Зависимость интегральных гармоник Vn от центральности в PbPb-столкновениях на LHC

$$\sqrt{s_{NN}} = 2.76 \text{ TeV}$$

Мотивация

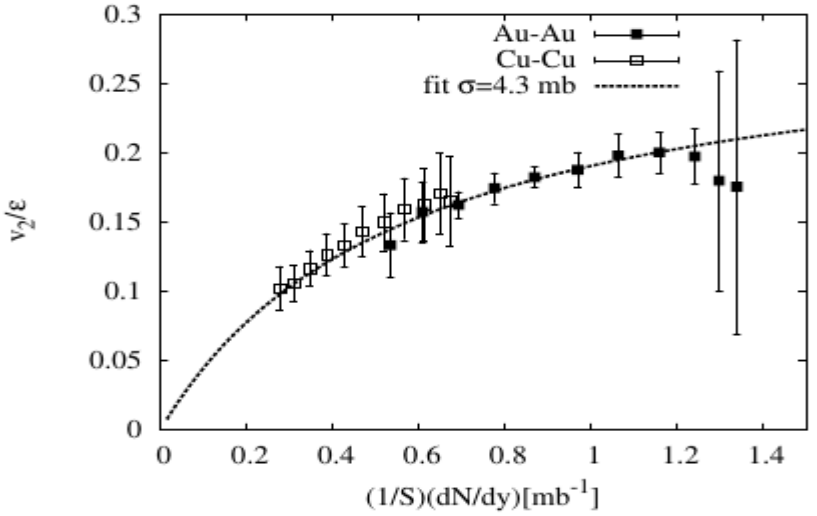


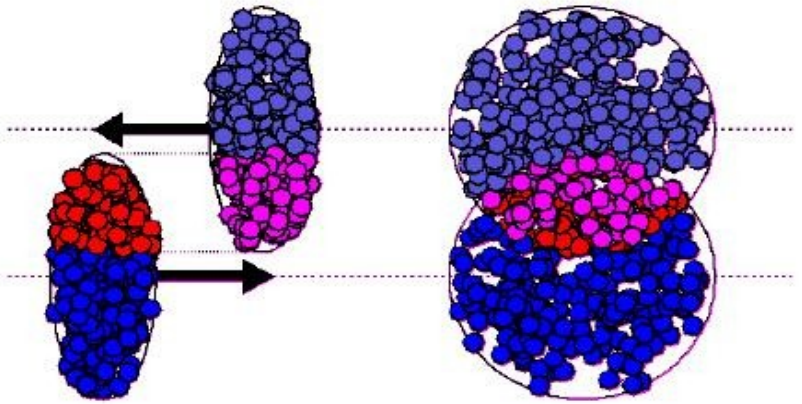
FIG. 1: Variation of the scaled elliptic flow with the density, assuming initial conditions from the Glauber model. The line is a 2-parameter fit using Eqs. (2) and (4).

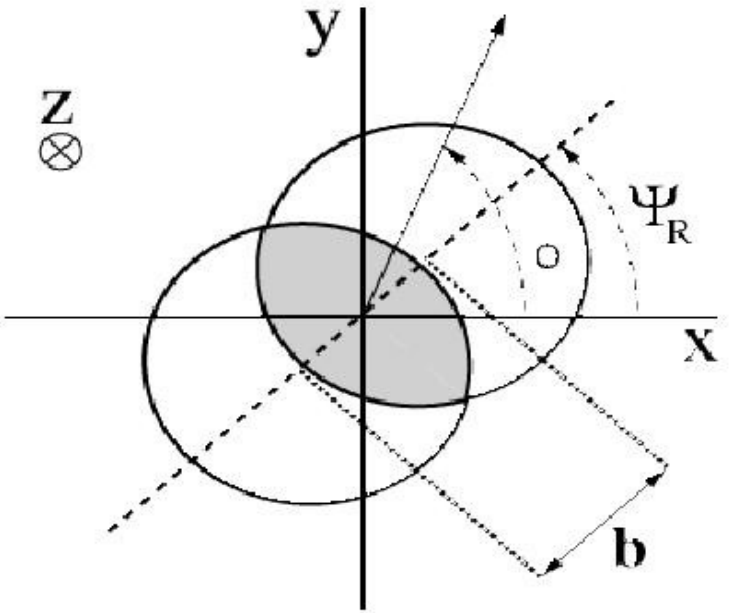
Извлечение вязкости КГП,
исходя из зависимости V_n/ε *vs.* $1/S\,dN/dy$

$$\left(\frac{v_2}{\epsilon}\right)^{ex} = \left(\frac{v_2}{\epsilon}\right)^{ih} \frac{\frac{1}{S}\frac{dN}{dy}\left[1+\frac{2}{3\tau_i T_i}\left(\frac{\eta}{s}\right)\right]^{-3}}{\frac{1}{K_0\sigma c_s}+\frac{1}{S}\frac{dN}{dy}\left[1+\frac{2}{3\tau_i T_i}\left(\frac{\eta}{s}\right)\right]^{-3}}$$

