News from the hadron alley

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Outlook:

Reminder of the hadron alley

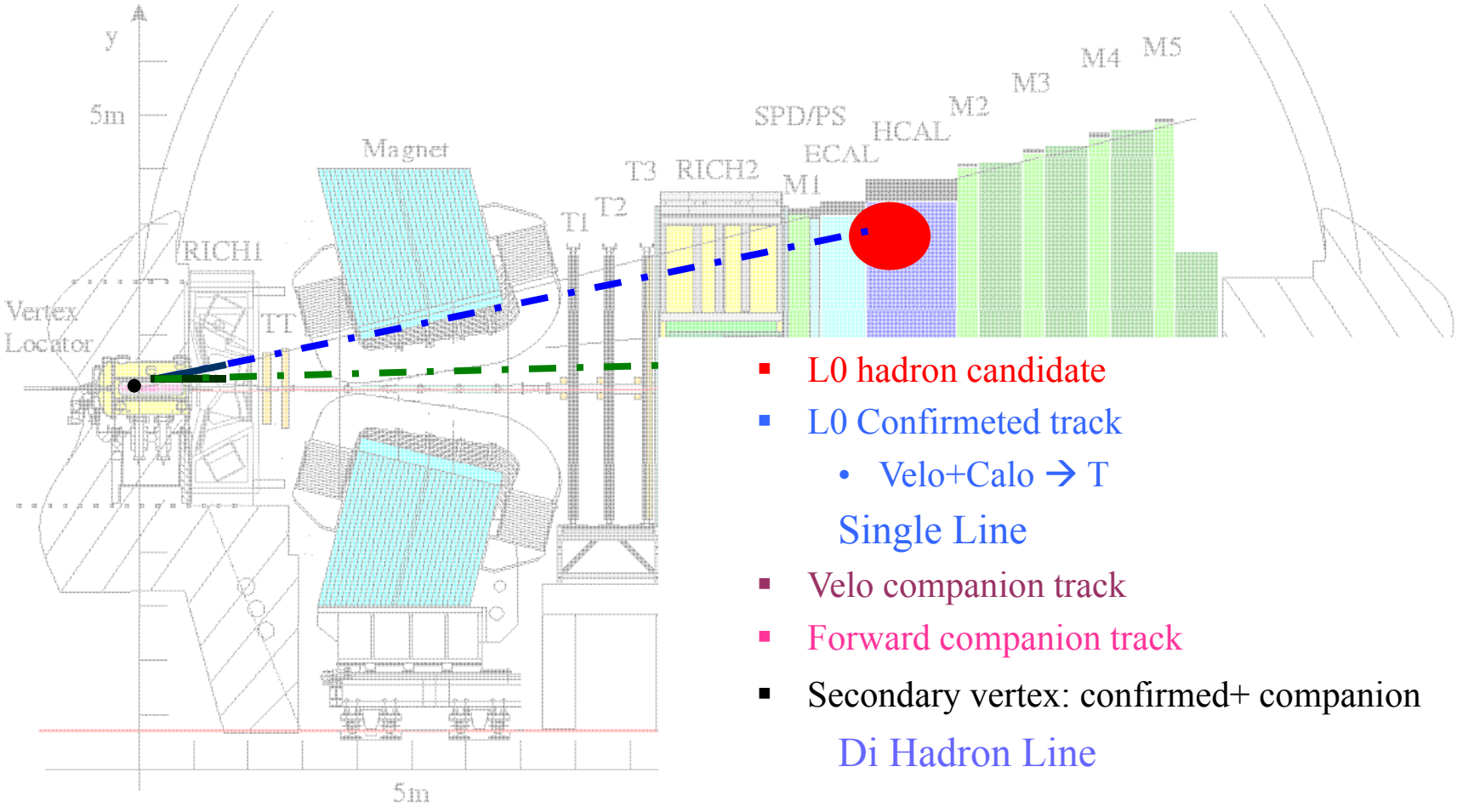
Use of the Fast Fit

Possibility of removing the GEC

Possibility of softening the hadron alley

Conclusions

Hadron Alley: Single and Di Hadron Lines



- L0 hadron candidate
- L0 Confirmeted track
  - Velo+Calo → T

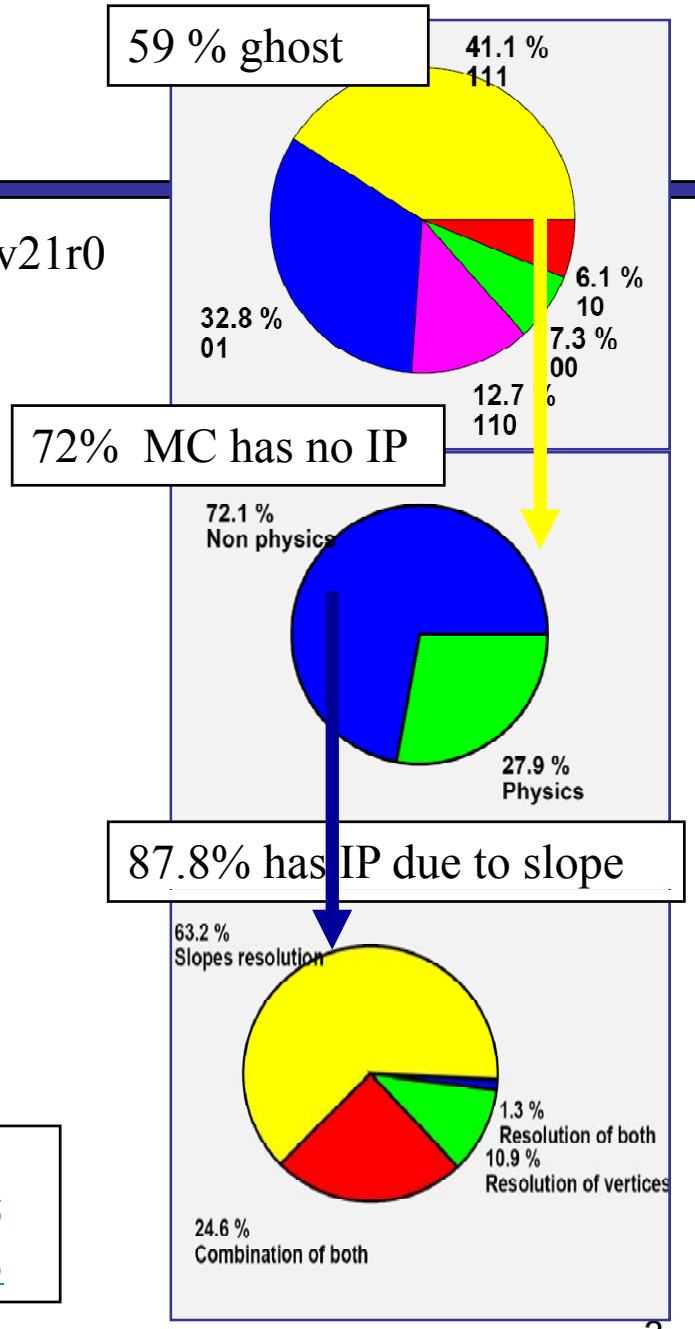
  Single Line
- Velo companion track
- Forward companion track
- Secondary vertex: confirmed+ companion

