PROPOSAL FOR A VERY FORWARD PROTON SPECTROMETER IN H1 AFTER 2000

L. FAVART
Université Libre de Bruxelles, IIHE
on behalf of the H1 Collaboration
E-mail: lfavart@ulb.ac.be

A new, very forward proton spectrometer (VFPS) with large acceptance is proposed to be installed in the proton beam of the H1 experiment after the luminosity upgrade in the year 2000. The spectrometer, located at 220 m downstream of the interaction point is based on the Roman Pot technique and consists of two stations situated in the cold section of the proton beam line. Physics motivations and a brief description of the proton spectrometer are presented.

1 Physics goal

In recent years, due to the results obtained by the ZEUS and H1 experiments at HERA, considerable progress has been achieved in the partonic interpretations of diffractive processes, see e.g. [1]. However, the small cross sections involved and the difficulty in selecting clean diffractive event samples have left many basic QCD predictions untested. Therefore further progress in this field will rely on collecting large statistics in various inclusive, semi-inclusive and exclusive diffractive channels, in particular those in which a hard scale is present.

Most of diffractive studies performed up to now at HERA have been based on the characteristic presence of a rapidity gap in the diffractive final state. However the only precise and unambiguous way of studying diffraction is by tagging the diffracted proton and measuring its four momentum by means of a proton spectrometer. Such devices have been used by the H1 and ZEUS Collaborations and have delivered interesting results, but their acceptances are small, with the result that the collected statistics are limited and large systematic errors affect the measurements. To fully profit from the HERA luminosity upgrade in the study of diffraction after the year 2000, a proton spectrometer which identifies and measures the momentum of the diffracted proton with a very good acceptance is thus essential.

The installation of a new proton spectrometer is proposed[a] at 220 m downstream of the H1 main detector. In the proposed location, the strong horizon-

[a]Antwerp (UIA), Birmingham, Brussels (ULB-VUB), Hamburg II and Lund groups from the H1 Collaboration

tal beam bend, as shown in Fig. 1, allows scattered protons to be measured down to the lowest $|t|$ values[b]: $|t_{min}| < |t| \lesssim 0.5$ GeV^2. The anticipated acceptance, shown in Fig. 2a) and b) as a function of $x_{I\!P}$, is above 80 % for $5.10^{-3} < x_{I\!P} < 3.10^{-2}$. With the measurement of two impact point positions, the variables $x_{I\!P}$, t and the azimuthal angle of the scattered proton can be determined. The resolution in t, shown in Fig. 2c), permits a measurement of 4-5 bins in t^2.

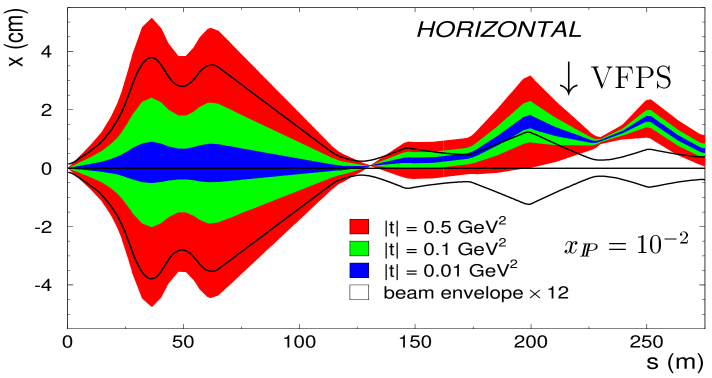

Figure 1: Horizontal projections of the beam envelope (12 sigma), as a function of the distance to the interaction point (hatched areas). The projection of the transverse distances of the scattered protons for three different t values and for $x_{I\!P} = 10^{-2}$ are given by the shaded areas. The vertical arrow indicates the position for the new Roman pots .

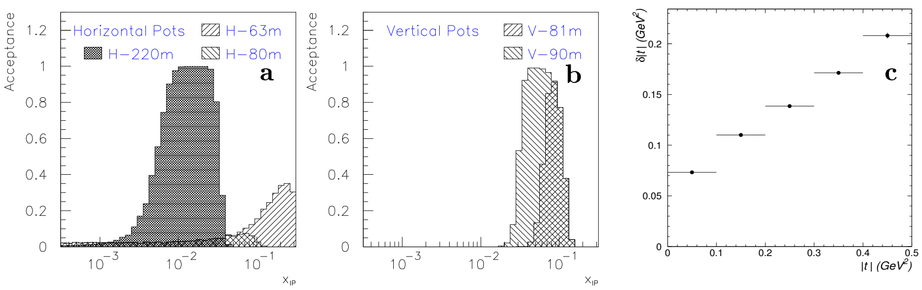

Figure 2: a) and b): acceptances of all present and proposed (220m) FPS as a function of $x_{I\!P}$ for the vertical and horizontal stations respectively. c) resolution of t as a function of t.

The installation of the high acceptance proton spectrometer will thus

[b] t beeing the four-momentum transfer squared at the proton vertex

provide remarkable improvements in the study of diffraction: genuine elastic events not contaminated by proton dissociation can be selected with high acceptance, in particular, for high transverse momentum jets and charm analysis. On top of that, measurements of basic importance can be performed: determination of the longitudinal cross section using the measurement of the azimuthal angle of the scattered proton and measurement of the fully differential $F_2^{D(4)}$ structure function, including its t-dependence down to the lowest t values.

2 Roman Pot detectors

The proton spectrometer (PS) is a set of two "Roman pots". Each pot consists of an insert into the beam pipe, allowing two tracking detectors equipped with scintillating fibres to be moved very close to the proton beam.

The Roman pots will be installed in the "cold" part of the HERA proton ring, which is equipped with superconducting magnets. However, in order to access the beam pipe with Roman pot detectors, the proton beam line has to be at room temperature. This implies that the beam pipe has to be separated in this area from the cold elements of the drift tube, and a bypass has to be installed to transport horizontally the helium lines to the next cold section [2].

Many aspects of the design of the Roman pots, including the stainless plunger vessel and the scintillating fibre detectors, are adaptations of the existing proton spectrometer, FPS [3], installed and operational in H1 since 1994. Both detectors of each Roman pot consists of two planes of scintillating fibres perpendicular to the beam line direction and oriented at $\pm 45^0$ from the horizontal direction. Each detector thus provides the reconstruction of the position of one impact point of the scattered proton trajectory with a precision of about 100 μm, leading (after inclusion of the beam spread effect) to the resolution shown above.

The installation should take place during 2001-2002, so that data taking with the new proton spectrometer will start in 2003.

References

1. M. Arneodo, these proceedings.
2. *Proposal for Installation of a Very Forward Proton Spectrometer in H1 after 2000*, Proposal submitted to the Physics Research Committee, **PRC-01/00**, H1 note **H1-05/00-582**, http://web.iihe.ac.be/h1pot/
3. *Upgarde of the H1 Forward Spectrometer*, **PRC-96/01**