H. J. Drescher http://arxiv.org/abs/0704.3553v2

A. K. Chaundhuri http://arxiv.org/abs/1006.4478v2



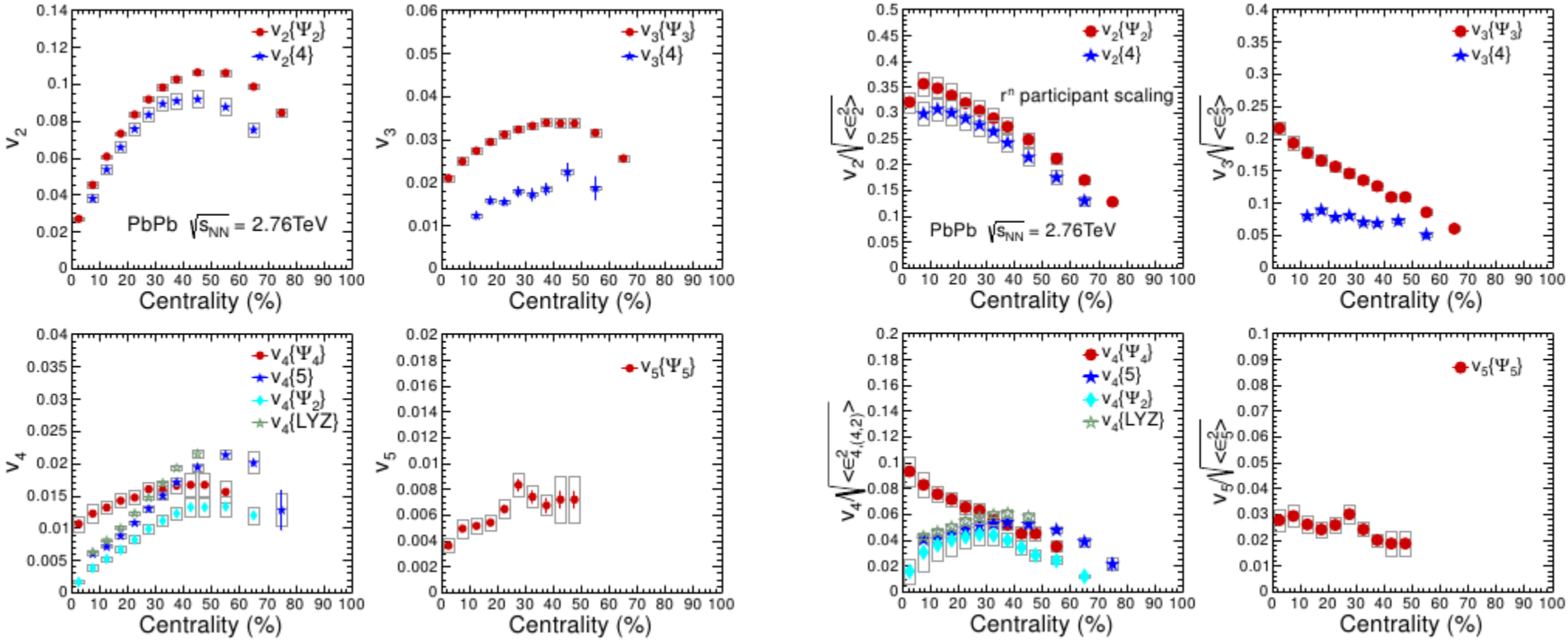


$$\frac{d^2N}{p_T dp_T d\varphi} = \frac{1}{2\pi}\frac{dN}{p_T dp_T}\left(1 + \sum_{n=1}^{\infty} 2v_n(p_T)\cos\left[n\left(\varphi - \Psi_R\right)\right]\right).$$

$$\bar{v}_n = \frac{\int dp_T \int_0^{2\pi} d\phi \cos[n(\phi)]\frac{d^2N}{p_T dp_T d\phi}(p_T,\phi)}{\int dp_T \int_0^{2\pi} d\phi \frac{d^2N}{p_T dp_T d\phi}(p_T,\phi)} = \frac{\int dp_T \frac{dN}{dp_T}(p_T)v_n(p_T)}{\int dp_T \frac{dN}{p_T dp_T}(p_T)}$$

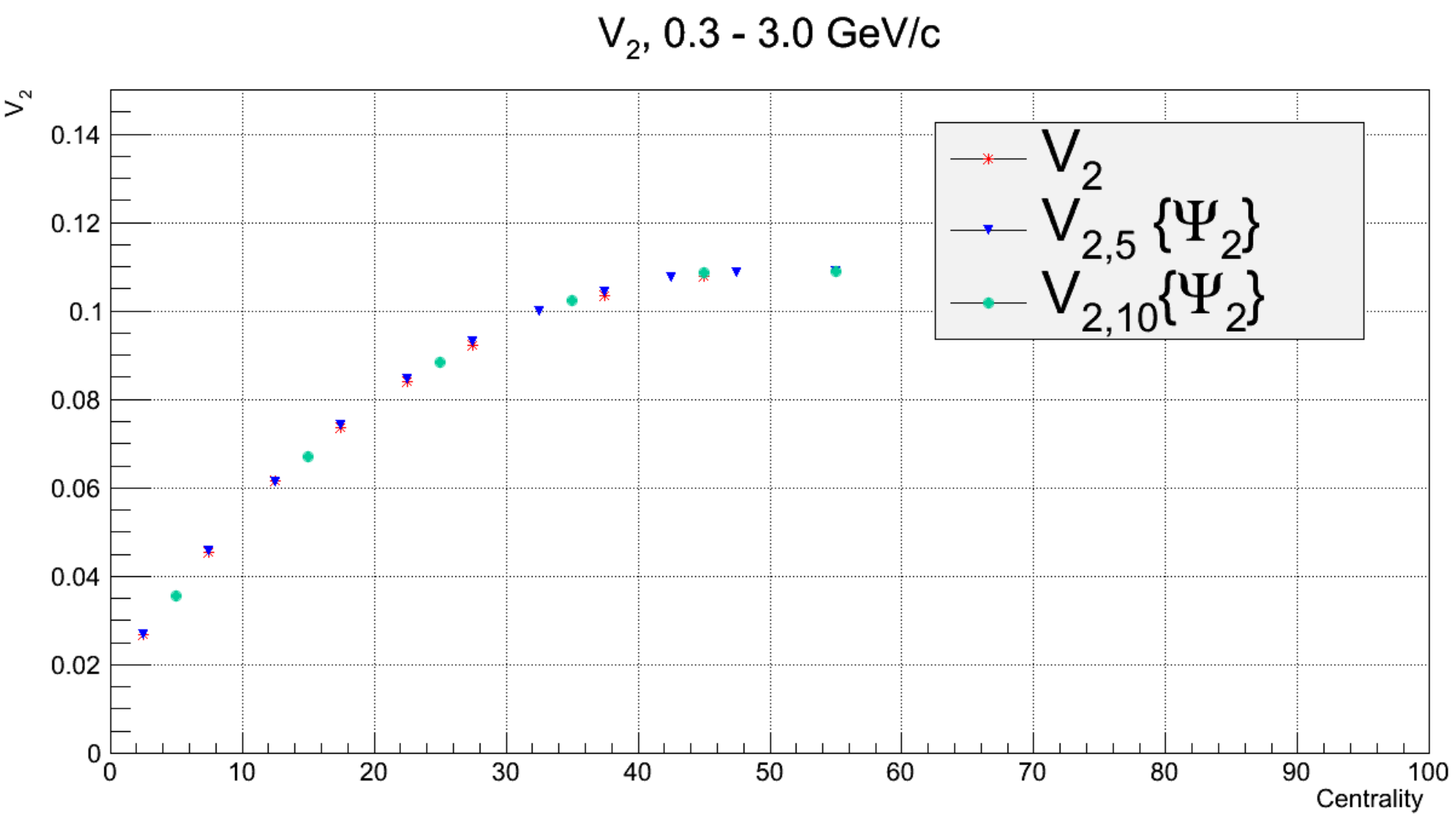
Функция фитирования:

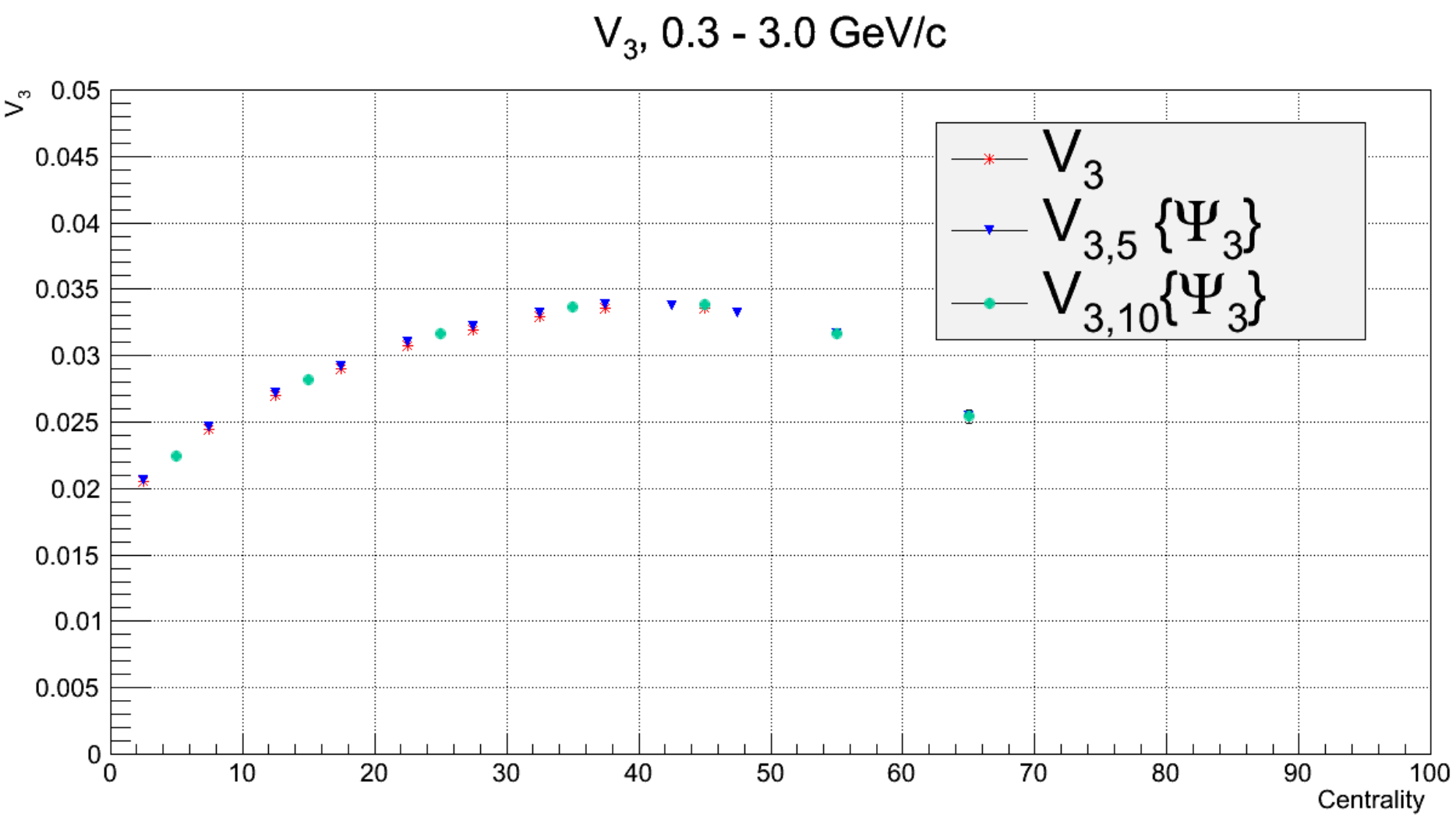
$$v_n(p_T) = a\, p_T^b \exp\left\{-\left(p_T/c\right)^d\right\}$$

