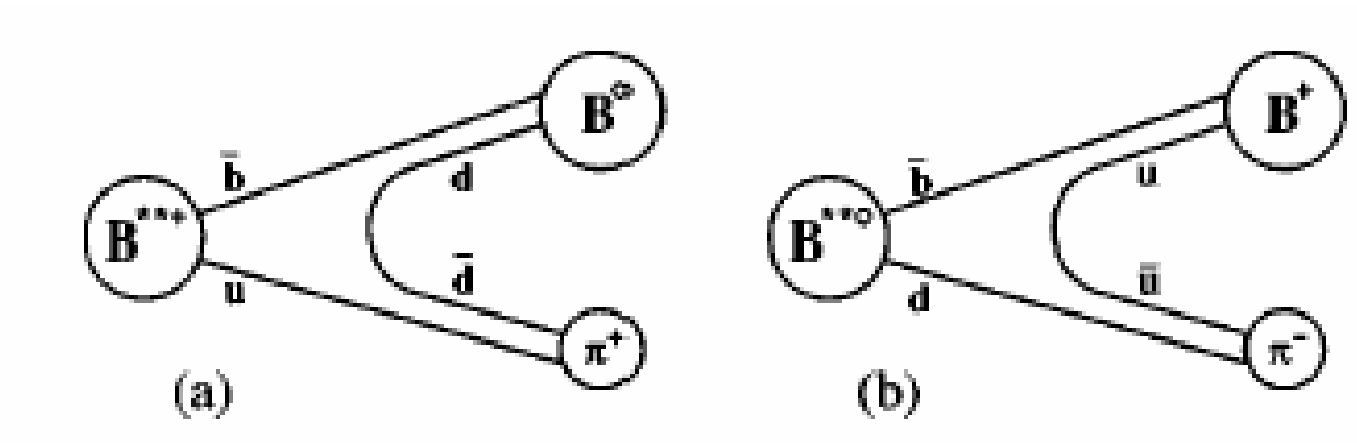
B** production using LEP settings in Pythia

Paul Szczypka

Importance of B** production

- B^{**} expected production fraction ~30%
- Same side tagging (SST): B^{**} states predicted to strongly decay to $B\,\pi^{\pm}$
- SST obviously useful for b flavour-oscillation studies.



PARJ settings explained

Pythia parameter	meaning	Default value
PARJ(1)	Meson, baryon fraction	0.10
PARJ(2)	Strangeness production	0.30
PARJ(11)	*P*(light meson has spin 1)	0.5
PARJ(12)	*P*(strange meson has spin 1)	0.6
PARJ(13)	*P*(S=1 (b, c))	0.75
PARJ(14)	*P*(S=0,L=1,J=1)	0.0
PARJ(15)	*P*(S=1,L=1,J=0)	0.0
PARJ(16)	*P*(S=1,L=1,J=1)	0.0
PARJ(17)	*P*(S=1,L=1,J=2)	0.0

Settings used in the program

LHCb Tune settings are:

```
     mstp(52) = 2
     mstp(51) = 4032
     mstp(82) = 3
     mstp(2) = 2
     mstp(33) = 3
     parp(82) = 3.47
     parp(89) = 14000.
     parp(90) = 2*0.087
     msel = 1

* Turn off some decays
      mdcy(pycomp(130),1)=0 ! K0s
    mdcy(pycomp(310),1)=0 ! K0l
    mdcy(pycomp(3122),1)=0 !
Lambda
      mdcy(pycomp(-130),1)=0 ! K0s
    mdcy(pycomp(-310),1)=0 ! K0l
    mdcy(pycomp(-3122),1)=0 !
Lambda
* Correct for SUSY BLOCK DATA bug
!
      mdme(4178,1) = -1
```

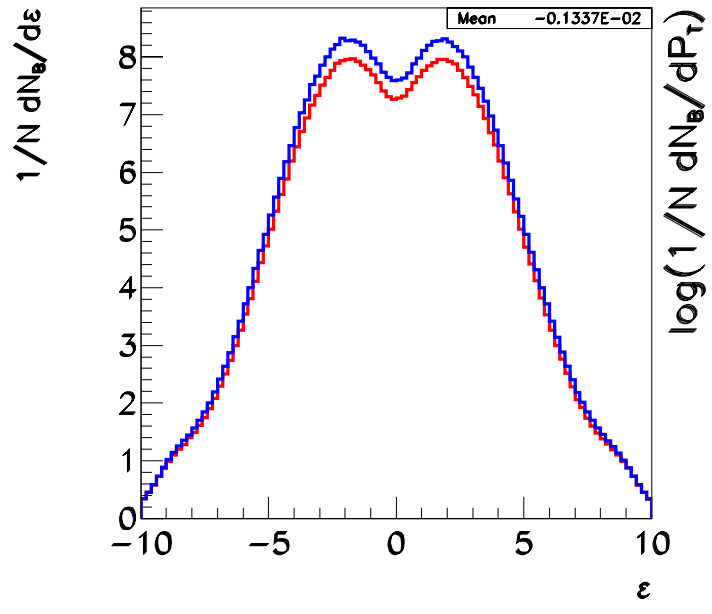
*New (DC04) B** settings are:*

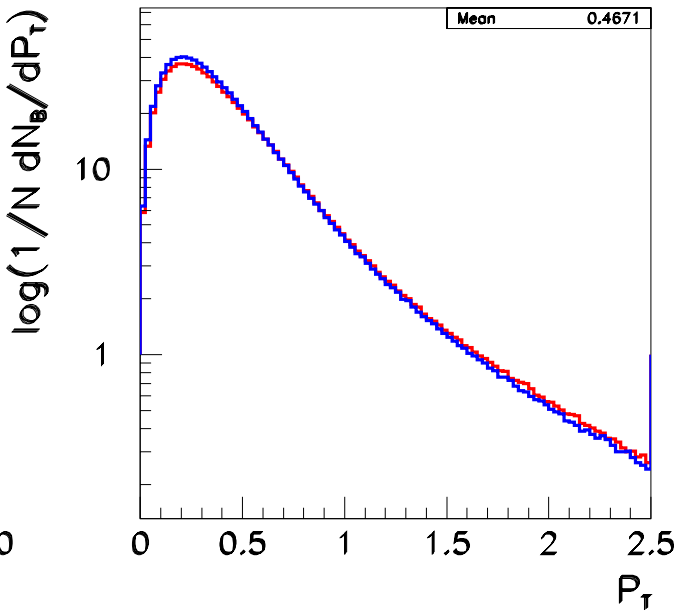
LHCb Tune +

```
PARJ(1)=0.1
PARJ(2)=0.3
PARJ(13)=0.75
PARJ(14)=0.162
PARJ(15)=0.018
PARJ(16)=0.054
PARJ(17)=0.09
```

(Tuned to LEP B** production ratios)

Min bias plots of DC04 settings compared to LHCb tune

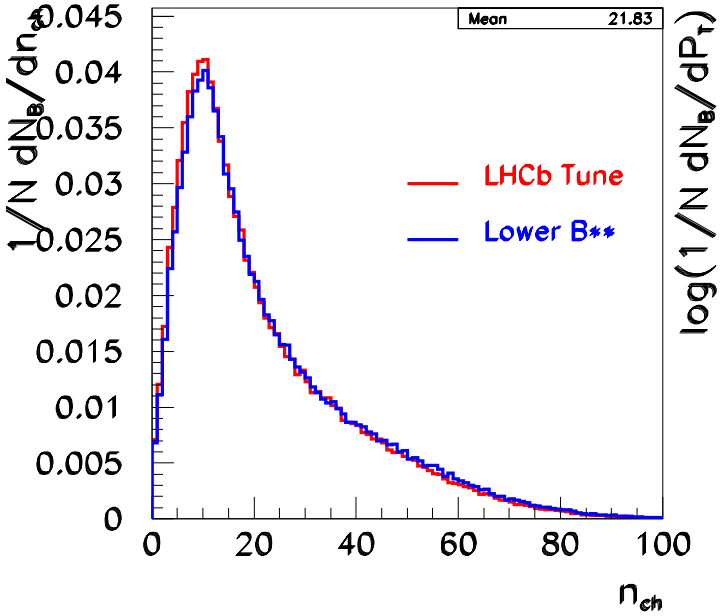


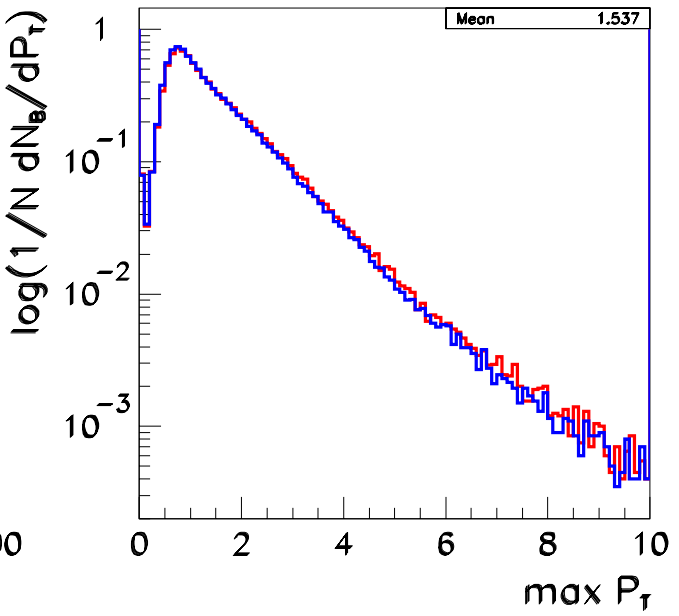


New settings:

PARJ(1)=0.1
PARJ(2)=0.3
PARJ(13)=0.75
PARJ(14)=0.162
PARJ(15)=0.018
PARJ(16)=0.054
PARJ(17)=0.09

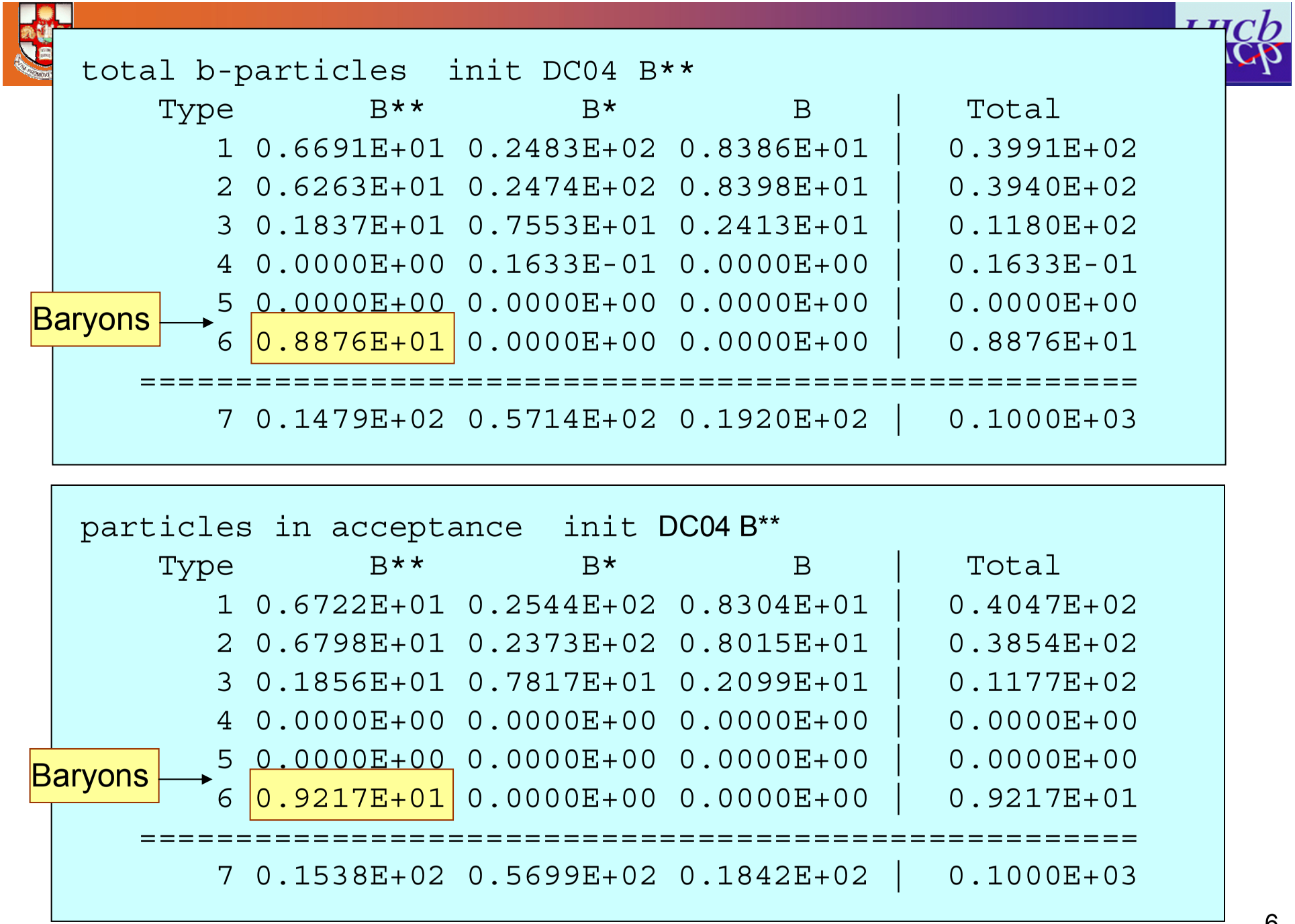
<n> = 22.70





LHCb tune:

<n> = 21.83


total b-particles init DC04 B**
Type B** B* B | Total
1 0.6691E+01 0.2483E+02 0.8386E+01 | 0.3991E+02
2 0.6263E+01 0.2474E+02 0.8398E+01 | 0.3940E+02
3 0.1837E+01 0.7553E+01 0.2413E+01 | 0.1180E+02
4 0.0000E+00 0.1633E-01 0.0000E+00 | 0.1633E-01
5 0.0000E+00 0.0000E+00 0.0000E+00 | 0.0000E+00
6 0.8876E+01 0.0000E+00 0.0000E+00 | 0.8876E+01
7 0.1479E+02 0.5714E+02 0.1920E+02 | 0.1000E+03
Baryons
particles in acceptance init DC04 B**
Type B** B* B | Total
1 0.6722E+01 0.2544E+02 0.8304E+01 | 0.4047E+02
2 0.6798E+01 0.2373E+02 0.8015E+01 | 0.3854E+02
3 0.1856E+01 0.7817E+01 0.2099E+01 | 0.1177E+02
4 0.0000E+00 0.0000E+00 0.0000E+00 | 0.0000E+00
5 0.0000E+00 0.0000E+00 0.0000E+00 | 0.0000E+00
6 0.9217E+01 0.0000E+00 0.0000E+00 | 0.9217E+01
7 0.1538E+02 0.5699E+02 0.1842E+02 | 0.1000E+03
Baryons

total b-particles final DC04 B**

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4060E+02	0.4060E+02
2	0.0000E+00	0.0000E+00	0.4054E+02	0.4054E+02
3	0.0000E+00	0.0000E+00	0.9966E+01	0.9966E+01
4	0.0000E+00	0.0000E+00	0.1633E-01	0.1633E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8876E+01	0.0000E+00	0.0000E+00	0.8876E+01
7	0.0000E+00	0.0000E+00	0.9112E+02	0.1000E+03

Baryons →

particles in acceptance DC04 B**

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4131E+02	0.4131E+02
2	0.0000E+00	0.0000E+00	0.3956E+02	0.3956E+02
3	0.0000E+00	0.0000E+00	0.9916E+01	0.9916E+01
4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.9217E+01	0.0000E+00	0.0000E+00	0.9217E+01
7	0.0000E+00	0.0000E+00	0.9078E+02	0.1000E+03

Baryons →

B** production fractions using new PARJ settings compared to calculated values

	Calculated	Simulated
Fraction of B0 mesons	40.49 %	40.60 %
Fraction of B+ mesons	40.49 %	40.54 %
Fraction of Bs mesons	9.94 %	9.97 %
Fraction of b baryons	9.09 %	8.88 %
Absolute fraction of B**	14.73 %	14.79 %
Fraction of B** in meson sample	16.20 %	16.23 %

Before B** decays After B** decays

Implications of DC04 settings

- Multiplicity increased by ~4%
  - Softer p_t – trigger problems?
  - Re-tuning required incorporating new PARJ settings
- Central multiplicity increased

Table showing % differences of *n* in the LHCb acceptance

Settings	<n>	% difference with LHCb default	% difference with LHCb + CDF PARJ
LHCb default	21.83	0.0 %	-7.97 %
LHCb + CDF PARJ	23.72	8.66 %	0.0 %
Aleph	20.74	-4.99 %	-12.56 %
L3	21.27	-2.57 %	-10.33 %
Opal	22.49	3.02 %	-5.19 %
DC04 B**	22.70	3.99 %	-4.30 %

(LEP data below)

Start of LEP & CDF Data

LEP settings including Pythia default.

