TWO STEP EFFECTS BY DI-ELECTRON PRODUCTION IN P-P AND D-P REACTIONS

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O U T L O O K

I. Motivation to study the di-electron production in $p-p$ and $d-p$ processes at intermediate energies

II. Conventional analysis of di-electron production in $p-p$ and $d-p$ reactions

III. FSI effect in $pp \to e^+e^-X$ process

IV. FSI contribution in $dp \to e^+e^-X$ reaction

V. Di-electron production in $np \to e^+e^-X$ process

VI. Summary

$p\ p \to e^+e^-\ X$

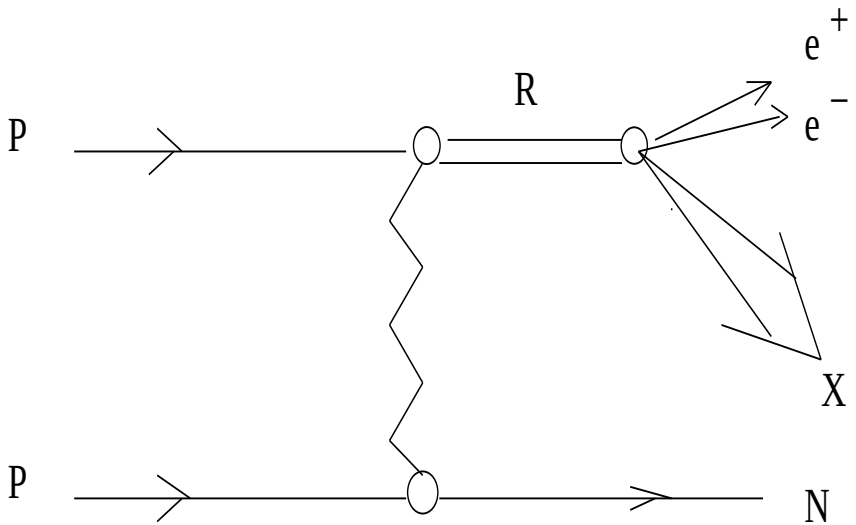

Figure 1: Di-electron production in $p-p$ collision

Dilepton production within the resonance model

$$B\ B \to R\ X\ ,\ R \to e^+e^-\ X\ or\ R \to R'\ X\ ,\ R' \to e^+e^-\ X$$

(*E.L.Bratkovskaya, W.Cassing and U.Mosel, Nucl.Phys.,***A686**,*568 (2001); L.P.Kaptari and B.Kaempfer,Nucl.Phys.,* **A764**,*338 (2006)*)

