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Status of the WIMP analysis using 1997 and 1999 data

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Contents

Which cuts do we apply on 97 data to select WIMPS ?

Cuts at level 1

→ Zenith(Linefit) > 70°
→ Speed(Linefit) > 0.1 m/ns

Cuts at level 2

→ Zenith(upandel likelihood) > 70°
→ Zenith(iterative upandel 6) > 80°
→ Likelihoodparameter(iterative upandel 6) < 9.5
→ $N_{direct}^{-20ns:25ns}$(iterative upandel 6) $\geqslant 4$
→ Zenith(iterative upandel 16) > 80°
→ Likelihoodparameter(iterative upandel 16) < 9.5
→ $N_{direct}^{-20ns:25ns}$(iterative upandel 16) $\geqslant 4$

Cuts at level 3

→ Zenith(iterative upandel 16) > 90°
→ -100m < $c.o.g._z$ < 170m
→ Cut on the sphericity of the event
→ Likelihoodparameter(iterative upandel 16) < 8.7
→ Likelihoodparameter(energy reconstruction) < 6
→ Likelihoodparameter(cascade reconstruction) * Likelihoodparameter(iterative upandel 16) > 0.95
→ $N_{direct}^{-15ns:75ns}$(iterative upandel 16) - $N_{direct}^{-15ns:75ns}$(cascade reconstruction) > 0.5

Cuts at level 4

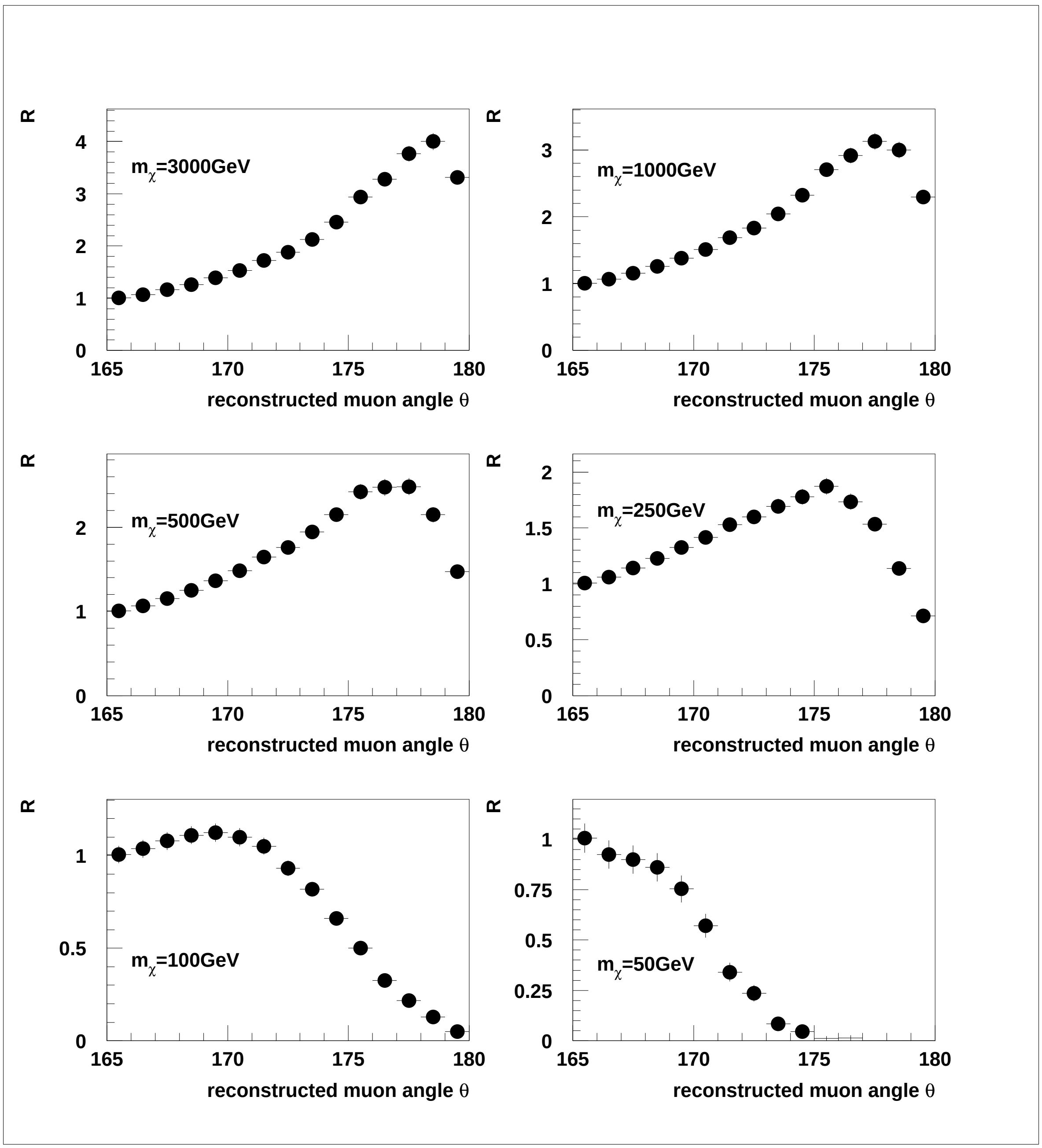
→ Zenith(iterative MPE upandel + Phit) > 165°

Final angular cut

$$R \equiv \frac{\int_{\theta_1}^{180^\circ} \frac{dN_S}{d\theta} * \frac{1}{N_S^{total}} d\theta}{\sqrt{\int_{\theta_1}^{180^\circ} \frac{dN_{BG}}{d\theta} * \frac{1}{N_{BG}^{total}} d\theta}}$$

S = simulation of neutralinos with different masses

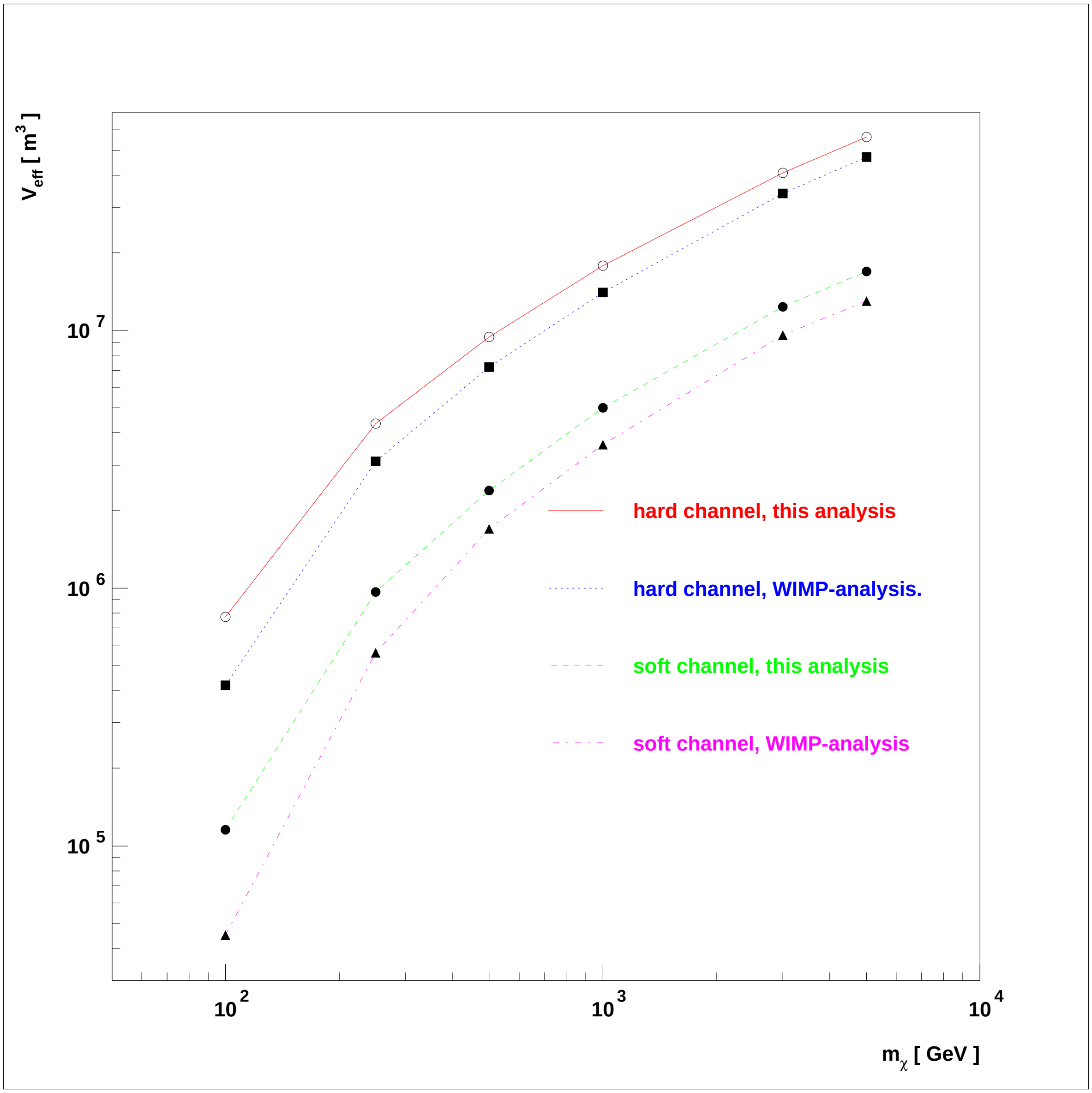
BG = simulation of atmospheric neutrinos (upgoing)