Parameter	Name	Default	ALEPH	DELPHI	L3	OPAL
Fragmentation function	MSTJ(11)	4	3	3	3	3
Baryon model option	MSTJ(12)	2	2	3	2	2
Azimuthal correlations	MSTJ(46)	3	0	3	3	3
$\mathcal{P}(qq)/\mathcal{P}(q)$	PARJ(1)	0.100	0.095	0.099	0.100	0.085
$\mathcal{P}(s)/\mathcal{P}(u)$	PARJ(2)	0.300	0.285	0.308	0.300	0.310
$(\mathcal{P}(us)/\mathcal{P}(ud))/(\mathcal{P}(s)/\mathcal{P}(d))$	PARJ(3)	0.400	0.580	0.650	0.400	0.450
$(1/3)\mathcal{P}(ud_1)/\mathcal{P}(ud_0)$	PARJ(4)	0.050	0.050	0.070	0.050	0.025
$\mathcal{P}(S=1)_{d,u}$	PARJ(11)	0.500	0.550	–	0.500	0.600
$\mathcal{P}(S=1)_s$	PARJ(12)	0.600	0.470	–	0.600	0.400
$\mathcal{P}(S=1)_{c,b}$	PARJ(13)	0.750	0.600	–	0.750	0.720
Axial, $\mathcal{P}(S=0,L=1;J=1)$	PARJ(14)	0.000	0.096	–	0.100	0.430
Scalar, $\mathcal{P}(S=1,L=1;J=0)$	PARJ(15)	0.000	0.032	–	0.100	0.080
Axial, $\mathcal{P}(S=1,L=1;J=1)$	PARJ(16)	0.000	0.096	–	0.100	0.080
Tensor, $\mathcal{P}(S=1,L=1;J=2)$	PARJ(17)	0.000	0.160	–	0.250	0.170
Extra baryon suppression	PARJ(19)	1.000	1.000	0.500	1.000	1.000
σ_q	PARJ(21)	0.360	0.360	0.408	0.399	0.400
extra η suppression	PARJ(25)	1.000	1.000	0.650	0.600	1.000
extra η' suppression	PARJ(26)	0.400	0.400	0.230	0.300	0.400
a	PARJ(41)	0.300	0.400	0.417	0.500	0.110
b	PARJ(42)	0.580	1.030	0.850	0.848	0.520
ϵ_c	PARJ(54)	−0.050	−0.050	−0.038	−0.030	−0.031
ϵ_b	PARJ(55)	−0.0050	−0.0045	−0.00284	−0.0035	−0.0038
Λ_{LLA}	PARJ(81)	0.290	0.320	0.297	0.306	0.250
Q_0	PARJ(82)	1.000	1.220	1.560	1.000	1.900

(Pythia: B** not allowed by default)

LEP parameters compared to LHC Pythia with B** on

Parameter	Name	Pythia B**	ALEPH	DELPHI	L3	OPAL
Fragmentation function	MSTJ(11)	4	3	3	3	3
Baryon model option	MSTJ(12)	2	2	2	2	2
Azimuthal correlations	MSTJ(46)	3	0	3	3	3
$\mathcal{P}(qq)/\mathcal{P}(q)$	PARJ(1)	0.100	0.095	0.099	0.100	0.085
$\mathcal{P}(s)/\mathcal{P}(u)$	PARJ(2)	0.300	0.285	0.308	0.300	0.310
$(\mathcal{P}(us)/\mathcal{P}(ud))/(\mathcal{P}(s)/\mathcal{P}(d))$	PARJ(3)	0.400	0.580	0.650	0.400	0.450
$(1/3)\mathcal{P}(ud_1)/\mathcal{P}(ud_0)$	PARJ(4)	0.050	0.050	0.070	0.050	0.025
$\mathcal{P}(S=1)_{d,u}$	PARJ(11)	0.500	0.550	–	0.500	0.600
$\mathcal{P}(S=1)_s$	PARJ(12)	0.600	0.470	–	0.600	0.400
$\mathcal{P}(S=1)_{c,b}$	PARJ(13)	0.7625	0.600	–	0.750	0.720
Axial, $\mathcal{P}(S=0,L=1;J=1)$	PARJ(14)	0.320	0.096	–	0.100	0.430
Scalar, $\mathcal{P}(S=1,L=1;J=0)$	PARJ(15)	0.033	0.032	–	0.100	0.080
Axial, $\mathcal{P}(S=1,L=1;J=1)$	PARJ(16)	0.099	0.096	–	0.100	0.080
Tensor, $\mathcal{P}(S=1,L=1;J=2)$	PARJ(17)	0.165	0.160	–	0.250	0.170
Extra baryon suppression	PARJ(19)	1.000	1.000	0.500	1.000	1.000
σ_q	PARJ(21)	0.360	0.360	0.408	0.399	0.400
extra η suppression	PARJ(25)	1.000	1.000	0.650	0.600	1.000
extra η' suppression	PARJ(26)	0.400	0.400	0.280	0.300	0.400
a	PARJ(41)	0.300	0.400	0.417	0.500	0.110
b	PARJ(42)	0.580	1.030	0.850	0.848	0.520
ϵ_c	PARJ(54)	−0.050	−0.050	−0.038	−0.030	−0.031
ϵ_b	PARJ(55)	−0.0050	−0.0045	−0.00284	−0.0035	−0.0038
Λ_{LLA}	PARJ(81)	0.290	0.320	0.297	0.306	0.250
Q_0	PARJ(82)	1.000	1.220	1.560	1.000	1.900

B settings taken from CDF model**

LHCb Tune settings are:

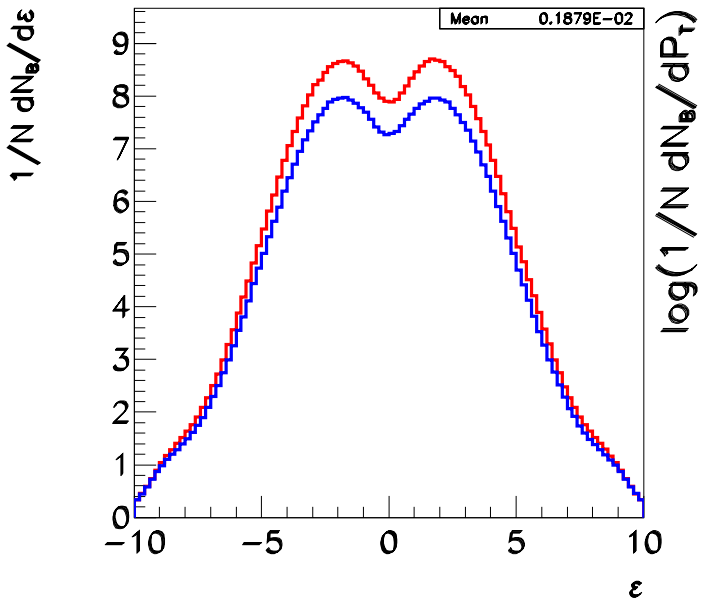
```
    mstp(52) = 2
    mstp(51) = 4032
    mstp(82) = 3
    mstp(2) = 2
    mstp(33) = 3
    parp(82) = 3.47
    parp(89) = 14000.
    parp(90) = 2*0.087
    msel = 1

* Turn off some decays
     mdcy(pycomp(130),1)=0 ! K0s
   mdcy(pycomp(310),1)=0 ! K0l
   mdcy(pycomp(3122),1)=0 ! Lambda
     mdcy(pycomp(-130),1)=0 ! K0s
   mdcy(pycomp(-310),1)=0 ! K0l
   mdcy(pycomp(-3122),1)=0 ! Lambda
*
* Correct for SUSY BLOCK DATA bug !
     mdme(4178,1) = -1
```

