Use of Generators in LHCb (Status Report)

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Overview

- Need for B** inclusion
- DC'04 settings
- Re-tune of Pythia
  - ➢Tuning Method
- Current Status/Results
- Further Work

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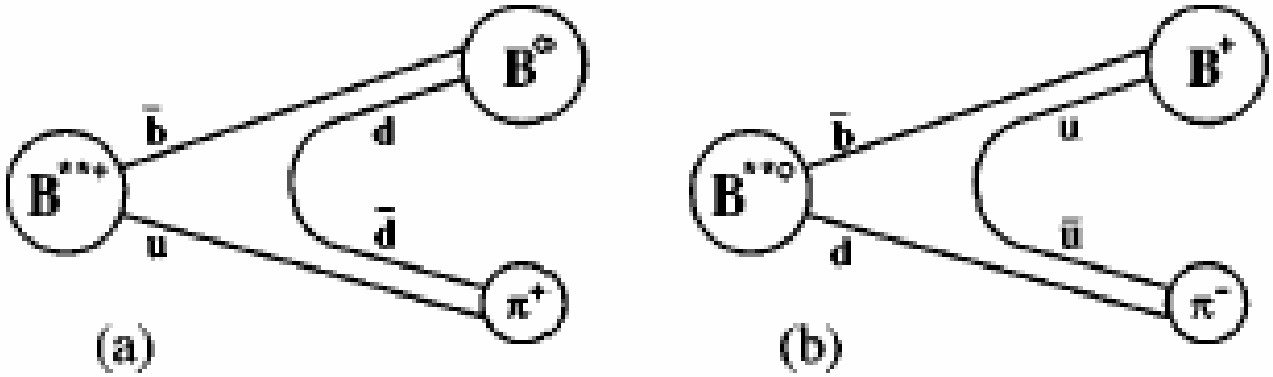
Importance of B** production

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



Refs: **PHYS REVIEW D, Vol 64, 072002; PHYS REVIEW D, Vol 59, 032001**

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Settings used in DC'04

LHCb Tune settings were:

```
     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 (DC'04) 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)

Settings from Vinchenzo: vagnoni@bo.infn.it

PARJ settings

Pythia parameter	Meaning	Default value	DC'04 B** value
PARJ(1)	Meson, baryon fraction	0.10	0.10
PARJ(2)	Strangeness production	0.30	0.30
