

DCH Efficiency and Resolution at high Luminosity

M. Margoni, M. Posocco, M. Zancan

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1) Summary of Track Results for

$L=2*10^{34} \text{ cm}^{-2}\text{s}^{-1}$ and $L=4*10^{34} \text{ cm}^{-2}\text{s}^{-1}$:

- Background Extrapolation versus the Beam Currents
- Charged Track Efficiency and Momentum Resolution

2) Bkg Impact on Exclusive Events Reconstruction:

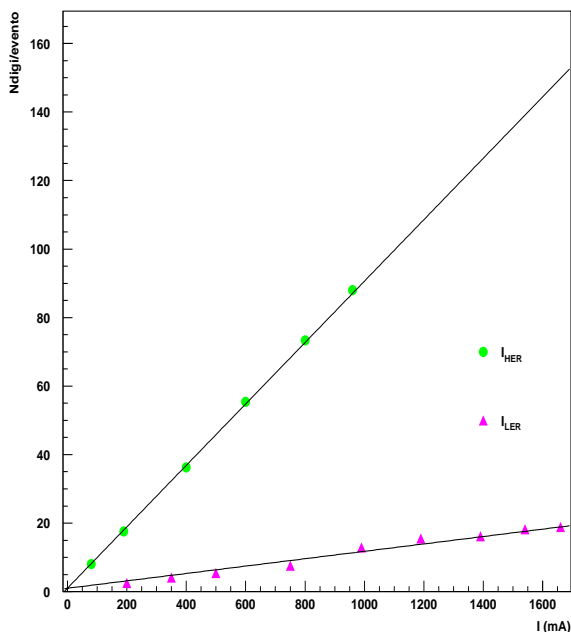
$B^0 \rightarrow D^*D^*$ Results:

- D^0/D^* Reconstruction Efficiency, Signal/Noise Ratio
- $m(D^0)$, $m(D^*)$ Resolution

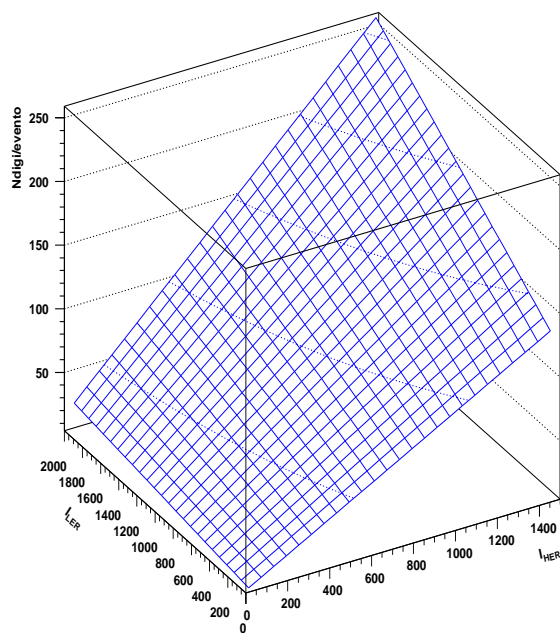
Background Extrapolation vs Beam Current

- **Goal:** Obtain a Background description in terms of $n_{digi} = N_{digi}/events$ vs (I_{HER}, I_{LER}) in order to extrapolate the DCH occupancy to high Luminosity.
- **Strategy:** Use the "Background Runs" (February 2002) with varying beam currents and only one (both) beam(s) in the machine. Use trigger informations to select the "Cyclic Trigger" events sample.
- **Single Beam:** $n_{digi} = p1 + p2 * I$
- **Two Beams:**

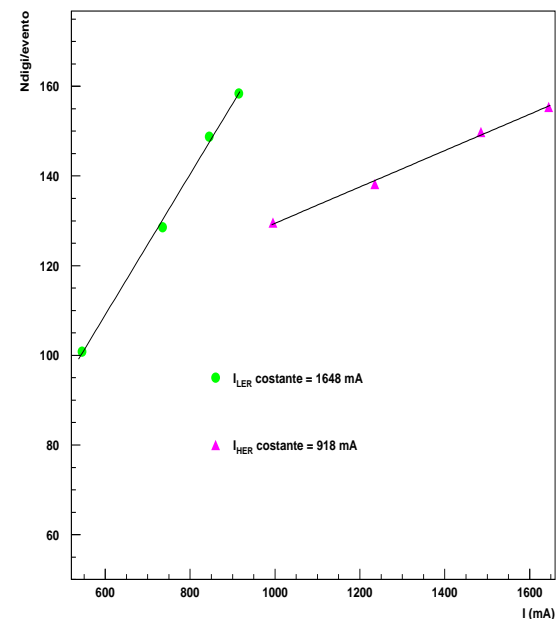
$$n_{digi} = p1 + p2 * I_{HER} + p3 * I_{LER} + p4 * I_{HER} * I_{LER}$$



n_{digi} vs I (Single Beam)



n_{digi} vs (I_{HER}, I_{LER})



n_{digi} vs I (Two Beams) 2

● MC Sample:

10000 B^+B^- events were produced with different BKG amount ([release 10.3.1a+analysis-13b](#))

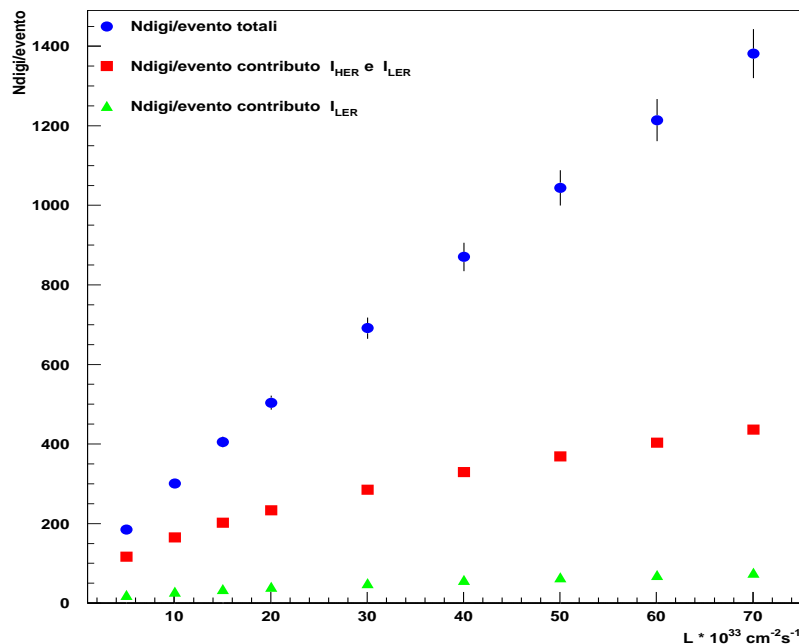
● The average $N_{\text{digi/event}}$ increases of 154 for each BKG file added

$$\longrightarrow N_{\text{BKG files}} = n_{\text{digi}}(\text{extrap.})/154$$

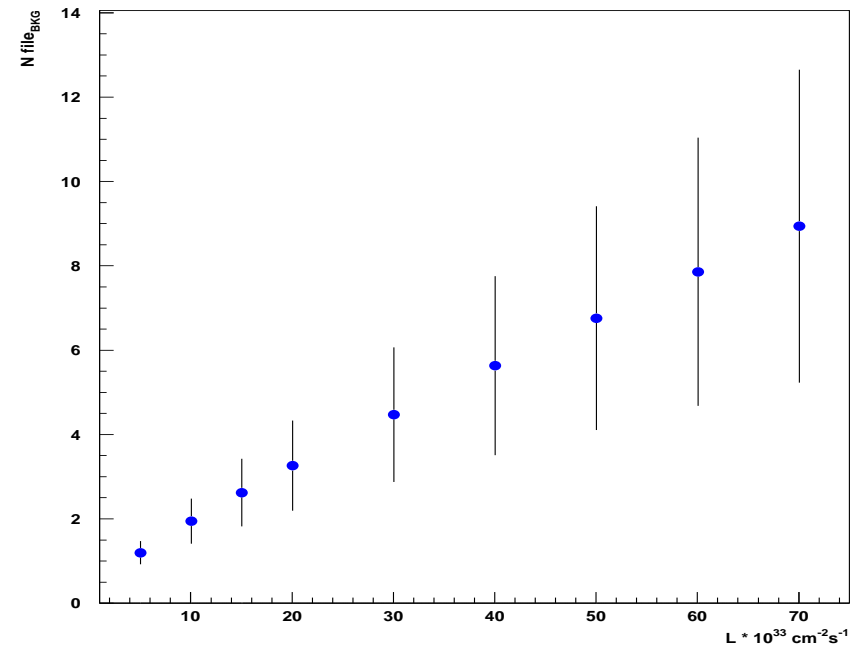
● The extrapolation at the Current Luminosity underestimates by 6% the Bkg amount at the current conditions \longrightarrow Correction applied.