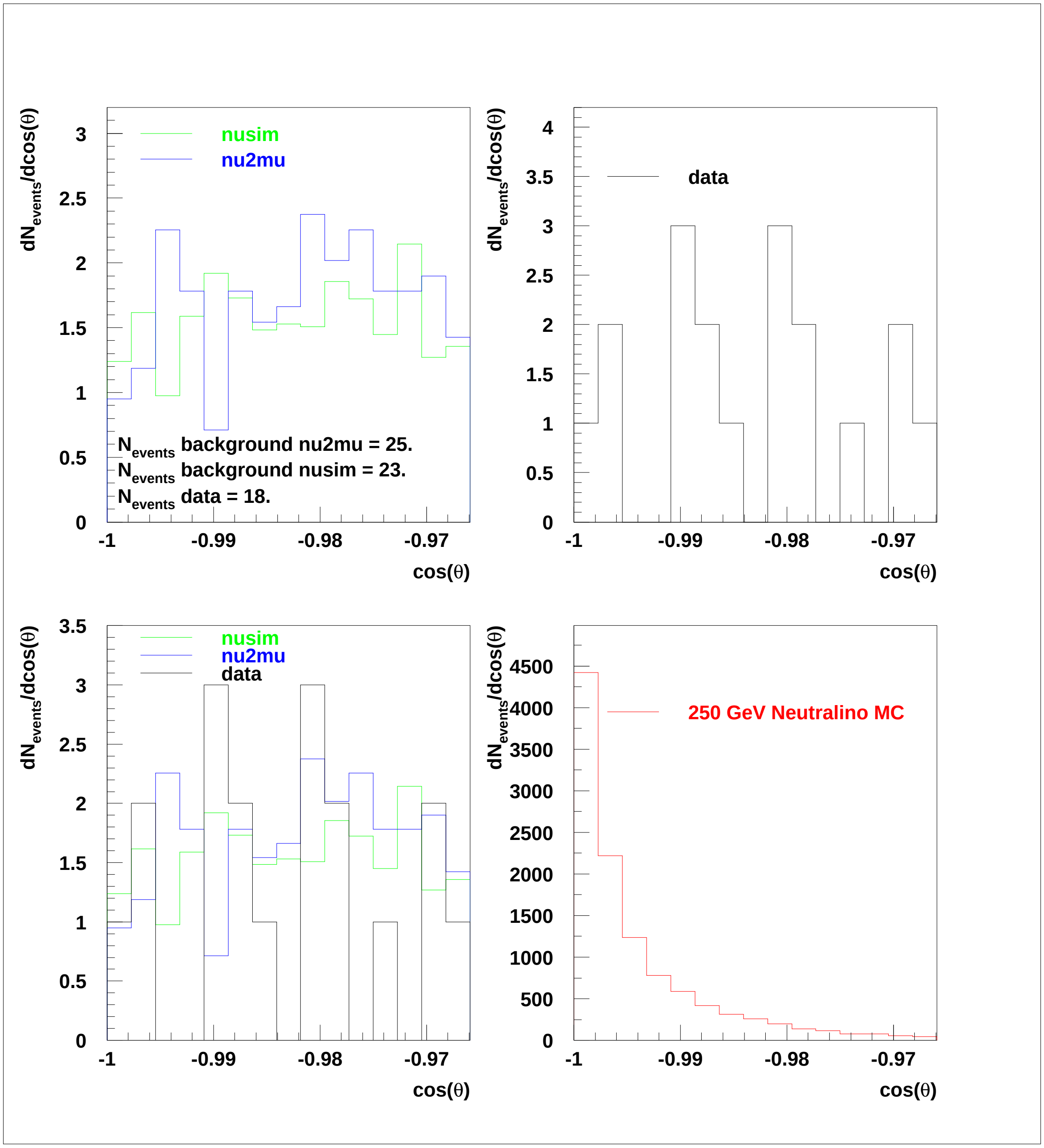
Effective volumes after level 4

Effective volumes for the neutralino signal at filter level 4 as a function of the neutralino mass for a zenith cut on $\theta > 165°$.

$$V_{\mathrm{eff}_{\mathrm{L}_5}} = \frac{n_{\mathrm{L}_5}}{n_{\mathrm{gen}}} V_{\mathrm{gen}}$$



Results of the WIMP analysis using 97 data



When applying this analysis on the data taken during 1997, we select

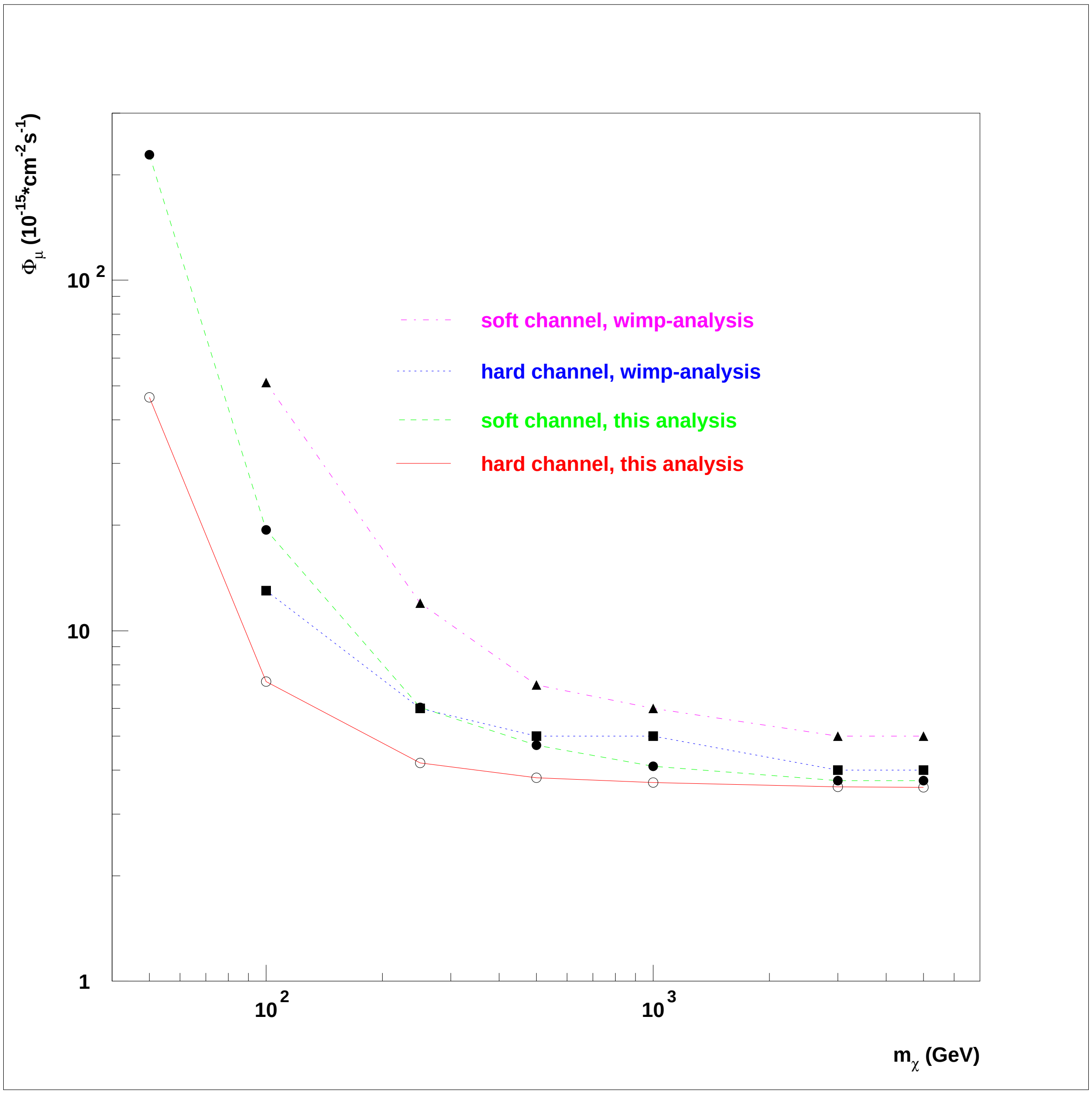
18 experimental data while we expect
23 (25) atmospheric neutrinos
in the angular region [165°, 180°].

Since no neutralino signal has been found, we will determine the upperlimit on the muonflux coming from the annihilation of neutralinos in the center of the earth.

Muonflux

90% confidence level upper limits on the muon flux
as a function of the neutralino mass

$$\Phi_\mu(E_\mu \geq E_{\mu,thr}, \vartheta \geq \vartheta_c) = \frac{\Gamma_A}{4\pi R_\oplus^2} \int_{E_{\mu,thr}}^{\infty} \int_{\vartheta_c}^{180^\circ} \frac{dN_\mu}{dE_\mu d\vartheta} dE_\mu d\vartheta$$



Reconstructions and cuts applied on 99 data

Level 1

→ Fit1: Tensor of inertia
→ Fit2: Linefit
→ Fit3: Planewave
→ Fit4: upandel likelihood
→ Fit5: cascade reconstruction
→ Zenith(Linefit) $> 70°$

Level 2

→ Zenith(upandel likelihood) $> 80°$
→ $N_{direct}^{-20ns:25ns}$(upandel likelihood) > 3

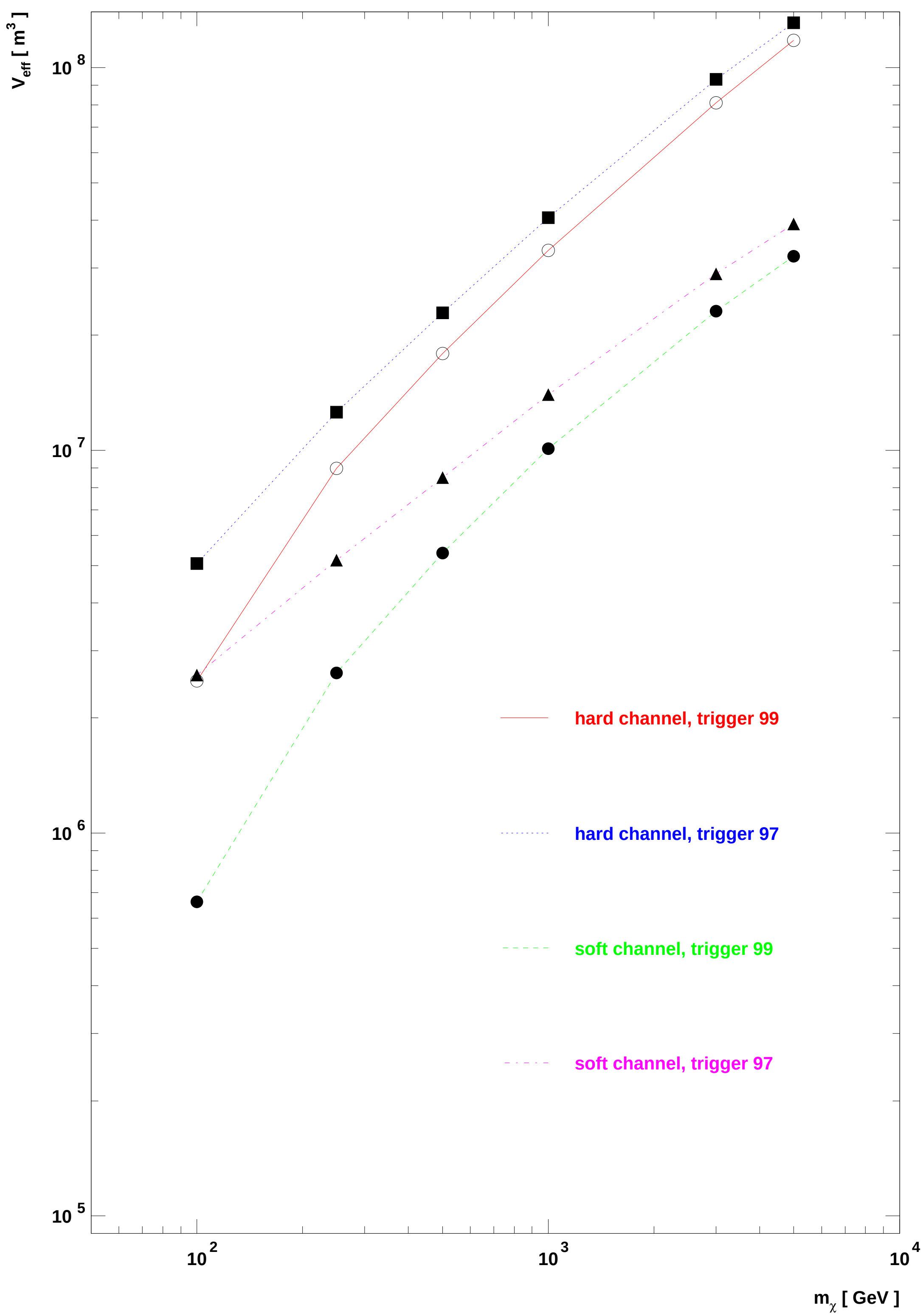
Level 3

→ Fit6: upandel likelihood f=4 M=6
→ Fit7: energy reconstruction f=6
→ Fit8: upandel likelihood f=6 M=16
→ Fit9: energy reconstruction f=8