FSI in $p\ p \to e^+e^-\ pp$

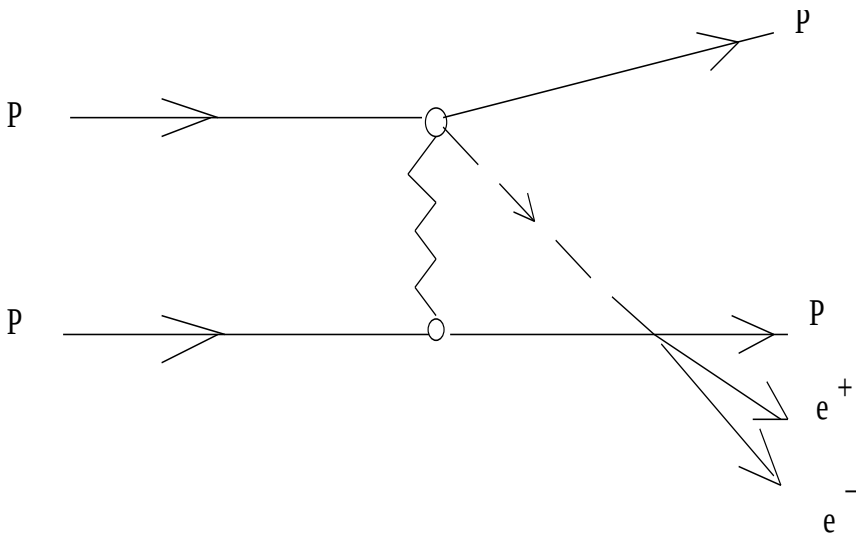

Figure 2: Di-electron production in $p - p$ collision

Estimation of FSI in $p\ p \to e^+e^-\ pp$

$$\frac{dN_{pp}^{FSI}}{dm_{ee}} = \frac{dN_{pp}^{0}}{dm_{ee}} + w_{\pi^+}\frac{dN_{\pi^+ n}}{dm_{ee}} + w_{\pi^0}\frac{dN_{\pi^0 p}}{dm_{ee}}\ ,$$

where $w_{\pi^+} = \frac{\sigma_{pp\to\pi^+np}}{\sigma_{pp}^{tot}}$ and $w_{\pi^0} = \frac{\sigma_{pp\to\pi^0pp}}{\sigma_{pp}^{tot}}$

FSI effect in $p\ p \to e^+e^-\ pp$

Assuming that $dN_{\pi^+p}/dm_{ee} \simeq dN_{\pi^0 p}/dm_{ee}$ we have

$$\frac{dN_{pp}^{FSI}}{dm_{ee}} \simeq \frac{dN_{pp}^{0}}{dm_{ee}}(1 + w_\pi \alpha_\pi(E_p)) \ ,$$

where $\alpha = \frac{dN_{\pi^+p}/dm_{ee}}{dN_{pp}^0/dm_{ee}}$ and $w_\pi = \frac{\sigma_{pp\to\pi^+np} + \sigma_{pp\to\pi^0pp}}{\sigma_{pp}^{tot}}$

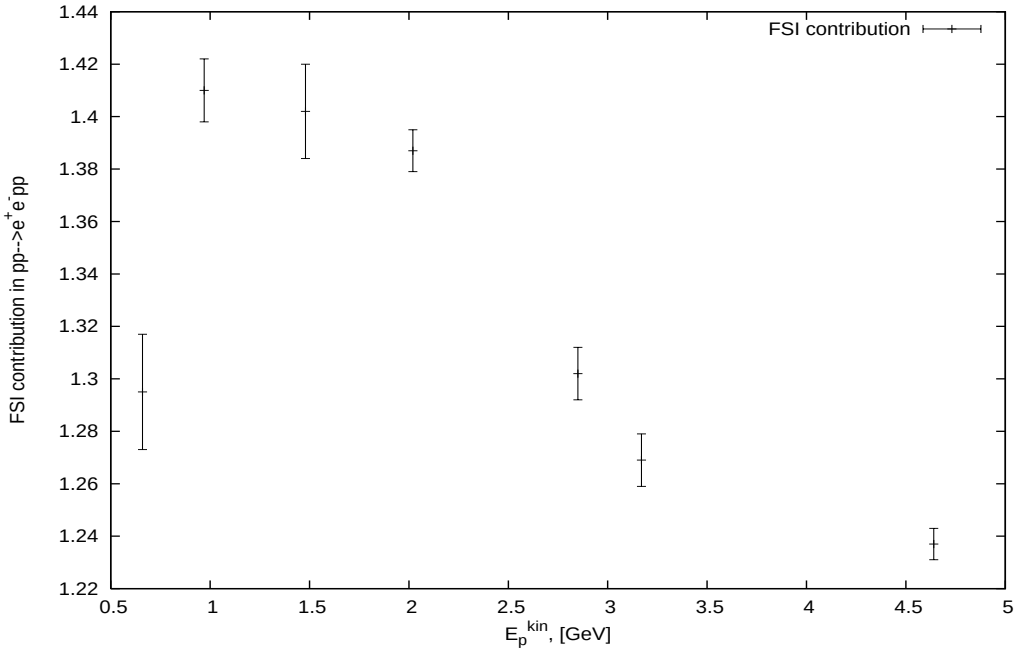

Figure 3: FSI effect for $pp \to e^+e^-pp$ process as a function of the kinetic energy of proton E_p^{kin}