PARJ(11)	*P*(light meson has spin 1)	0.50	0.50
PARJ(12)	*P*(strange meson has spin 1)	0.60	0.60
PARJ(13)	*P*(S=1 (b, c))	0.75	0.75
PARJ(14)	*P*(S=0,L=1,J=1)	0.0	0.162
PARJ(15)	*P*(S=1,L=1,J=0)	0.0	0.018
PARJ(16)	*P*(S=1,L=1,J=1)	0.0	0.054
PARJ(17)	*P*(S=1,L=1,J=2)	0.0	0.090

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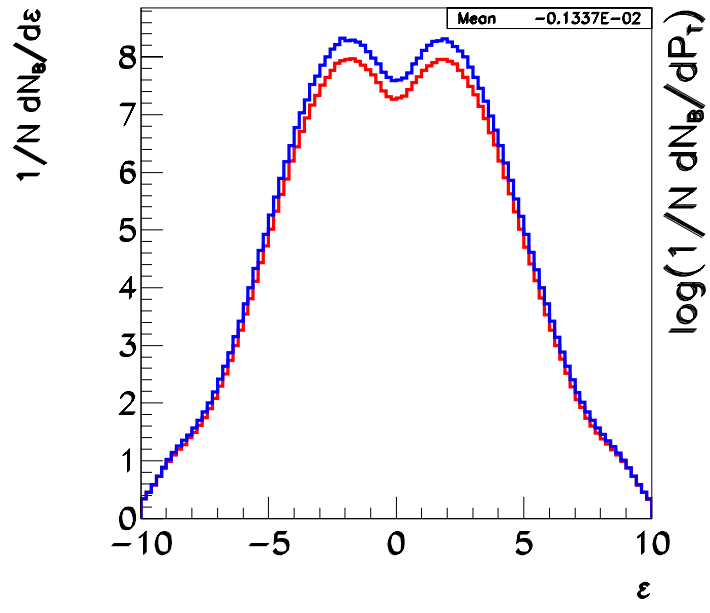
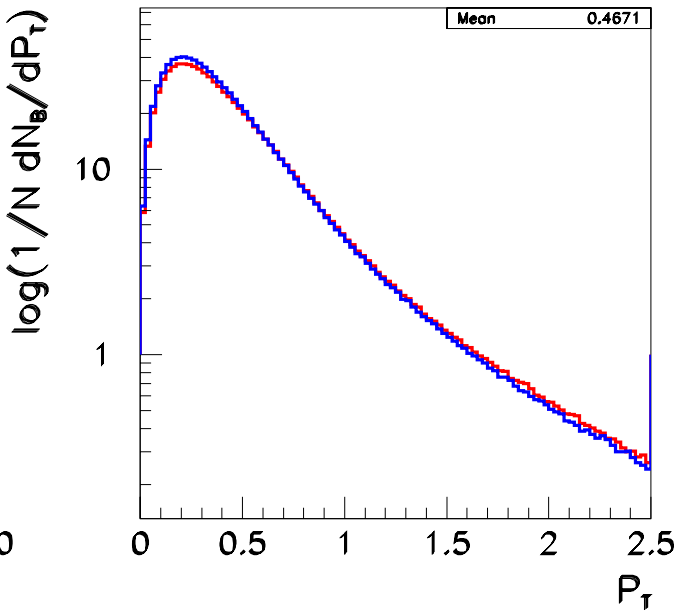
Min bias plots of DC04 settings compared to LHCb tune

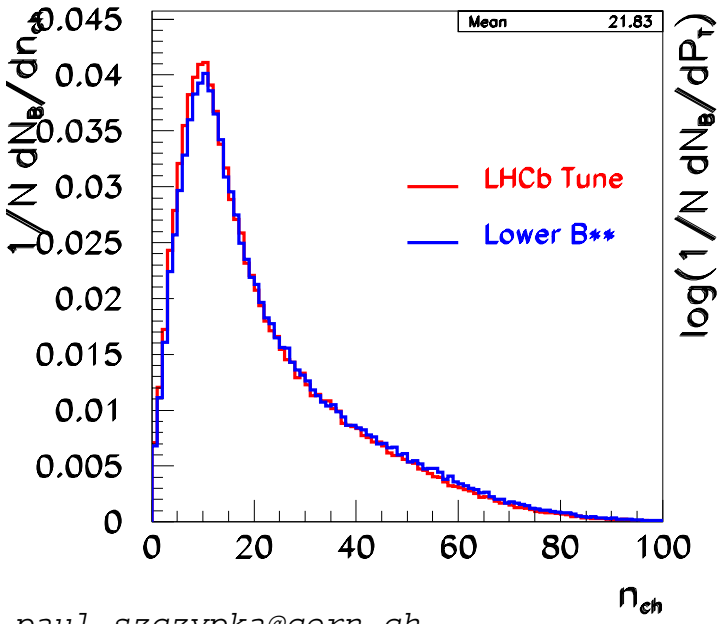


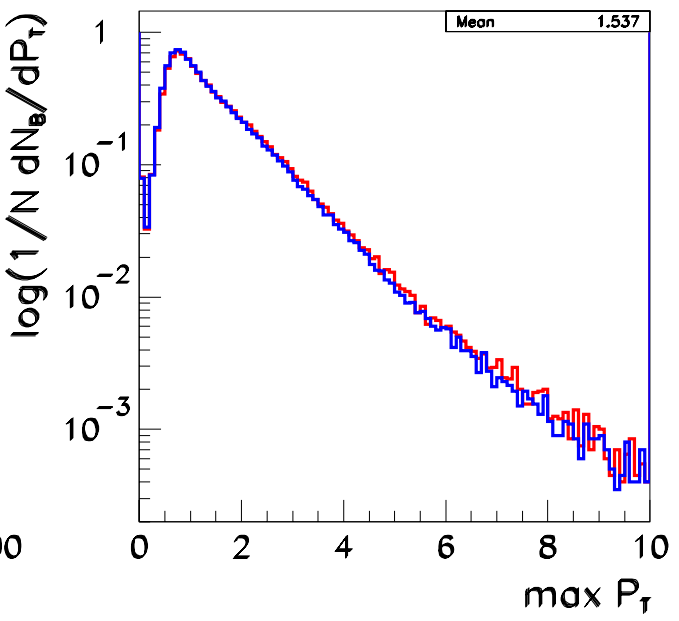


New settings:

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

Re-tune required

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Tuning Method

Multiplicity data from:

http://oschneid.home.cern.ch/oschneid/minbias_data/cdf_eta.txt

(Both UA5 and CDF data)

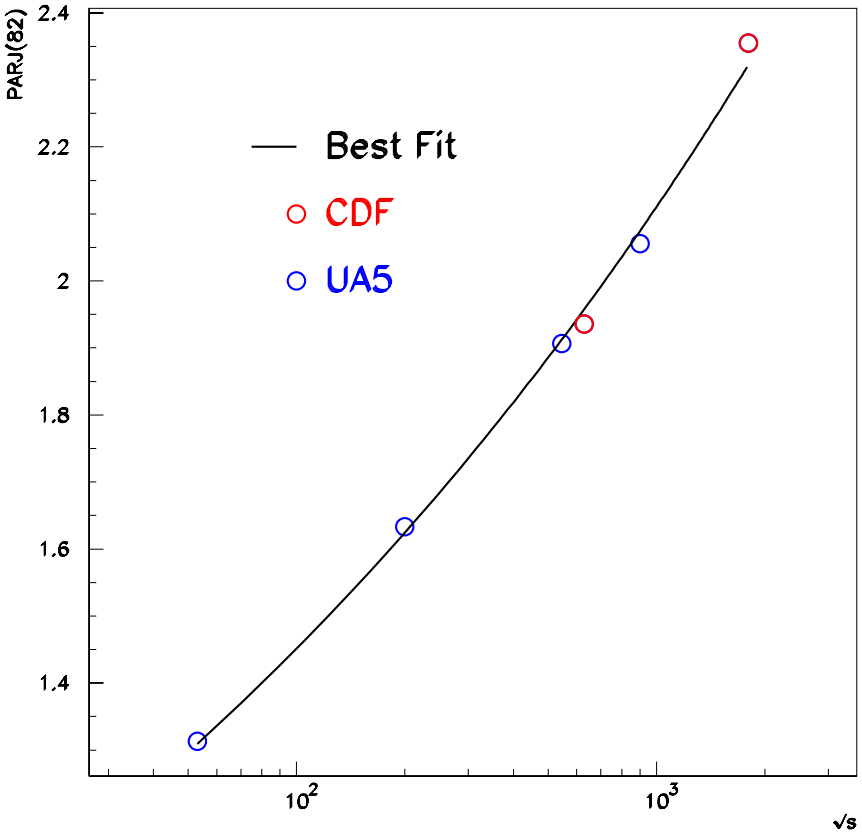