  Di Hadron Line

I) Fast Fit in Hadron Line

DaVinci v21r0

- What triggers the single hadron line?
  - 60% are ghosts
  - 72% of tracks its MC particle has no IP
    - 87.8% tracks has IP due to slopes
- Are these tracks offline ?
  - Offline: Best container in DST
  - Tracks that MC has IP 96%
  - Tracks that MC has no IP 31%
  - Ghosts 32%



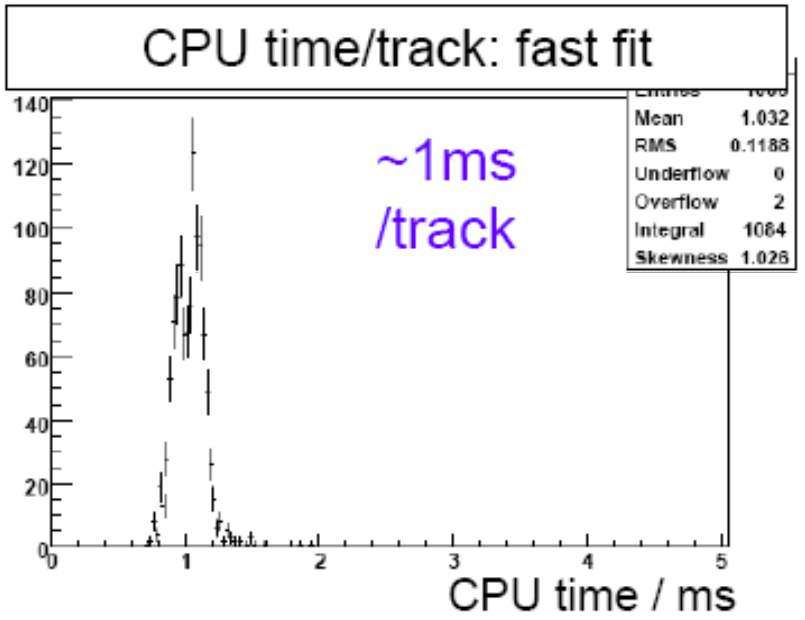
Xabier Cid's studies:

- Indico: contribId=4&confId=26985
- Indico: contribId=0&confId=33063

Fast fit in Hadron alley

➢ Fast Fit (Wouter, Johannes)

