

# Sudakov Suppression of Azimuthal Spin Asymmetries

Daniël Boer\*

RIKEN-BNL Research Center  
Brookhaven National Laboratory  
Upton, New York 11973, U.S.A.

## Abstract

We will demonstrate that transverse momentum dependent azimuthal spin asymmetries, like the Collins effect asymmetry, generally suffer from suppression due to Sudakov factors. This means that tree level estimates of such asymmetries tend to overestimate the magnitude. This observation will be illustrated by two examples, which are relevant for present day studies. In these examples the inclusion of Sudakov factors cause suppression by at least an order of magnitude compared to the tree level result. Moreover, this suppression increases with energy approximately as a fractional power, numerically found to be  $\alpha \approx 0.3$ .

The first example [1] is a helicity non-flip double transverse spin asymmetry in vector boson production, relevant for instance for the polarized proton-proton collisions to be performed at RHIC. In this case, the Sudakov suppression (on top of a kinematical suppression) implies that the asymmetry will be negligible for  $Z$  or  $W$  production at RHIC. On the other hand, this opens the way towards studies of physics beyond the Standard Model using the spin observable  $A_{TT}^W$ .

The second example is a Collins effect driven  $\cos(2\phi)$  asymmetry in electron-positron annihilation into two almost back-to-back pions [2], which in principle can be determined from existing LEP data. Such a determination of the Collins effect fragmentation function would be useful for the extraction of the transversity distribution function. However, the Sudakov suppression casts some doubt on the actual determination [3] of the Collins fragmentation function from LEP data. The same does not hold for a similar determination of the interference fragmentation functions from LEP data which is therefore much more promising.

[1] D. Boer, hep-ph/0004217, to appear in Phys. Rev. D.

[2] D. Boer, R. Jakob, P.J. Mulders, Phys. Lett. B 424 (1998) 143.

[3] A.V. Efremov, O.G. Smirnova, L.G. Tkachev, Nucl. Phys. B (Proc. Suppl.) 74 (1999) 49.

---

\*e-mail: dboer@bnl.gov