

Recent changes in D0 Luminosity Measurement

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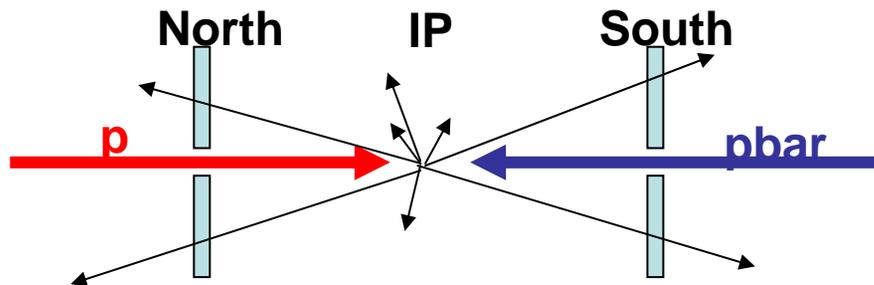
2006.9.20

Halo BG veto:

1. Characteristics of Halo and In-time hit
2. Criteria of halo BG
 - RunIIa and RunIIb
3. Changes
4. Performance of new calculation
5. BG from Halo
6. Summary

Characteristics of hit

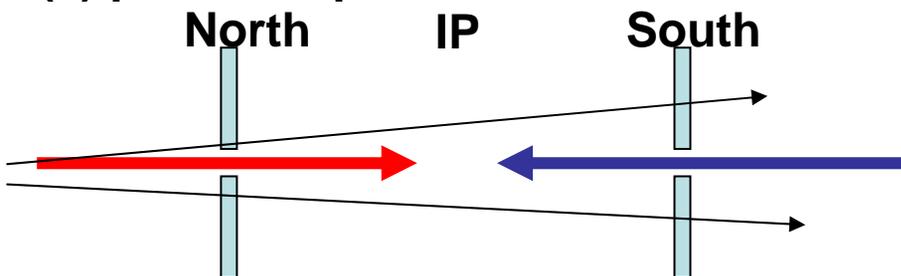
(1) Double or single side p-pbar interaction.



T0 is set for detecting this event.

In time hit: $- 6.4 < t < 6.4$ (ns)

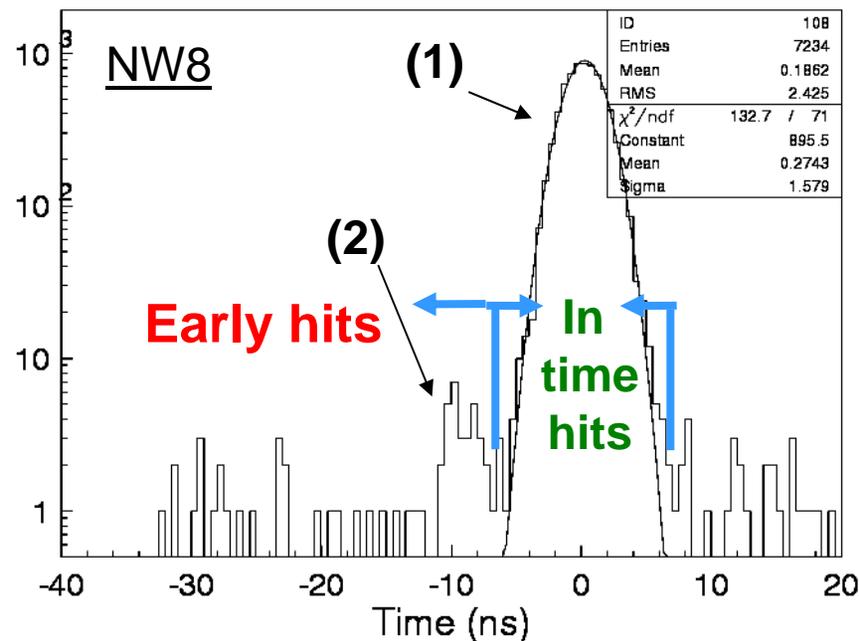
(2) p-Halo or pbar-Halo



Halo coming from upstream

Timing : $\sim - 9.5$ ns.