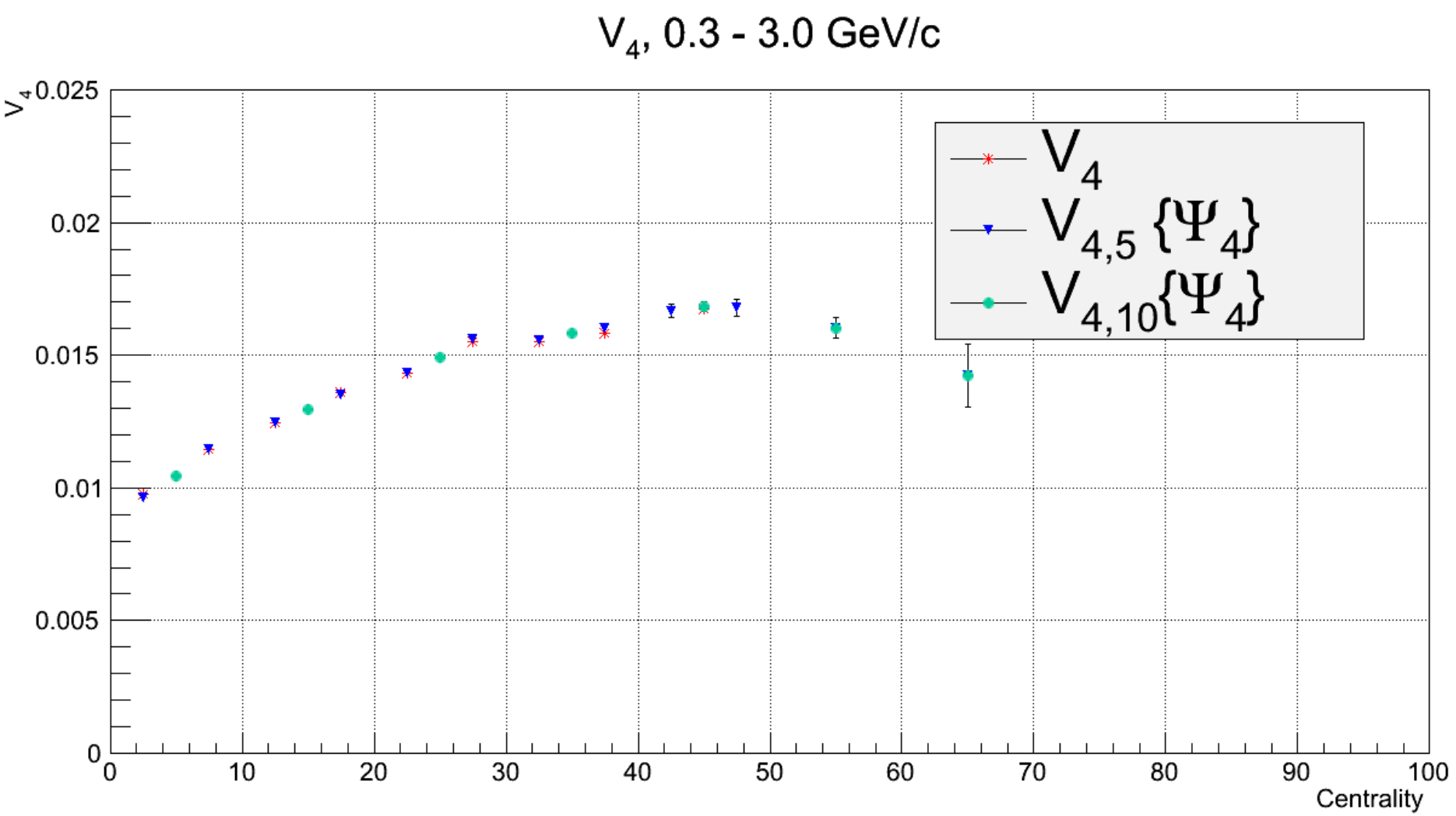


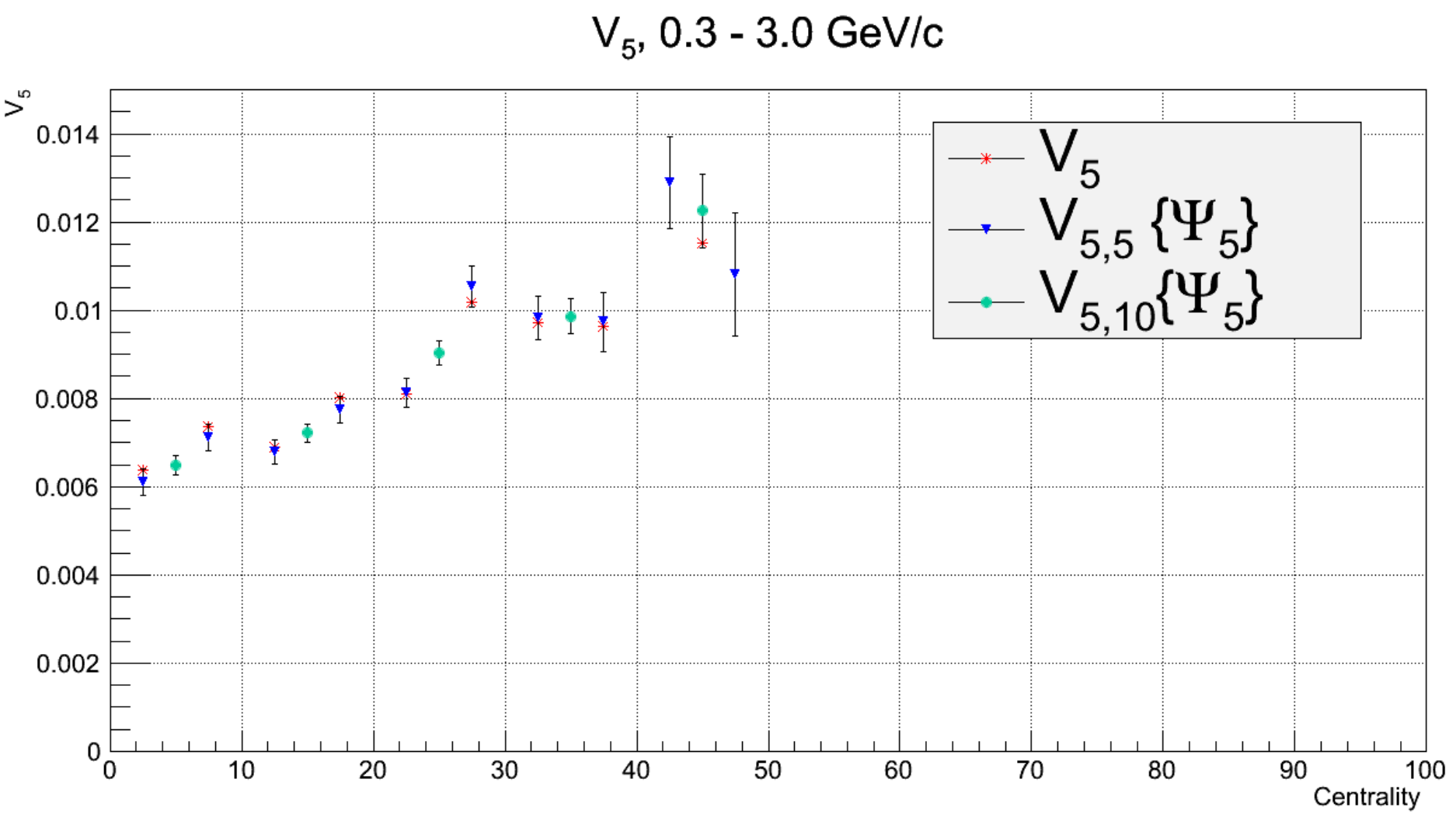
HIN-11-005.pdf
Fig.7 and Fig.12

https://twiki.cern.ch/twiki/pub/CMS/FlowHIRun2011/HIN-11-005.pdf


V_2, 0.3 - 3.0 GeV/c
V_2
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
V_2
$V_{2,5}\{\Psi_2\}$
$V_{2,10}\{\Psi_2\}$


V_3, 0.3 - 3.0 GeV/c
V_3
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
V_3
$V_{3,5}\{\Psi_3\}$
$V_{3,10}\{\Psi_3\}$

