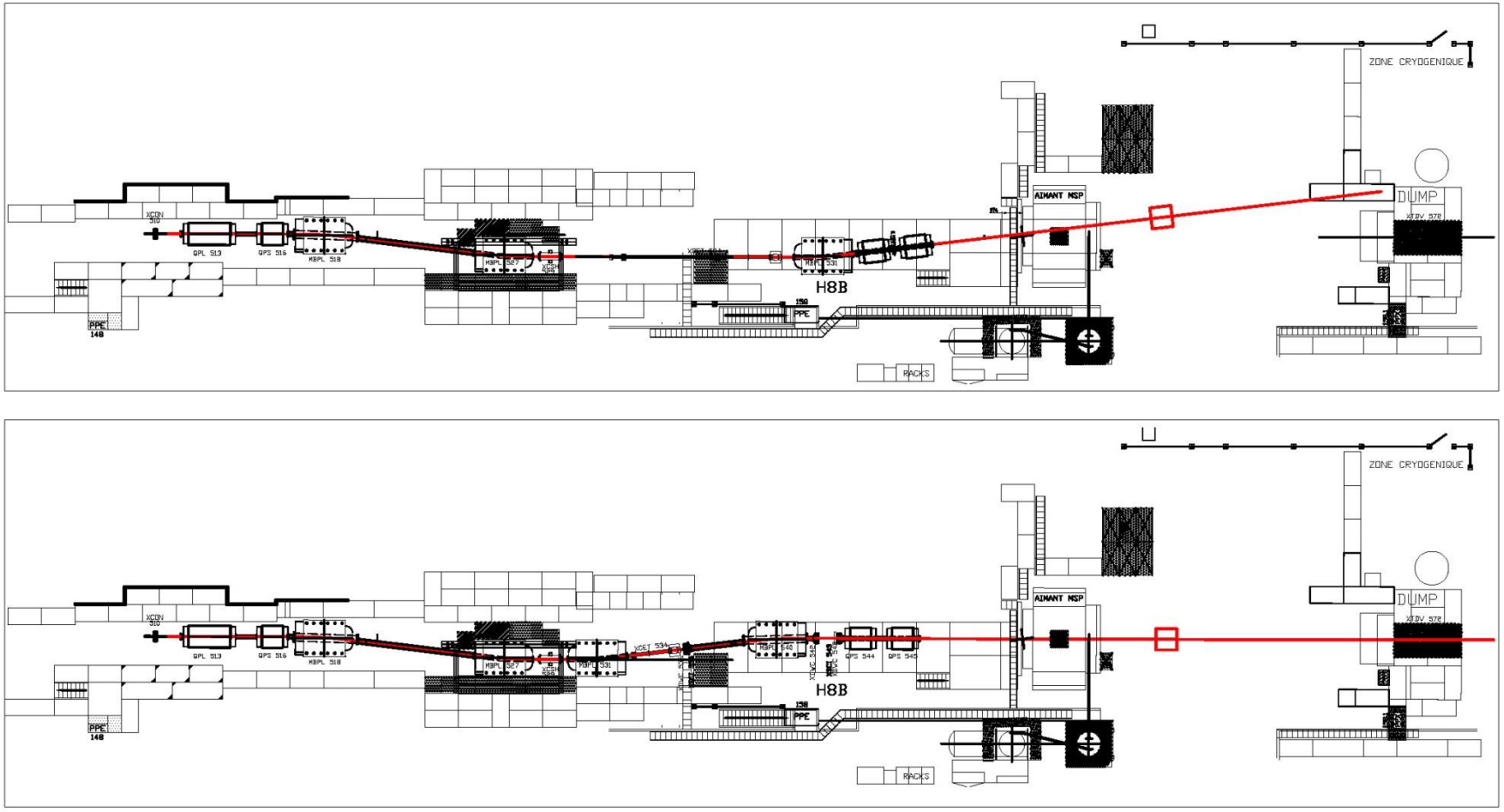
- Selecting the “tertiary” muons by setting the first and second half of the VLE spectrometer at cascading energies.





9 GeV varied energy

Real-case implementation



Summary

- Cases for pion/proton, electron, muon optimised
  - Target options
  - Spectrometer layout

  report: http://cds.cern.ch/record/1637970
- Beam performance(s) matching the specifications
- Real case implementation in H8 available

- Positioning of ν-prototype detectors and the existing/future ATLAS installation to be coordinated