Proton and antiproton beam polarization due to spin filtering by a polarized hydrogen target

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LAYOUT

I. INTRODUCTION

II. CROSS SECTIONS

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Introduction

(V.F. Dmitriev, A.I. Milstein and V.M. Strakhovenko, arXiv:0707.3006v1)

- Only proton polarization in a target is important
- Beam polarization is completely due to filtering mechanism
- Cross sections are obtained using the standard partial-wave analysis

Paris nucleon-antinucleon optical potential $V_{N\bar{N}}$

$$V_{N\bar{N}} = U_{N\bar{N}} - iW_{N\bar{N}}$$

is used with the latest set of parameters

For pp interaction, the cross section

is a sum $\sigma = \sigma_{ann} + \sigma_{coh} + \sigma_{el}$

Remember that

$$\sigma = \sigma_0 + (\zeta_1 \cdot \zeta_2)\,\sigma_1 + (\zeta_1 \cdot \nu)(\zeta_2 \cdot \nu)\,(\sigma_2 - \sigma_1)$$

Quantization axis is chosen along $\nu = p/p$

Then

$S=1$

and

$S=0$

$$\sigma_0 = \frac{1}{2}\Sigma_{11} + \frac{1}{4}(\Sigma_{10} + \Sigma_{00})$$

$$\sigma_1 = \frac{1}{4}(\Sigma_{10} - \Sigma_{00}),$$

$$\sigma_2 = \frac{1}{2}\Sigma_{11} - \frac{1}{4}(\Sigma_{10} + \Sigma_{00})$$

Potential used is a sum of  and Coulomb potential, so that the elastic scattering amplitude is a sum of strong and electromagnetic amplitude

$$F = F_h + F_{em}$$

In the nonrelativistic limit $F_{em} = f_C(\vartheta)$ for both, triplet and singlet states

Then each cross section

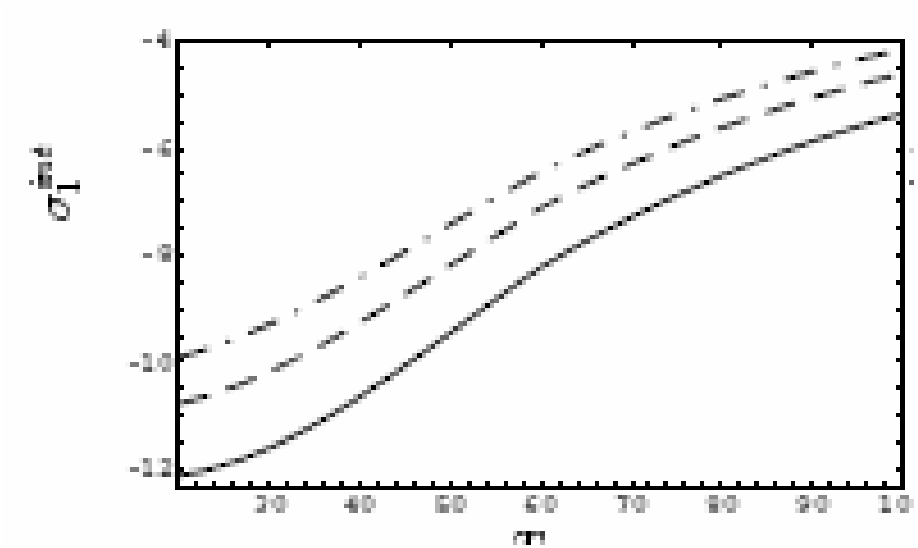
$$\Sigma_{mn} = \Sigma_{mn}^{h} + \Sigma_{mn}^{C} + \Sigma_{mn}^{\mathrm{int}}$$

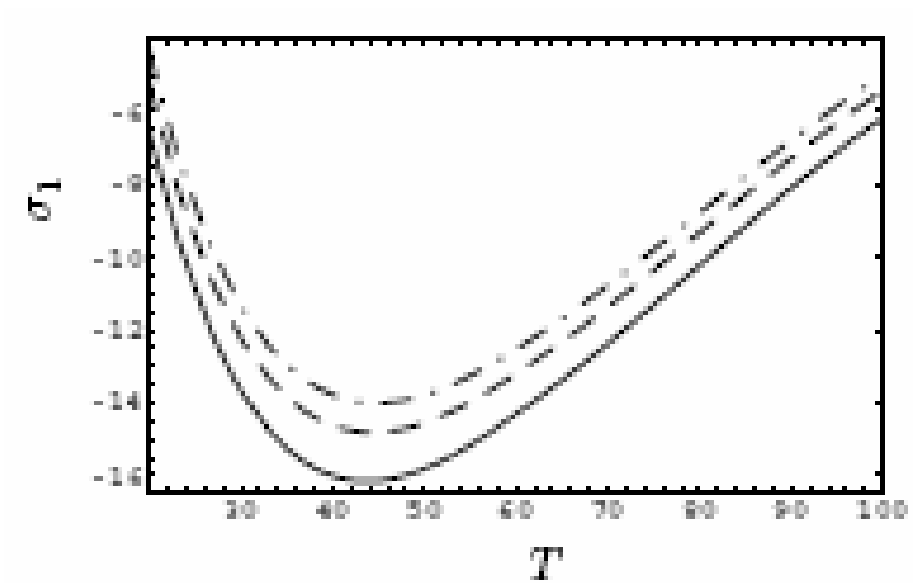
So far interference terms for anti-p are calculated with logarithmic accuracy

$$\Sigma_{mn}^{\text{int}} = 4\pi \,\text{Re} \int_{\vartheta_{acc}} d\vartheta \sin\vartheta f_C^*(\vartheta) F_{mn}^h(\vartheta)$$