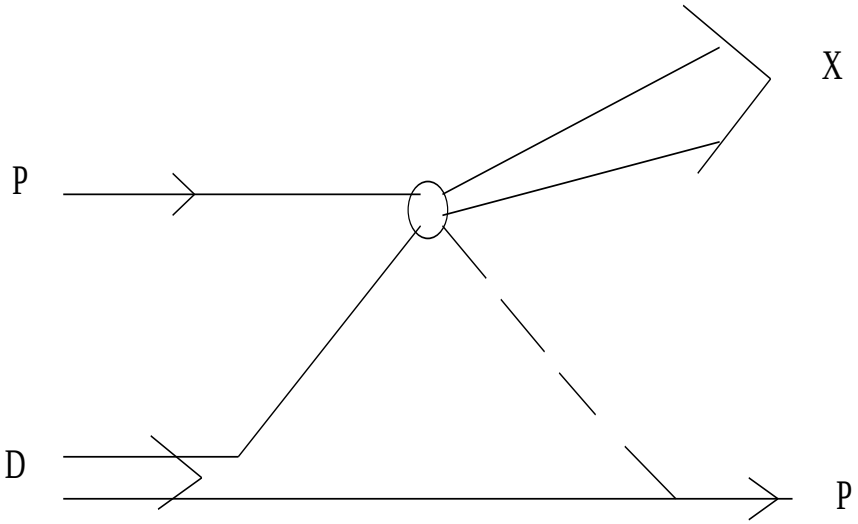

Figure 4: Reaction $dp \to pX$

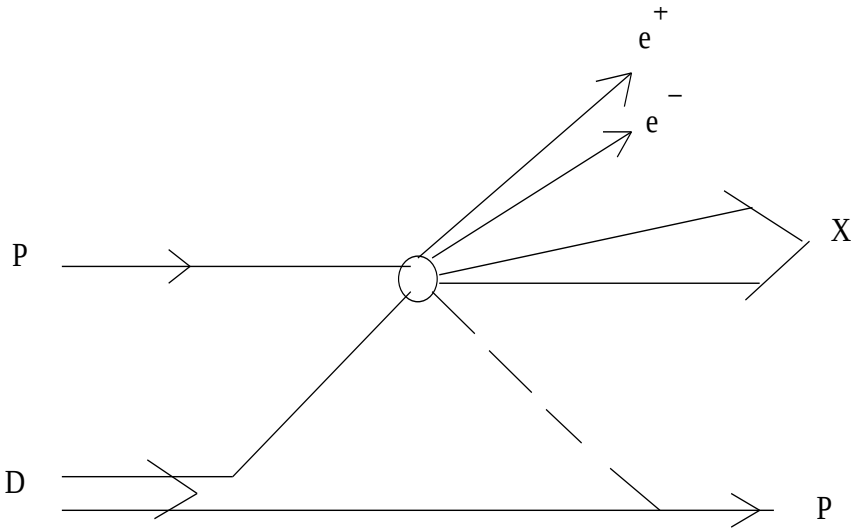

Figure 5: Reaction $dp \to pX$

FSI in $d\ p \to e^+e^-\ ppn$

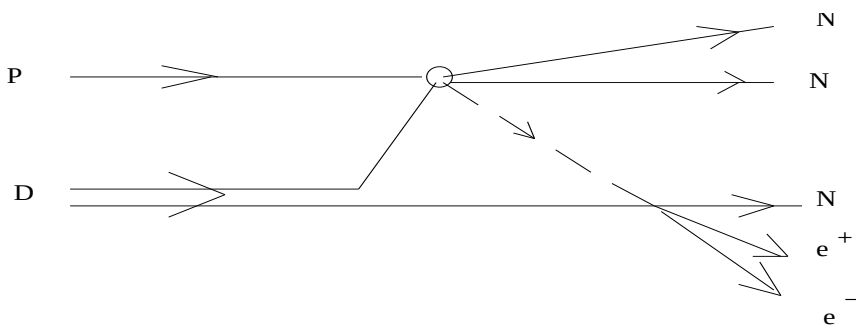

Figure 6: FSI for the di-electron production in $d - p$ collision

Estimation of FSI in $d\ p \to e^+e^-\ ppn$

$$\frac{dN_{dp}^{FSI}}{dm_{ee}} = \frac{dN_{pp}^{0}}{dm_{ee}} + \frac{dN_{np}^{0}}{dm_{ee}} + \delta^{FSI} \ ,$$