Early hit: $t < - 6.4$ (ns)



(3) Other BG.

Timing : Almost flat dist.

Note: TDC can measure single hit.

→ An “**early hits**” prevents counting an “**in time hit**”

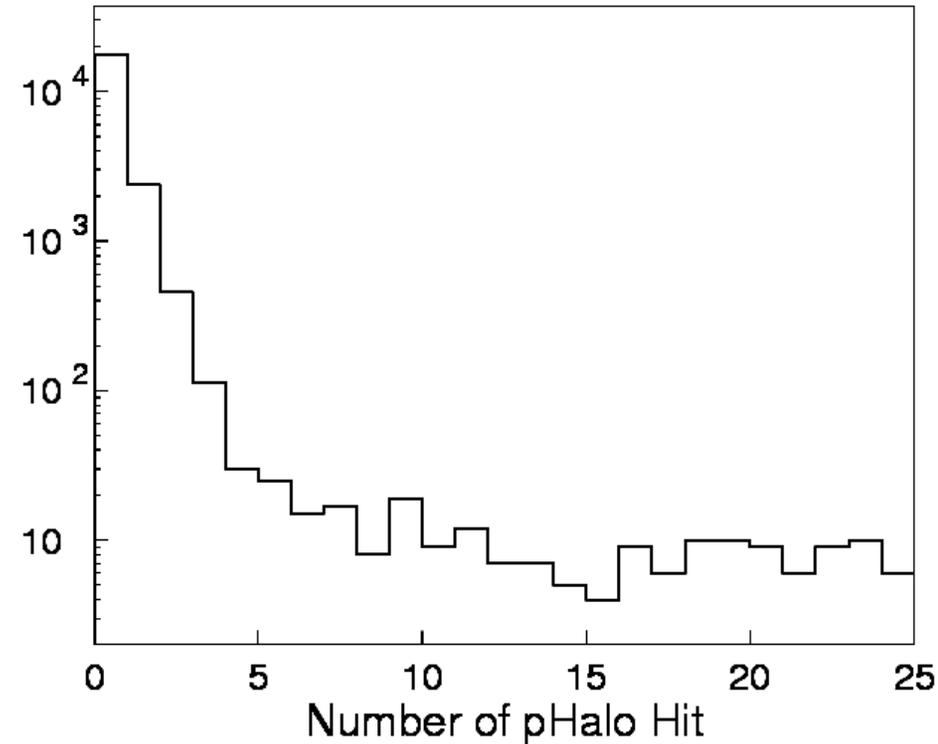
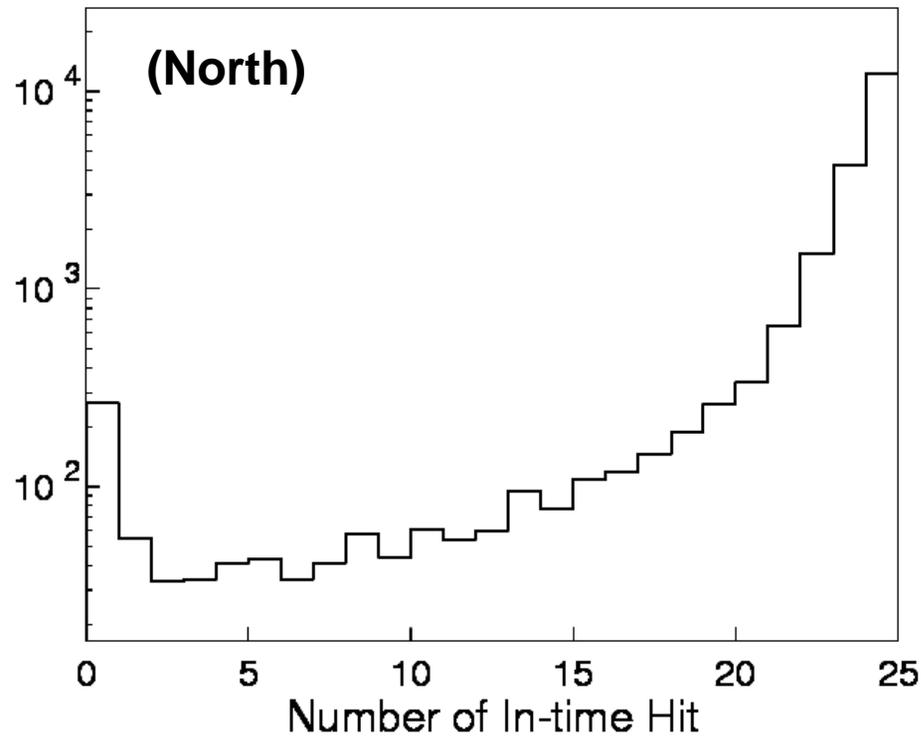