Method: *(LHCb 99-028 PHYS)*

- In the multiple interaction models available in Pythia, P_{Tmin} is the minimum transverse momentum of the parton – parton collisions.
- At each $\sqrt{s}$, the P_{Tmin} parameter, PARP(82) , is adjusted to reproduce the average multiplicity from the measured data.
- Fit performed using the following form:

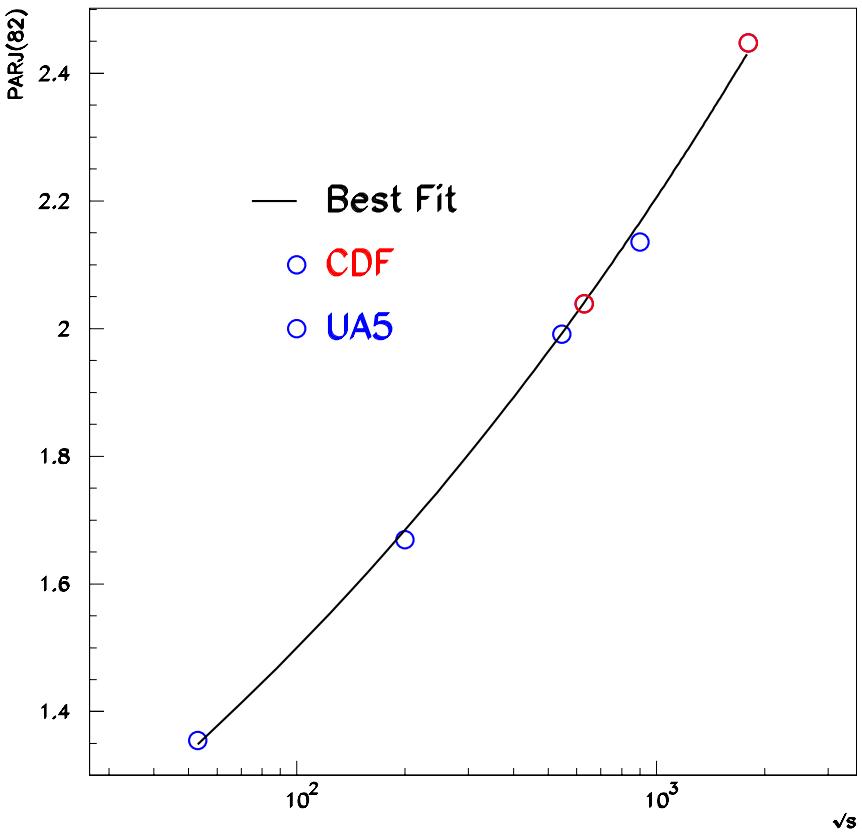
$$P_{T_{min}}(\sqrt{s}) = P_{T_{min}}^{\mathrm{LHC}} \left(\frac{\sqrt{s}}{14\ \mathrm{TeV}} \right)^{2\epsilon}$$

Fit Plots - v6.224 B**

Pythia v6.224 no B**



Pythia v6.224 B** included



Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	No		3.24	0.0077	0.0813	0.0003
6.224	Yes		3.43	0.0150	0.0837	0.0002

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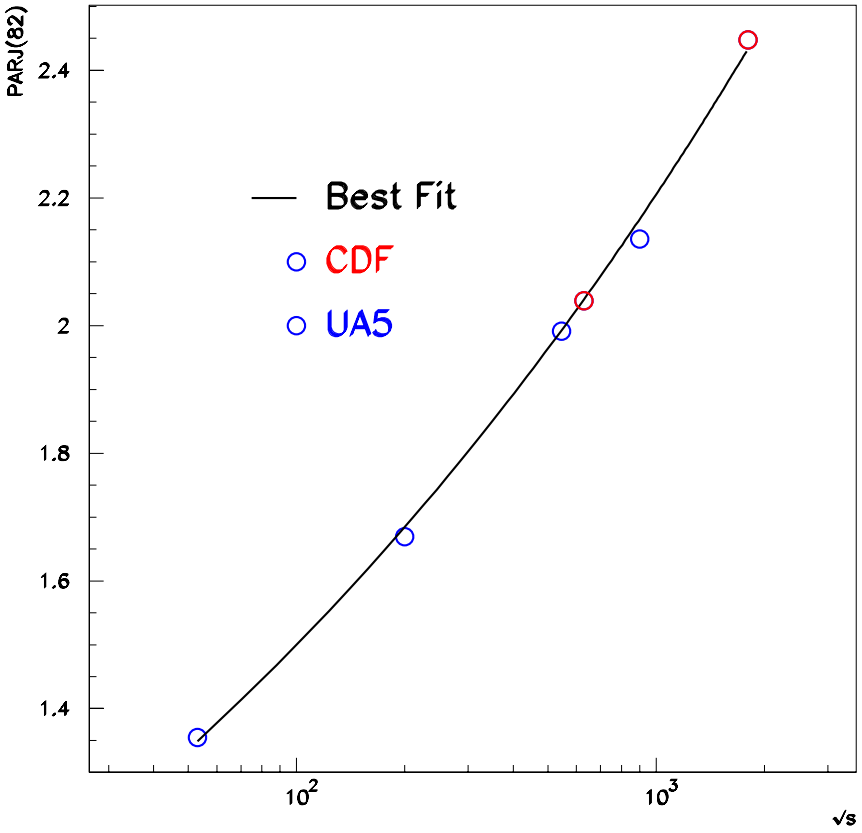
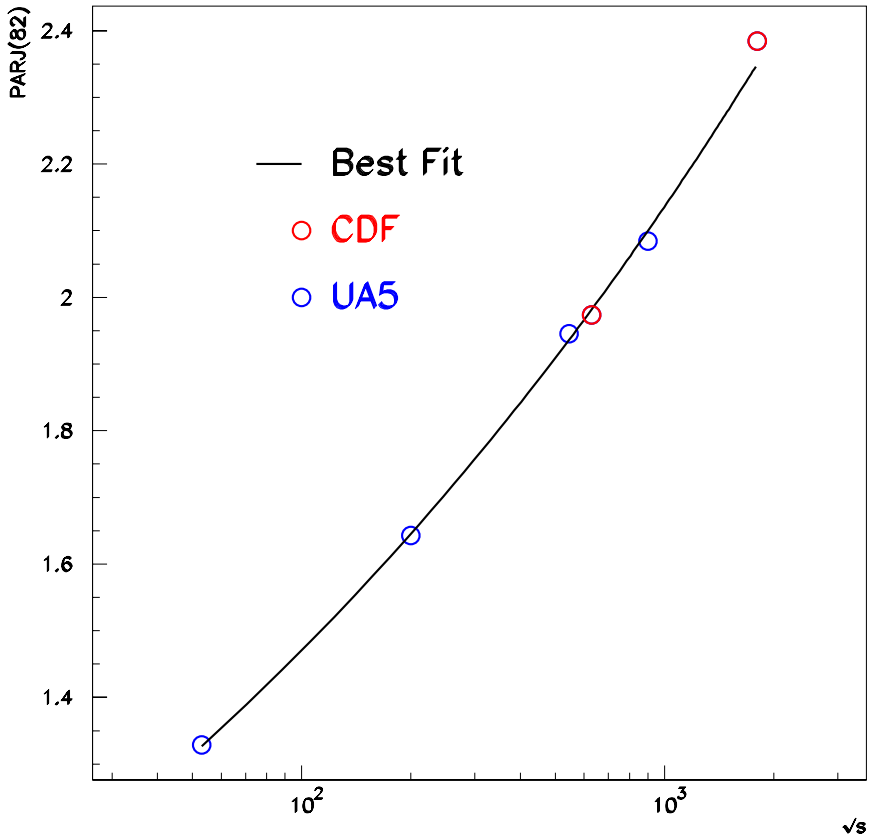
Fit Plots - v6.304 B** old MI

Pythia v6.224 B** included



