Top Quark Production – (Brief) Theoretical Summary: (S.D. Ellis)

- Extra Radiation – effects the final state and event reconstruction

1. Influence on M_{TOP} reconstruction – L. Orr
   Perturbative study of events with extra jet (E_T > 15 GeV, ΔR > 0.4)

   Three sources: Production stage radiation (t's before onshell)
   Decay stage radiation: b & t (after onshell)
   q's from W decay

   Want to include only decay stage but have similar kinematic distributions so difficult to separate!

   Test influence by NOT including the lowest E_T jet in reconstruction of TOP mass [in events with 3rd jet, the lowest E_T jet is gluon 55% of time]

   ⇒ Results in shoulder on low mass side of peak for lepton + jets

   ⇒ Likely to become important as statistics improve - maybe can fit to this expected shape – (see next item)

2. Include matrix element corrections in MC – M. Mangano (for Corcella & Seymour) – currently for $e^+e^- \to t\bar{t}$;

   ⇒ Now agrees with perturbative calculations to good precision

   ⇒ Predict that $p\bar{p} \to t\bar{t}$ MC with corrections will exist in 1 year!! Will allow full analysis of events with extra jet

3. Crosstalk/Interference from various types of emissions – V. Khoze

For example, in $e^+e^- \to b\bar{b}W^+W^-$, the $b\bar{b}$ pair must communicate in order to generate a color singlet system of hadrons

$\Rightarrow$ Only important for soft gluons ($k < \Gamma_{TOP}$)

$\Rightarrow$ Impact on M_{TOP} analysis $\sim (\alpha_s/\pi)\,\Gamma_{TOP} \sim 100$ MeV

$\Rightarrow$ Will be many sources of crosstalk in full hadronic event (including debris of incident protons) –
Predict full uncertainty in M_{TOP} analysis < 2 GeV!!

- Soft Radiation summation in cross section – K. Ellis

Issue for sub-energy near threshold, includes Coulomb potential ($1/\beta$) and Sudakov form factor ($\ln \beta$ & $\ln^2 \beta$)

Must integrate over sub-energy through the Landau pole (where coupling blows-up) yielding an asymptotic series – the next term in truncated series is of magnitude $\sim \Lambda/Q$ – so need to control power corrections

Another issue is the role of sub-leading terms resulting from Mellin transform back from moment space – issue separates the current 3 calculations - an interesting theoretical question (but maybe better studied elsewhere)

$\Rightarrow$ But NOT a relevant uncertainty for Run II (maybe Run III)

(Need to understand the role of Γ_{TOP} ?)

- Non-Standard Model Physics -

1. Looking in the $M_{t\bar{t}}$ Distribution – S. Parke

Various conjectured resonances:

$q\bar{q}$ channel - Color singlet – Z'
TopColor - Coloron (can reduce cross section)

GG channel - Techni-eta $\left(GG \rightarrow \eta_t \rightarrow t\bar{t}\right)$

$\Rightarrow$ Can see effects for mass below 1 TeV

2. New physics at very high mass scales – L. Simmons

Describe in $t\bar{t}$ system via effective contact terms – make list of all $1/\Lambda^2$ terms

Effective 3 gluon coupling G^3
Color magnetic moment $GQ\bar{Q}$
Four varieties of 4 quark couplings - vector/axial vector couplings – with and without color

Measure production rate, p_T distribution, angular distribution

$\Rightarrow$ There are differences but seeing effects will take careful analysis if $\Lambda > 2$ TeV

- Spin issues – G. Mahlon

There is a right answer for the choice of spin axis to maximize the spin correlation of t quarks

$\Rightarrow$ Use Off-Diagonal Basis – gives complete anti-correlation,
$\Uparrow\Downarrow + \Downarrow\Uparrow$, if production pure $q\bar{q}$ annihilation, at 1.8 TeV with 10% GG contribution expect 92% – test for SM couplings of TOP quark

$\Rightarrow$ Use as analyzer for funny J^P states in $t\bar{t}$ channel

$\therefore$ Is an experimental challenge to measure

$\therefore$ Spin de-correlation scale is small ~ Λ^2_{QCD}/M_{TOP} ~ 0.2 MeV, correlation lasts a long time