→ ldirc(6) > 127
→ ndirc(6) > 8
→ Speed(linefit) > 0.127 m/ns
→ Zenith(6) $> 168°$

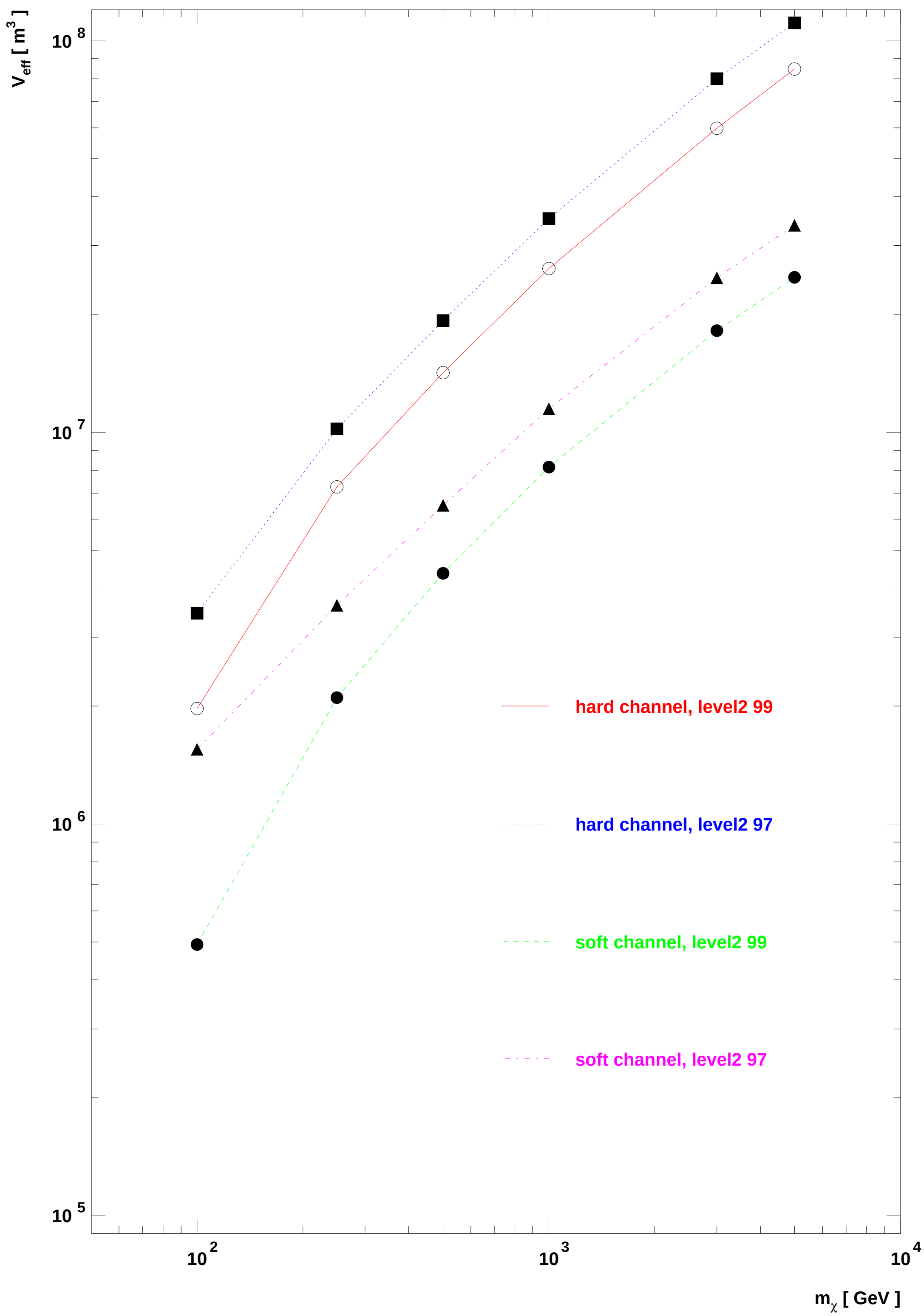
Effective volume at trigger level

$$V_{\mathrm{eff}_{\mathrm{trigger}}} = \frac{n_{\mathrm{L}_{\mathrm{trigger}}}}{n_{\mathrm{gen}}} V_{\mathrm{gen}}$$



Effective volume at level 2

$$V_{\text{eff}_{\text{L}_2}} = \frac{n_{\text{L}_2}}{n_{\text{gen}}} V_{\text{gen}}$$



Selection procedure of wimps using 99 data

The idea is to find a selection procedure that points out
the most interesting variable to cut on
(among a collection of variables) and
on top of that also determines
the most optimal cutvalue

How ?
By calculating
$\epsilon_{signal} * (1 - \epsilon_{background})$
as function of the cut on the studied variable

$\Rightarrow$ maximum gives weight of the variable
$\Rightarrow$ position of maximum gives most optimal cutvalue

Selection procedure of wimps using 99 data

List of variables investigated so far ...

Speed(linefit)

Zenith(upandel likelihood)

Zenith(upandel likelihood 6)

Number of hit channels

Likelihoodparameter(upandel likelihood 6)

$N_{direct}^{-15ns:25ns}$(upandel likelihood 6)

$N_{direct}^{-15ns:75ns}$(upandel likelihood 6)

$L_{direct}^{-15ns:25ns}$(upandel likelihood 6)

$L_{direct}^{-15ns:75ns}$(upandel likelihood 6)

...

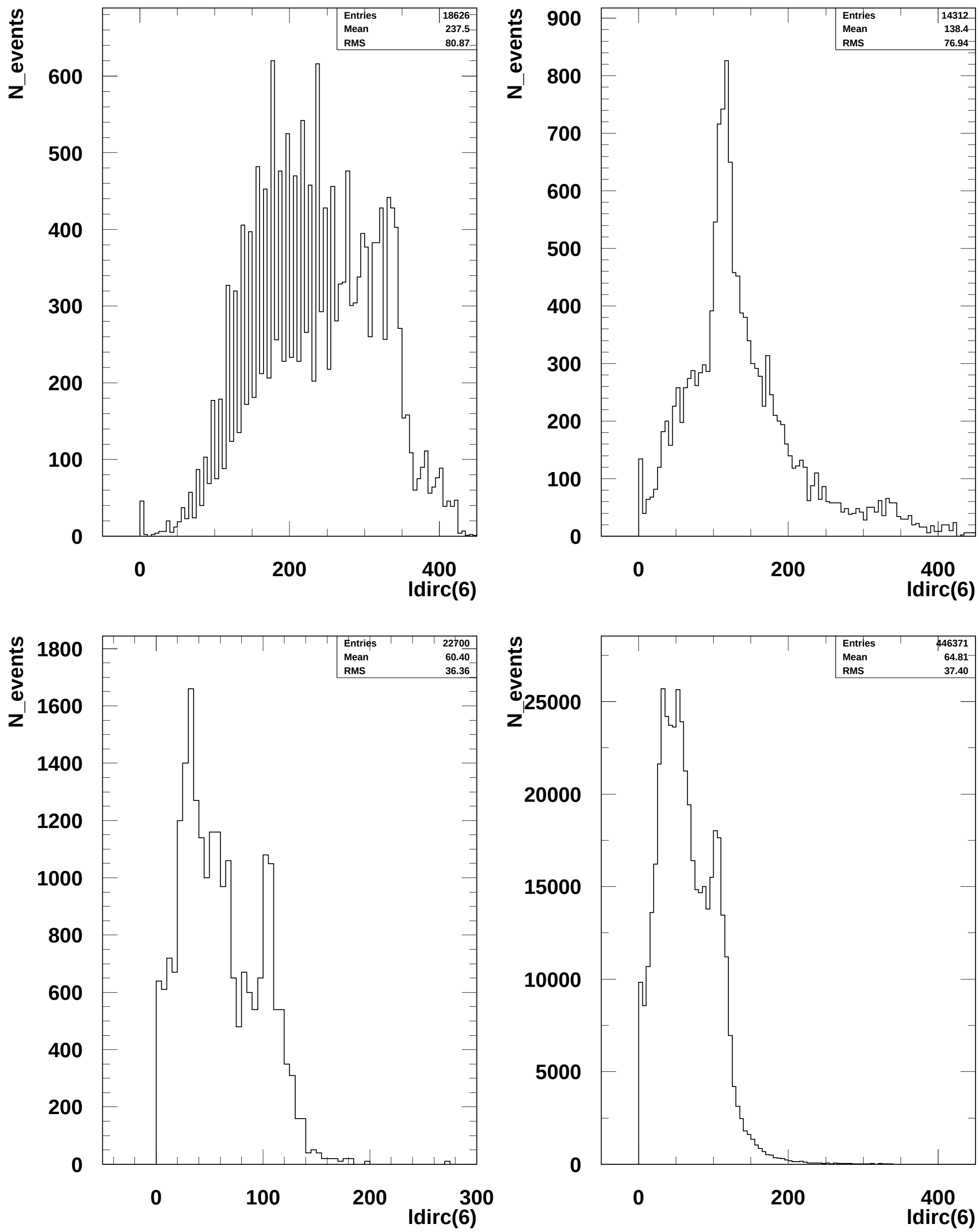
Signalevents

I have used two samples:
- → the 250 GeV hard annihilationchannel
- → a combination of 7 neutralino masses and 2 annihilationchannels