- Use simplified geometry
- One filter pass (from T to Velo)
- No out layers removal
- News at Heidelberg Tracking workshop
  - Use of litle clusters (Matt, David)
  - Time ~1 ms/track



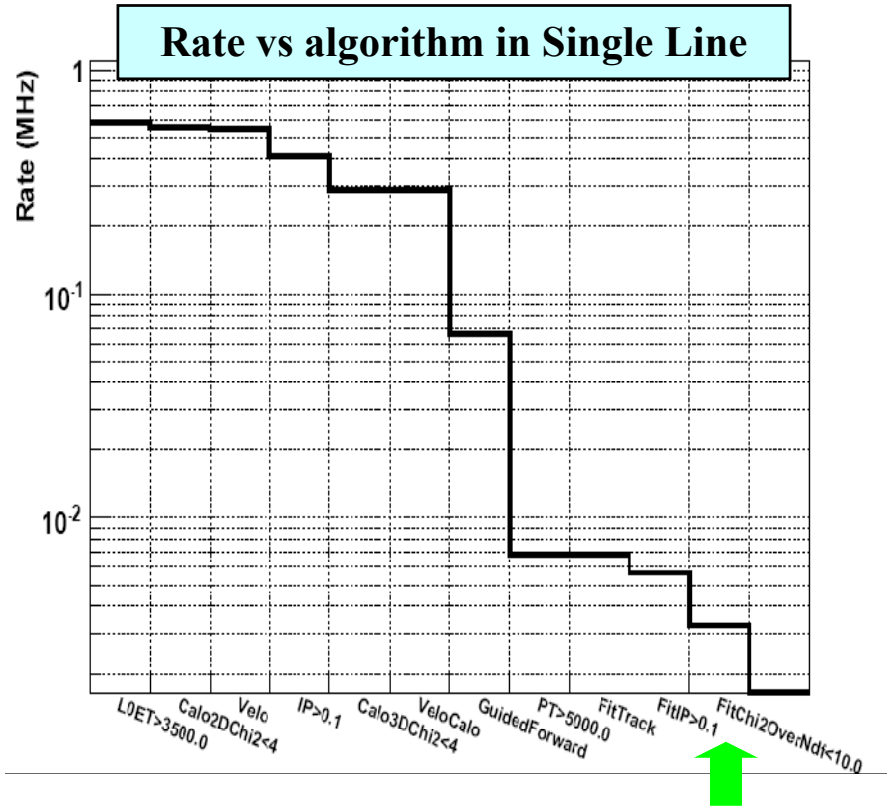
➢ Fast fit in Hlt1

- Apply Fast fit to the tracks that fires the single and di hadron lines
  - Note that enters at ~10 kHz
- Apply a χ^2 and reapply the IP>0.1 mm cut

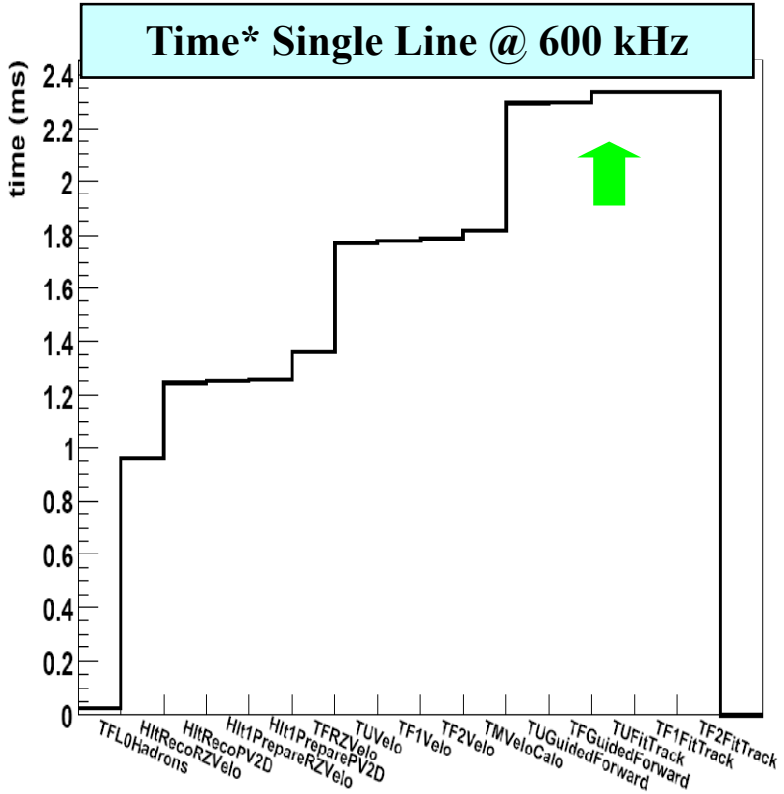
Johannes, Wouter at Heidelberg tracking workshop:

- Indico: confId=50859

Single and DiHadron with fast fit



Rate reduced by ½



DaVinci v22r0p2 (+patch from Diego)