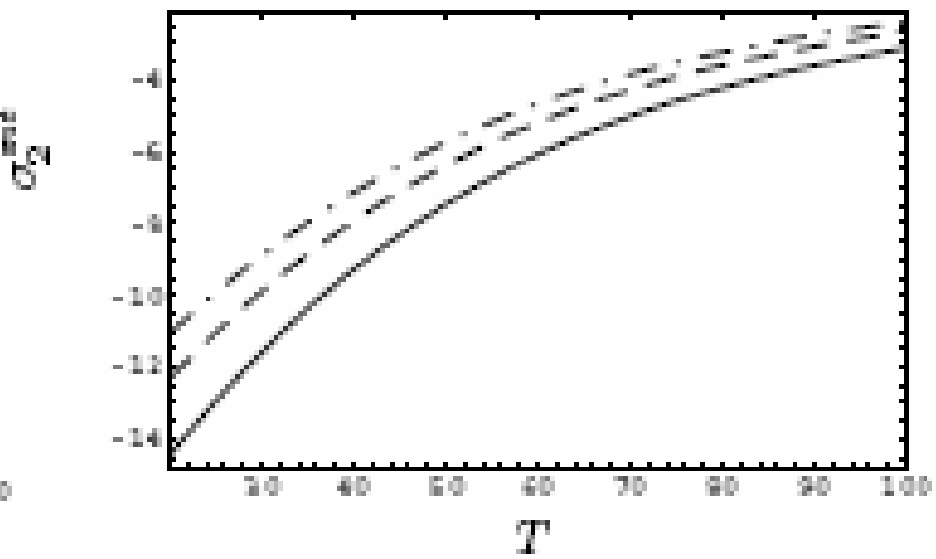
In log approx we change $F_{mn}^h(\vartheta) \to F_{mn}^h(0)$

For protons the accuracy was about 1% for σ_1^{int} and about 7% for σ_2^{int}





Interference term is of the same order as the strong contribution to $\sigma_{1,2}$



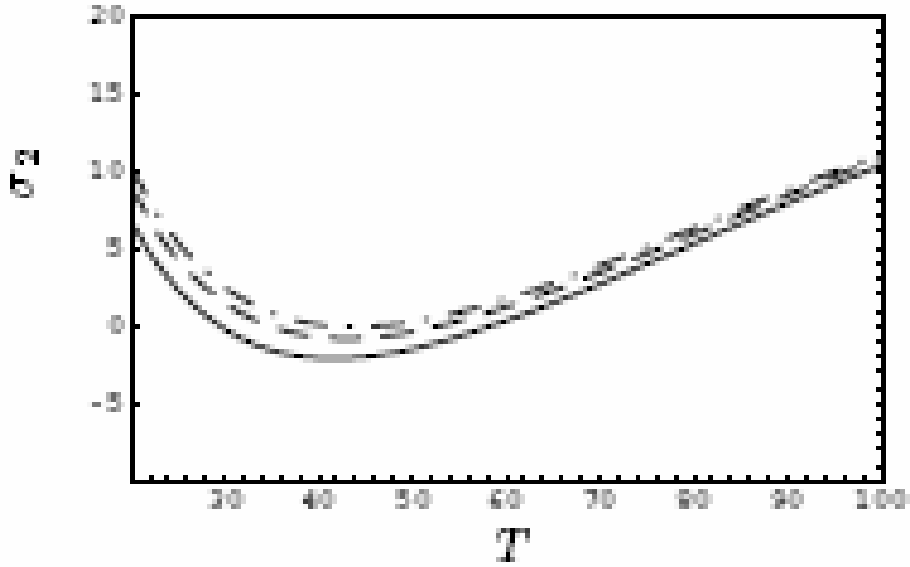
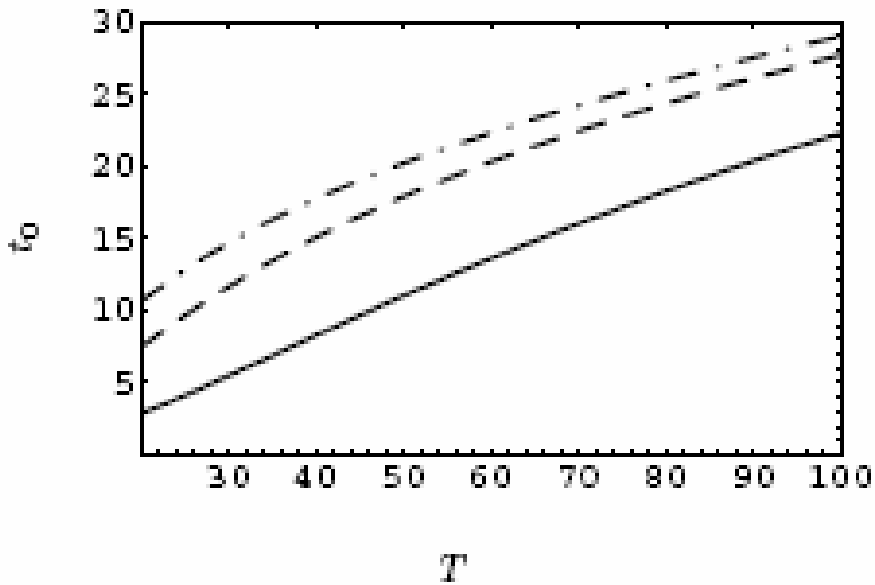


Figure Of Merit is maximal at $t_0 = 2\tau_b$



t_0 is shown for

$n = 10^{14} cm^{-2}$ and

$f_{rev} = 10^6 \sec^{-1}$

Beam polarization at $t = t_0$ for $P_t = 1$