Pythia v6.304 B** old MI



Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	Yes		3.43	0.0150	0.0837	0.0002
6.304	Yes	Old MI	3.28	0.0052	0.0811	0.0002

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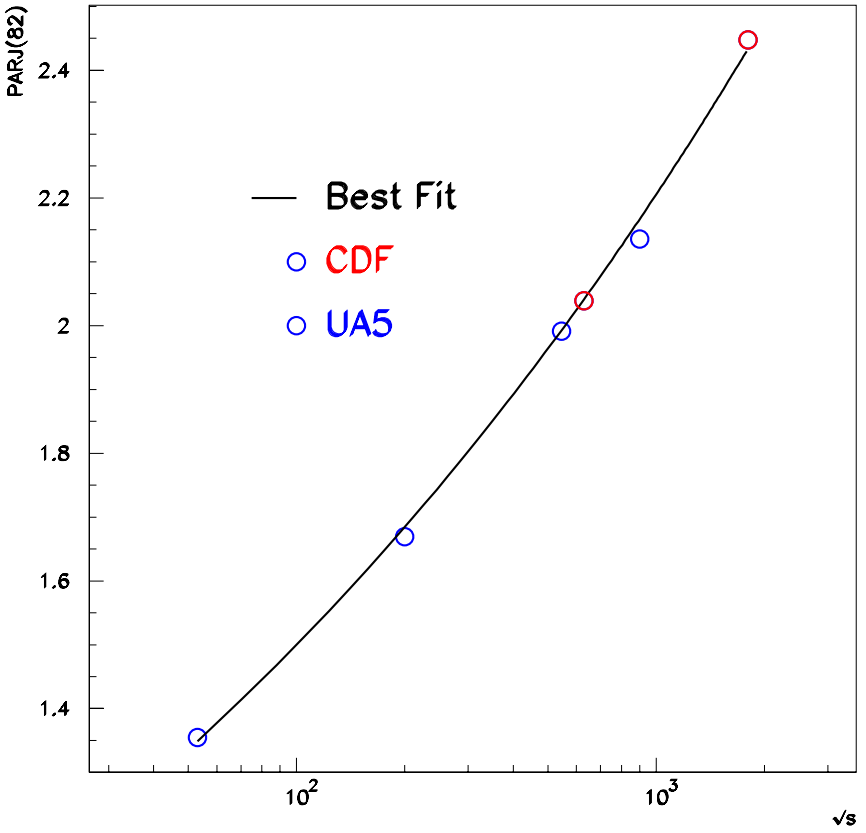
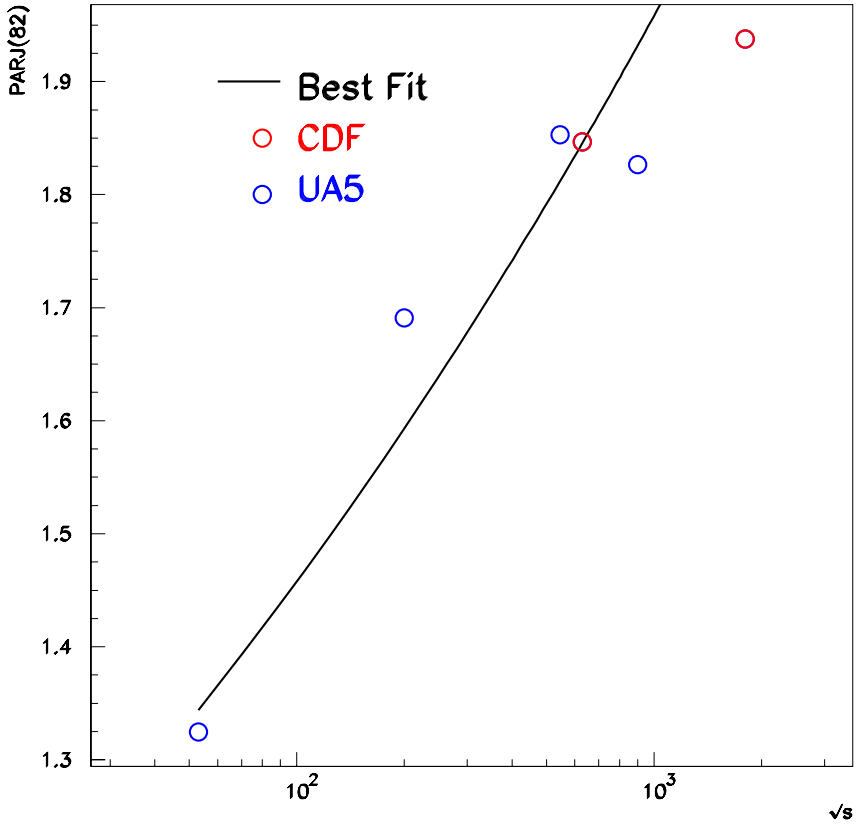
Fit Plots - v6.304 B**

Pythia v6.224 B** included



Pythia v6.304 B** new MI



Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	Yes		3.43	0.0150	0.0837	0.0002
6.304	Yes		2.75	0.0080	0.0641	0.0005

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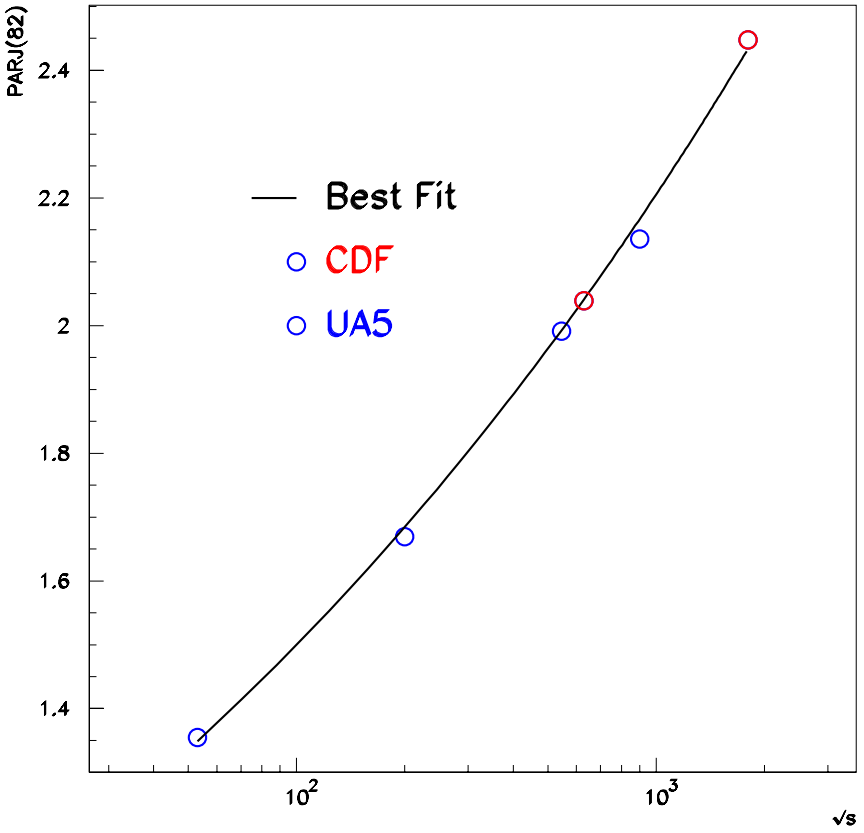
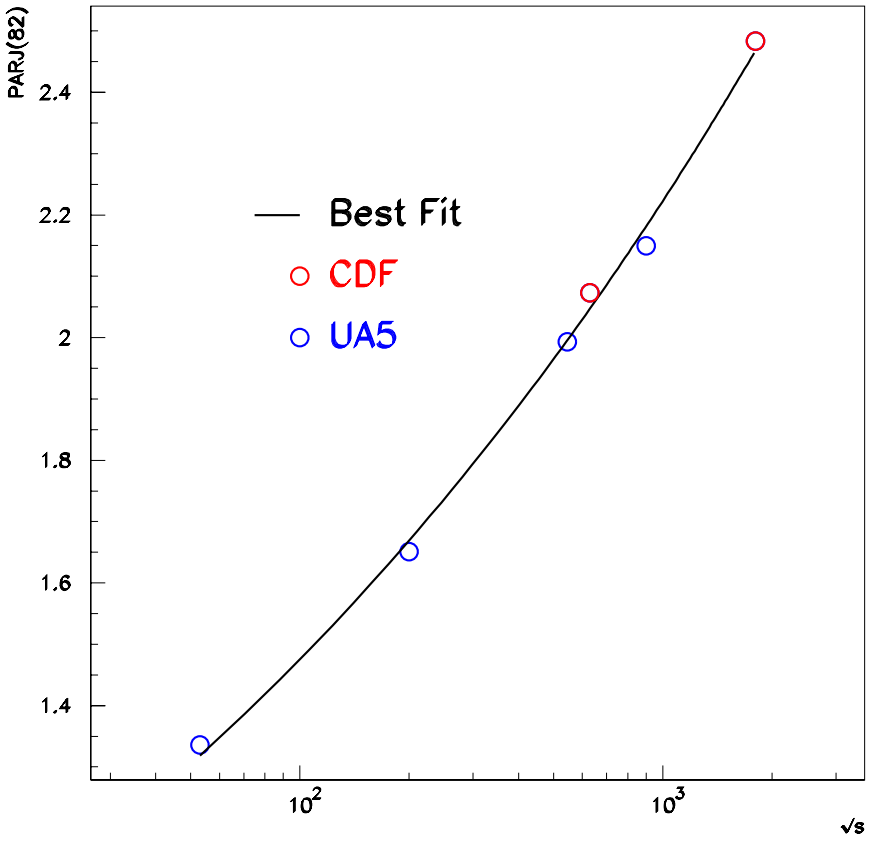
Fit Plots - v6.312 B**

Pythia v6.224 B** included



Pythia v6.312 B**



Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	Yes		3.43	0.0150	0.0837	0.0002
6.312	Yes		3.56	0.0786	0.0890	0.0034

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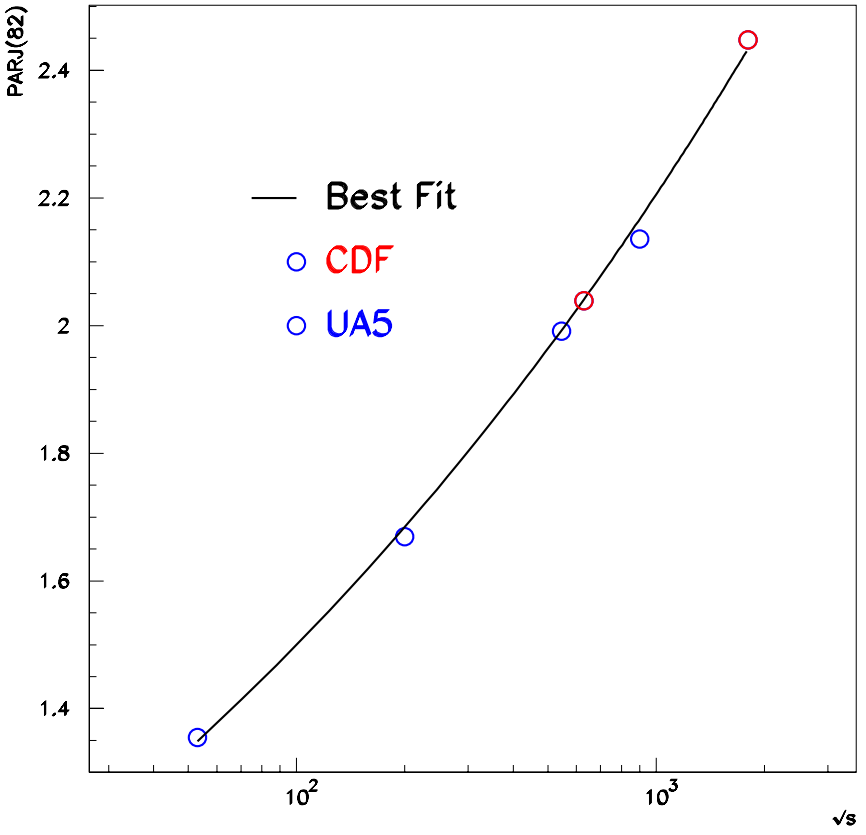