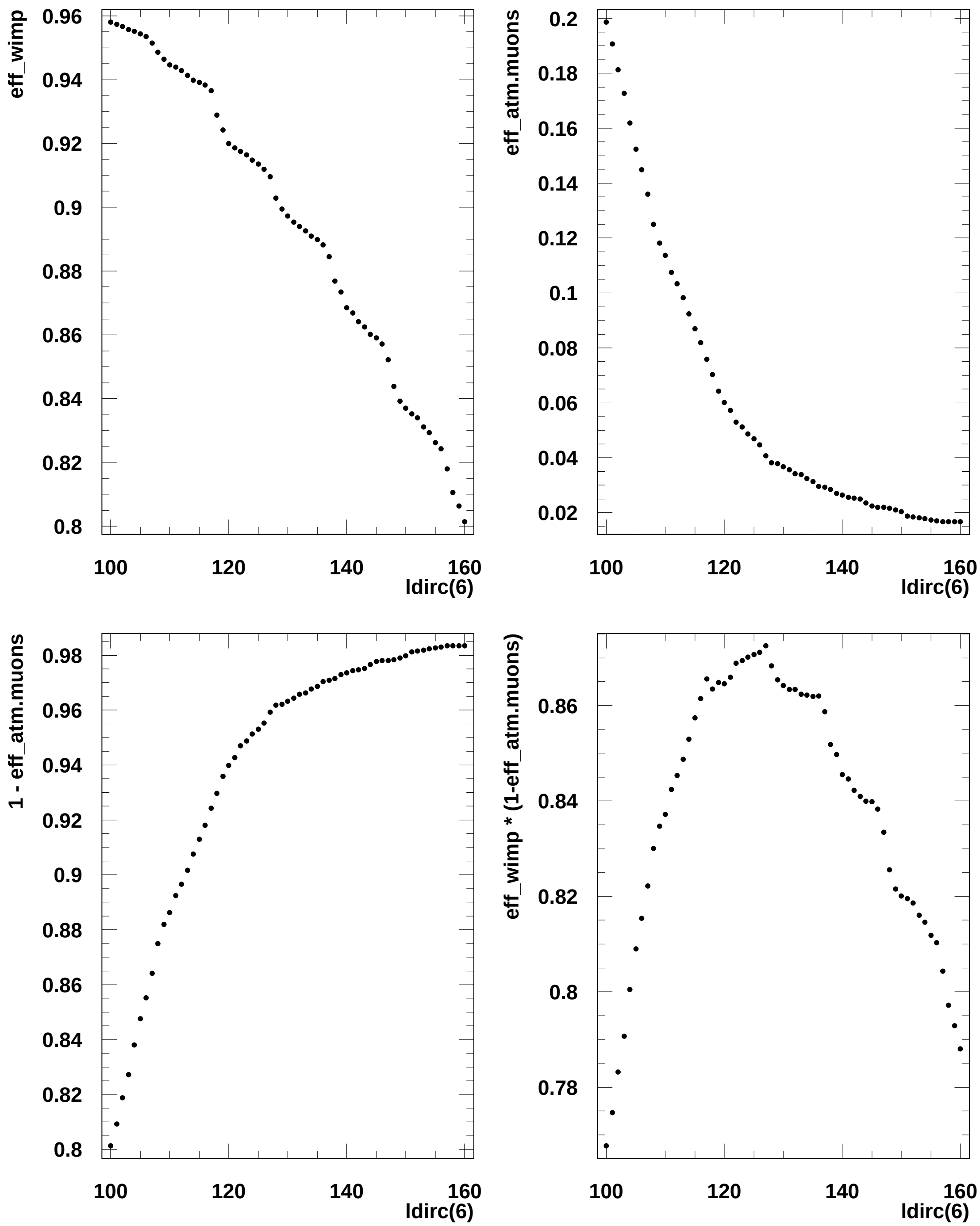
Backgroundevents

I have used both:
- → the atmospheric muon background (still limited to $\sim$ 20000 events at level2)
- → 5.7% of 99 data

Example: length of direct hits projected on the track



Efficiencies as function of cutvalue



Preliminary results of the WIMP analysis using 99 data

Efficiency \ cut	$v_{linefit} > 0.114$ m/ns	zenith(4) > 162.5°	zenith(6) > 164°
ϵ_{signal}	81.1 %	97.8 %	96.8 %
$\epsilon_{background}$	10.8 %	3.4 %	2.4 %
ϵ_s * (1-ϵ_{bg})	72.3 %	94.4 %	94.5 %

Efficiency \ cut	Number of hit channels > 19	jkrchi(6) < 8.5	ndirb(6) > 4
ϵ_{signal}	66.4 %	83.0 %	81.0 %
$\epsilon_{background}$	28.7 %	25.3 %	19.2 %
ϵ_s * (1-ϵ_{bg})	47.3 %	62.0 %	65.5 %

Efficiency \ cut	ndirc(6) > 8	ldirb(6) > 110 m	ldirc(6) > 127 m
ϵ_{signal}	76.8 %	86.5 %	91.0 %
$\epsilon_{background}$	14.5 %	5.4 %	4.1 %
ϵ_s * (1-ϵ_{bg})	65.7 %	81.8 %	87.2 %

cut 1 = ldirc(6) > 127 m

Efficiencies after cut 1

Efficiency \ cut	$v_{linefit} > 0.13$ m/ns	Number of hit channels > 19
ϵ_{signal}	77.4 %	71.7 %
$\epsilon_{background}$	20.9 %	32.2 %
ϵ_s * (1-ϵ_{bg})	61.2 %	48.7 %

Efficiency \ cut	ndirb(6) > 4	ndirc(6) > 8	jkrchi(6) < 8.5
ϵ_{signal}	82.9 %	80.2 %	85.8 %
$\epsilon_{background}$	18.2 %	14.5 %	22.9 %
ϵ_s * (1-ϵ_{bg})	67.8 %	68.5 %	66.2 %

cut 2 = ndirc(6) > 8

Efficiencies after cut 1 and cut 2, cut 3, cut 4

Efficiency \ cut	$v_{linefit} > 0.127$	Number of hit channels > 19	jkrchi(6) < 7.5
ϵ_{signal}	81.4 %	66.7 %	55.1 %
$\epsilon_{background}$	10.2 %	60.7 %	5.5 %
ϵ_s * (1-ϵ_{bg})	73.1 %	26.2 %	52.0 %

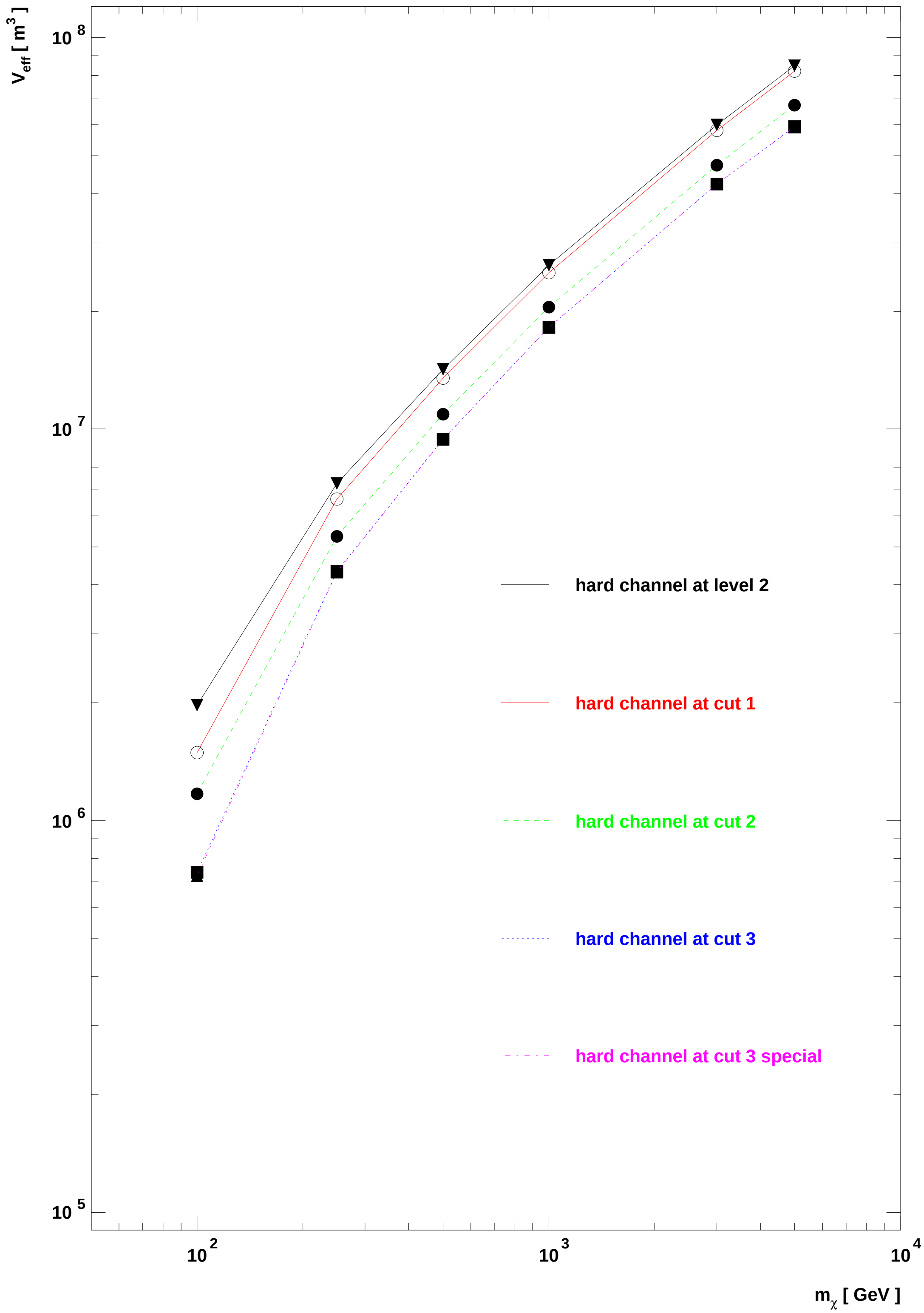
cut 3 = jkprob(2) > 0.127

Efficiency \ cut	jkrchi(6) < 8.5	nch > 20
ϵ_{signal}	98.4 %	81.8 %
$\epsilon_{background}$	43.1 %	19.7 %
ϵ_s * (1-ϵ_{bg})	56.0 %	65.7 %

