VFPS addendum

Impact of t and $x_{I\!P}$ resolution on VFPS physics program

During the meeting on 11/7/2000 regarding the VFPS proposal, R.Klanner submitted the following question to the VFPS group for futher clarification:

How does the $x_{I\!P}$ and t-resolution affect the VFPS physics program ?

In the present addendum we will try to answer this question and we will also add a paragraph on the rejection of the proton dissociation background because of its importance in the VFPS program.

The $x_{I\!P}$ resolution

As stated in the VFPS proposal, the $x_{I\!P}$ measurement obtained with the VFPS detector alone has a resolution of about 8% and is quite independent of $x_{I\!P}$. This resolution is far better than the one obtained from the central H1 detector information which is 20%. Hence the VPFS physics program would only benefit from this improved resolution. The worst case scenario ($\sigma_{x_{I\!P}} \approx 20\%$) would coincide with the quality of the present H1 analysis as far as the $x_{I\!P}$ resolution is concerned with the additional benefit that we can cross check the $x_{I\!P}$ reconstruction.

The t-resolution

The VFPS has been optimised for acceptance, not particularly for resolution. As

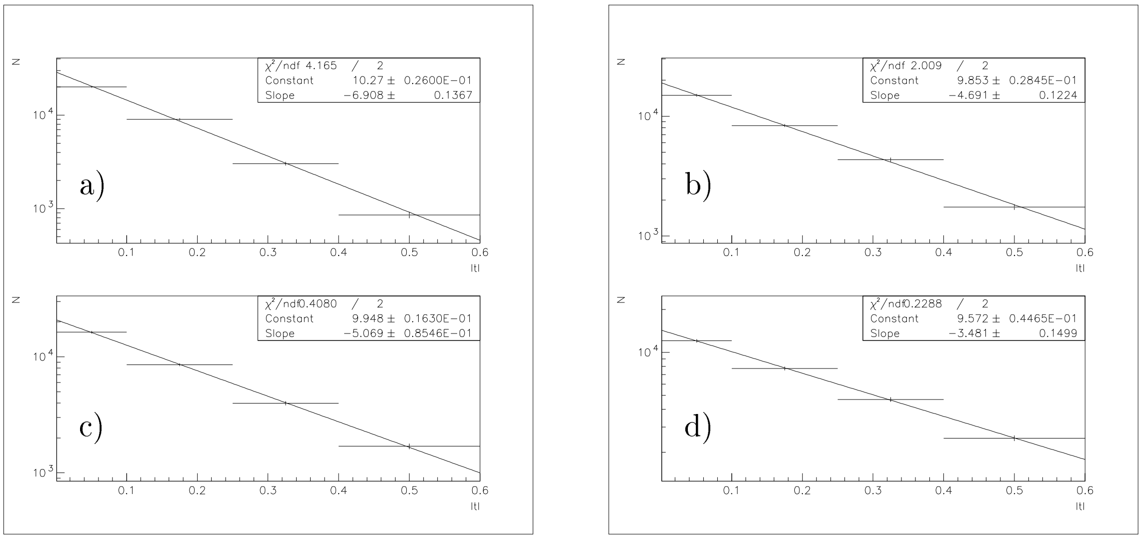

Figure 1: Generated (a,b) and reconstructed (c,d) t-distributions for two different t-slope values 4.7 GeV^{-2} and 7 GeV^{-2}.

