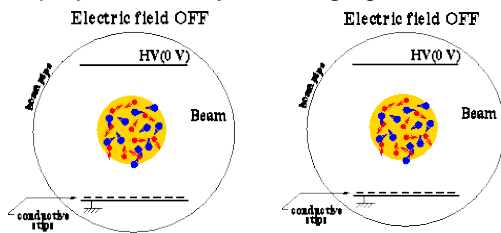


NON INVASIVE PROFILE MONITOR FOR BEAM PROFILE MEASUREMENT OF ESS BEAM

DESCRIPTION ET PROBLÉMATIQUE

ESS¹ is a new European facility with a very powerful proton beam (5 MW). For beam tuning purpose, the accelerator physicists need different kind of monitors (diagnostics) for leading beam safely toward the whole accelerator with specific characteristics. Beam profiles at various locations are requested. Therefore we are in charge of designing Non intrusive Profile Monitors (NPM). They are based on ionization induced by the beam protons on molecules of the residual gas enclosed in the beam pipe. Ionization products are then drifted thanks to a transverse electric field, toward conductive strips as depicted below.

This project is really challenging due to a weak



ionization signal expected since proton energies are high (90 to 2000 MeV) and the vacuum beam pipe pressure is quite low ($\sim 10^{-9}$ mbar).

Thus a first feasibility study should be done for determine if an amplifying primary signal should have been foreseen.

Another topic may have also to be investigated which is the interaction of the beam with ionization products for avoiding spurious profile enlargement (space charge effect). Software or hardware solutions must be provided for mitigating this effect.

Electric field Uniformity is the key to extract realistic profiles and must be inquire thoroughly using simulations.

Once these studies are done, a prototype must be developed including vacuum vessel, electronic processing signal and read out. This prototype will be tested on accelerator at Saclay (IPHI : 3 MeV – 0.3 MW) in a first time, and on an abroad high-energy facility close to ESS characteristics for qualifying the monitor on a second time.

¹<https://europeanspallationsource.se/european-spallation-source>

This project will begin by end 2015.

DESCRIPTION

GROUPE/LABO/ENCADREMENT

You will join the Sédi (Service d'Électronique, Détecteurs et Informatique) devoted to electronic, detectors and computing science. You will work in a laboratory which has skills in particle detection, electronic, system integration and which is already involved in beam diagnostics.

The thesis will be managed by the responsible of the laboratory who is still working on beam diagnostics.

This work will be done in collaboration with ESS people (Sweden).

TRAVAIL PROPOSE

The goal of this PhD thesis is to study the feasibility and define criteria for designing a NPM prototype including electronics and control command. Then, this prototype will be tested on particle accelerator for qualification.

FORMATION ET COMPÉTENCES REQUISES

Master 2 or equivalent; it will be really fruitful to start this project during the final year internship.

Required skills are good knowledge on particle-matter interactions, electronics, computing for simulation.

COMPÉTENCES ACQUISES

Computing science: simulations and used of sophisticated software with Maxwell's equations...

Electronics: analogic and low noise electronics

Detector: particle interactions, vacuum, data read-out and analysis.

COLLABORATIONS/PARTENARIATS

- ESS people at Lund (Sweden), implying missions
- Prototype tests on a proton high-energy beam in Europe, implying missions on site.



- Industrial contacts for the prototype manufacturing.

CONTACTS

Scientifique : Jacques Marroncle
CEA Saclay : Irfu / Sédi / LaSyD
Tel : +33 1 69 08 74 88
Email : Jacques.marroncle@cea.fr