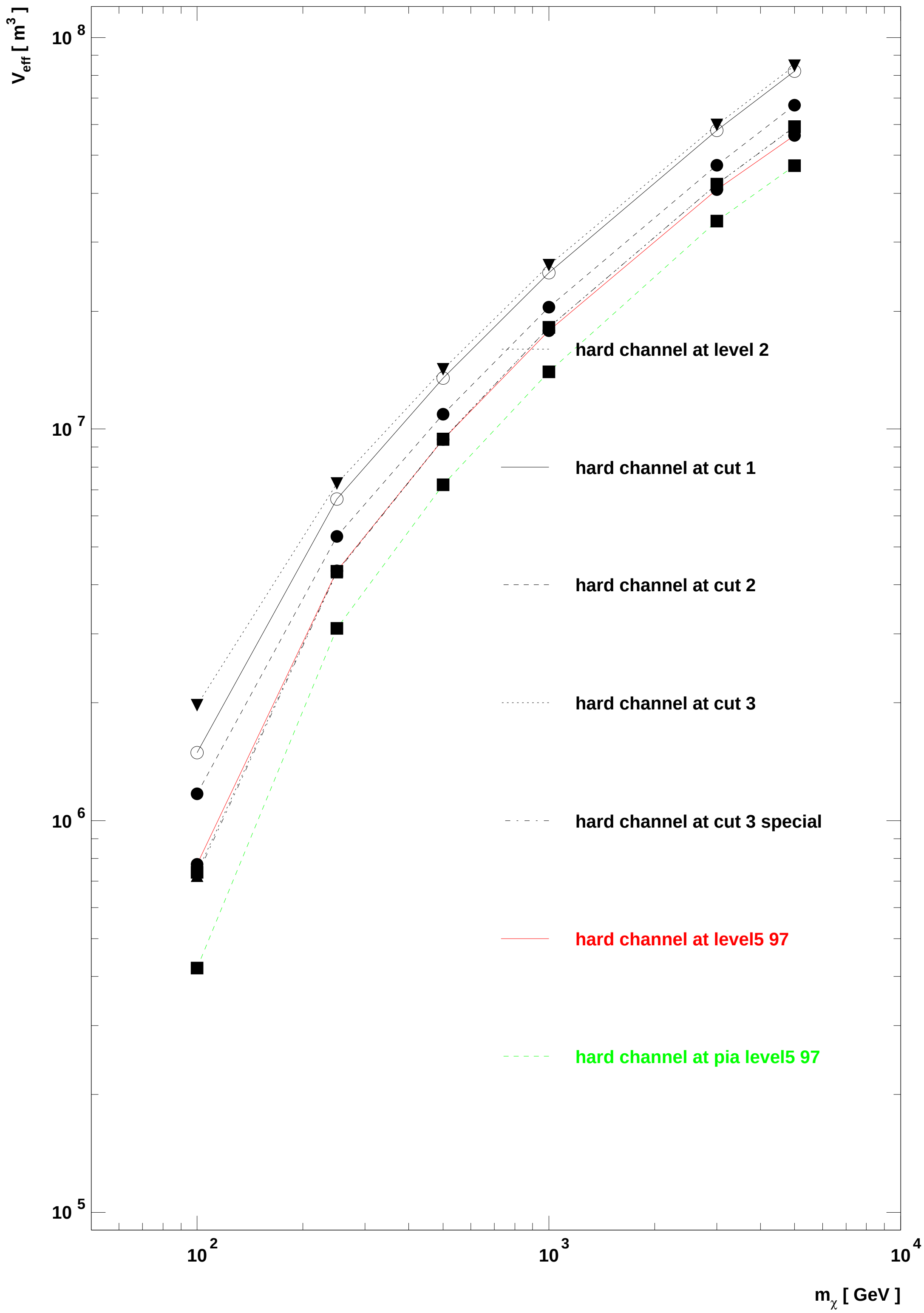
Efficiency \ cut	zenith(6) > 168°	zenith(4) > 168°
ϵ_{signal}	98.8 %	98.8 %
$\epsilon_{background}$	1.5 %	1.5 %
ϵ_s * (1-ϵ_{bg})	97.4 %	97.4 %

cut 4 = zenith(6) > 168°

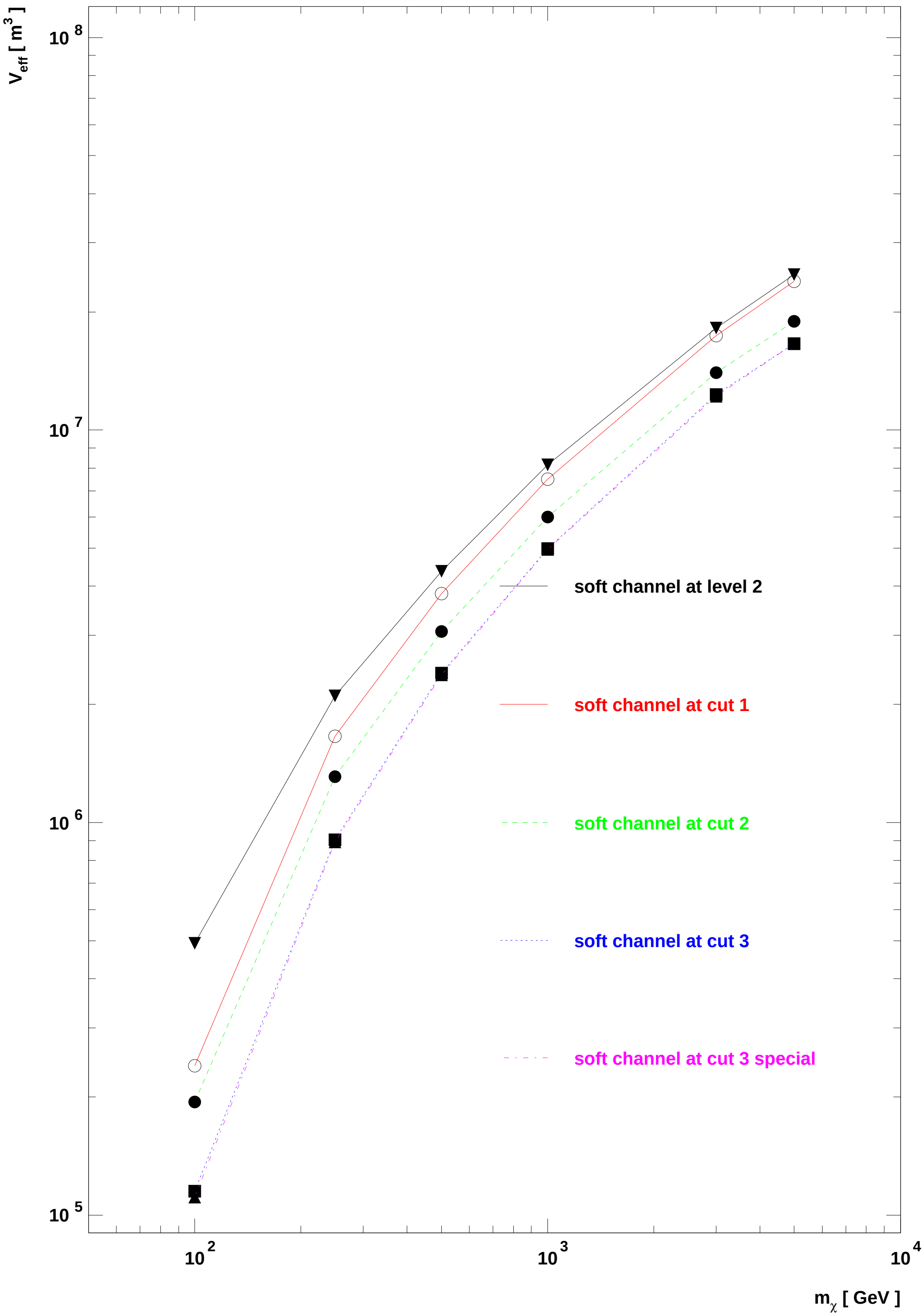
Effective volume after the different cuts for the hard channel



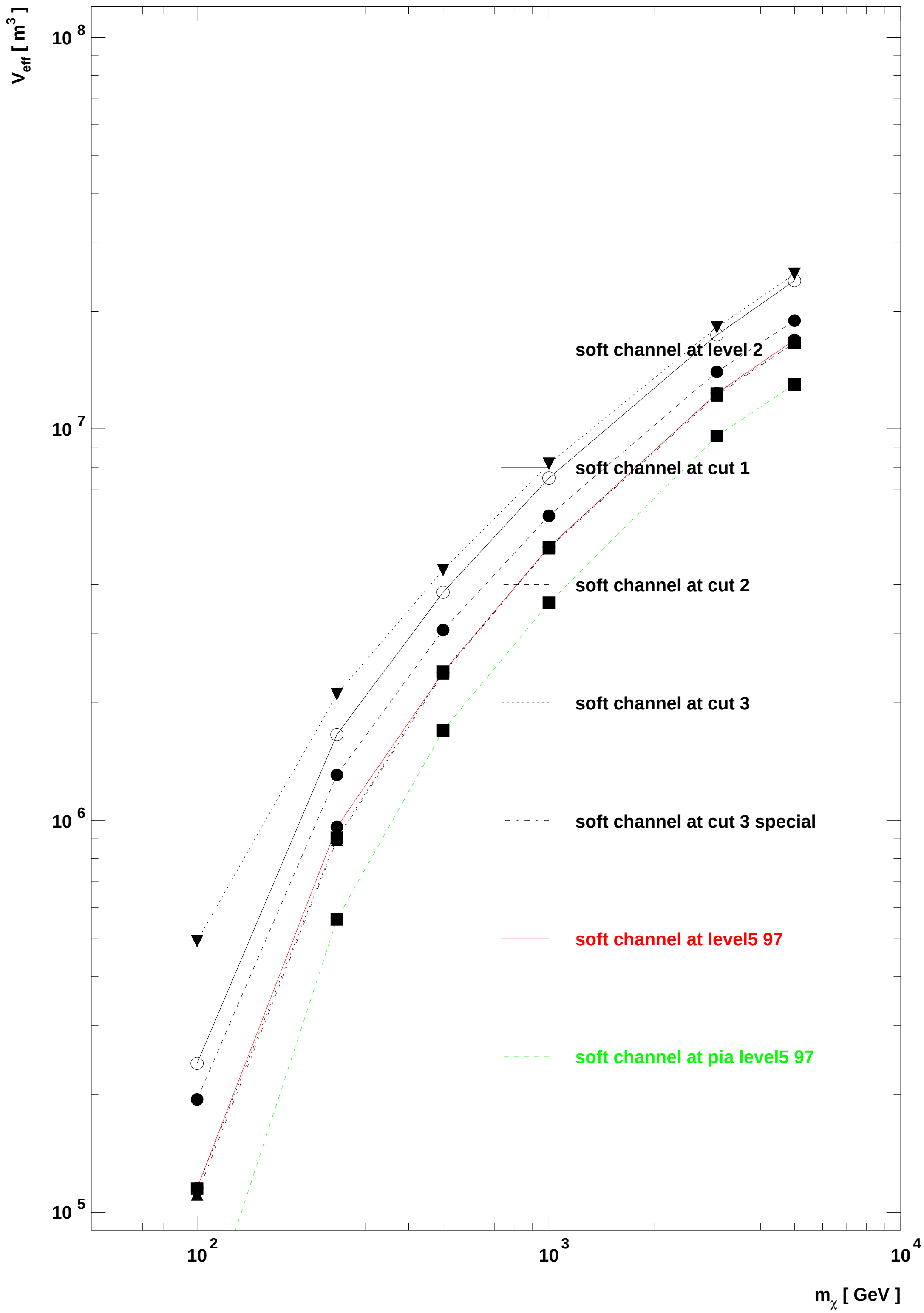
Effective volume after the different cuts for the hard channel