In-time hit

$-6.4 < t < 6.4$ (ns)

Halo (Early) hit

$t < -6.4$ (ns)



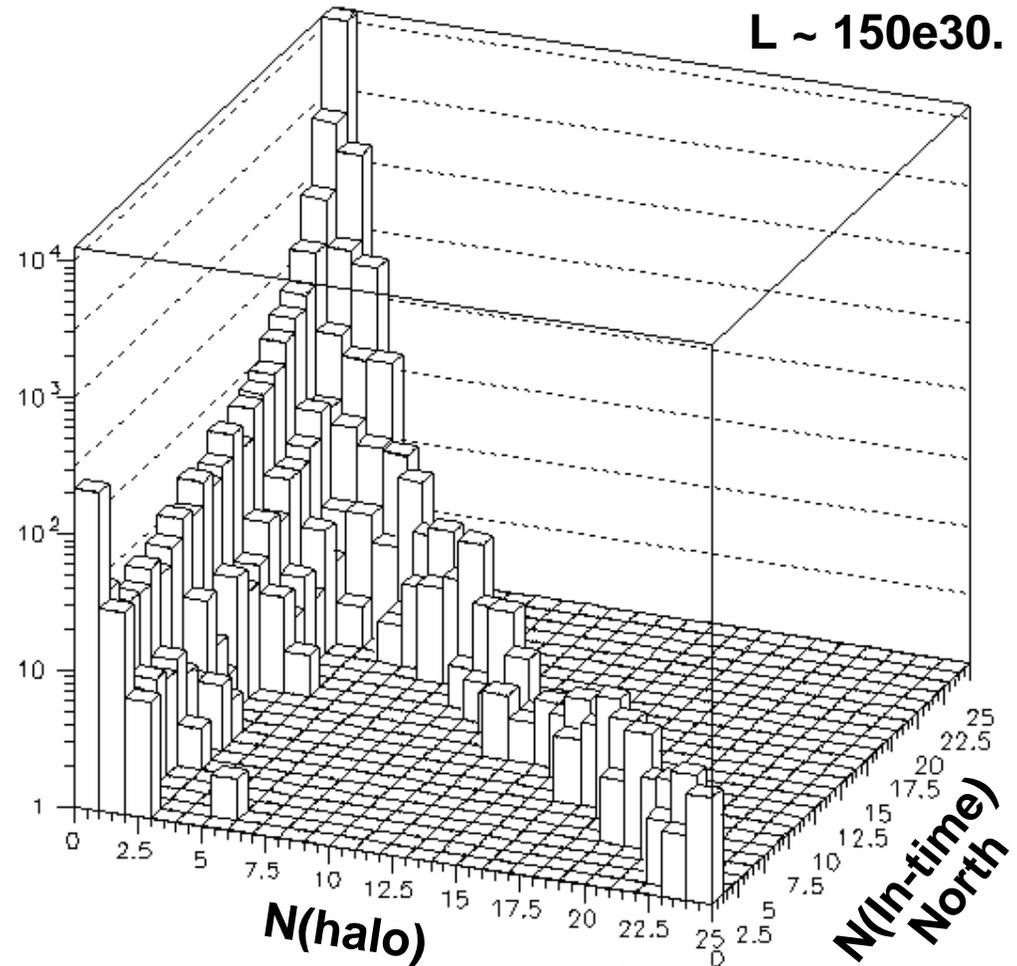
Average multiplicity of p-pbar interaction is quite high, mean = 22.