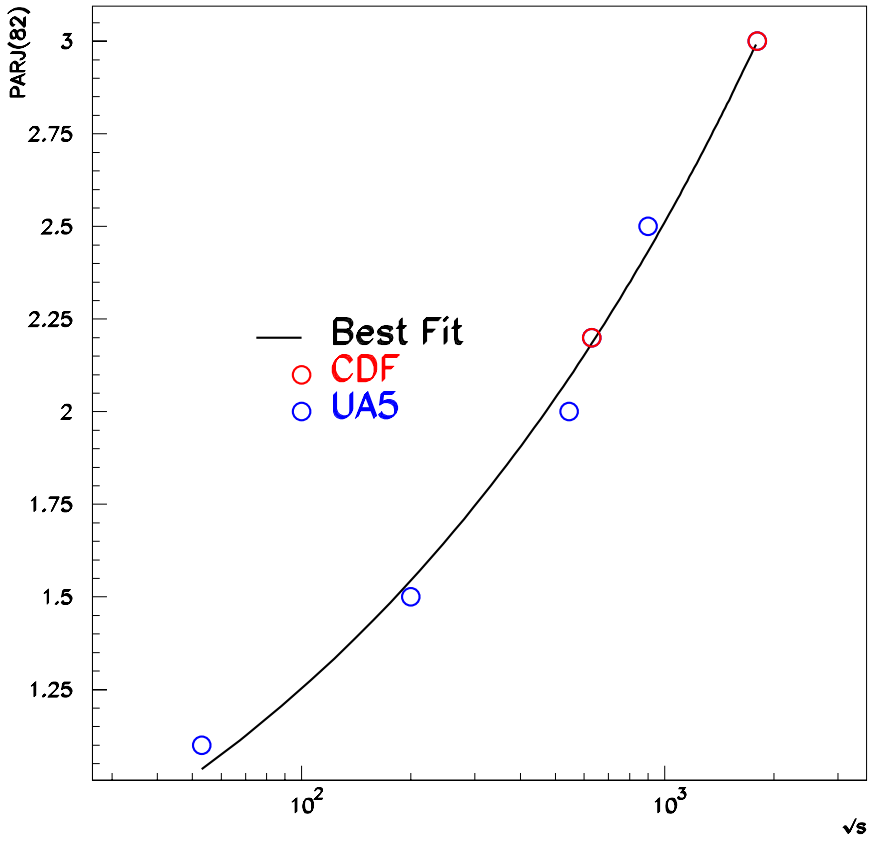
Fit Plots - v6.312 B** new MI

Pythia v6.224 B** included



Pythia v6.312 B** new MI



Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	Yes		3.43	0.0150	0.0837	0.0002
6.312	Yes	**Low Stats**	**5.57**	0.1903	0.1509	0.0057

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Preliminary fit results

Version #	B**	Notes	P_{Tmin}	P_{Tmin} Error	ε	ε Error
6.224	No		3.24	0.0077	0.0813	0.0003
6.224	Yes		3.43	0.0150	0.0837	0.0002
6.304	No	Old MI	3.18	0.0086	0.0817	0.0004
6.304	Yes	Old MI	3.28	0.0052	0.0811	0.0002
6.304	No		2.54	0.0049	0.0609	0.0002
6.304	Yes		2.75	0.0080	0.0641	0.0005
6.312	No		3.31	0.1209	0.0845	0.0056
6.312	Yes		3.56	0.0786	0.0890	0.0034
6.312	No	New MI	5.33	0.1836	0.1469	0.0057
6.312	Yes	New MI	5.57	0.1903	0.1509	0.0057

Note: data requires more stats - ongoing work - do not use (yet).