Effective volume after the different cuts for the soft channel

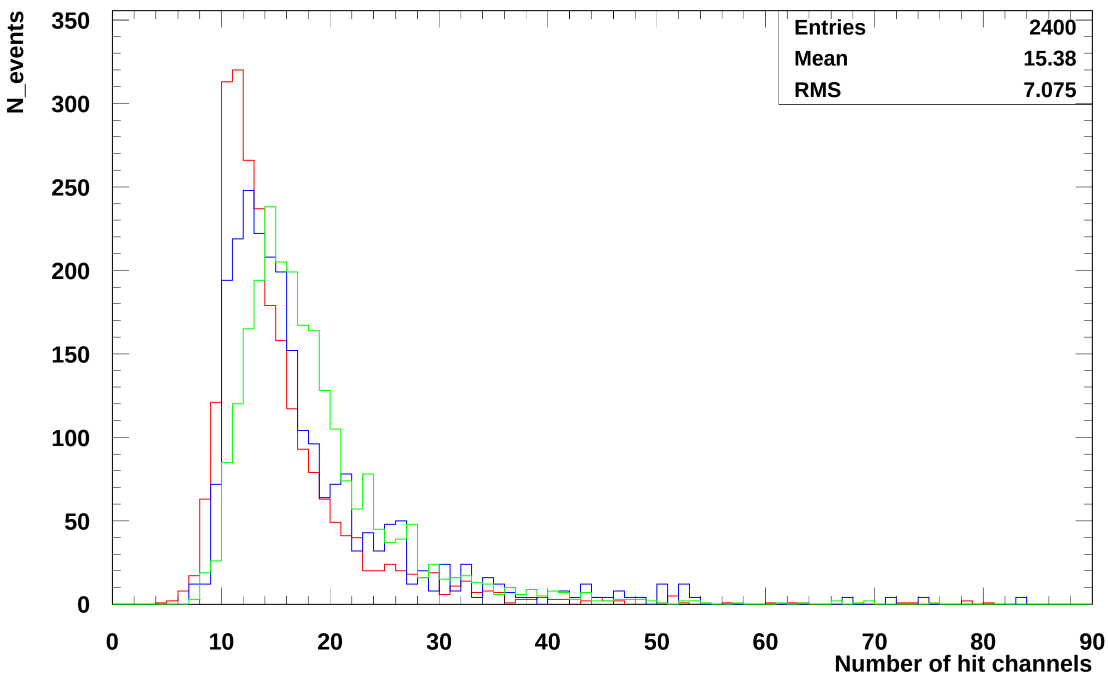


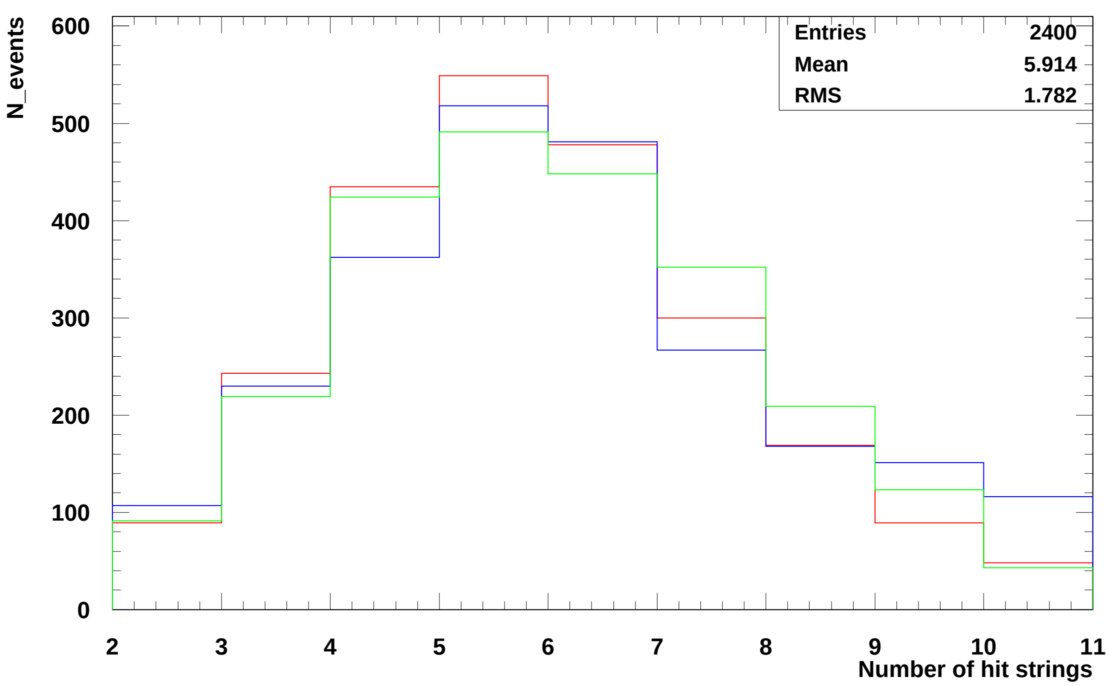
Effective volume after the different cuts for the soft channel



Checkplots 98 data

98 data (calibration constants 2)
99 background MC
99 data





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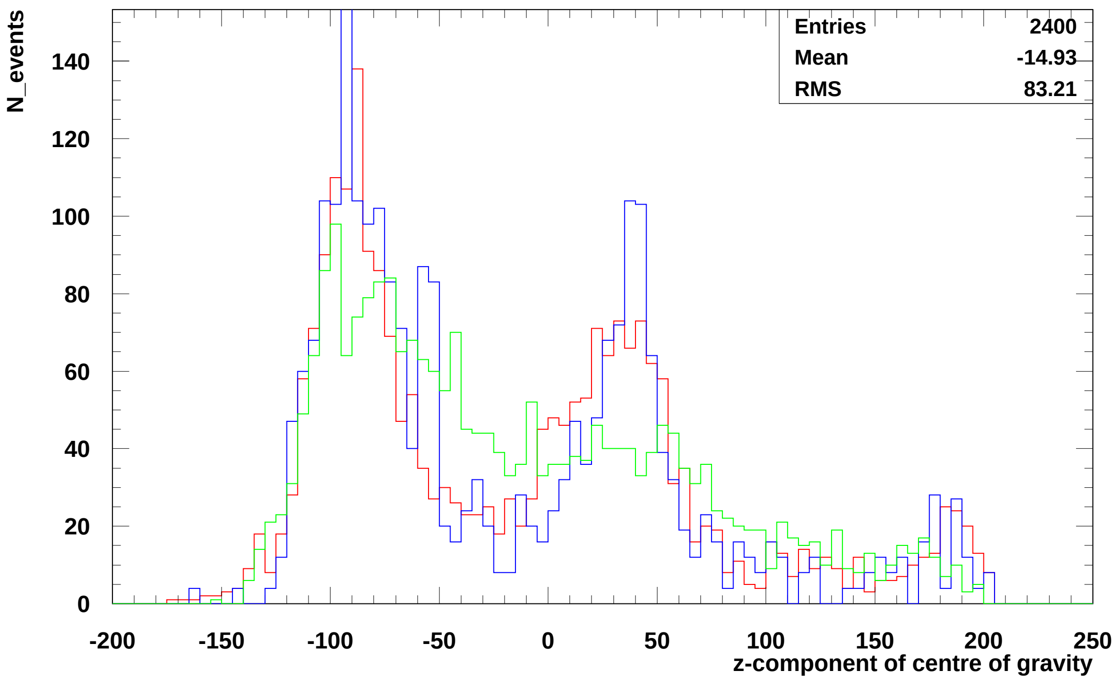

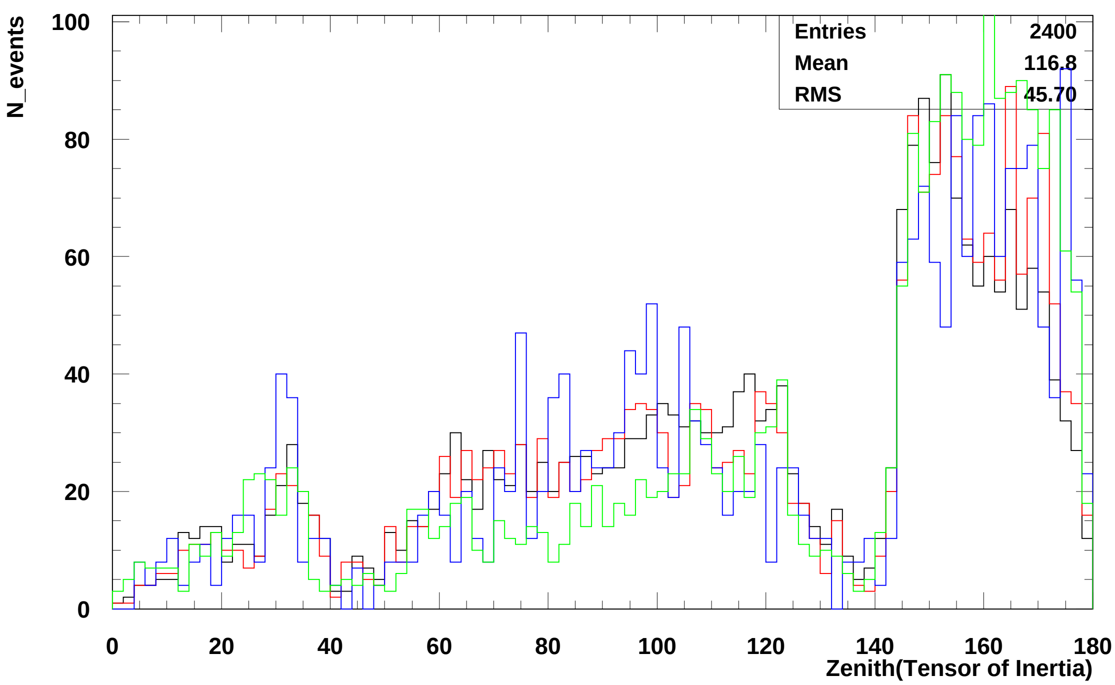

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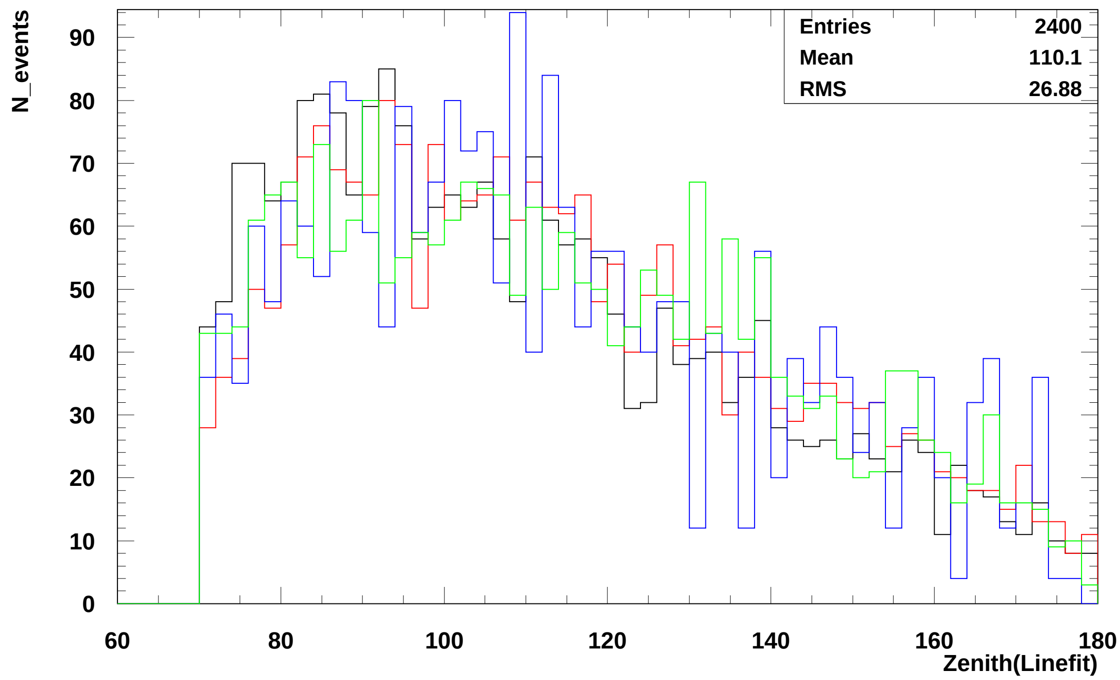