There are events with a high multiplicity of Halo hits.

$L \sim 150e30$.

Halo multiplicity is also high!

- When such an event comes, we may not count any 'In-time hits'.
- So, **HALO event veto** is required to obtain reliable measurement.



We changed halo event definition.

- RunIIa

$$N(\text{p-halo}) > 0$$

$$N(\text{In-time}^{\text{north}}) = 0$$

$$N(\text{In-time}^{\text{south}}) > 0$$

AND

Only applied in “non-interaction”

- RunIIb

$$N(\text{p-halo}) > 2$$

$$N(\text{a-halo}) > 2$$

OR

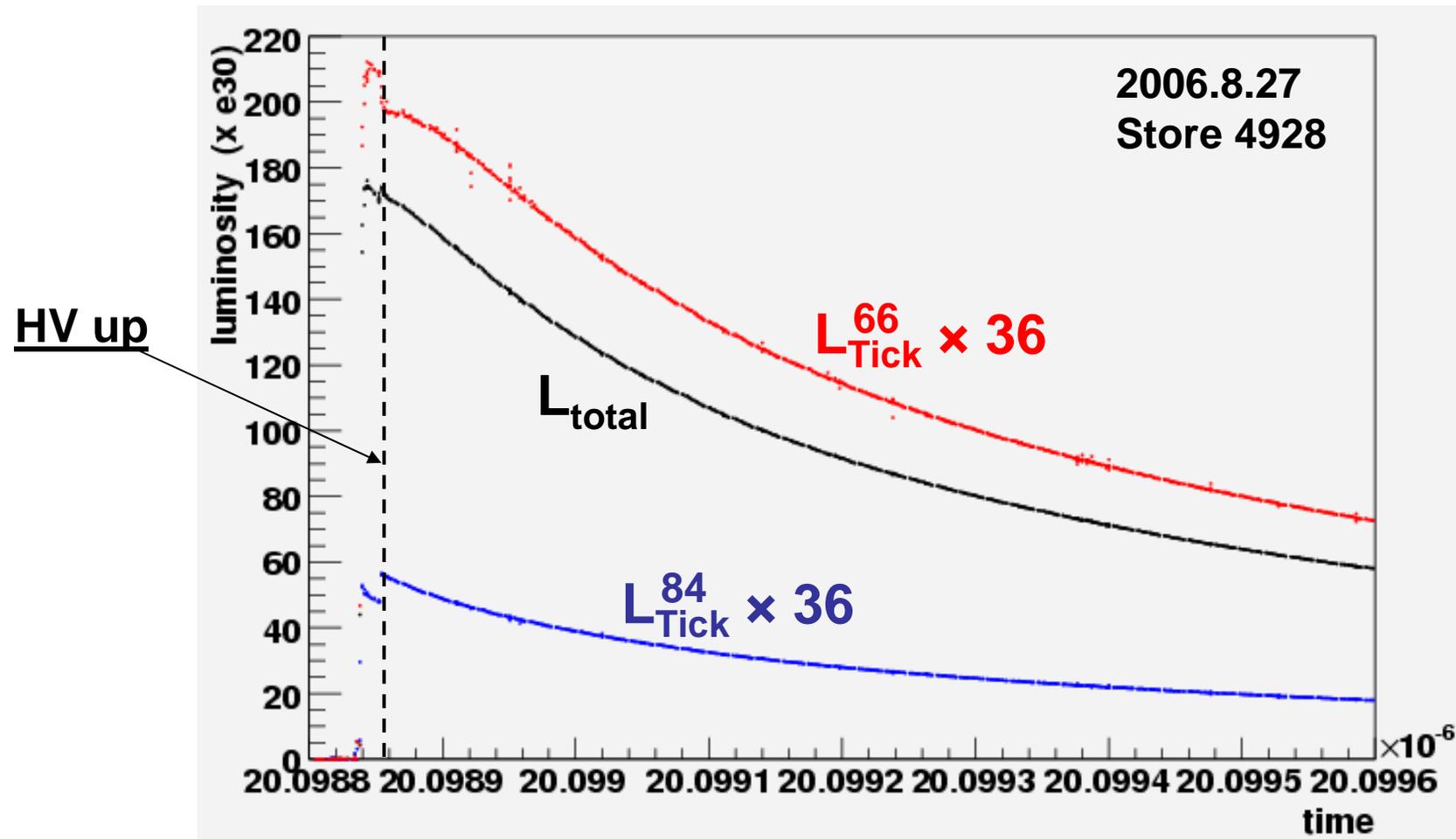
Positively measure halo event.

