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Form Factor at χ_0 scan energy.

In the second version of the form factor draft we used all events selected in the energy range of the χ_0 to calculate only one value of the form factor around this energy. Looking at the statistics of the data collected around the energy of the χ_0 we are able to understand that it is possible to use all these events together. We have also to proof that the contamination from $J/\psi X$ is negligible. At this point, in order to estimate the background contamination, we cannot use the method used in the first draft, because now we use all events. The only way to estimate the background contamination at χ_0 energy is to use the same method used in the background evaluation at h_c energy.

1 All point together at χ_0 scan energy.

The problem about how many form factor points we have to consider around the energy of the χ_0 can be solved looking at the integrated luminosity accumulated at each energy. In Fig. 1 accumulated luminosity and number of form factor events versus the energy are shown, in the energy range around the χ_0.

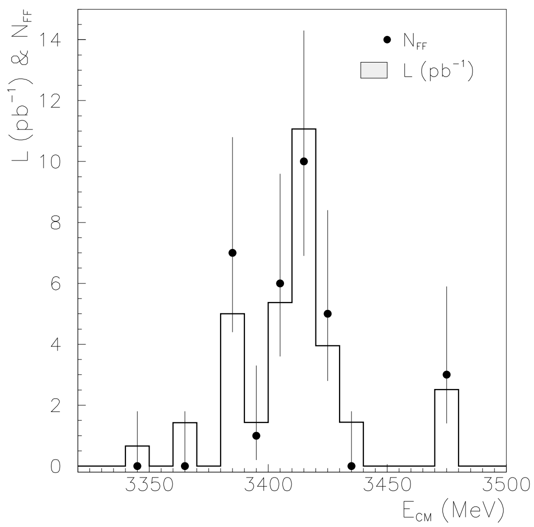

Figure 1: Accumulated luminosity and form factor events versus energy, in the range of the χ_0.

If the distribution of the energy, at which data has been taken, was flat one could divide the range in more parts to calculate the form factor at different energies. Since the distribution shows a behaviour peaked about at 3420 MeV, then it makes sense to use all form factor events selected in the range of the χ_0 to calculate only one point.

2 Inclusive J/ψ contamination.

We define the expected background contamination at certain value of s from $J/\psi X$ events as:

$$\sigma^{'}_{J/\psi X}(s) = \alpha \times \sigma_{\overline{p}p\to J/\psi X}(s) \tag{1}$$

where $\alpha = (1.3 \pm 1.3) \times 10^{-3}$ is the probability, for an inclusive event, of satisfying two-body kinematics [1]. While $\sigma_{\overline{p}p\to J/\psi X}(s)$ is the ratio between the number of $J/\psi X$ events and the luminosity selected from other analysis in the same energy ranges.
In the following two paragraphs we show the values of $\sigma^{'}_{J/\psi X}(s)$ at the energy of the χ_0 and of the h_c.

2.1 Inclusive J/ψ at χ_0

From the paper [1] we find that in the energy region between 3339.5 MeV and 3469.9 MeV there are 392 of $\chi_0 \to J/\psi\gamma$ events ($N_{J/\psi X}$) with an integrated luminosity of 32.79 pb^{-1} (L_{χ_0}), then we define $\sigma_{\overline{p}p\to J/\psi X}$ as:

$$\sigma_{\overline{p}p\to J/\psi X}(s = 11.63\ \mathrm{GeV}^2) = \frac{N_{J/\psi X}}{L_{\chi_0}} = 12\ \mathrm{pb} \tag{2}$$

then, from the (1), the expected background contamination at $s = 11.63\ \mathrm{GeV}^2$ is:

$$\sigma^{'}_{J/\psi X}(s = 11.63\ \mathrm{GeV}^2) = 1.6 \times 10^{-2}\ \mathrm{pb} \tag{3}$$

2.2 Inclusive J/ψ at h_c

In the same way used for the χ_0 we estimate the expected background cross section at $s = 12.43$ GeV^2. For this energy we use the results from the paper [2]. Now $N_{J/\psi X} = 122$ is the sum of the $J/\psi\gamma$ (55) and $J/\psi\pi^0$ (67) events in the energy range between 3524.3 MeV and 3526.2 MeV, with an integrated luminosity of 15.9 pb^{-1} (L_{h_c}), then, as before, we define $\sigma_{\overline{p}p\to J/\psi X}$ as:

$$\sigma_{\overline{p}p\to J/\psi X}(s = 12.43\ \mathrm{GeV}^2) = \frac{N_{J/\psi X}}{L_{h_c}} = 8\ \mathrm{pb} \tag{4}$$

then, from the (1), the expected background contamination at $s = 12.43\ \mathrm{GeV}^2$ is:

$$\sigma^{'}_{J/\psi X}(s = 12.43\ \mathrm{GeV}^2) = 1.0 \times 10^{-2}\ \mathrm{pb} \tag{5}$$

References

[1] S. Bagnasco et al.(2002). *New Measurements of the Resonance Parameters of the χ_{c0} (1^3P_0) State of Charmonium.* Phys. Lett. B **533**, 237.

[2] T.A. Armstrong et al.(1992). *Observation of the $^1P_1$ State of Charmonium.* Phys. Rev. Lett. **69**(16),2337-2340.

[1] α has been evaluated at the χ_1 resonance, in $J/\psi\gamma$ decays in which the photon is not detected, selected requiring $Prb(J/\psi X) > 1\%$, $Prb(e^+e^-) > 10\%$ and only two clusters.