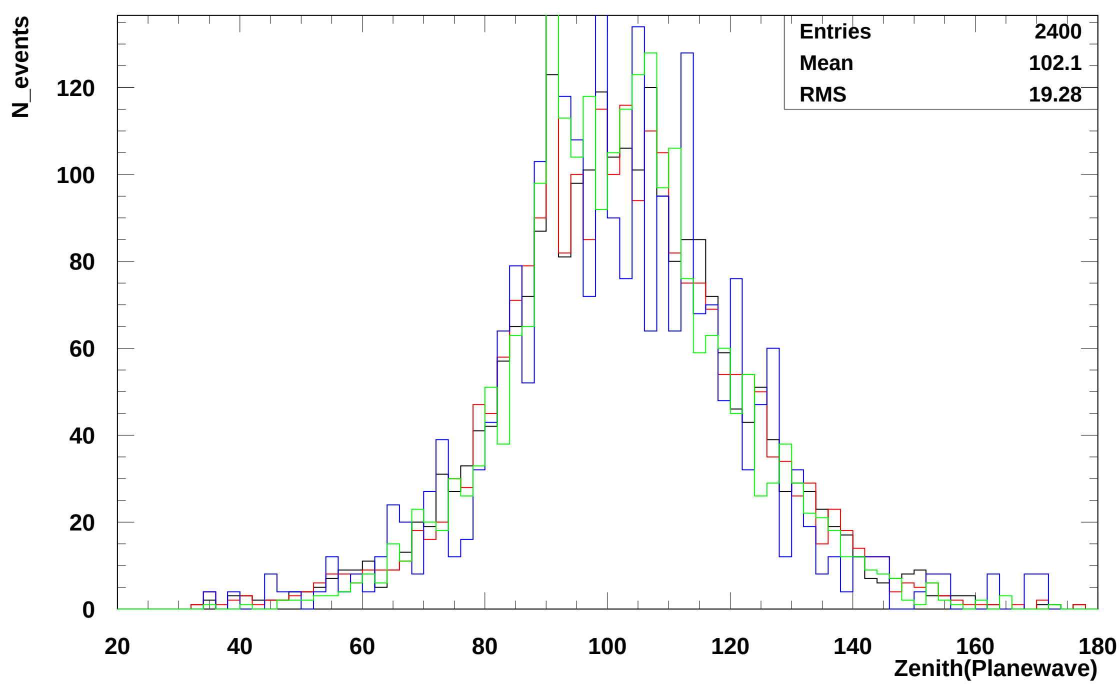

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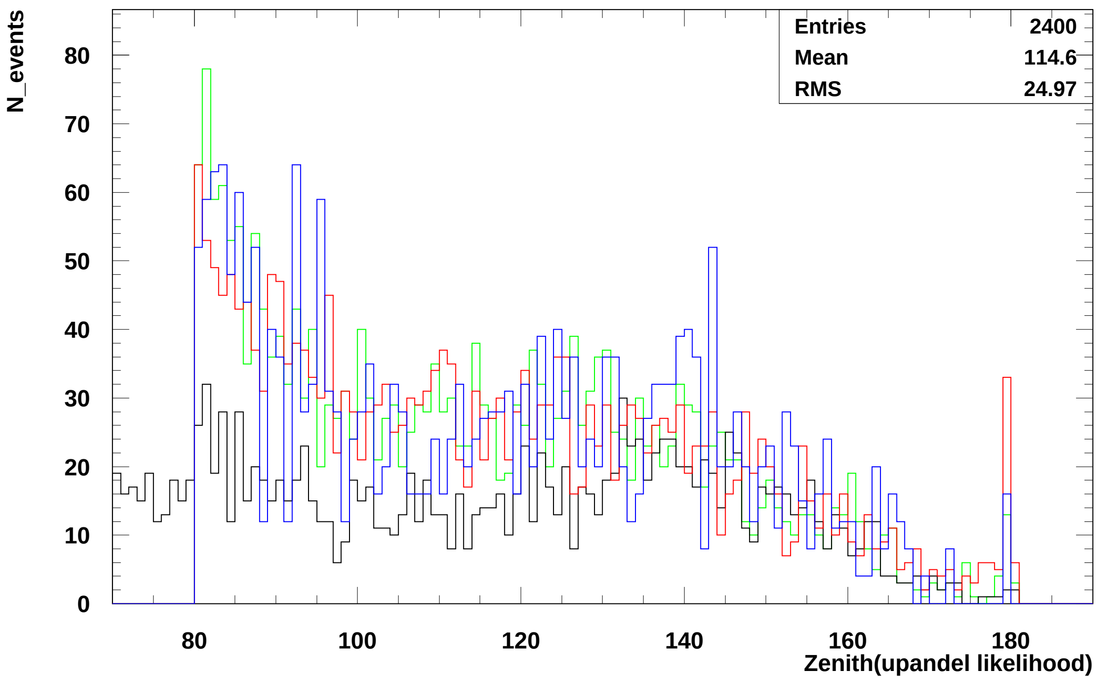