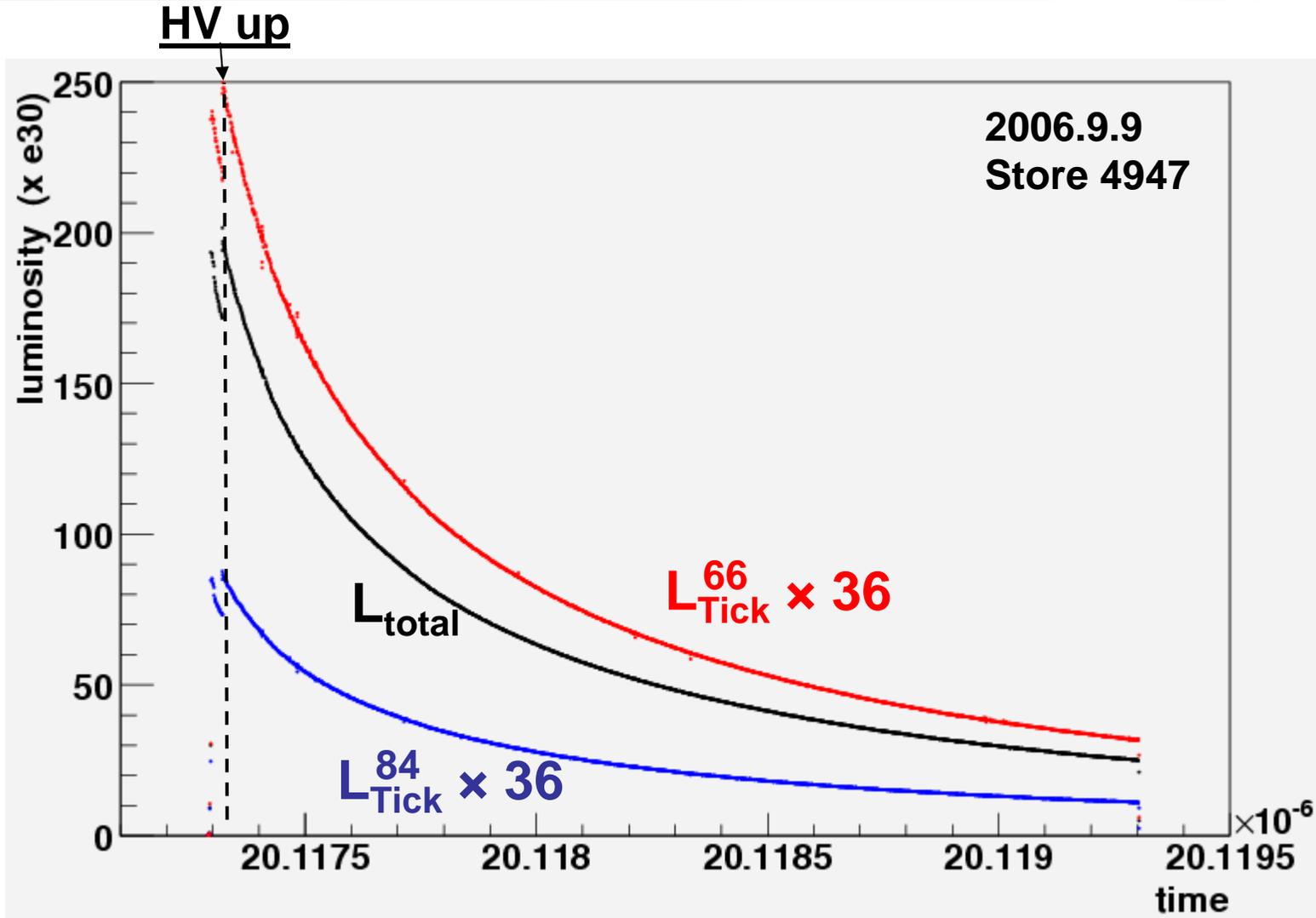
By defining halo event positively, we can explicitly veto crossing with halo and make a more precise luminosity measurements.