100k minbias events

* Output of DaVinci, 2.12 x 2.8 GHz Xeon

missing preparation of seeds algorithm +0.2 ms

Ongoing: measuring time of HLT in core of EFF (Stephan)

DiHadron line: mb rate, candidates and L0xHLT1 TOS efficiencies

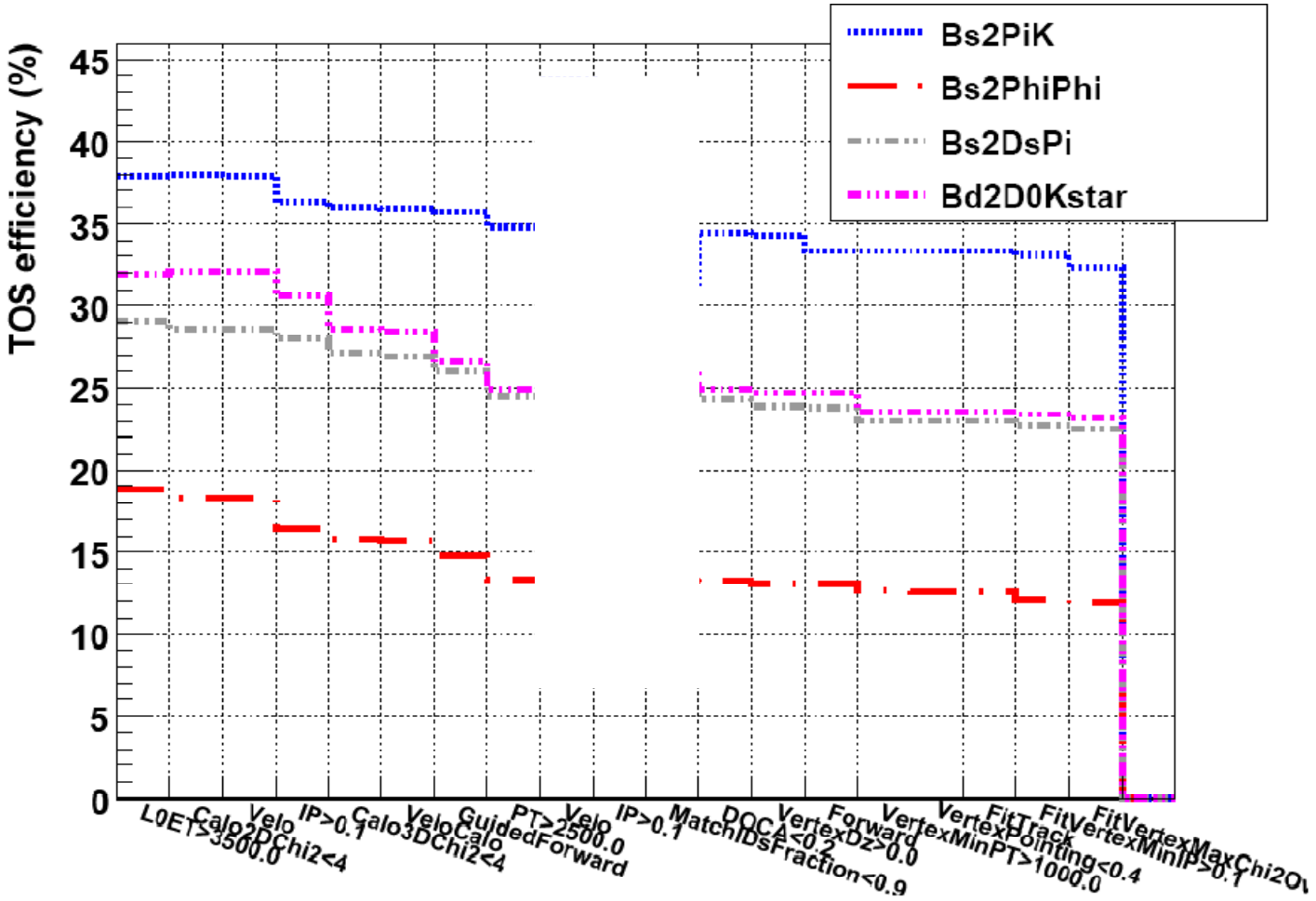
	mb rate (kHz)	mb candidates	Bs2PiK	Bs2PhiPhi	Bs2DsPi	Bd2D0Kstar
L0ET>3500.0	582.13	1.27	37.90	18.80	29.10	31.90
Calo2DChi2<4	555.09	4.81	38.00	18.30	28.60	32.10
Velo	552.70	4.89	37.90	18.30	28.60	32.10
IP>0.1	407.05	2.74	36.30	16.40	28.00	30.60
Calo3DChi2<4	290.84	2.17	36.00	15.80	27.10	28.60
VeloCalo	290.84	2.30	35.90	15.70	26.90	28.40
GuidedForward	66.47	1.35	35.70	14.80	26.00	26.60
PT>2500.0	27.04	1.36	34.80	13.30	24.50	24.90
Velo1	27.04	58.38	43.70	21.60	34.80	34.00
IP>0.11	27.04	33.49	35.50	14.40	25.60	26.00
MatchIDsFraction<0.9	27.04	32.25	31.00	13.90	25.40	25.80
DOCA<0.2	26.29	15.85	34.50	13.20	24.30	24.90
VertexDz>0.0	25.84	9.08	34.30	13.10	23.90	24.70
Forward	23.75	5.46	33.30	13.10	23.80	24.70
VertexMinPT>1000.0	7.77	1.96	33.30	12.70	23.00	23.60
VertexPointing<0.4	4.48	1.87	33.30	12.60	23.00	23.60
FitTrack	4.48	1.87	33.30	12.60	23.00	23.60
FitVertexMinIP>0.1	4.18	1.82	33.10	12.10	22.70	23.40
FitVertexMaxChi2OverNdf<10.0	1.79	1.75	32.30	11.90	22.50	23.20