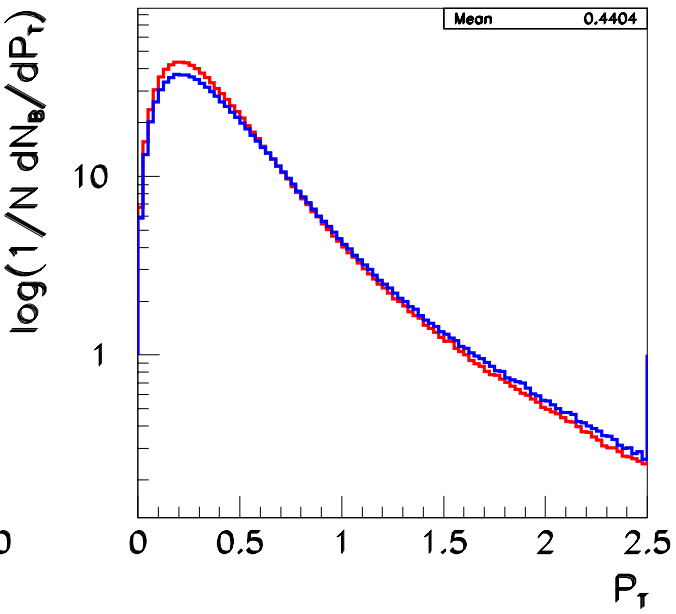
LHCb Tune + (CDF) PARJ settings are:

LHCb Tune +

```
PARJ(13) = 0.7625
PARJ(14) = 0.320
PARJ(15) = 0.033
PARJ(16) = 0.099
PARJ(17) = 0.165
```

Plots of LHCb tune and LHCb tune + CDF PARJ settings



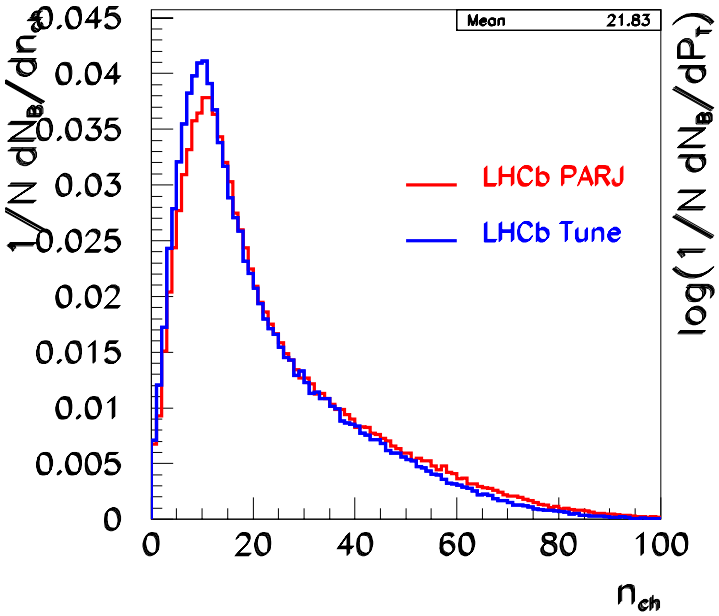


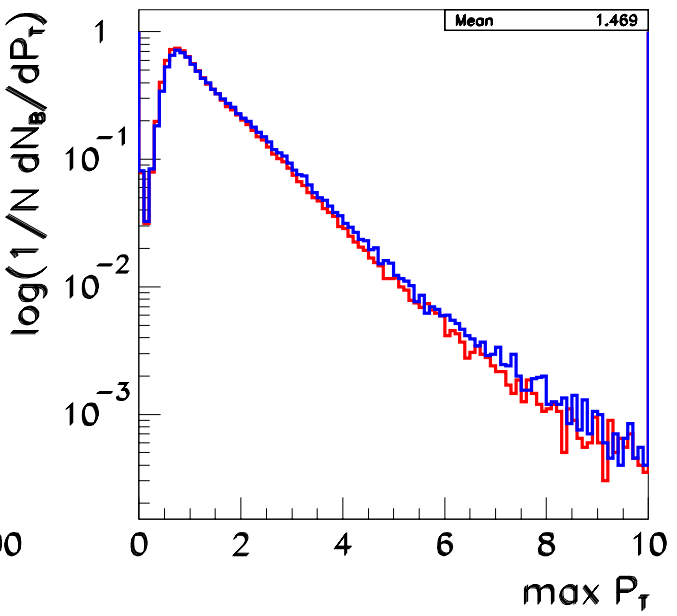
LHCb Tune

<*n*> = 21.83

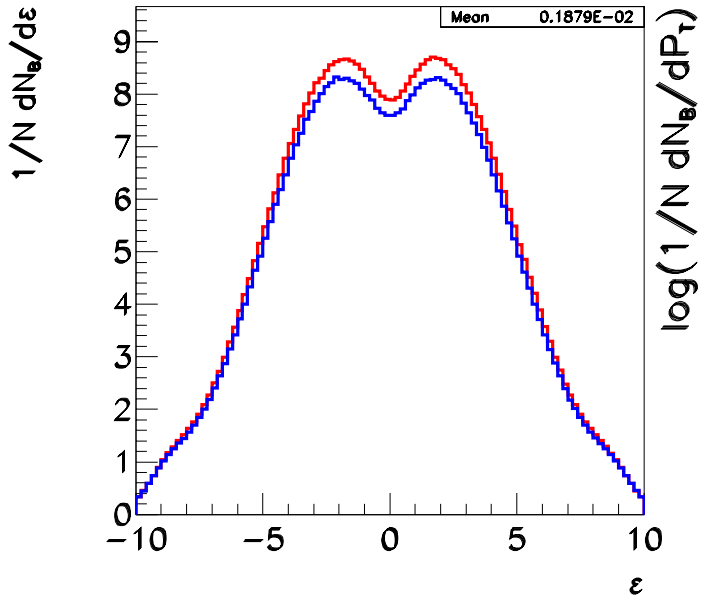
LHCb Tune + CDF B**

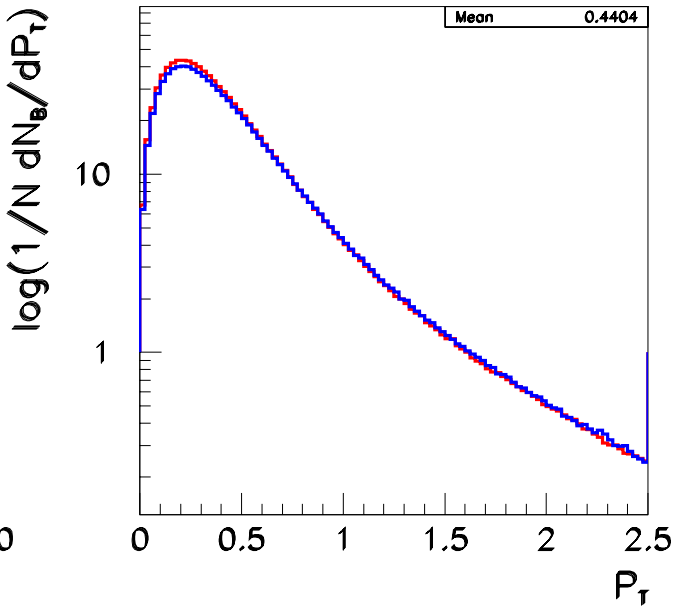
<*n*> = 23.72





Plots of DC04 B** and LHCb tune + CDF PARJ settings



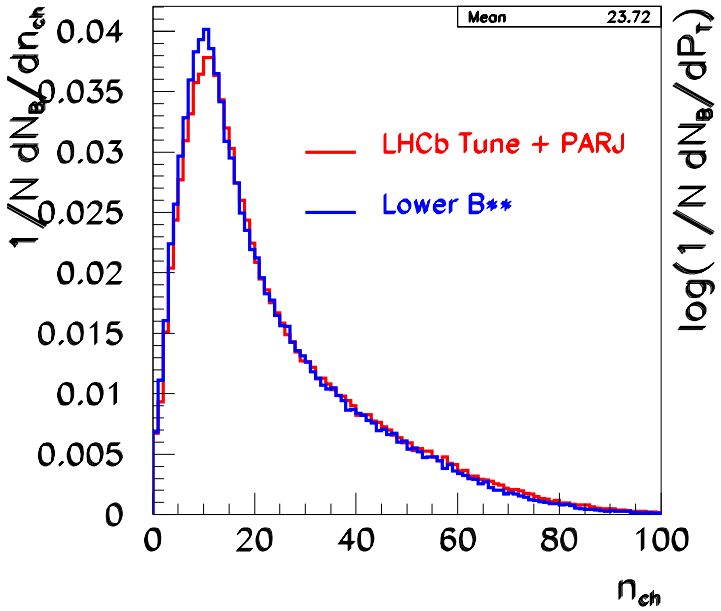


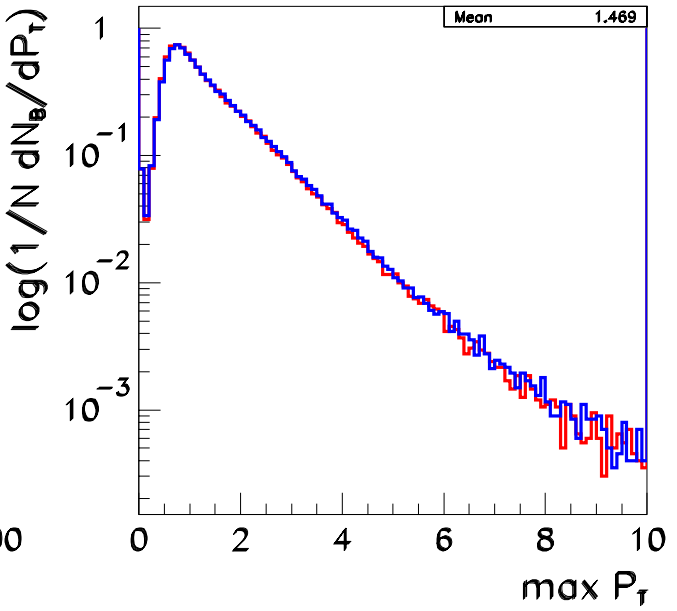
New settings:

PARJ(1)=0.1

PARJ(2)=0.3
PARJ(13)=0.75
PARJ(14)=0.162
PARJ(15)=0.018
PARJ(16)=0.054
PARJ(17)=0.09

<n> = 22.70





LHCb tune + CDF B**:

<n> = 23.72

total b-particles init LHCB

Type	B**	B*	B	Total
1	0.1201E+02	0.2122E+02	0.6378E+01	0.3960E+02
2	0.1206E+02	0.2135E+02	0.6413E+01	0.3982E+02
3	0.3552E+01	0.6322E+01	0.1909E+01	0.1178E+02
4	0.0000E+00	0.1062E-01	0.3342E-02	0.1396E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8779E+01	0.0000E+00	0.0000E+00	0.8779E+01
7	0.2762E+02	0.4889E+02	0.1470E+02	0.1000E+03

Baryons →

particles in acceptance init

Type	B**	B*	B	Total
1	0.1200E+02	0.2118E+02	0.6328E+01	0.3951E+02
2	0.1205E+02	0.2124E+02	0.6409E+01	0.3970E+02
3	0.3572E+01	0.6362E+01	0.1913E+01	0.1185E+02
4	0.0000E+00	0.1162E-01	0.3042E-02	0.1466E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8933E+01	0.0000E+00	0.0000E+00	0.8933E+01
7	0.2762E+02	0.4879E+02	0.1465E+02	0.1000E+03

Baryons →

total b-particles final

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4140E+02	0.4140E+02
2	0.0000E+00	0.0000E+00	0.4157E+02	0.4157E+02
3	0.0000E+00	0.0000E+00	0.8231E+01	0.8231E+01
4	0.0000E+00	0.0000E+00	0.1396E-01	0.1396E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8779E+01	0.0000E+00	0.0000E+00	0.8779E+01
7	0.0000E+00	0.0000E+00	0.9122E+02	0.1000E+03

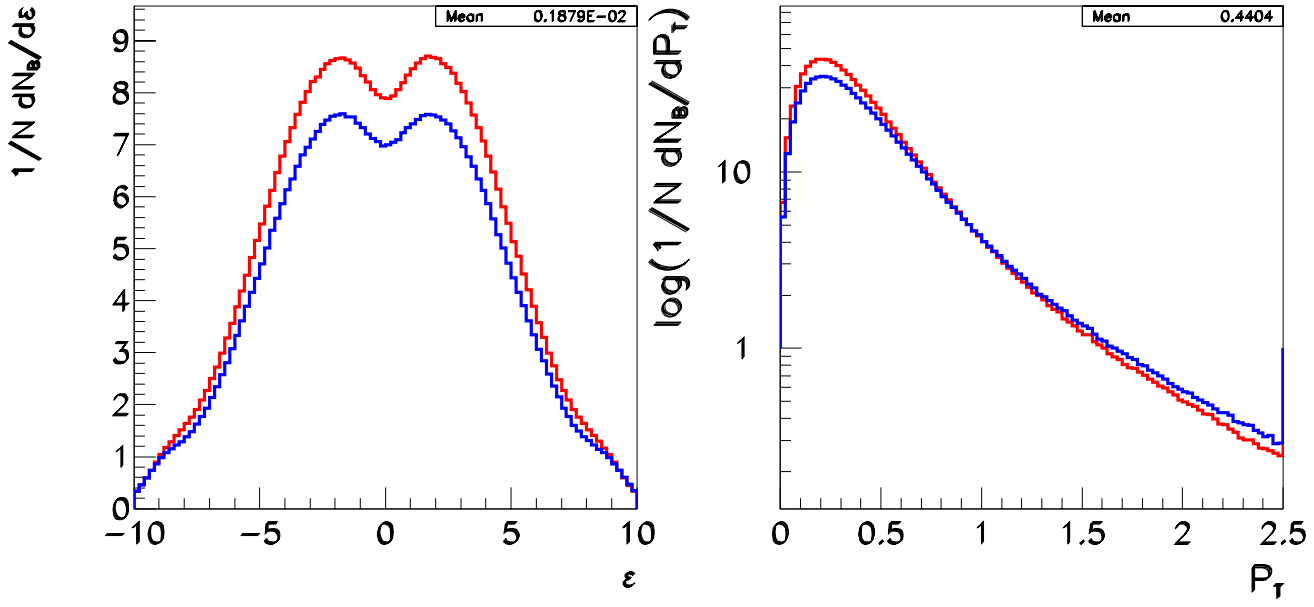
Baryons →

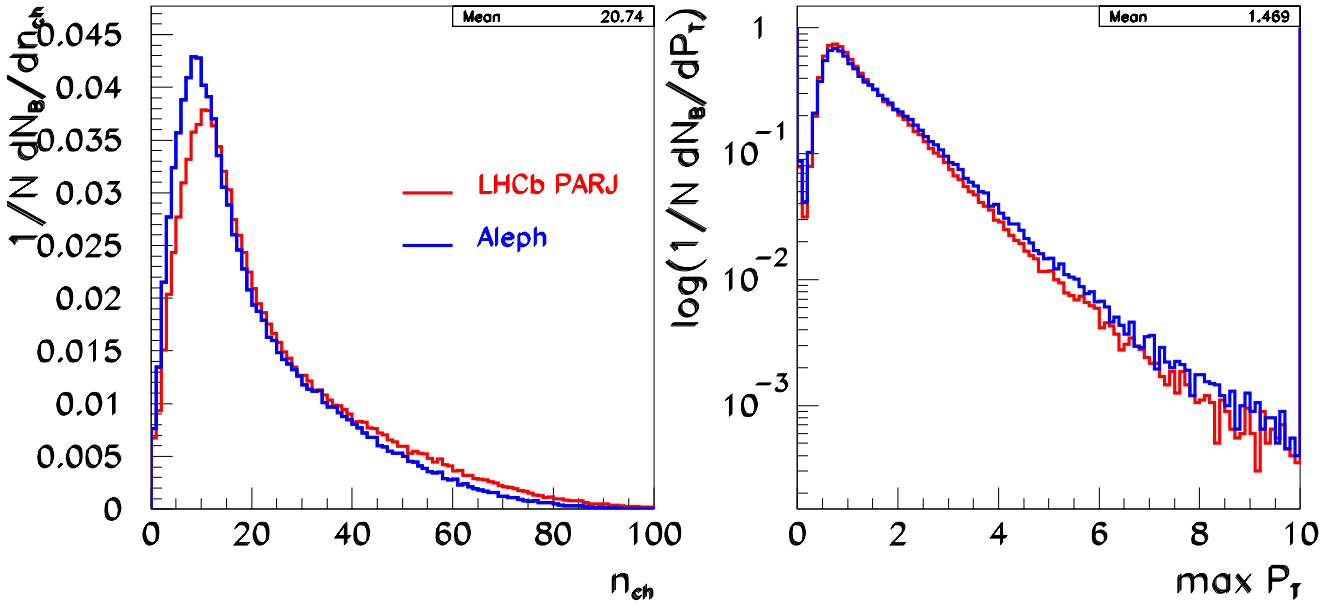
particles in acceptance final

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4134E+02	0.4134E+02
2	0.0000E+00	0.0000E+00	0.4144E+02	0.4144E+02
3	0.0000E+00	0.0000E+00	0.8275E+01	0.8275E+01
4	0.0000E+00	0.0000E+00	0.1466E-01	0.1466E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8933E+01	0.0000E+00	0.0000E+00	0.8933E+01
7	0.0000E+00	0.0000E+00	0.9107E+02	0.1000E+03