- To update halo event veto, we had to change firmware.
We applied changes step by step

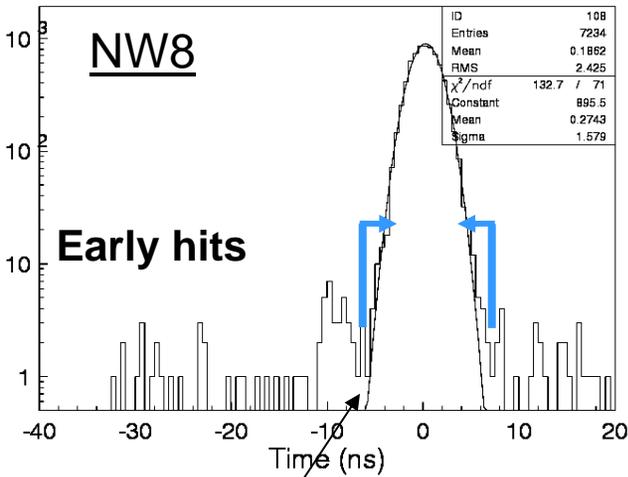
Changes	When
1. TDC firmware	Last shutdown
2. VTX board firmware	2006.8.31 (Store 4932)
Veto condition: $N(\text{p-halo}) > 2$ or $N(\text{a-halo}) > 2$	
3. Luminosity Calculation	2006.9.7 (Store 4942)
Fixed a bug in the treatment of the halo event event. Detailed description can be found in D0note 5241. (http://www-d0.fnal.gov/d0notes_forms/d0noteSelMin.html)	

- No halo event veto.