DaVinci v22r0p2 (+patch from Diego)

100k minbias events, 1k signal

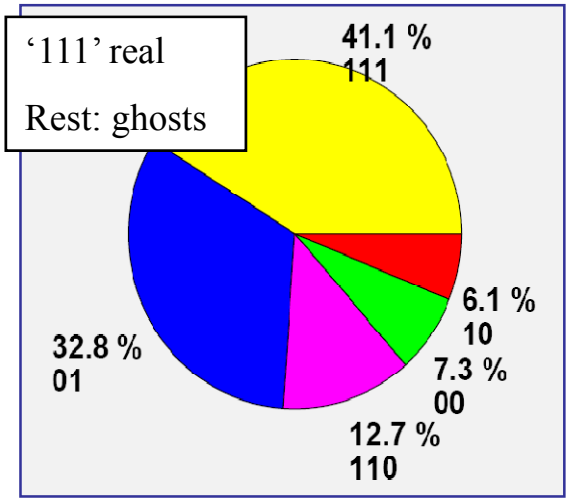
DiHadron Rate TOS efficiency

L0xHLT1 TOS efficiency vs algorithm in DiHadron Line

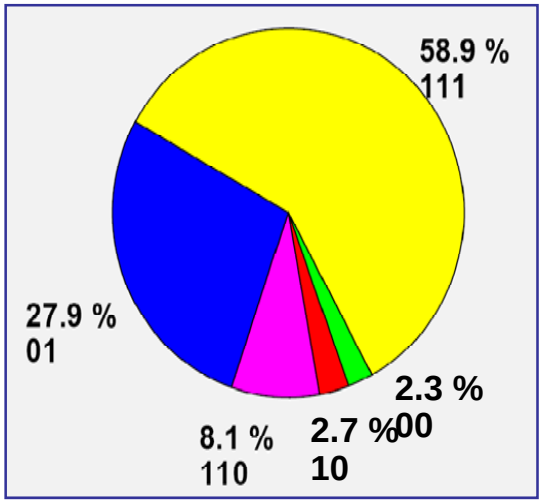


What still triggers the hadron alley?

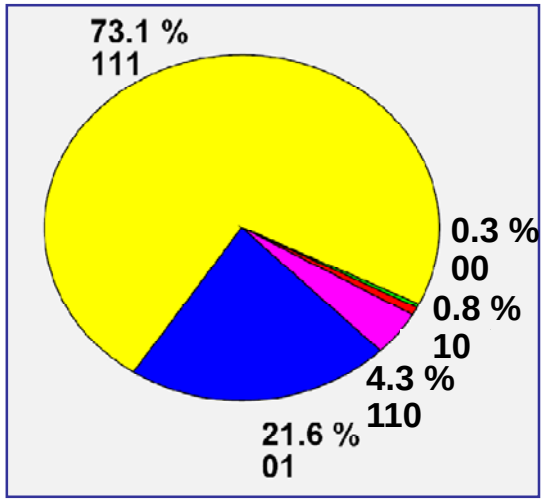
Hlt1 (no fit)