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Summary

- LHCb B** settings based on LEP/CDF settings
- Inclusion of B** necessary
- Re-tune of generator required
- Work is ongoing

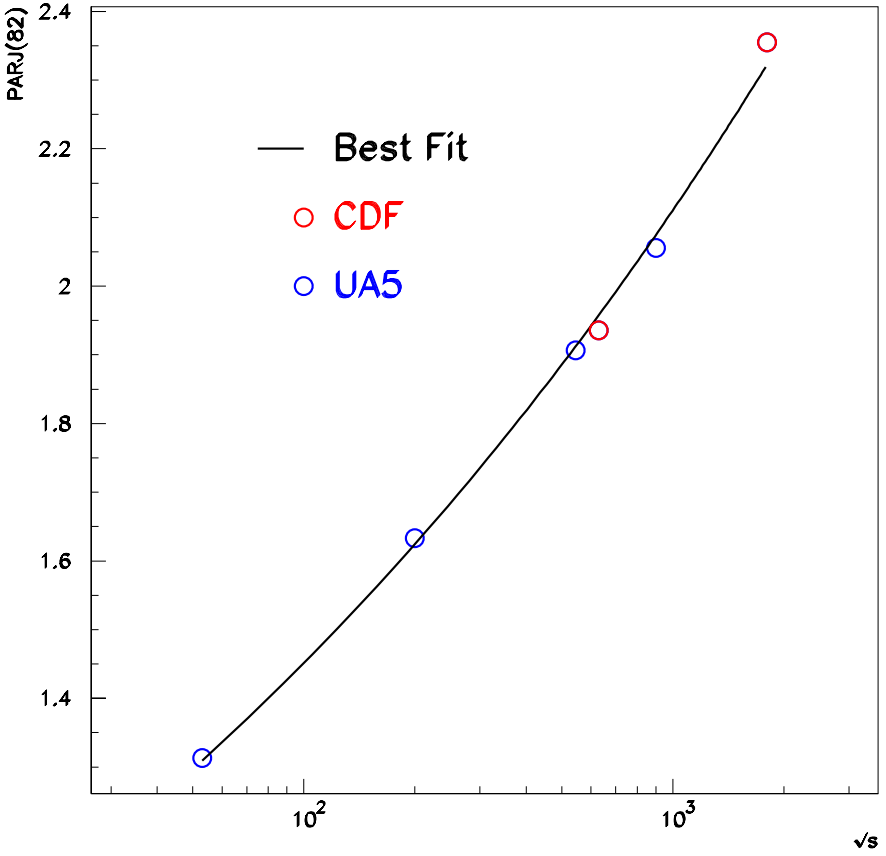
PDF Model: MSTP(51) = 4032

Further Work

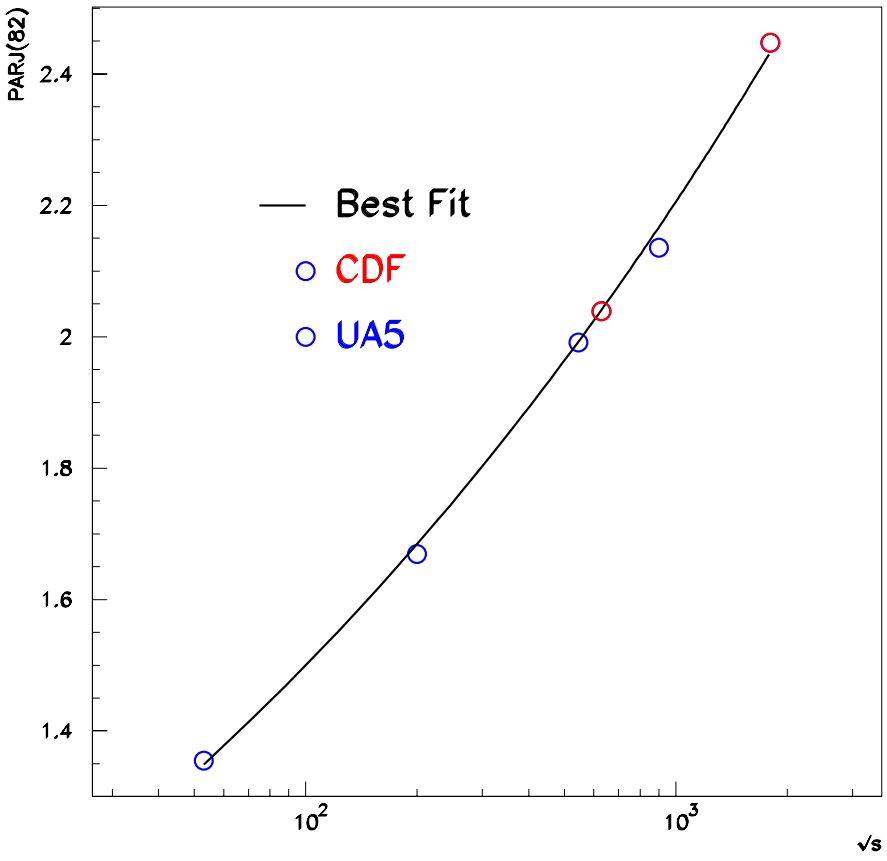
- Re-run ‘no B**’ tuning programs and obtain better statistics.
- Produce several LHCb Tunes

- Any suggestions?