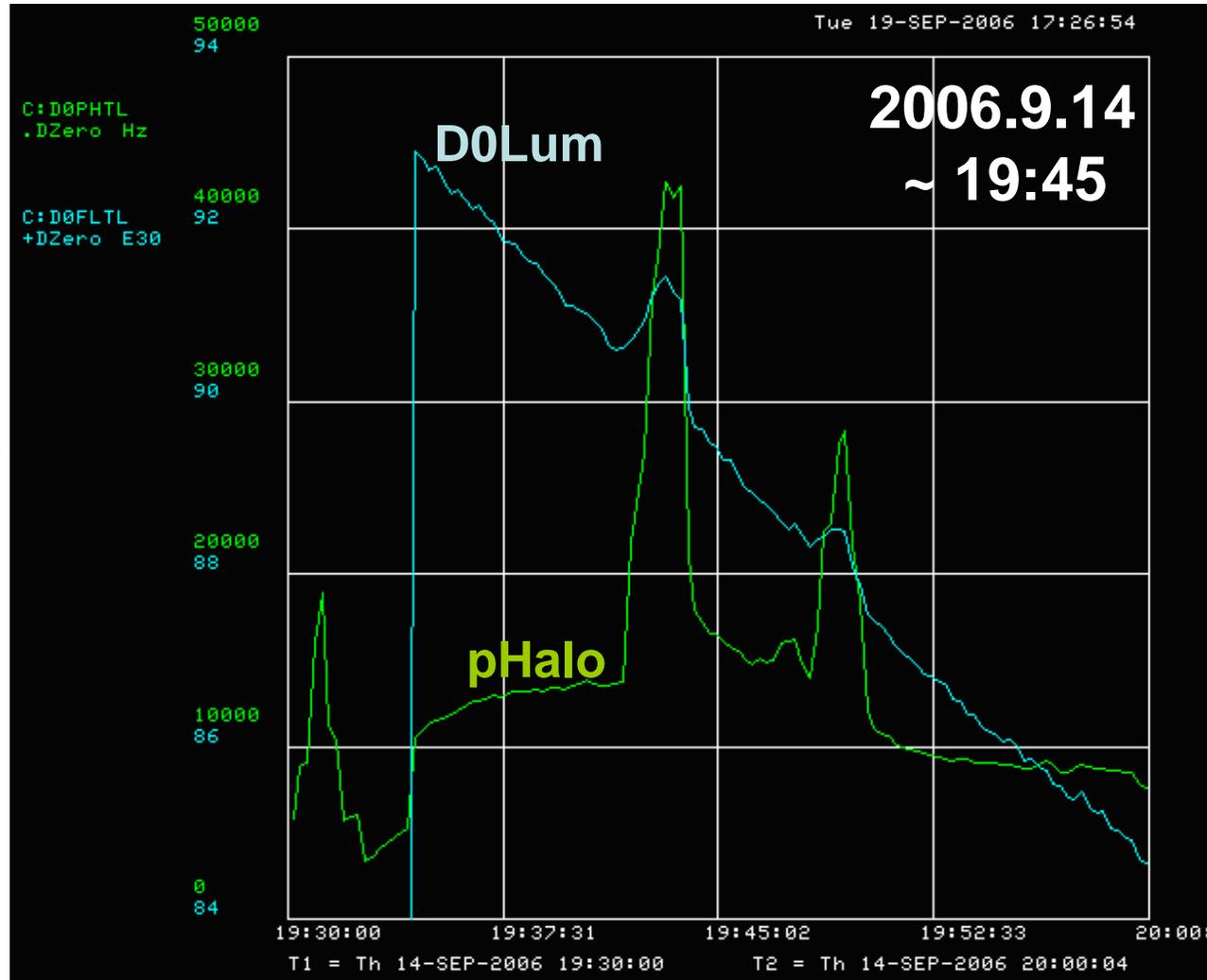




Luminosity Measurement looks stable. At least there is no problem by $L = 250e30$.



**Tail of halo hits makes
In-time hit.
→ BG of halo.**



Even for very high halo rates (40 kHz), D0Lum is stable within ~1%.

In RunIIb, halo rates are significantly higher than RunIIa.

- We have **updated the halo event definition** in the VME system.
(Halo rate on Acnet is from the NIM system, which has not changed.)
- During the shutdown, we updated the **TDC firmware** to count **halo hits**.
The **VTX board firmware** was updated 2006.8.31, store 4932 to count **veto halo events**. No halo event veto was applied before 2006.8.31.
- We found a bug in the halo calculation, fixed it 2006.9.7, store 4942.
- After that, luminosity measurement looks stable.
 - Confirmed: No problem up to $L \sim 250 \text{ e}30 \text{ cm}^{-2}\text{s}^{-1}$.
 - Expected : Can be measured up to $L \sim 400 \text{ e}30 \text{ cm}^{-2}\text{s}^{-1}$
 - BG from halo:
Measurement is stable with Halo rates up to 40kHz within 1%.