Hlt1 Fast Fit



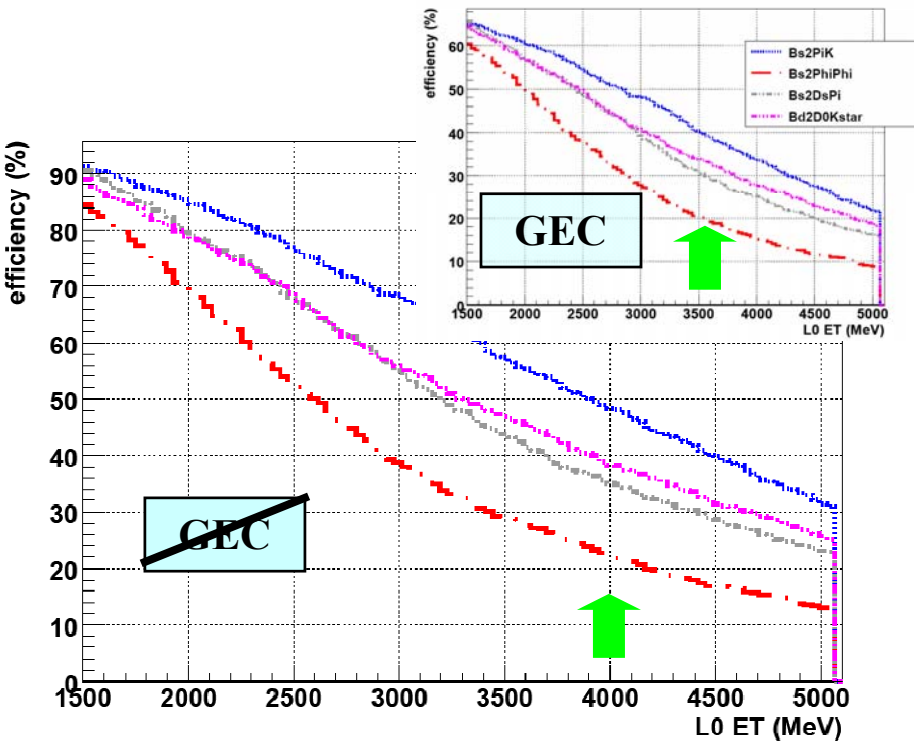
Full Fit



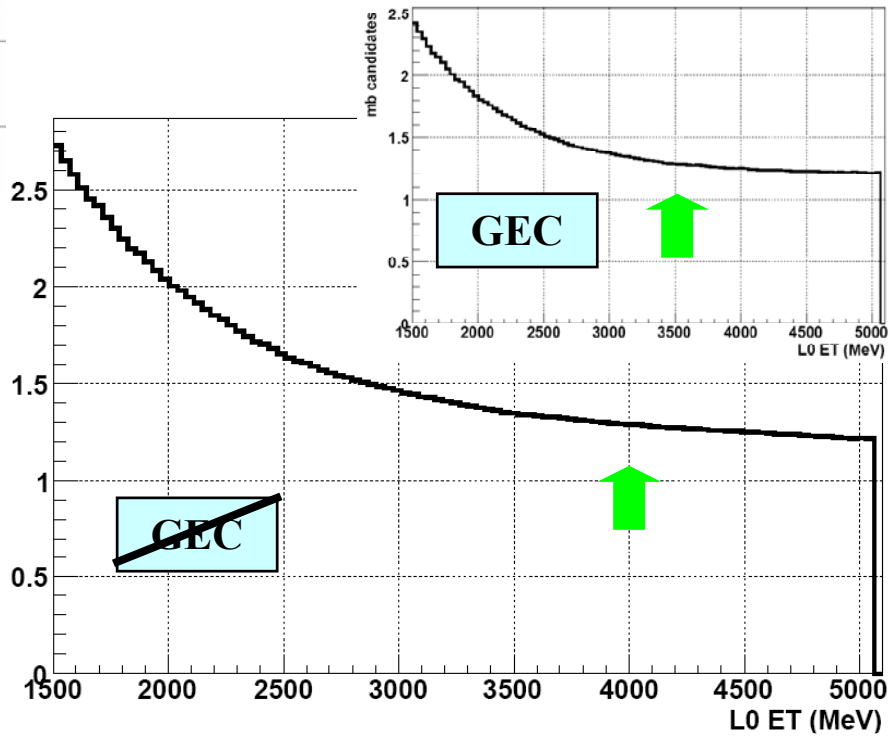
- **Ongoing work**
  - Add TT hits in Hlt1 (Jose, Johannes)
  - Fast fit with outlayers removal in Velo (Wouter)
  - Ghost killing (Vava (see this meeting) , Georg)
  - …

II) Possibility of removing GEC

- GEC reduce high multiplicity and multi primary vertices events at L0
- L0ET>4 GeV @ 600 Hz, candidates 1.3 (as with GEC)
- L0 TOS efficiency B→hh (38% → 48%), Bs→ΦΦ (19%→22%)



