

# PHI 13 PSI 13

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## Final state Coulomb interaction and asymmetry of pair production close to threshold in $e^+e^-$ annihilation.

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We investigate a contribution of the  $d$  wave to the cross section of  $e^+e^-$  annihilation to the pair of charged leptons or nucleons close to threshold of the process.

In contrast to the point of view accepted in literature, due to the Coulomb final state interaction this contribution does not vanish even at zero relative velocity of produced particles. This results in the nonzero asymmetry in angular distribution at threshold. Though value of the asymmetry is small, observation of this effect is not hopeless.

### Summary

We have calculated the asymmetry in angular distribution of pair production in  $e^+e^-$  annihilation taking into account the Coulomb FSI. It is shown that the asymmetry does not vanish in the limit  $\beta \rightarrow 0$ . The origin of this anomaly is the singularity of the “dressed” Dirac form factors  $calF_1$  and  $calF_2$  at  $\beta \rightarrow 0$ , see Eq. (ref{calf1f2}).

The corresponding electromagnetic Sachs form factors  $G_E$  and  $G_M$  are not singular, but  $G_E \neq G_M$  at  $\beta \rightarrow 0$ . The effect is non-perturbative, since in this limit  $\alpha/\beta \gg 1$ . This very nonzero difference  $G_E - G_M$  at  $\beta \rightarrow 0$  provides nonzero asymmetry at threshold. Although the value of the asymmetry is small for electromagnetic Coulomb interaction ( $\sim \alpha^2/24$ ), the asymmetry for heavy quark pair production, where the Coulomb-like strong interaction must be considered, can be noticeable.

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