Baryons →

Aleph compared to LHCb tune + CDF B**





Aleph minimum bias plots compared to LHCb tune + CDf B settings**

- **Aleph charged multiplicity < LHCb + B****

Aleph <n> = 20.74

LHCb + B** <n> = 23.72

Aleph total b-particles initial

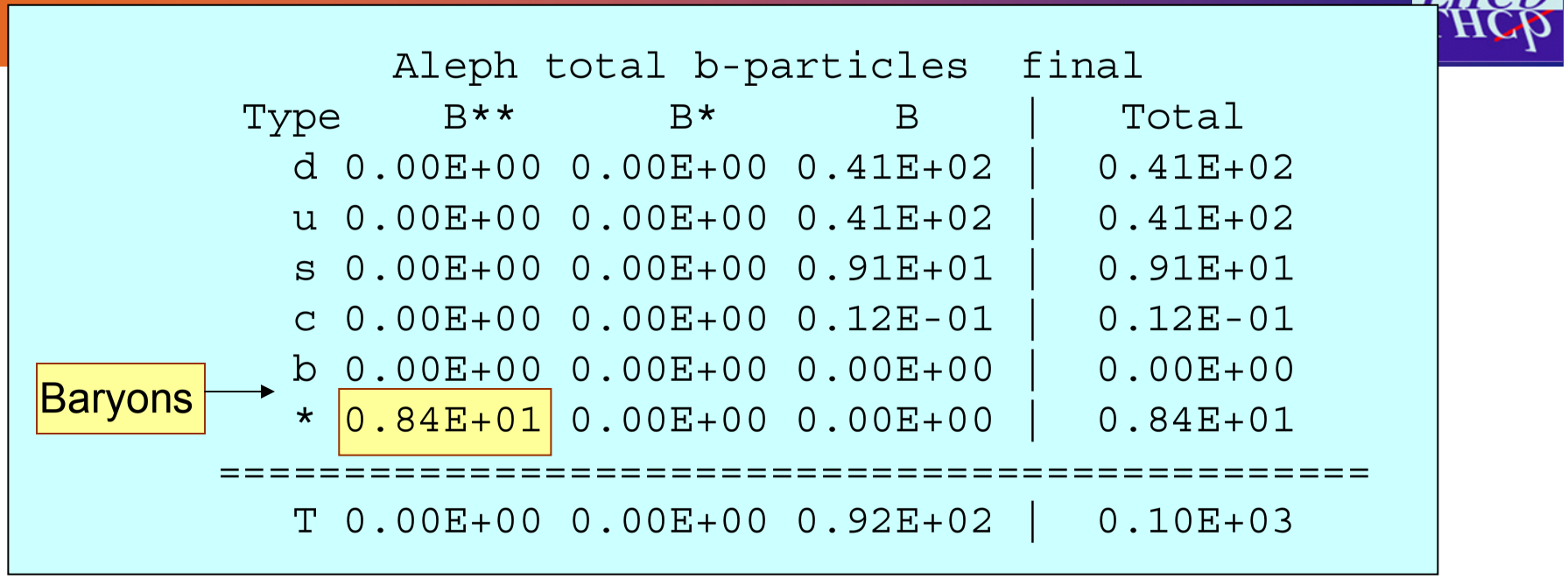
Type	B**	B*	B	Total
d	0.76E+01	0.18E+02	0.14E+02	0.40E+02
u	0.72E+01	0.18E+02	0.15E+02	0.40E+02
s	0.17E+01	0.56E+01	0.42E+01	0.11E+02
c	0.00E+00	0.62E-02	0.62E-02	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.84E+01	0.00E+00	0.00E+00	0.84E+01
T	0.16E+02	0.42E+02	0.33E+02	0.10E+03

Baryons →

Aleph particles in acceptance initial

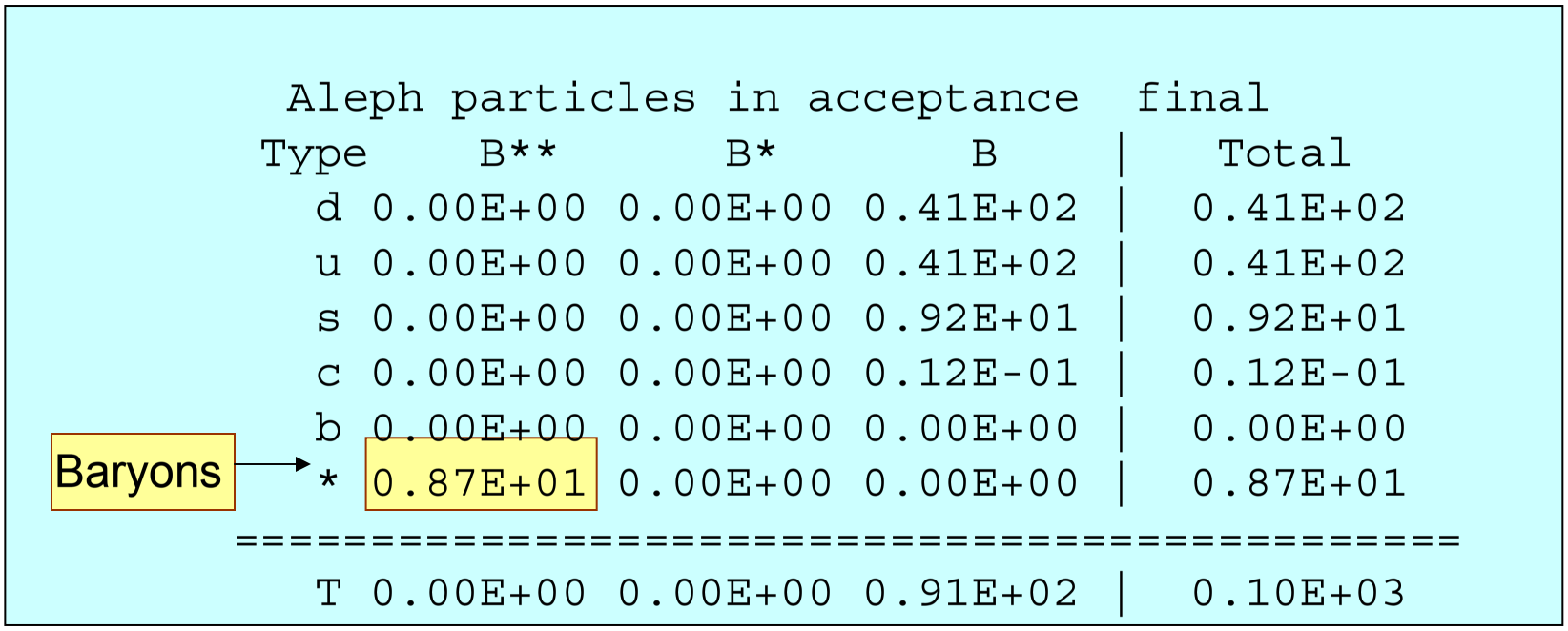
Type	B**	B*	B	Total
d	0.76E+01	0.18E+02	0.15E+02	0.40E+02
u	0.72E+01	0.18E+02	0.14E+02	0.40E+02
s	0.16E+01	0.57E+01	0.42E+01	0.11E+02
c	0.00E+00	0.46E-02	0.77E-02	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.87E+01	0.00E+00	0.00E+00	0.87E+01
T	0.16E+02	0.42E+02	0.33E+02	0.10E+03