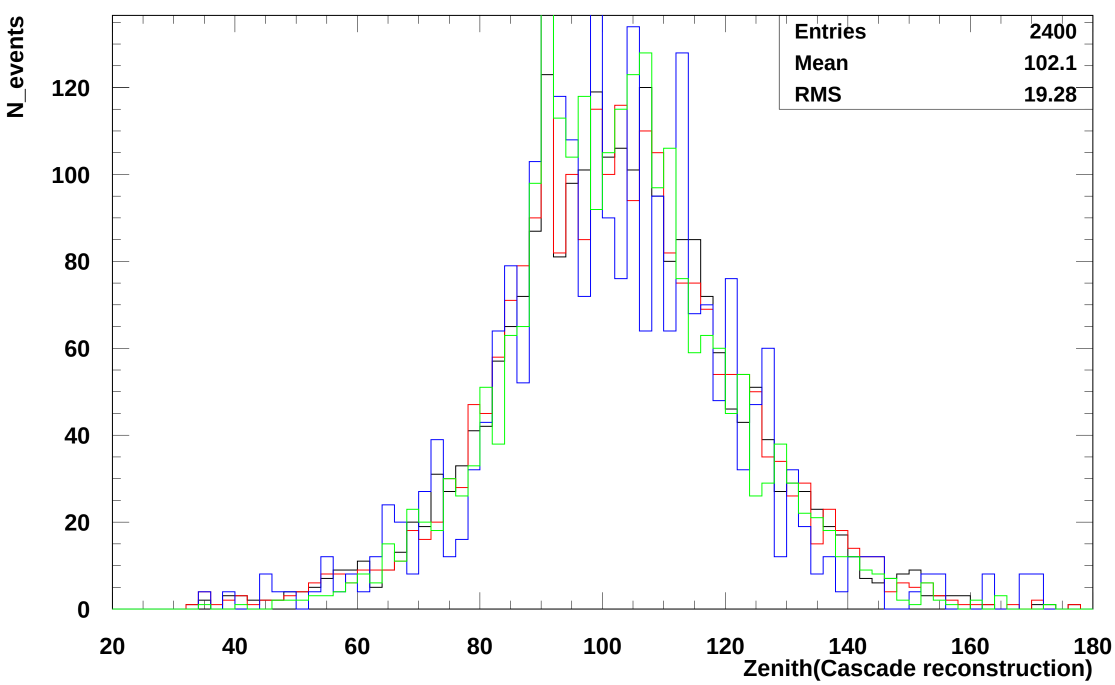

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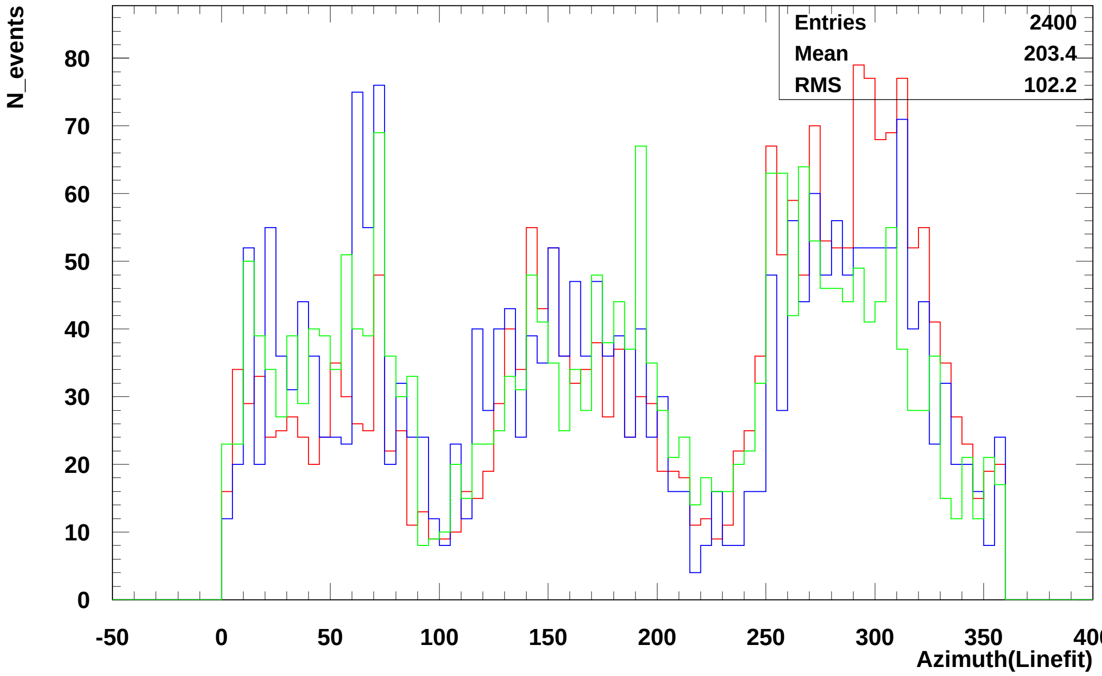
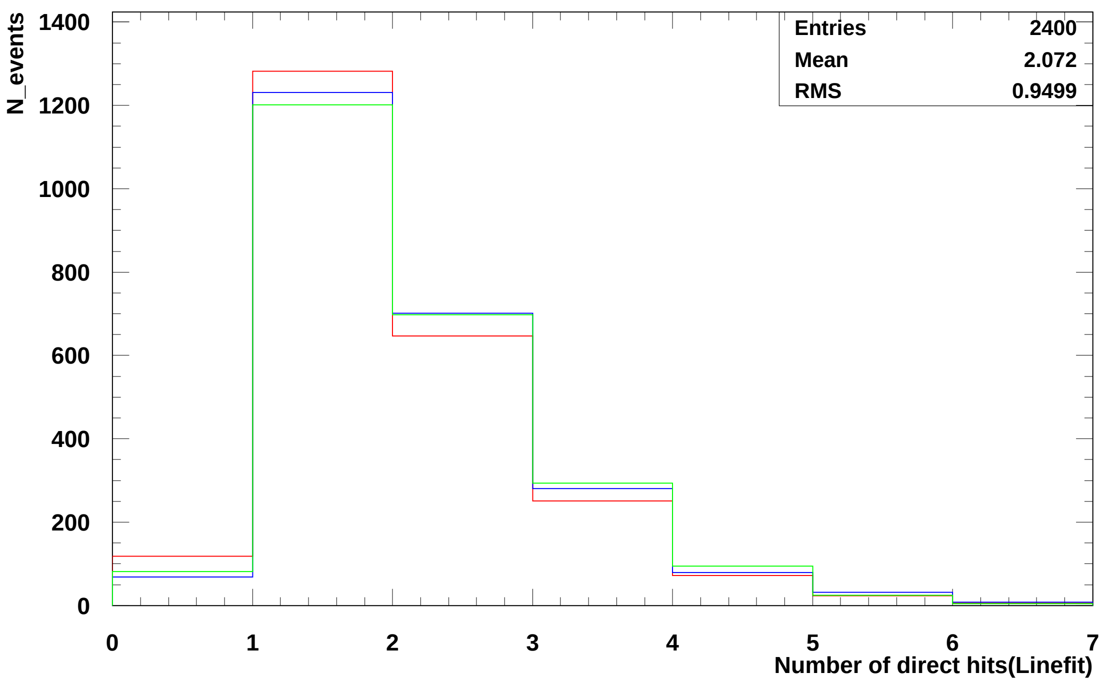
98 data (calibration constants 2)

99 background MC

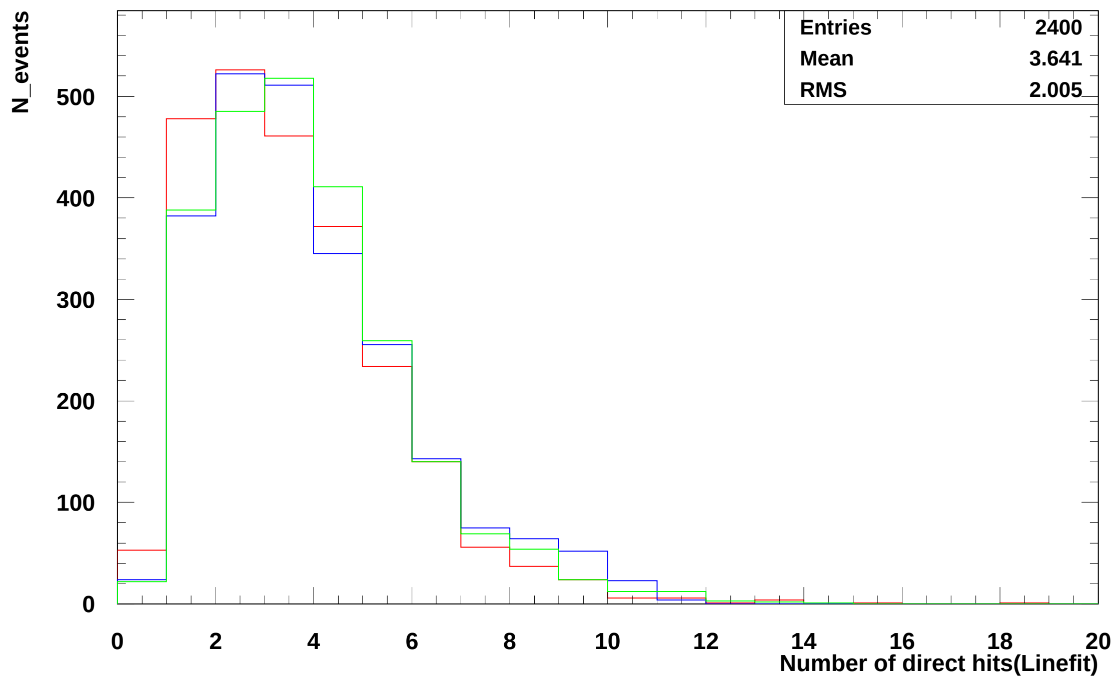
99 data

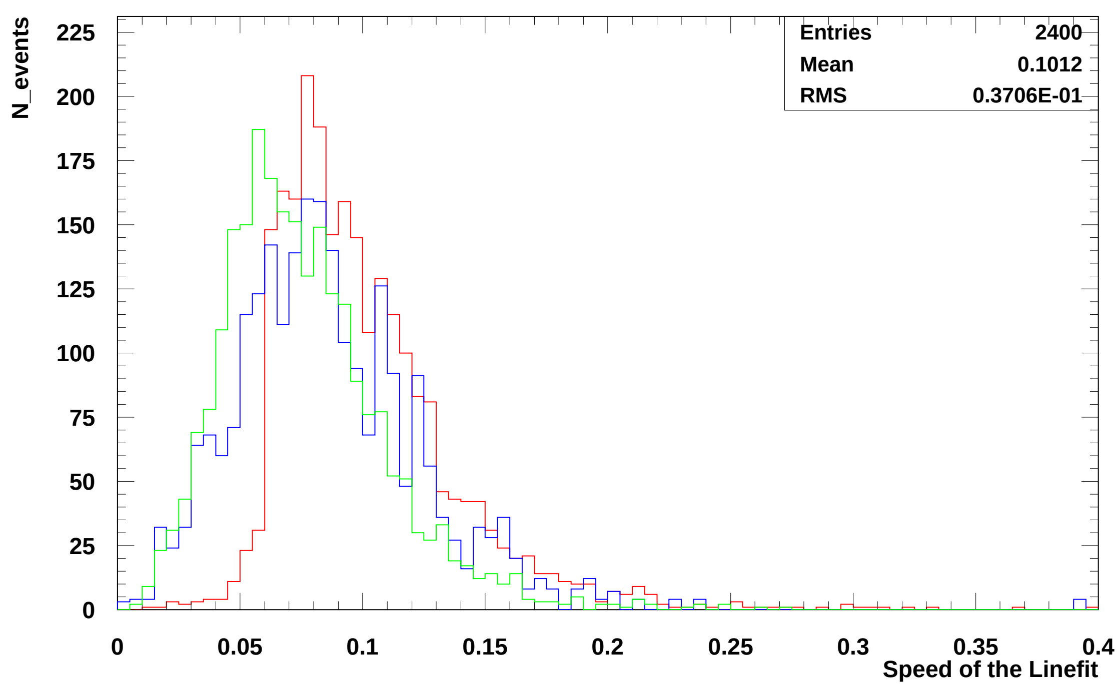




Checkplots 98 data

98 data (calibration constants 2)
99 background MC
99 data



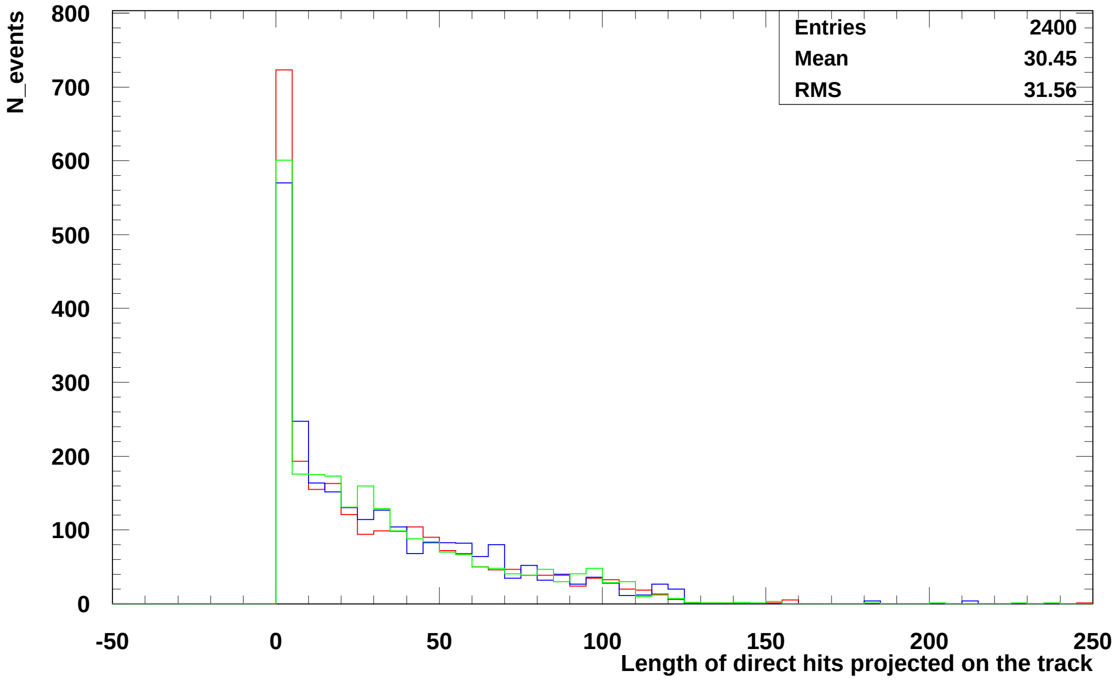


Checkplots 98 data

98 data (calibration constants 2)

99 background MC

99 data



Conclusions and outlook

97 data:

→ The selected number of events and the calculated upperlimit on the muonflux is in good agreement with the results of previous analysis

99 data:

→ We need more background Monte Carlo

→ We need to reconstruct more of the 20 % of 99 data

→ We will apply the selection procedure on a larger collection of variables

98 data:

→ We compared 98 data with 99 data at level 2 and didn't see any large discrepancy