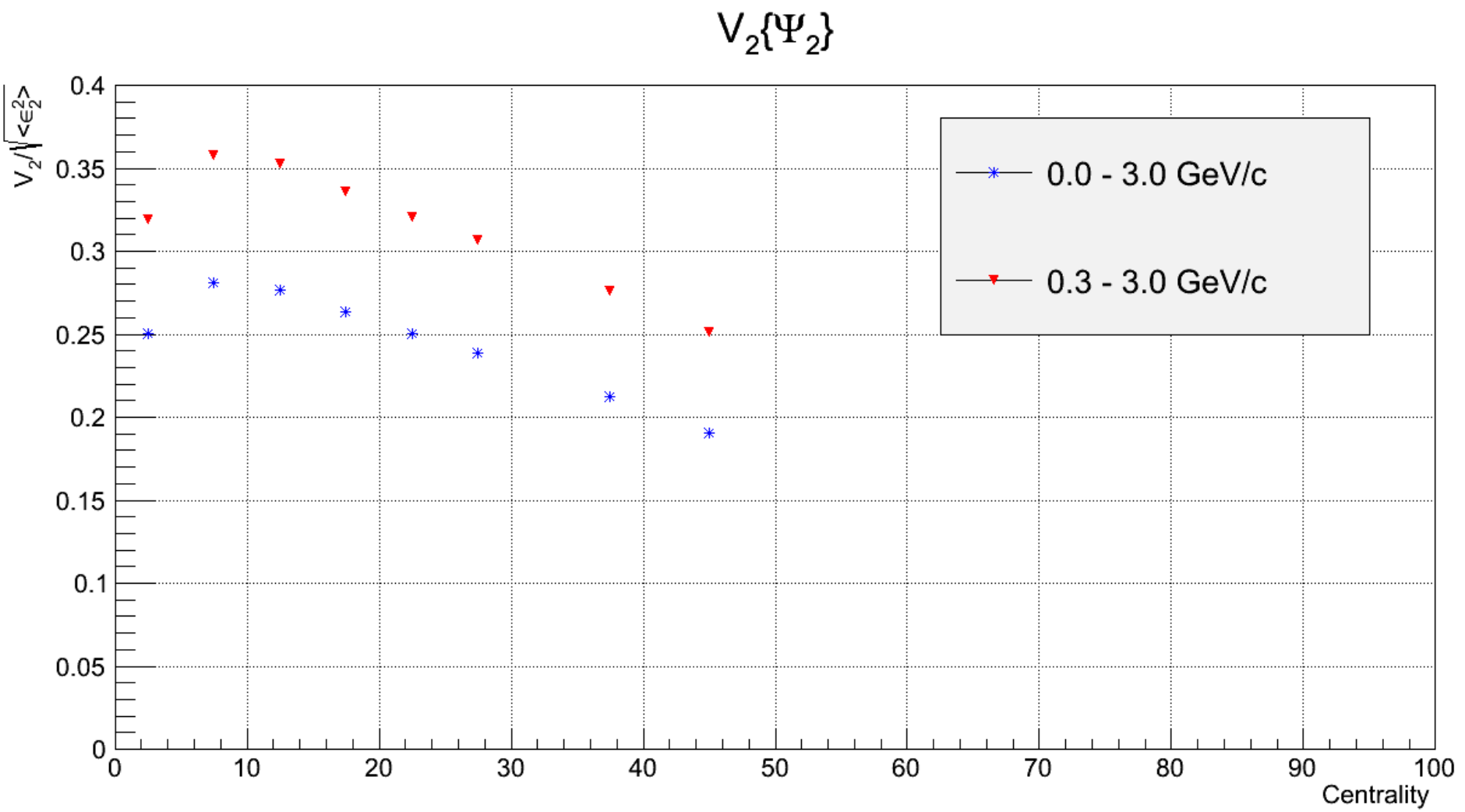

V_4, 0.3 - 3.0 GeV/c
V_4
0.025
0.02
0.015
0.01
0.005
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
V_4
$V_{4,5}\{\Psi_4\}$
$V_{4,10}\{\Psi_4\}$

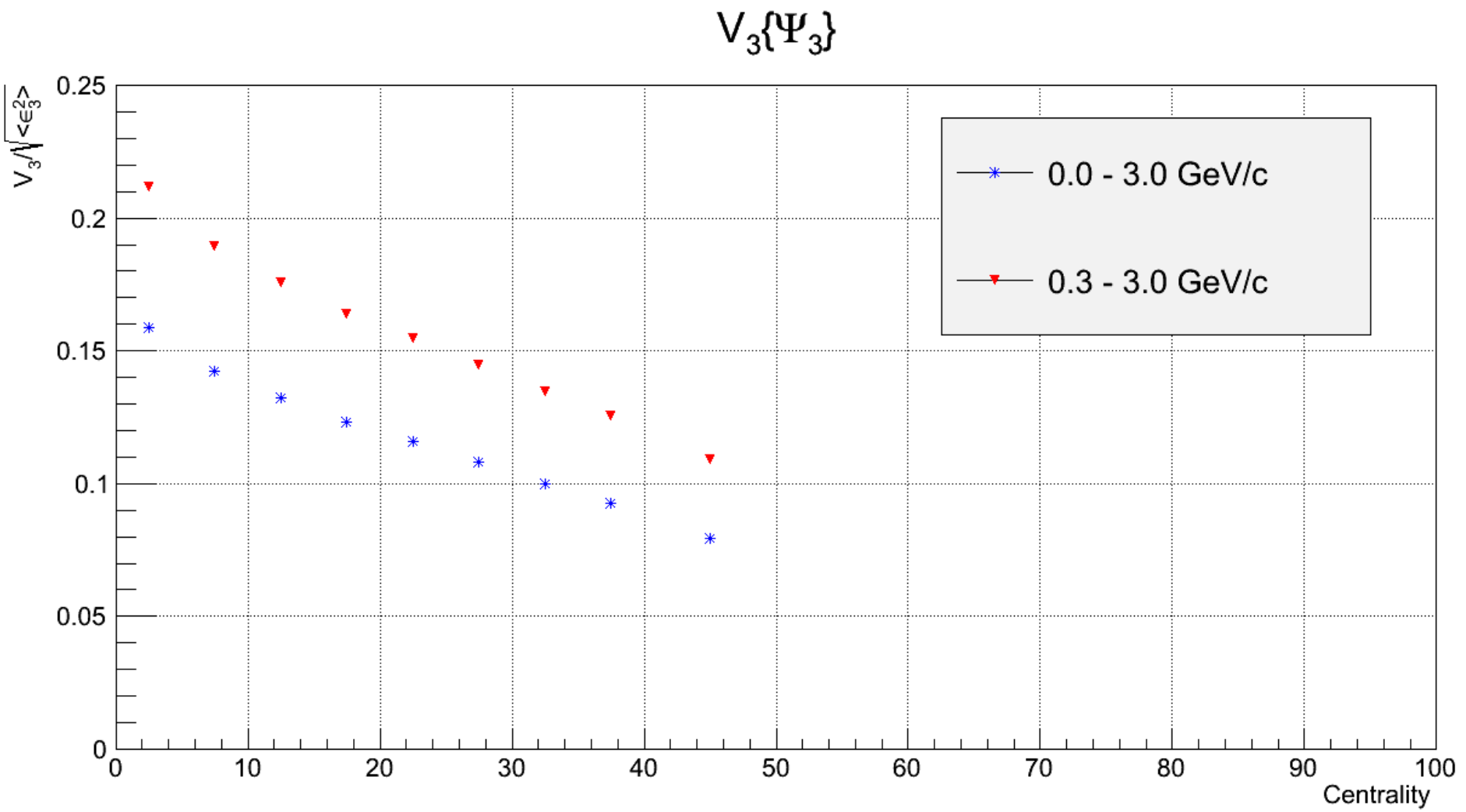

V_5, 0.3 - 3.0 GeV/c
V_5
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
V_5
$V_{5,5}\{\Psi_5\}$
$V_{5,10}\{\Psi_5\}$