Baryons →



Aleph total b-particles final

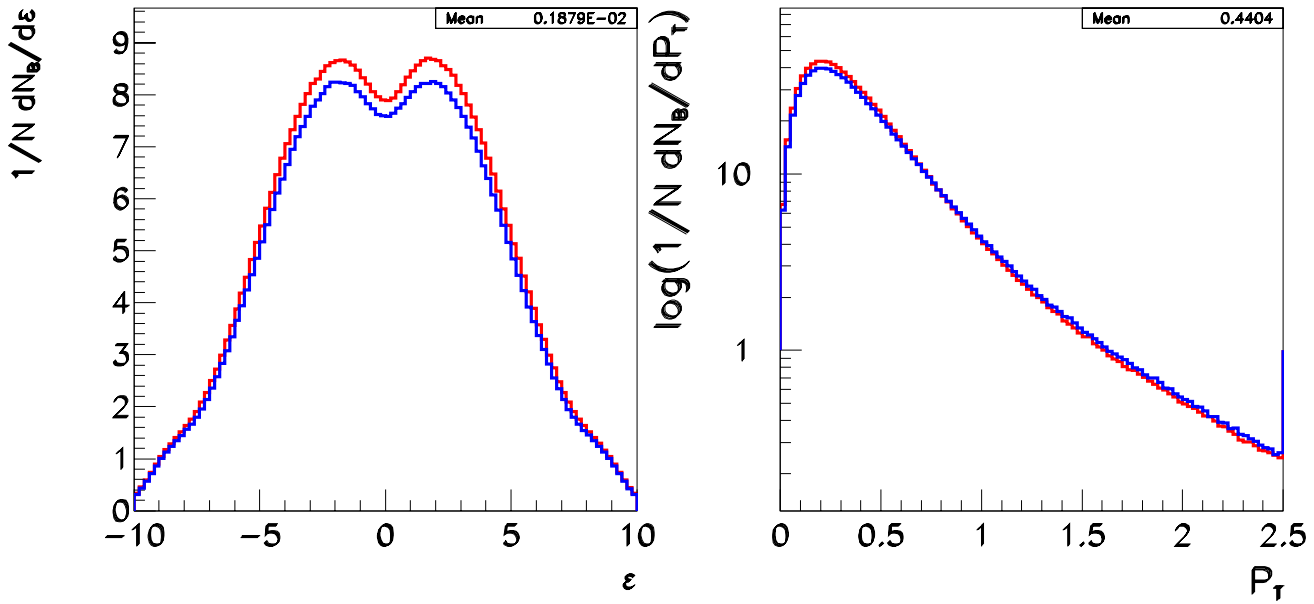
Type	B**	B*	B	Total
d	0.00E+00	0.00E+00	0.41E+02	0.41E+02
u	0.00E+00	0.00E+00	0.41E+02	0.41E+02
s	0.00E+00	0.00E+00	0.91E+01	0.91E+01
c	0.00E+00	0.00E+00	0.12E-01	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.84E+01	0.00E+00	0.00E+00	0.84E+01
T	0.00E+00	0.00E+00	0.92E+02	0.10E+03

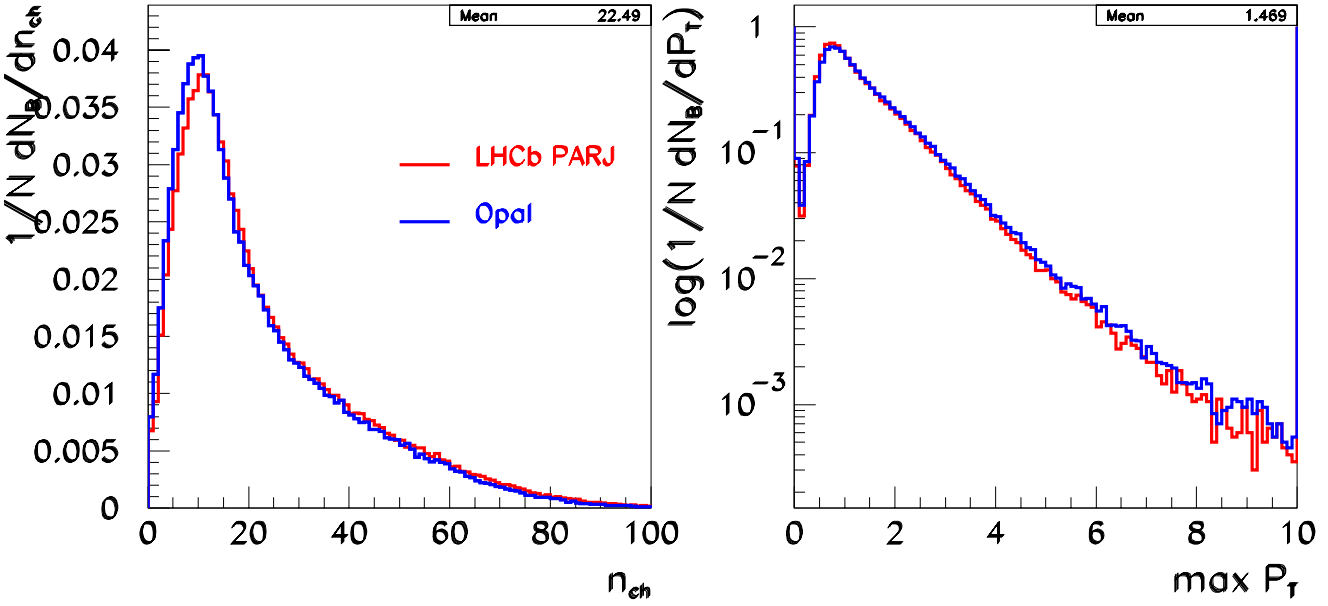


Aleph particles in acceptance final

Type	B**	B*	B	Total
d	0.00E+00	0.00E+00	0.41E+02	0.41E+02
u	0.00E+00	0.00E+00	0.41E+02	0.41E+02
s	0.00E+00	0.00E+00	0.92E+01	0.92E+01
c	0.00E+00	0.00E+00	0.12E-01	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.87E+01	0.00E+00	0.00E+00	0.87E+01
T	0.00E+00	0.00E+00	0.91E+02	0.10E+03

Opal compared to LHCb tune + CDF B**





Opal charged multiplicity ~ LHCb + B**

Opal <n> = 22.49

LHCb + B** <n> = 23.72

total b-particles init Opal

Type	B**	B*	B	Total
1	0.8364E+01	0.1711E+02	0.1444E+02	0.3991E+02
2	0.8432E+01	0.1720E+02	0.1462E+02	0.4025E+02
3	0.2381E+01	0.4893E+01	0.4153E+01	0.1143E+02
4	0.0000E+00	0.7189E-02	0.5041E-02	0.1223E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8392E+01	0.0000E+00	0.0000E+00	0.8392E+01
7	0.1918E+02	0.3921E+02	0.3322E+02	0.1000E+03

Baryons →

particles in acceptance init Opal

Type	B**	B*	B	Total
1	0.8407E+01	0.1703E+02	0.1444E+02	0.3988E+02
2	0.8462E+01	0.1712E+02	0.1448E+02	0.4006E+02
3	0.2429E+01	0.4896E+01	0.4183E+01	0.1151E+02
4	0.0000E+00	0.7117E-02	0.5260E-02	0.1238E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8538E+01	0.0000E+00	0.0000E+00	0.8538E+01
7	0.1930E+02	0.3906E+02	0.3311E+02	0.1000E+03

Baryons →

total b-particles final Opal

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4117E+02	0.4117E+02
2	0.0000E+00	0.0000E+00	0.4138E+02	0.4138E+02
3	0.0000E+00	0.0000E+00	0.9046E+01	0.9046E+01
4	0.0000E+00	0.0000E+00	0.1223E-01	0.1223E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8392E+01	0.0000E+00	0.0000E+00	0.8392E+01
7	0.0000E+00	0.0000E+00	0.9161E+02	0.1000E+03