L0 TOS efficiency vs L0 ET cut



mb candidates vs L0 ET cut

DiHadron line without GEC

	mb rate (kHz)	mb candidates	Bs2PiK	Bs2PhiPhi	Bs2DsPi	Bd2D0Kstar
L0ET>4000.0	596.02	1.30	48.30	22.00	34.90	38.40
Calo2DChi2<4	575.70	5.76	48.10	21.70	34.60	38.60
Velo	572.86	5.95	48.00	21.70	34.60	38.60
IP>0.1	441.71	3.40	45.90	19.80	33.80	36.20
Calo3DChi2<4	334.01	2.54	45.50	19.10	33.10	33.90
VeloCalo	334.01	2.68	45.50	18.90	32.70	33.60
GuidedForward	84.10	1.38	45.10	17.90	31.60	31.30
PT>2500.0	39.29	1.40	44.30	16.50	30.10	30.30
Velo1	39.29	62.34	55.00	27.10	40.60	42.10
IP>0.11	39.29	43.64	45.20	17.90	31.50	31.90
MatchIDsFraction<0.9	39.29	42.39	40.00	17.40	31.30	31.80
DOCA<0.2	38.39	16.47	43.50	16.40	29.90	30.30
VertexDz>0.0	37.79	9.51	42.80	16.00	29.40	29.80
Forward	34.66	6.09	41.20	16.00	29.40	29.70
VertexMinPT>1000.0	11.65	2.15	41.20	15.40	28.30	28.40
VertexPointing<0.4	7.92	1.87	41.20	15.30	28.30	28.40
FitTrack	7.92	1.87	41.20	15.30	28.30	28.40
FitVertexMinIP>0.1	7.02	1.83	40.90	14.90	27.90	28.20
FitVertexMaxChi2OverNdf<10.0	3.44	1.57	40.20	14.60	27.60	27.90

~~GEC~~

FitVertexMaxChi2OverNdf<10.0	1.79	1.75	32.30	11.90	22.50	23.20

GEC

GEC or not GECs?

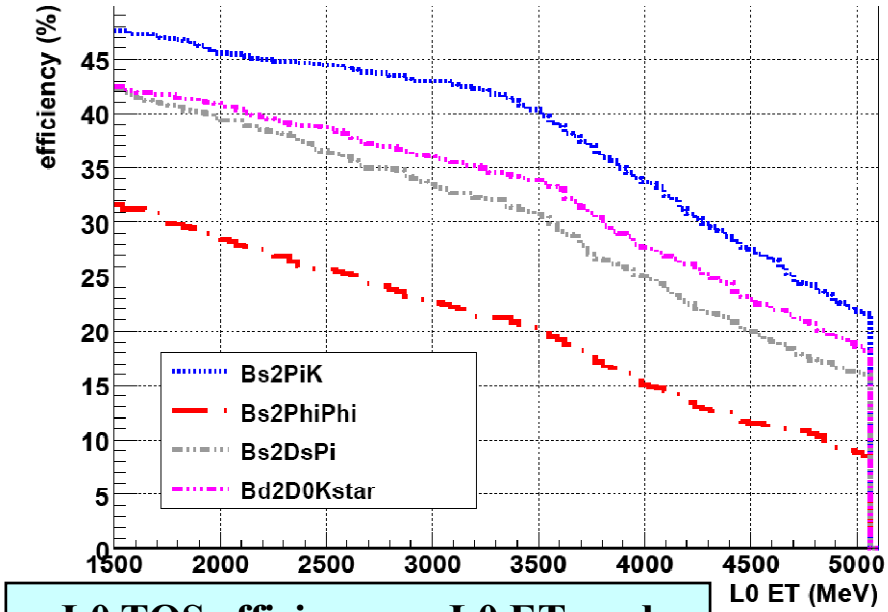
- L0 HLT cuts to be re-optimized in the bandwidth division (Miriam)

III) Possibility of a soft dihadron line

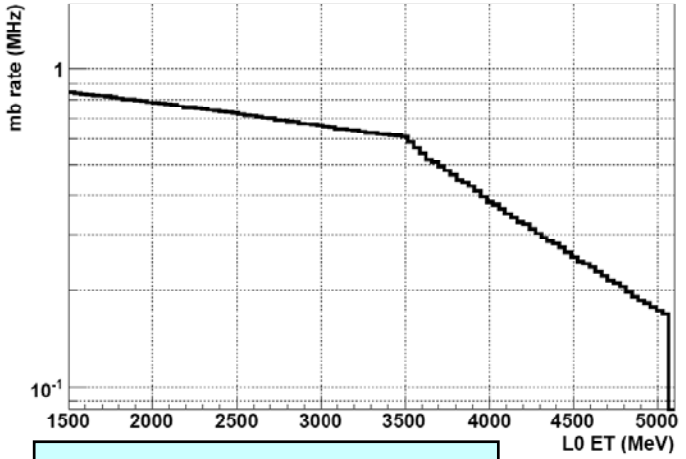
- L0 TOS on signal is 20-40% of L0!
  - Bs→ΦΦ 34% L0, 19% L0 TOS
- Exits a L0 calo TOS below L0 ET threshold
- Starts with L0 calo seeds with a lower ET

