Z→bbbar Luminosity/Data Estimation

- Luminosity Modeling
- Store Estimation
- Total Luminosity for Current Level1 Trigger
- Dynamic Prescale
- Estimated Lum. for DPS Trigger
- Summary

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Luminosity Modeling Equation

- A Web search reveals Brian Drendel, AD Deputy Run Coordinator, has studied different luminosity models.
  - Without going into too much detail the one that I will use is the "modified exponential model."
  - $$L(t) = L_0 \exp\left[\frac{-t}{(\tau + \mu t^{\alpha})}\right]$$
  - Here τ, μ, and α are constants to be derived.
  - Brian has fit ten stores to this equation and derived values for τ, μ, and α.
  - What I have done is take a weighted average of these values, using the fits χ^2 as weights.
    - $\tau=3.787 \quad \mu=1.855 \quad \alpha=0.56$
  - I use these constants in my calculations.

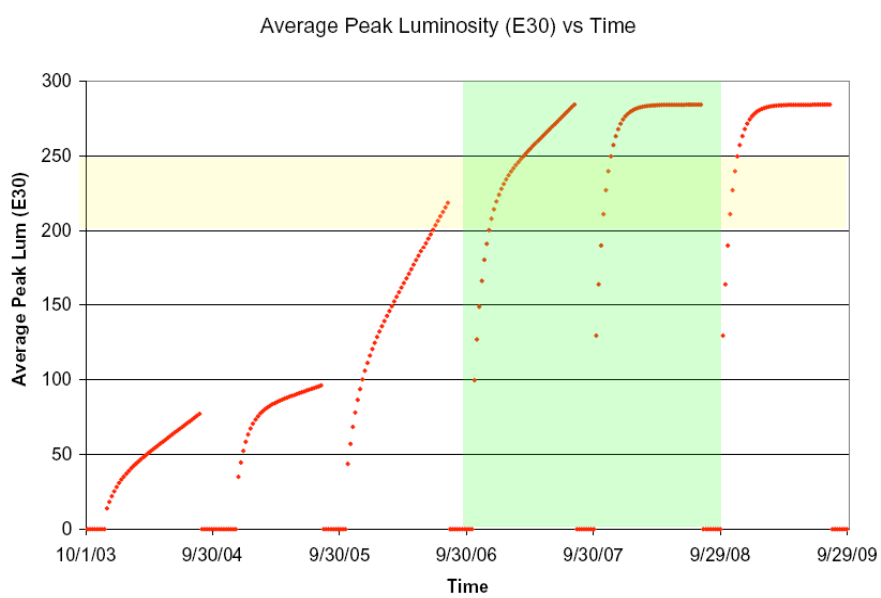
Numerically Integrating

- I Numerically Integrate this equation to determine the total luminosity of each store.
- This "accurately" calculates the total luminosity for a store given the initial luminosity and length.
  - Initial Lum (10^{30} cm^{-2} s^{-1}) length (hours)
  - Conversion factor is 3.6 $nb^{-1}/10^{30}$ cm^{-2} s^{-1}
- Examples:

Store Number	Duration (hrs)	Initial Lum (E30cm^{-2}s^{-1})	Delivered Lum (nb^{-1})	Calculated Lum (nb^{-1})	%difference
4930	16.0	163.60	4,523.90	4,627.56	2.24%
4929	19.8	125.60	4,003.60	3,992.62	-0.28%
4928	26.7	203.40	6,991.30	7,497.54	6.75%
4927	28.0	178.80	6,554.20	6,736.03	2.70%
4925	27.0	155.40	5,688.50	5,757.89	1.21%

Future Stores

- Based on the CDF Run IIb Physics Priorities and Triggers Committee, the graph shows the initial luminosities for the next few years.
- Here is how I determined the number of stores:
  - These are estimates presented for the sake of argument
  - Given 52 weeks in a year, the Tevatron runs 40 weeks
    - There are 5 stores per week
    - Typical store lasts 24 hours
  - Two years of running (9/06–9/08) results in 400 stores
  - Each with initial lum. of 200–250 E30 cm^{-2} s^{-1}



Current Data Taking

- Our current L1 trigger: `L1_TRK5.5_TRK2.5_&_CJET5_LUMI_150` turns on at 150E30.
- First I need to calculate how much time it takes to go from 200/250E30 to 150E30.
  - I can (numerically) solve the luminosity equation for t.
    - $t_{250\rightarrow150}$=3.780 hours
    - $t_{200\rightarrow150}$=1.754 hours
  - L_0=150E30 and t_{dur}=20.22 hr Ltot=4706.42nb^{-1}
  - L_0=150E30 and t_{dur}=22.246 hr Ltot=4939.70nb^{-1}
- If we assume most stores have initial luminosity of 200E30 to 250E30 then I estimated total luminosity as 4800nb^{-1}.
- For 400 stores this amounts to is 1.92fb^{-1} of data.

Trigger with DPS

- It is very difficult to determine concrete information on the proposed Dynamic PreScale (DPS) L1 trigger.
  - This is because of how DPS operates.
  - DPS may scale our L1 trigger to zero for high luminosity runs, or it may allow a trickle of events through.
  - There is no definitive luminosity where our trigger would "turn on."
- With these caveats in mind lets do a "back of the envelope" calculation making these assumptions.
  - The DPS will "turn on" our trigger at 150E30.
  - From 150E30→105E30 we will receive 1/3 of our current amount of data.
  - These estimates were determined from looking at Chris' presentation at the last Z→bbbar meeting.
    - Feb 20, 2006: Run 211984
    - Trigger includes an additional L1 DPS 20:1:1
- There is a newer B group trigger proposal (according to Ted) that has several high p_T triggers on L1 DPS.

Data with DPS

- Repeating what I showed two slides ago.
- I calculate how much time it takes to go from 200/250E30 to 105E30.
  - I can (numerically) solve the luminosity equation for t.
    - $t_{250\rightarrow105}$=8.234 hours
    - $t_{200\rightarrow105}$=5.272 hours
  - L_0=105E30 and t_{dur}=15.766 hr Ltot=2871.51nb^{-1}
  - L_0=105E30 and t_{dur}=18.728 hr Ltot=3413.61nb^{-1}
- Estimated total luminosity as 3000nb^{-1}.
- For 400 stores this amounts to is 1.2fb^{-1} of data.
- Estimated from 150E30→105E30 there is a 1/3 reduction
  - 1/3 of 1800nb^{-1} is 600nb^{-1}.
  - 3000nb^{-1} becomes 3600nb^{-1}.
  - For 400 stores this amounts to 1.44fb^{-1} of data.
  - Previous total Lum. was 1.92fb^{-1}.
- *This is a ¼ reduction of luminosity*.

Summary

- I can't stress enough that what I have shown are estimates.
  - As the slides continue, the number and uncertainty of the assumptions have grown.
- Especially true when dealing with DPS triggers.
- One thing I did not cover are the implications to actual physics results: Jet resolution, Mass resolution, etc.
  - Total Luminosity can only tell us so much.