● Systematic Error determined from a different n_{digi} parameterization.

$$\longrightarrow N_{\text{BKG files}} = 3 \pm 1 (L=2*10^{34}); \quad 5 \pm 2 (L=4*10^{34})$$



Ndigi vs L



Bkg files vs L

● **Track Efficiency and Momentum Resolution** in the different Luminosity Scenarios have been computed for each particle species (**e, μ , π , **K**, **p**) and for each track selection kind (**ChargedTracks, GoodTracksVeryLoose, GoodTracksLoose, GoodTracksTight**) and compared with the current ones:**

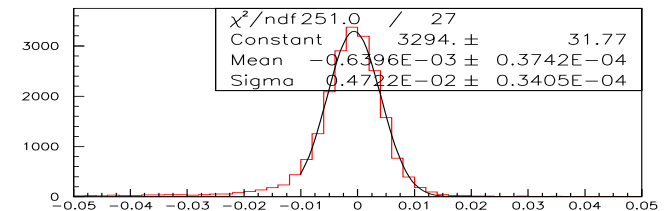
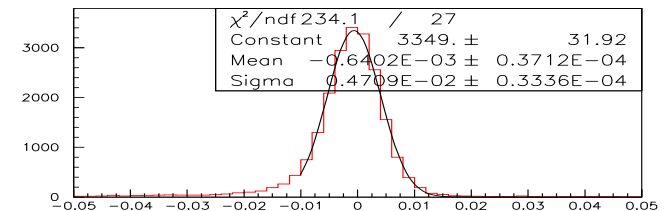
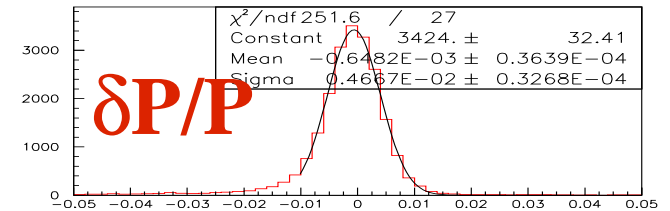
Average Efficiency Ratio (%):

	CT	GTVL	GTL	GTT
L=2*10³⁴/Current	99.2\pm.1\pm.4	99.1\pm.1\pm.4	98.6\pm.1\pm.7	98.3\pm.1\pm1.0
L=4*10³⁴/Current	98.8\pm.1\pm.4	98.7\pm.1\pm.6	97.4\pm.1\pm1.0	97.1\pm.1\pm1.0

● **Average Momentum Resolution Worsening:**

$\delta P/P$ (L=2*10³⁴) – $\delta P/P$ (Current L) = **4.2*10⁻⁵**

$\delta P/P$ (L=4*10³⁴) – $\delta P/P$ (Current L) = **5.5*10⁻⁵**



Background Impact on Exclusive Event Reconstruction

- **Goal:** Study the effect of the increasing machine background on the exclusive reconstruction of many tracks–topology events;

- **Strategy:** Use the $B^0 \rightarrow D^* D^*$ Analysis chain to check the Efficiency and the D^0/D^* invariant mass Resolution in the different Luminosity Scenarios.

(Many thanks to Sergio Grancagnolo + Lorenzo Vitale for providing us their analysis package and very useful informations!)

- **MC Sample:**

15000 $B^0 B^0 \text{bar}$ $D^* D^*$ $D^0 D^0$ exclusive events were produced with different BKG amount (release 12.4.0j + Breco analysis–14)

- $D^* \rightarrow \pi^* D^0$; $D^0 \rightarrow K\pi, K3\pi, K\pi\pi^0, K_s 2\pi$

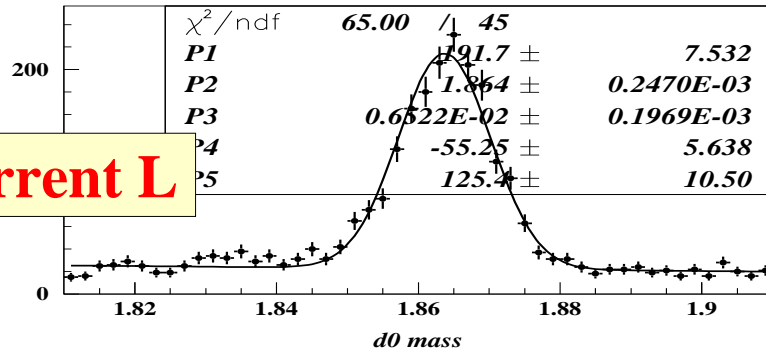
(only the $K\pi$ channel used up to now).