  i.e L0 yes & L0ET hadron seed > 2.5 GeV
- Lower PT cut on confirmation

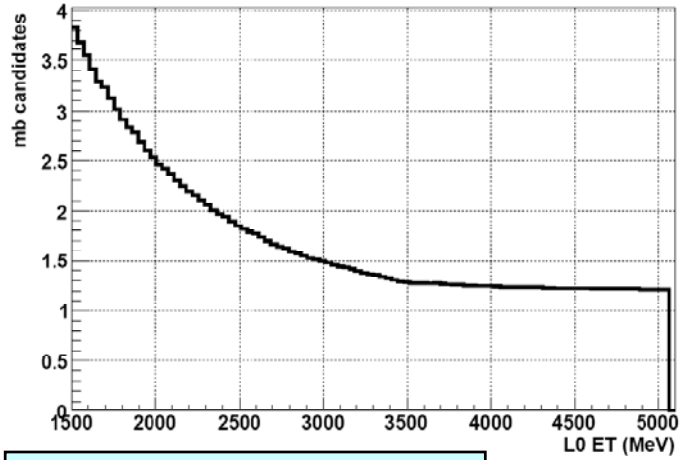
  i.e PT>1500 MeV



L0 TOS efficiency vs L0 ET seed



rate vs L0 ET seed



 # seeds vs L0 ET seed

Soft DiHadron

	mb rate (kHz)	mb candidates	Bs2PiK	Bs2PhiPhi	Bs2DsPi	Bd2D0Kstar	
L0ET>2500.0	727.62	1.85	44.50	25.80	36.60	38.70	
Calo2DChi2<4	705.81	7.63	44.70	25.60	36.80	38.70	
Velo	704.17	7.59	44.60	25.60	36.80	38.70	
IP>0.1	572.27	4.09	43.40	23.50	36.10	37.20	
Calo3DChi2<4	448.43	2.90	43.00	22.40	35.00	35.00	
VeloCalo	448.43	3.12	42.80	22.10	34.70	34.70	
GuidedForward	105.91	1.41	42.60	21.10	33.70	33.40	
PT>1500.0	65.73	1.43	42.50	20.60	33.10	32.60	
Velo1	65.73	58.38	43.70	21.60	34.80	34.00	
IP>0.11	65.73	36.32	43.70	21.60	34.80	34.00	
MatchIDsFraction<0.9	65.73	35.06	31.80	20.50	34.30	33.60	
DOCA<0.2	64.83	16.26	41.70	20.30	32.90	32.50	
VertexDz>0.0	63.19	9.91	41.50	20.10	32.40	32.20	
Forward	57.81	6.40	40.20	20.10	32.30	32.20	
VertexMinPT>1000.0	18.37	2.29	40.20	19.40	30.90	30.80	
VertexPointing<0.4	11.20	2.39	40.20	19.10	30.90	30.70	
FitTrack	11.20	2.39	40.20	19.10	30.90	30.70	
FitVertexMinIP>0.1	10.01	2.42	40.00	18.60	30.70	30.40	**Soft**
FitVertexMaxChi2OverNdf<10.0	5.98	2.08	39.10	18.40	30.50	30.20	
FitVertexMaxChi2OverNdf<10.0	1.79	1.75	32.30	11.90	22.50	23.20	**Di**

Hadron lines

	Single	*!GEC Single*	DiHadron	*!GEC DiHadron*	*Soft DiHadron*	*!GEC Soft DiHadron*
Input Rate [kHz]	582	596.	582.	596.	727.	
Output rate [kHz]	3.3	5.8	1.8±0.7	3.4	6.0	10.
Candidates (mb)	1.2	1.3	1.7	1.6	2.1	1.8
Time (ms) (2.12x2.68)	2.6	3.1	+0.65	+1	+1.5	+2.1
Bs2PiK TOS ε(L0*HLT)	23	31	32	40	39	47
Bs2DsPi	13	18	22	27	30	36
BsPhiPhi	4	6	12	14	18	22

- Low number of initial candidates
- Time to be measured in EFF
- Rates ~2 kHz (DiHadron) →3.4 (DiHadron !GEC) →6 (SoftDiHadron)
- TOS L0xHLT efficiencies Bs→ΦΦ 12% (DiHadron)→ 18% (SoftDiHadron)

Summary

- **Fast Fit in Hadron alley**
  - **Reduce rate ½,** ~4 kHz output of Hadron alley, time 1 ms/track
  - Further studies ongoing to reduce rate and ghost killing
- **Possibility of eliminating GEC**
  - To be included in the L0xHLT bandwidth optimization
  - In DiHadron: 5(8)% gain in efficiency B→hh (Bs→DsK), factor ~2 in rate, ~33% time
- **Possibility of soft DiHadron line**
  - Starts with L0 yes and L0 calo candidates at lower threshold (i.e Et>2500 MeV)
  - 6% gain in efficiency Bs→ΦΦ, ~3 factor rate, ~50% time
  - Not in the bandwidth division
  - Measuring time of HLT time in the EFF ongoing