Fit Plots - v6.224



B** included



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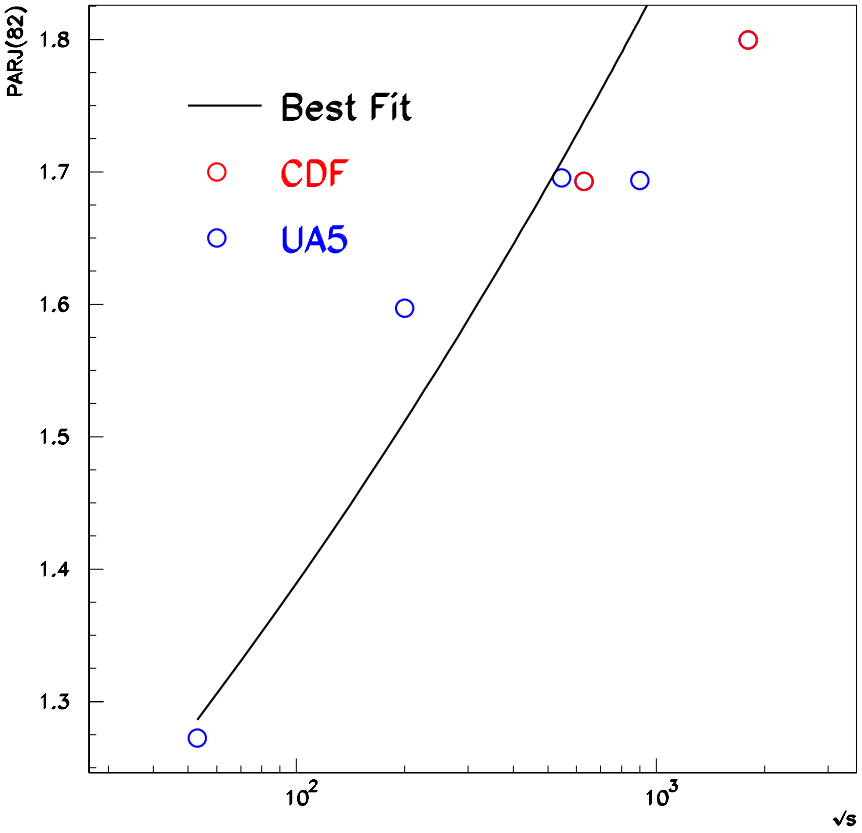
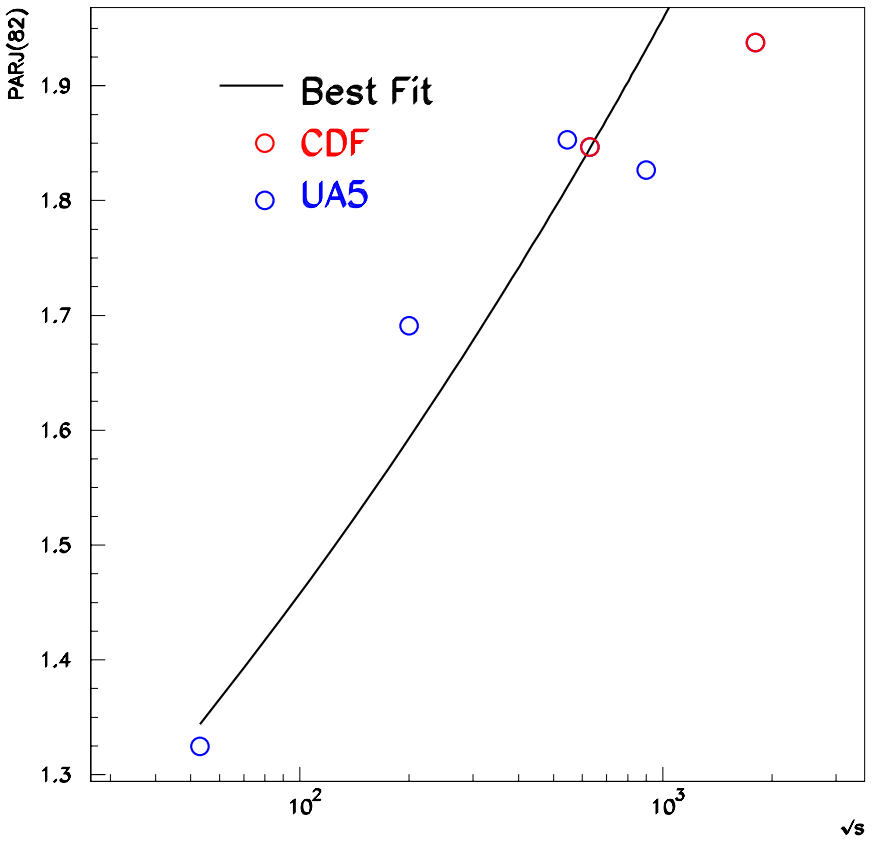
Fit Plots - v6.304



B** included



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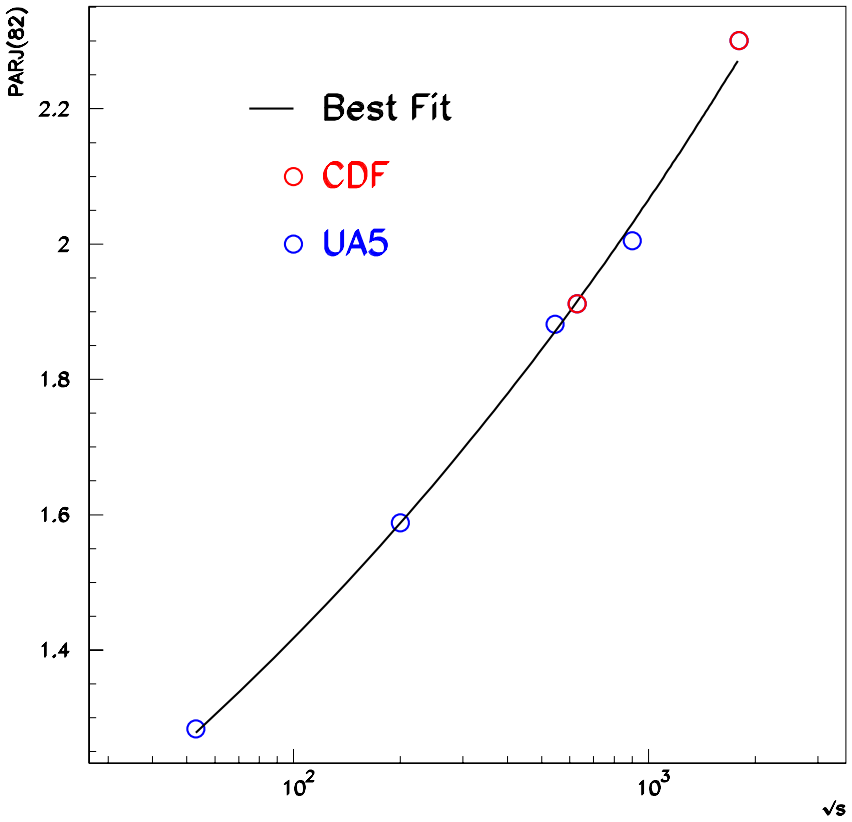
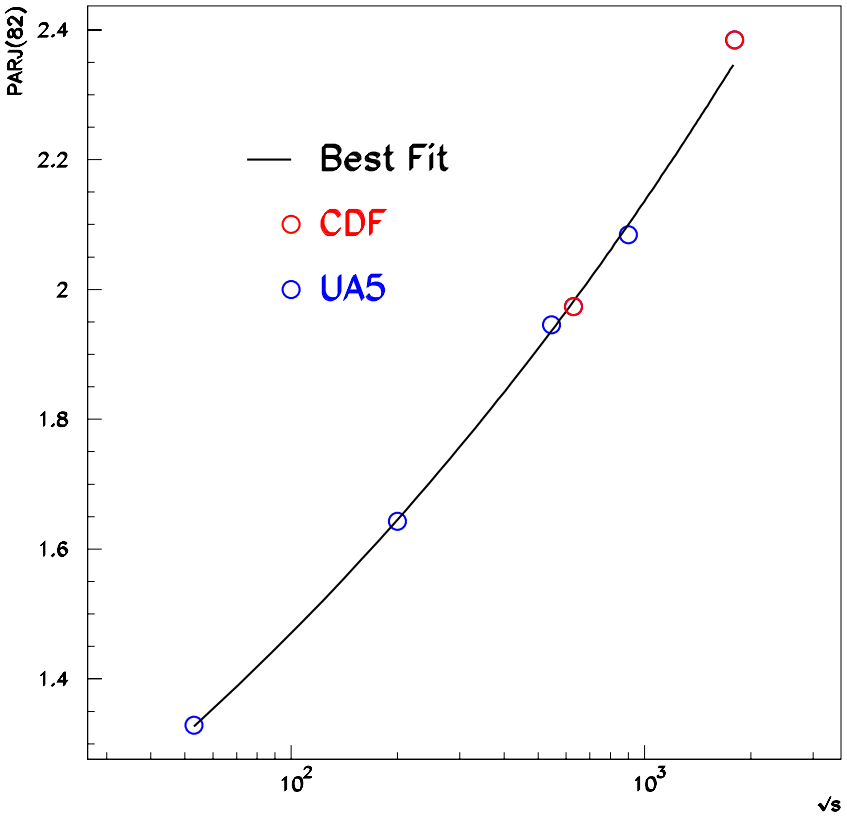
Fit Plots - v6.304 old MI



B** included