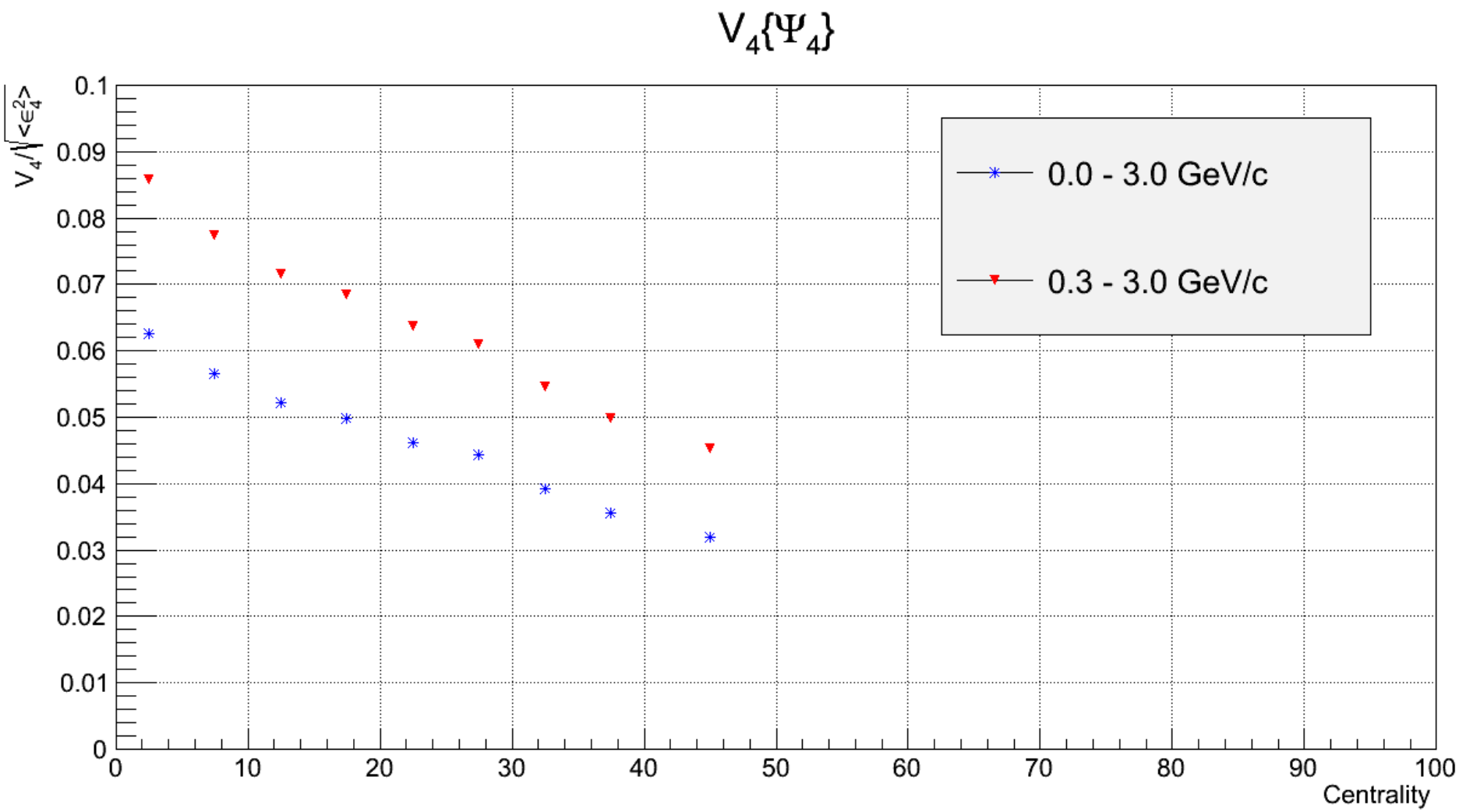
$$\varepsilon_{n,m} = \frac{\langle r^n \cos[n\,(\,\varphi - \Phi_m)]\rangle}{\langle r^2\rangle} \qquad r = \sqrt{x^2 + y^2} \qquad \Phi_m = \frac{1}{m}\, arctg\, \frac{\langle r^m \sin[m\varphi]\rangle}{\langle r^m \cos[m\varphi]\rangle}$$

