6 Upgrade possibilities

Spin offers unique degrees of freedom which can be exploited to search for new phenomena, for instance by measuring parity violating or CP violating asymmetries which are only available for polarized beams. The exploitation of such asymmetries which are zero or suppressed in the standard model (SM or MS) provides a new and very clean way to look for physics which may be present beyond the standard model (BSM). An example is a proposed quark-quark contact interaction which would be observable in high p_T jet production, but tends to be obscured by the standard QCD processes which are parity conserving. The intriguing feature of BSM processes with a scale $\Lambda \gg M_W$ is that they generally violate parity or, like supersymmetry, have different spin signatures than the SM processes. The parity violating signature allows RHIC, with a luminosity upgrade, to have greater sensitivity than the TEVATRON because the background from the SM parity violatiting W-gluon interference is considerably smaller and has less uncertainty than the pure QCD calculation. Furthermore, any residual uncertainty can be calibrated out using the measured parity violation at the $W \to$ jet peak, ~ 40 GeV (see Fig. 1 curve 'MS').

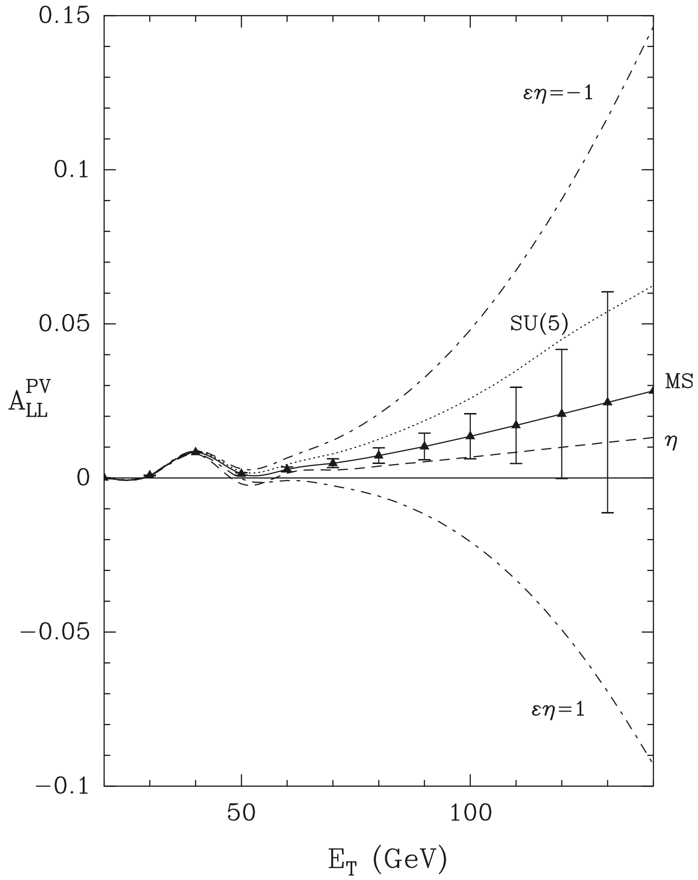

Figure 1: Asymmetry A_{LL}^{PV} for inclusive one-jet production from hep-ph/9707470

The limits of sensitivity for Λ in the contact model of quark compositeness are shown in Table 1 for the standard $L \sim 1$ fb^{-1} integrated luminosity of the first 6-year RHIC-spin run plan. The limits increase siginificantly with factors of 10 and 100 increase in luminosity (but for this reaction, are not much improved with increasing c.m. energy). For comparison, at the Tevatron, sensitivity is $\Lambda \sim 4$ TeV for $L = 2$ fb^{-1} (Run II) and 5 TeV for 30 fb^{-1} (Run III).

$\sqrt{s}$ GeV	L(fb^{-1})	Λ (TeV)
500	1	3.3
500	10	5.5
500	100	7.5
650	1	3.8
650	10	6.3
650	100	8.8

Table 1: Limits on $\Lambda(\epsilon = -1)$ at 95% CL, P=0.7, $\Delta\eta = 1$, 10% systematic error in Asymmetry

An energy upgrade to 650 GeV is more important to other reactions, in particular structure function measurements of neutrons using $W^{\pm}$ and Z production in polarized n-p collisions using ^{3}He and for transversity tests with $W^{\pm}$ and Z^{0} as noted by Soffer in hep-ph/9802301 and Vogelsang et al in CERN-TH/97-270.