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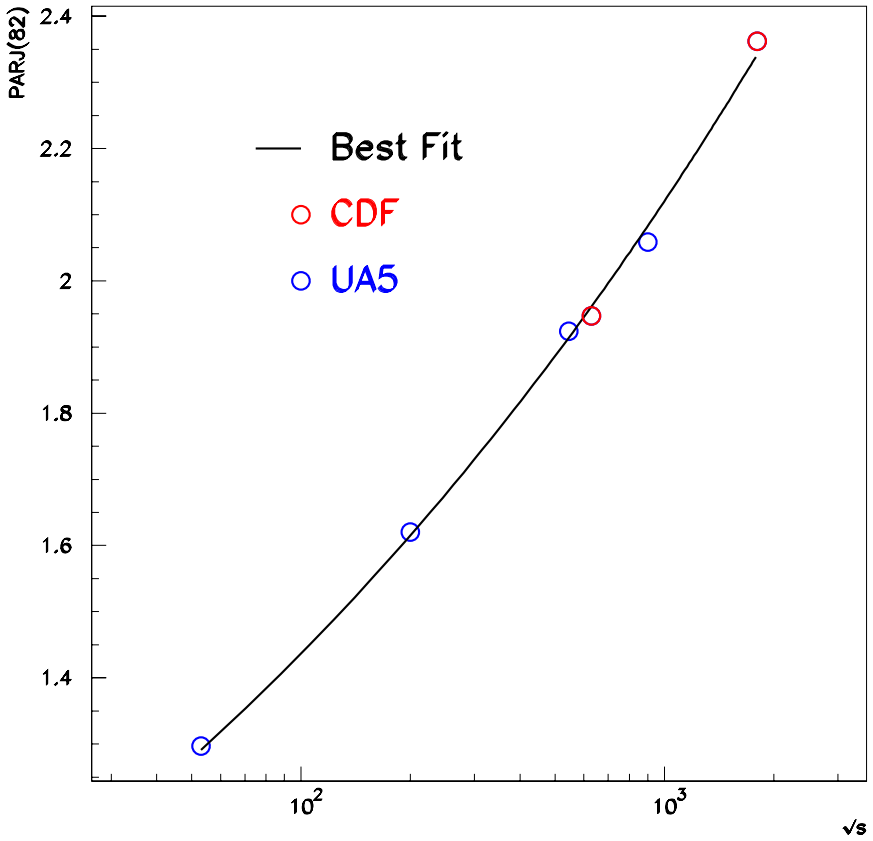
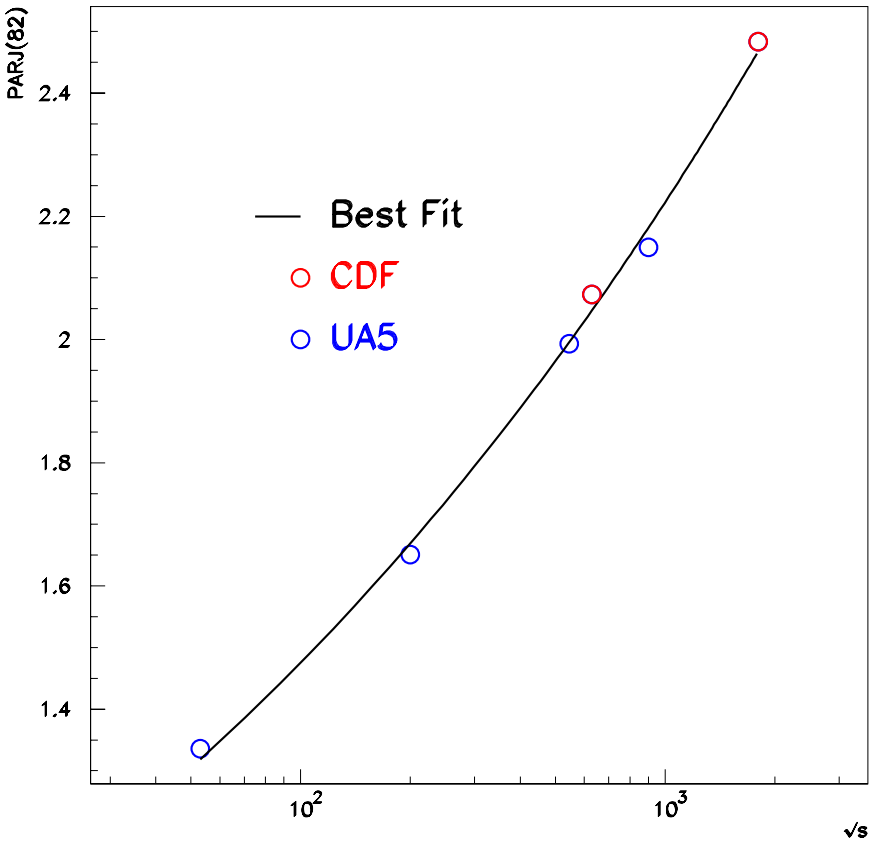
Fit Plots - v6.312



B** included



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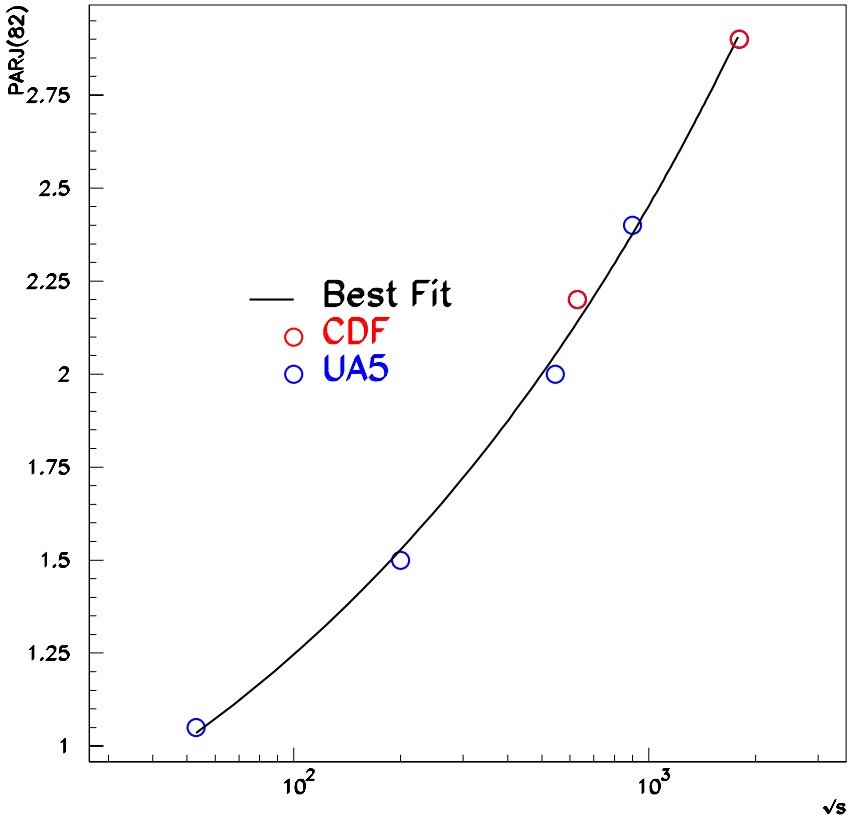
Fit Plots - v6.312 new MI



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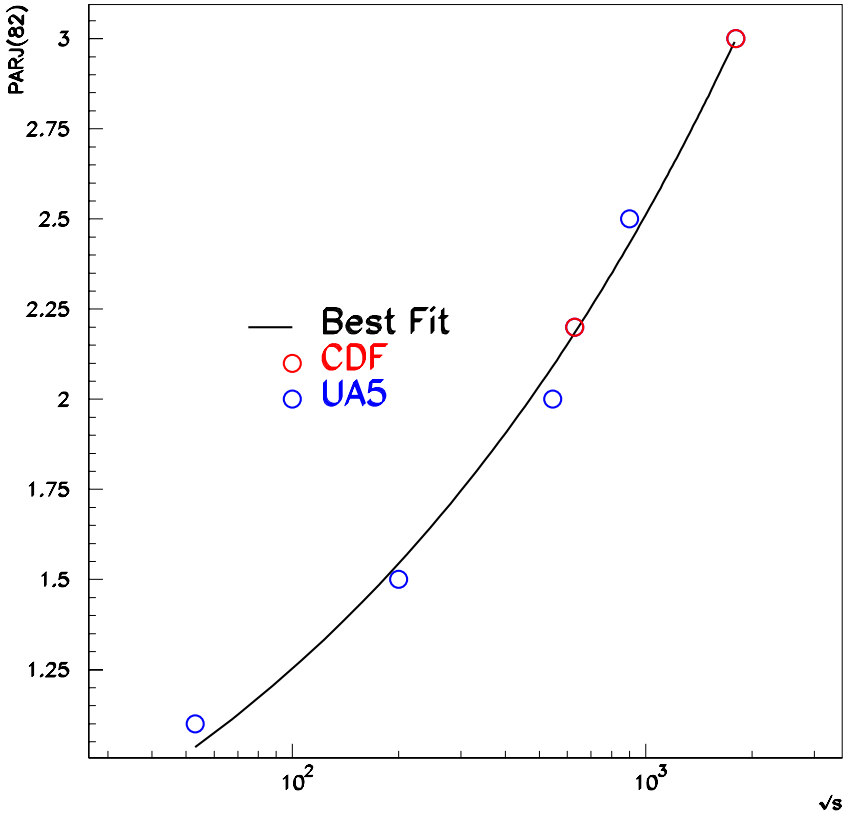

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