- See BAD 166 for Selection Details.

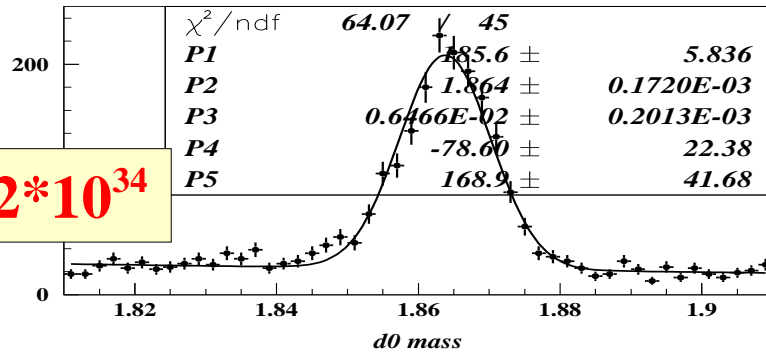
D⁰ → Kπ Candidates

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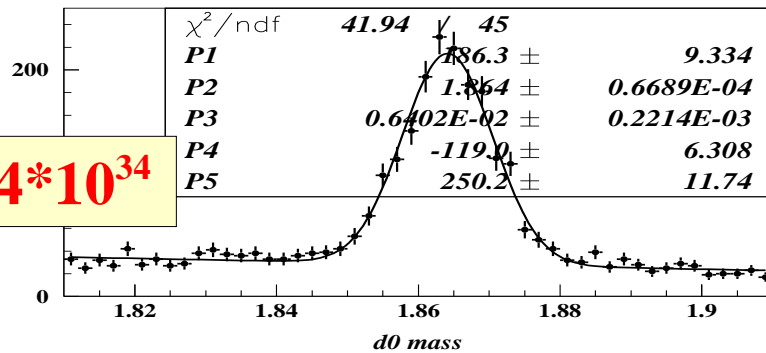
Current L



L=2*10³⁴



L=4*10³⁴



π : GTVL

K: GTL, no PID

$m(D^0)$:

Gaussian + Straight Background

Lumi **Current** **2*10³⁴** **4*10³⁴**

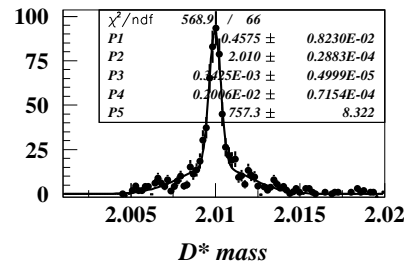
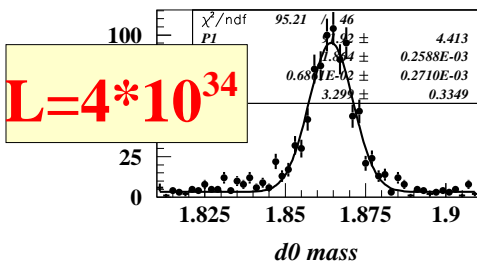
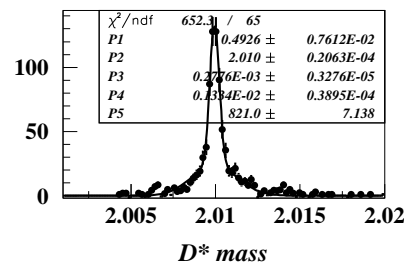
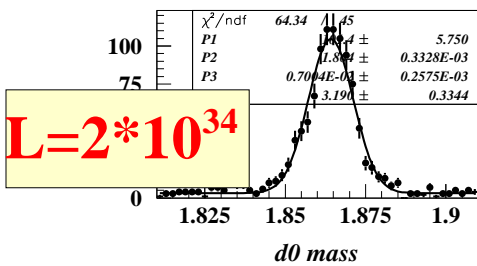
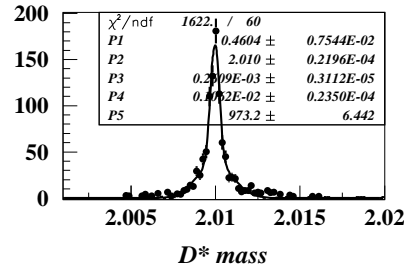
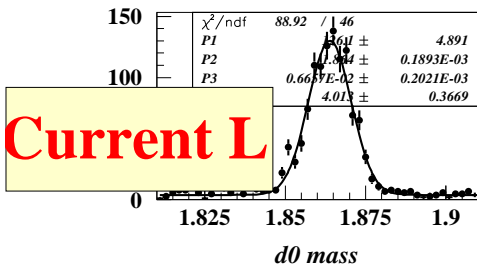
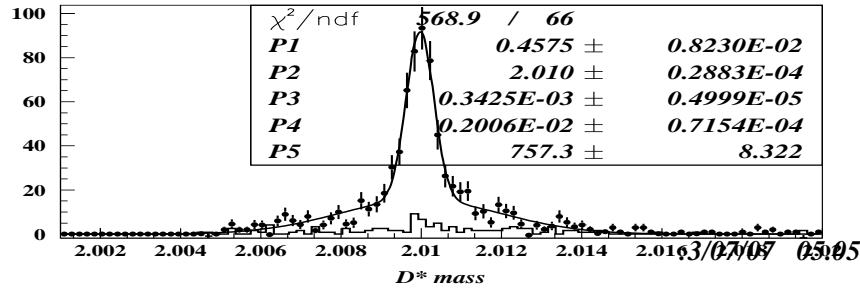
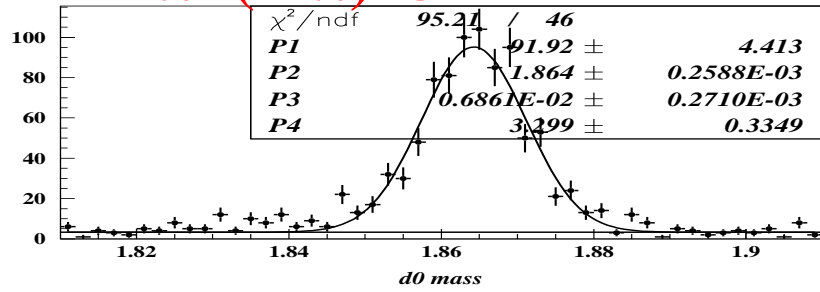
$s/(s+n)^{1/2}$ 35 34 33

ϵ ratio(%) — 96.0±.5 95.5±.5

$\sigma m(D^0)$ (MeV) 6.5±.2 6.5±.2 6.4±.2

D* → π*(Kπ) Candidates

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$p^T \pi^* < 200 \text{ MeV}$; $p^*(D^*) > 1.3 \text{ GeV}$;
 Vertex constrained to Beam Spot
 $m(D^0)$:
 Gaussian + flat Background

$m(D^*)$ ($m(D^0)=\text{PDG}$):
 2 Gaussians (after BKG subtraction
 rescaled from $m(D^0)$ Side Bands)

Current L

$L=2*10^{34}$

$L=4*10^{34}$

Lumi Current $2*10^{34}$ $4*10^{34}$

$s/(s+n)^{1/2}$ 31 28 27

ϵ ratio(%) - 84.4 ± 1.1 75.0 ± 1.3

$\sigma m(D^0)$ (MeV) 6.7 ± 2 7.0 ± 3 6.9 ± 3

$\sigma m(D^*)$ (MeV) 0.80 ± 03 0.97 ± 04 1.50 ± 08

Conclusions:

- In a high Luminosity Scenario the Track Efficiency is lowered from 1–2% ($L=2*10^{34}$) to 3–4% ($L=4*10^{34}$) depending on the particle species and the selection category.
- The Momentum Resolution worsening w.r.t. the Current one was found to be $\Delta = 4.2*10^{-5}$ ($L=2*10^{34}$); $\Delta = 5.5*10^{-5}$ ($L=4*10^{34}$)
- The Exclusive Reconstruction of the decay $D^* \rightarrow \pi^*(K\pi)$ shows an Efficiency Reduction $\sim 15\% - 25\%$ in the two high Luminosity Scenarios respectively;
- The D^* Mass Resolution increases from .80 MeV to .97 MeV ($L=2*10^{34}$) and 1.50 MeV ($L=4*10^{34}$)
- The D^0 Mass Resolution and the signal/noise ratio seem to be unaffected

Next Steps:

- Analysis of the other D^0 decay channels:
 $D^0 \rightarrow K3\pi, K\pi\pi^0, Ks2\pi$
- Write a BAD with a Summary of the Results.