Determinations of α_s from hadronic width of W and Z at TLEP

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Present value: without Lattice result.
$\alpha_s(M\_z) = 0.1183 \pm 0.0012$

1. From W hadronic width $B_h \equiv (\Gamma_{had,} / \Gamma_{tot})_W$

WW→ lv lv /(all WW) = $(1-B_h)^2$
WW→ lv qq /(all WW) = $2.B_h\ (1-B_h)$
WW→ qq qq /(all WW) = B_h^2

Present value at LEP ($4x10^4$ WW events) $B_h = 67.41 \pm 0.27$
Model dependence: assumption on unitarity of CKM matrix
(alternatively best experimental constraint on V_{cs}) (see arXiv:1302.3415)

With 0.5 10^8 W pairs, and assuming selection efficiency errors scale with statistics, expect reduction of error by factor ~70. Then extract value of αs(M_W) with error
$\alpha_s(M\_W) = 0.11xxx \pm 0.00018$ (reduction by factor 6 wrt present value)

NB ILC limited to one order of magnitude higher.

2. From Z hadronic width $R_l = \Gamma_{Z\to had} / \Gamma_l$

Present value at LEP (2×10^7 Z decays) 20.767 ± 0.0027 limited by lepton statistics.
0.1190 ± 0.0027
Model dependence: assumption on vector couplings of u,d,s.
Also sensitive to δ_b EW vertex correction to Z-> bb decay.

With 10^{12} Z decays, and assuming selection efficiency errors scale with statistics,
expect reduction of error by factor ~200!
At this level of precision many other effects come into the picture and a more detailed analysis is necessary – main worry are extreme QED effects that would affect topology/detection efficiency for lepton final state . Direct extraction of Rb constrains δ_b --> not a limitation.

➔ Error on value of $\alpha_s(M\_Z)$ extracted from Z hadronic width has a statistical potential at 10^{-5} level. Obtaining
$\alpha_s(M\_Z) = 0.11xxx \pm 0.0001$ (reduction by factor 30 wrt present value)
Seems feasible but lots of work, and not excluded that a better result could be obtained.

NB ILC limited to improvement by factor 7 (GigaZ)