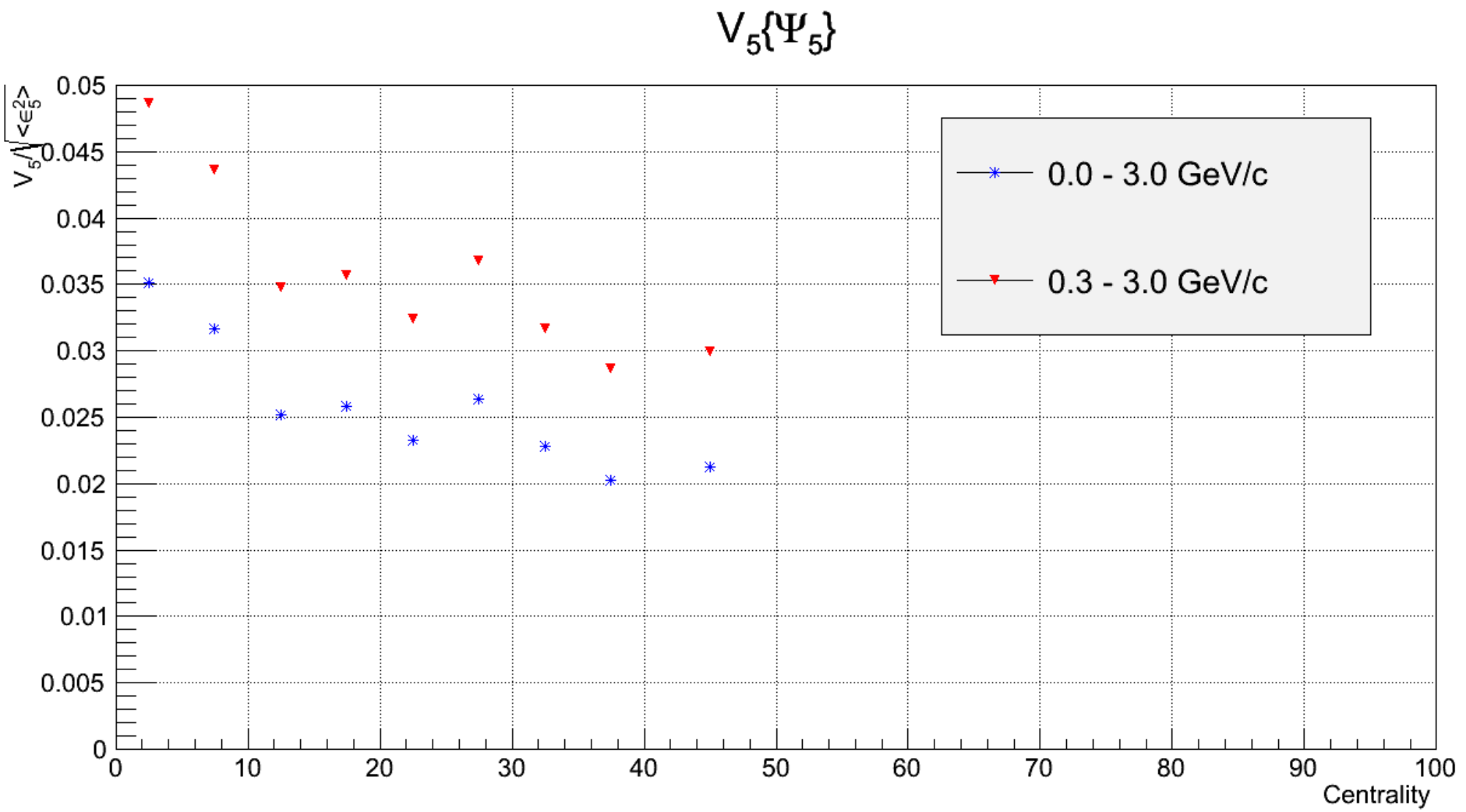
TABLE VIII. Glauber-model participant $\sqrt{\langle \epsilon_n^2 \rangle}$ eccentricities. The last column gives the 4^{th}-order eccentricities based on the 2^{nd}-order participant plane. Eccentricities are calculated using r^n weighting of participants.

Centrality (%)	$\langle \mathbf{N_{part}} \rangle$	$\sqrt{\langle \epsilon_2^2 \rangle}$	$\sqrt{\langle \epsilon_3^2 \rangle}$	$\sqrt{\langle \epsilon_4^2 \rangle}$	$\sqrt{\langle \epsilon_5^2 \rangle}$	$\sqrt{\langle \epsilon_{4,2}^2 \rangle}$
0 - 5	382.77	0.084 ± 0.004	0.097 ± 0.003	0.114 ± 0.005	0.131 ± 0.006	0.081 ± 0.041
5 - 10	329.73	0.127 ± 0.007	0.129 ± 0.005	0.148 ± 0.005	0.169 ± 0.007	0.104 ± 0.064
10 - 15	281.48	0.175 ± 0.011	0.154 ± 0.006	0.174 ± 0.006	0.198 ± 0.008	0.123 ± 0.059
15 - 20	239.15	0.219 ± 0.016	0.177 ± 0.007	0.199 ± 0.007	0.225 ± 0.008	0.143 ± 0.049
20 - 25	202.22	0.262 ± 0.016	0.199 ± 0.008	0.225 ± 0.009	0.250 ± 0.009	0.165 ± 0.049
25 - 30	169.82	0.301 ± 0.019	0.221 ± 0.009	0.254 ± 0.010	0.277 ± 0.010	0.193 ± 0.038
30 - 35	141.30	0.339 ± 0.022	0.245 ± 0.010	0.284 ± 0.011	0.307 ± 0.011	0.221 ± 0.039
35 - 40	116.41	0.375 ± 0.022	0.268 ± 0.011	0.317 ± 0.013	0.337 ± 0.012	0.254 ± 0.041
40 - 50	85.17	0.429 ± 0.024	0.308 ± 0.013	0.370 ± 0.016	0.385 ± 0.016	0.307 ± 0.035
50 - 60	52.66	0.501 ± 0.026	0.366 ± 0.015	0.445 ± 0.020	0.454 ± 0.018	0.385 ± 0.039
60 - 70	29.85	0.581 ± 0.027	0.422 ± 0.016	0.520 ± 0.023	0.513 ± 0.018	0.466 ± 0.039
70 - 80	15.36	0.662 ± 0.026	0.460 ± 0.012	0.596 ± 0.026	0.559 ± 0.015	0.549 ± 0.035


$V_2\{\Psi_2\}$
$V_2/\sqrt{<\epsilon_2^2>}$
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
0.0 - 3.0 GeV/c
0.3 - 3.0 GeV/c


$V_3\{\Psi_3\}$
$V_3/\sqrt{<\epsilon_3^2>}$
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
0.0 - 3.0 GeV/c
0.3 - 3.0 GeV/c


$V_4\{\Psi_4\}$
$V_4/\sqrt{<\epsilon_4^2>}$
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
0.0 - 3.0 GeV/c
0.3 - 3.0 GeV/c


$V_5\{\Psi_5\}$
$V_5/\sqrt{<\epsilon_5^2>}$
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
10
20
30
40
50
60
70
80
90
100
Centrality
0.0 - 3.0 GeV/c
0.3 - 3.0 GeV/c

Планы:

1) Переход

$$V_n / \varepsilon vs.Centrality \Rightarrow V_n / \varepsilon vs.1/SdN/dy$$

2) Извлечение вязкости