FSI effect in $d\ p \to p\ d$

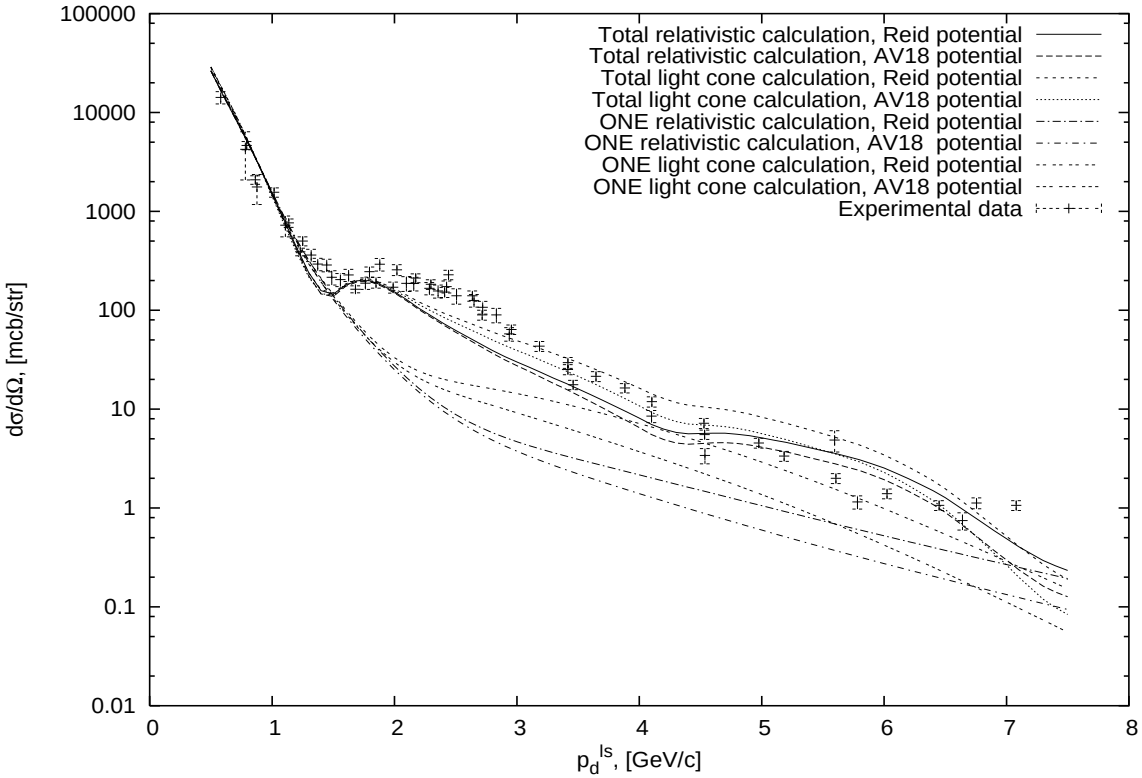

Figure 7: Differential cross section for elastic backward $d-p$ scattering as a function of the initial deuteron momentum $p_d^{l.s.}$

(*A.P.Ierusalimov, G.L., M.Viviani, talk at the EFB20 Conference, 9-14 September 2007; M.G.Dolidze, G.L., Z.Phys.A***335***,95 (1990); ibid. Z.Phys.A***336***,339 (1990); G.L.EPAN,* **24***, 140 (1993).*)