a result, the t-resolution of the VFPS is inferior to the resolution of the LPS and there is no competition at this level. Nevertheless, as stated in the proposal, we expect that with this inferior resolution we still can perform differential measurements with 3 to 4 bins in t. As an example, we want to show here that the VFPS could answer one of the presently pressing questions as to what is the size of the interacting dipole in diffraction. Discrimination between a typical large/small size object requires a t-slope measurement which differentiates between values of $b = 4.5$ GeV^{-2} and b=7 GeV^{-2}. That these measurements are perfectly whithin reach of the VFPS project is shown by the plots in fig 1. Fig.1.a,b show for jet events, the generated t-distributions with t-slopes of resp. 4.7 GeV^{-2} and 7 GeV^{-2}. Fig.1.c,d show the reconstructed t-distributions. The t-slope with a value of b_{gen}=7 GeV^{-2} is reconstructed to a value of $b_{rec} = 5.1 \pm 0.1$ GeV^{-2} while for $b_{gen} = 4.7$ GeV^{-2} a value of $b_{rec} = 3.5\pm$ 0.2 GeV^{-2} is found. These estimates indicate that discrimination between the different t-slopes is possible, although the difference between the generated and reconstructed values, related to the exponential fall of the t-distribution, is sizeable. Full understanding/control of these differences requires thorough understanding of the detector alignment method which, as explained in the proposal, in turn depends on the beam parameters and beam(pipe) acceptance. As a complete beam line simulation is presently not available, full control of these differences are hard to obtain.

Diffraction dissociation

Fig.2 shows the $F_2^{D(3)}$ measurements for a typical (β, Q^2) bin. As mentioned in the

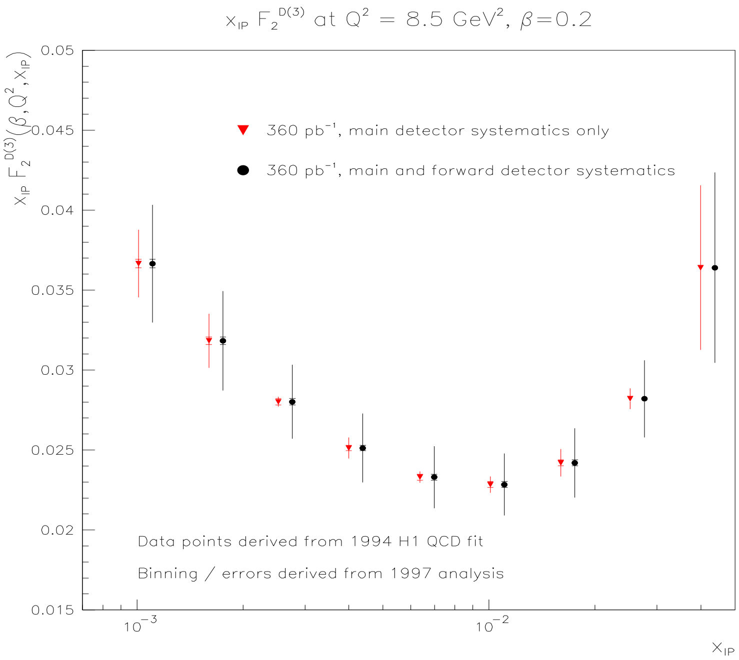

Figure 2: $F_2^{D(3)}$ measurements derived from the 1994 H1 QCD fit with statistical errors scaled to 360 pb^{-1}. The data points are shown with two different sets of systematics: intrinsic detector systematics only (triangles) and intrinsic detector systematics plus systematics due to the present forward detectors.

proposal, the proton dissociation background affects all diffractive analysis. To emphasize the importance of the rejection of this background with VFPS we examplify this by the $F_2^{D(3)}$ measurements. The two sets of data points shown (slightly displaced in $x_{I\!P}$ for visibility) are derived from the 1994 H1 QCD fit for which the statistical errors are scaled to the expected integrated VFPS luminosity of 360 pb^{-1}. The first set of data points (inverted triangles) are represented with systematic errors resulting from the central detector systematics only i.e. energy calibration LAr, SPACAL.. For the second data set (dots) the full systematics are displayed including in addition to the central detector systematics, the systematics related to the present forward detector tagging. As can be observed, the forward detector systematics are clearly dominating the systematics everywhere. Tagging of the diffractive proton with the VFPS will hence result in a dramatic reduction of the systematics and vastly improve the measurements. By the same token, the current assumption that proton dissociation background is uniformly distributed in kinematical variables, which is highly questionable and challenged by available data, is thereby also removed.