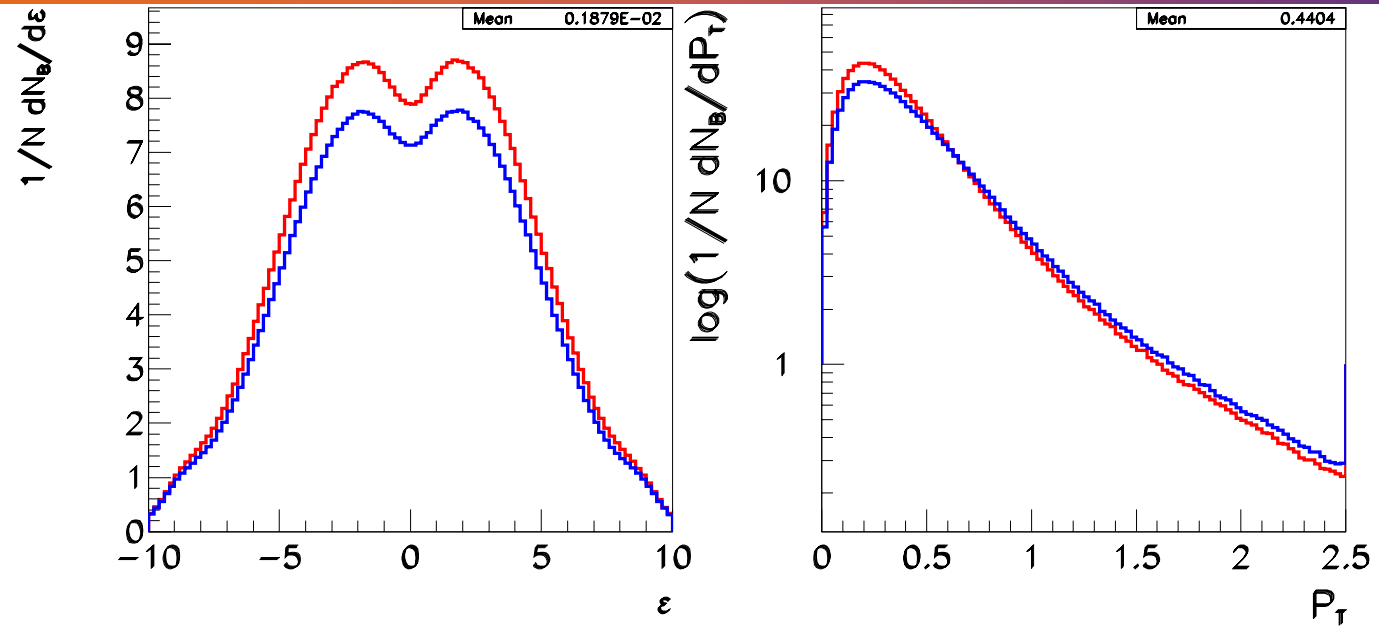
Baryons →

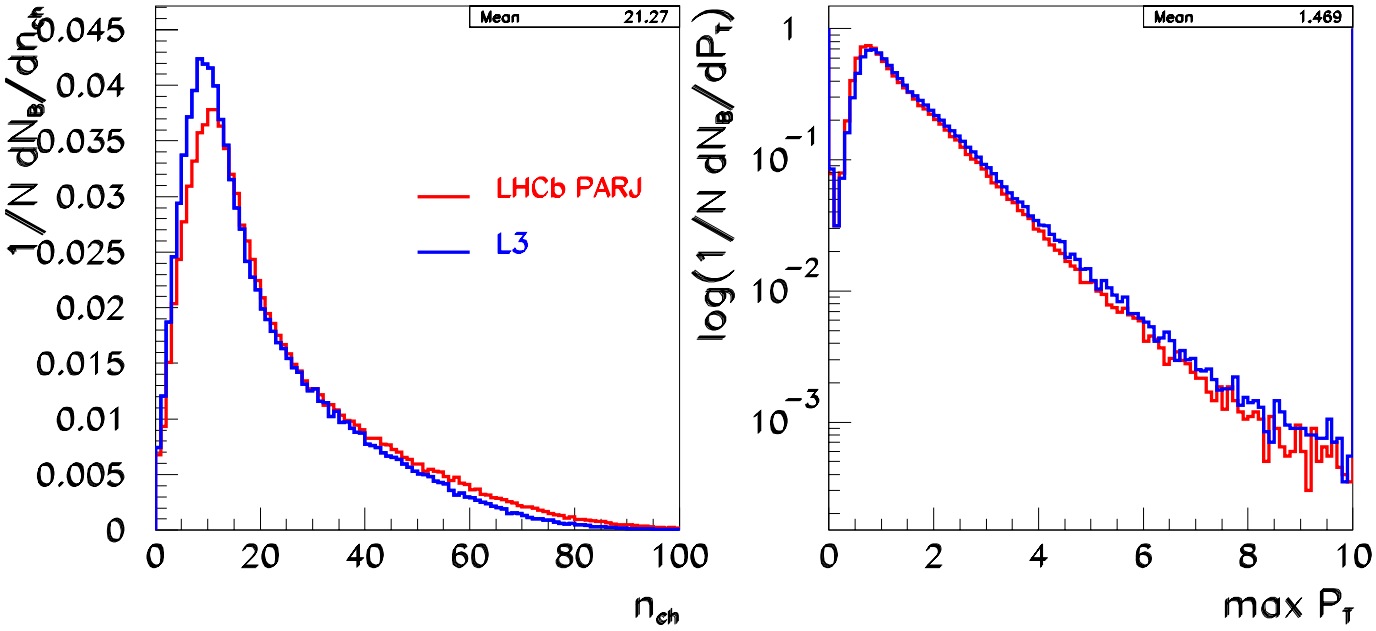
particles in acceptance final Opal

Type	B**	B*	B	Total
1	0.0000E+00	0.0000E+00	0.4111E+02	0.4111E+02
2	0.0000E+00	0.0000E+00	0.4126E+02	0.4126E+02
3	0.0000E+00	0.0000E+00	0.9079E+01	0.9079E+01
4	0.0000E+00	0.0000E+00	0.1238E-01	0.1238E-01
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
6	0.8538E+01	0.0000E+00	0.0000E+00	0.8538E+01
7	0.0000E+00	0.0000E+00	0.9146E+02	0.1000E+03

Baryons →

L3 compared to LHCb tune + CDF B**





L3 charged multiplicity < LHCb + B**

L3 <n> = 22.49

LHCb + B** <n> = 23.72

L3 total b-particles initial

Type	B**	B*	B	Total
d	0.11E+02	0.19E+02	0.90E+01	0.40E+02
u	0.10E+02	0.21E+02	0.90E+01	0.40E+02
s	0.24E+01	0.66E+01	0.27E+01	0.12E+02
c	0.00E+00	0.75E-02	0.33E-02	0.11E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.89E+01	0.00E+00	0.00E+00	0.89E+01
T	0.24E+02	0.47E+02	0.21E+02	0.10E+03

Baryons →

L3 particles in acceptance initial

Type	B**	B*	B	Total
d	0.11E+02	0.19E+02	0.90E+01	0.40E+02
u	0.10E+02	0.20E+02	0.89E+01	0.39E+02
s	0.24E+01	0.66E+01	0.26E+01	0.12E+02
c	0.00E+00	0.11E-01	0.16E-02	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.89E+01	0.00E+00	0.00E+00	0.89E+01
T	0.24E+02	0.46E+02	0.21E+02	0.10E+03

Baryons →

L3 total b-particles final

Type	B**	B*	B	Total
d	0.00E+00	0.00E+00	0.42E+02	0.42E+02
u	0.00E+00	0.00E+00	0.42E+02	0.42E+02
s	0.00E+00	0.00E+00	0.75E+01	0.75E+01
c	0.00E+00	0.00E+00	0.11E-01	0.11E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.89E+01	0.00E+00	0.00E+00	0.89E+01
T	0.00E+00	0.00E+00	0.91E+02	0.10E+03

Baryons →

L3 particles in acceptance final

Type	B**	B*	B	Total
d	0.00E+00	0.00E+00	0.42E+02	0.42E+02
u	0.00E+00	0.00E+00	0.42E+02	0.42E+02
s	0.00E+00	0.00E+00	0.74E+01	0.74E+01
c	0.00E+00	0.00E+00	0.12E-01	0.12E-01
b	0.00E+00	0.00E+00	0.00E+00	0.00E+00
*	0.89E+01	0.00E+00	0.00E+00	0.89E+01
T	0.00E+00	0.00E+00	0.91E+02	0.10E+03

Baryons →

Settings	<n>	% difference with LHCb default	% difference with LHCb + CDF PARJ
LHCb default	21.83	0.0 %	-7.97 %
LHCb + CDF PARJ	23.72	8.66 %	0.0 %
Aleph	20.74	-4.99 %	-12.56 %
L3	21.27	-2.57 %	-10.33 %
Opal	22.49	3.02 %	-5.19 %
DC04 B**	22.70	3.99 %	-4.30 %

Table showing % differences of charged multiplicity in the LHCb acceptance