FSI effect in $d\ p \to e^+e^-\ ppn$

where

$$\delta^{FSI} = < r_d^{-2} > (\sigma_{pp\to\pi^+pn}\frac{dN_{\pi^+n\to e^+e^-p}}{dm_{ee}} + \sigma_{pp\to\pi^0pp}\frac{dN_{\pi^0n\to e^+e^-n}}{dm_{ee}} + \sigma_{np\to\pi^-pp}\frac{dN_{\pi^-p\to e^+e^-n}}{dm_{ee}} + \sigma_{np\to\pi^0np}\frac{dN_{\pi^0p\to e^+e^-p}}{dm_{ee}}$$

Approximately we have

$$\frac{dN_{dp}^{FSI}}{dm_{ee}} = \frac{dN_{pp}^0}{dm_{ee}} + \frac{dN_{np}^0}{dm_{ee}} + 4 < r_d^{-2} > \sigma_{NN\to\pi NN}\frac{dN_{\pi N}}{dm_{ee}}\ ,\ R_{dp}^{FSI} \simeq 1 + 4 < r_d^{-2} > \sigma_{NN\to\pi NN}(E_p)$$

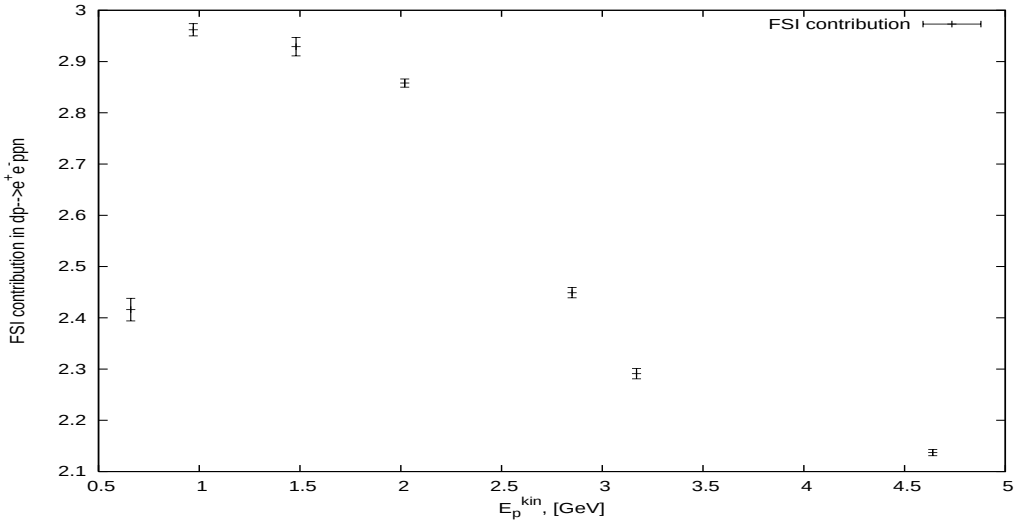

Figure 8: FSI effect for $dp \to e^+e^-ppn$ process as a function of the kinetic energy of proton E_p^{kin}

SUMMARY

I. The conventional approach describing e^+e^- *production in* $p-p$ *and* $d-p$ *collisions is the so called resonance model.*

II. It does not include the FSI effects.

III. The inclusion of the FSI contribution can increase dN/dm_{ee} *by factor 1.5 at* $E_p^{kin} \simeq 1.(GeV)$ *and* $m_{ee} > 0.2GeV/c^2$ *for* $pp \to e^+e^-X$ *process.*

IV. The FSI contribution for $dp \to e^+e^-NNN$ *reaction can increase the* m_{ee}*-spectrum by factor 3 at* $E_p^{kin} \simeq 1.(GeV)$ *and* $m_{ee} > 0.2GeV/c^2$.

V. To extract the m_{ee}*-spectrum in* $np \to e^+e^-X$ *process from* $dp \to e^+e^-X$ *reaction at kinetic energies close to* $1(GeV)$ *we have to include the FSI effect.*

VI. The FSI contribution falls down when the initial energy increases.