Exploration of Asymmetry

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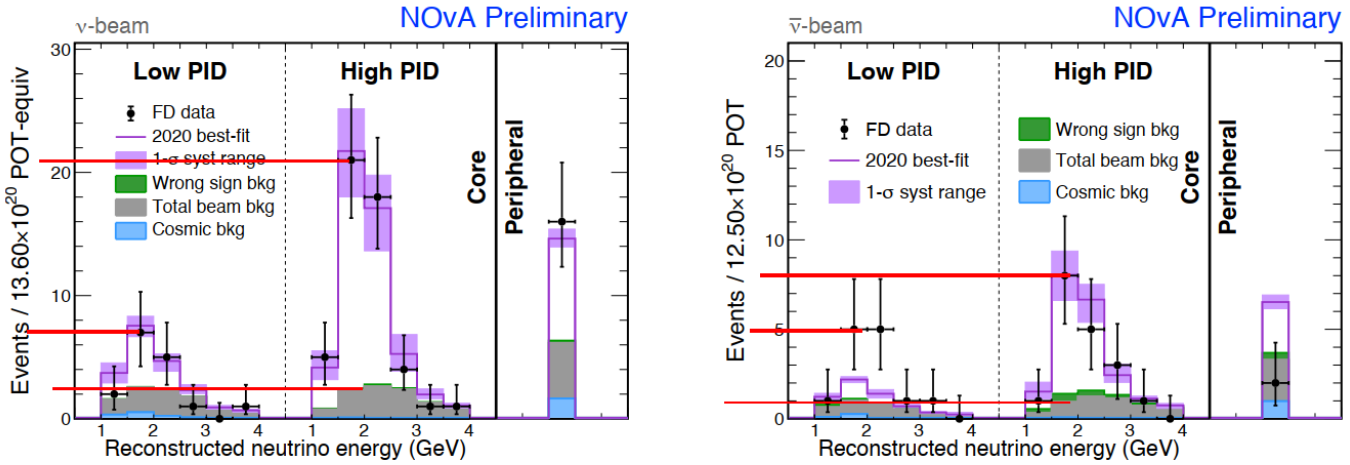
Corrections of Step 4

From P4 of Acp.pdf:

Numerator input



Measured real data "signal"

We can find:

$$\begin{cases} n_{\nu\_obs} = 21+7 = 28 \\ n_{\bar{\nu}\_obs} = 8+\boxed{5} = 13 \end{cases}, \quad \begin{cases} n_{\nu\_bkg} = 2.5+2.5 = \boxed{5} \\ n_{\bar{\nu}\_bkg} = 1.25+1.25 = \boxed{2.5} \end{cases}, \quad \begin{cases} n_{\nu\_pred} = 470 \\ n_{\bar{\nu}\_pred} = 180 \end{cases}$$

$$n_\nu + n_{\nu\_bkg} + n_{\bar{\nu}} + n_{\bar{\nu}\_bkg} = n_{\nu\_obs} + n_{\bar{\nu}\_obs} = n_{total} = 41$$

$$\Rightarrow \boxed{n_\nu + n_{\bar{\nu}} = 41 - 7.5 = 33.5}$$

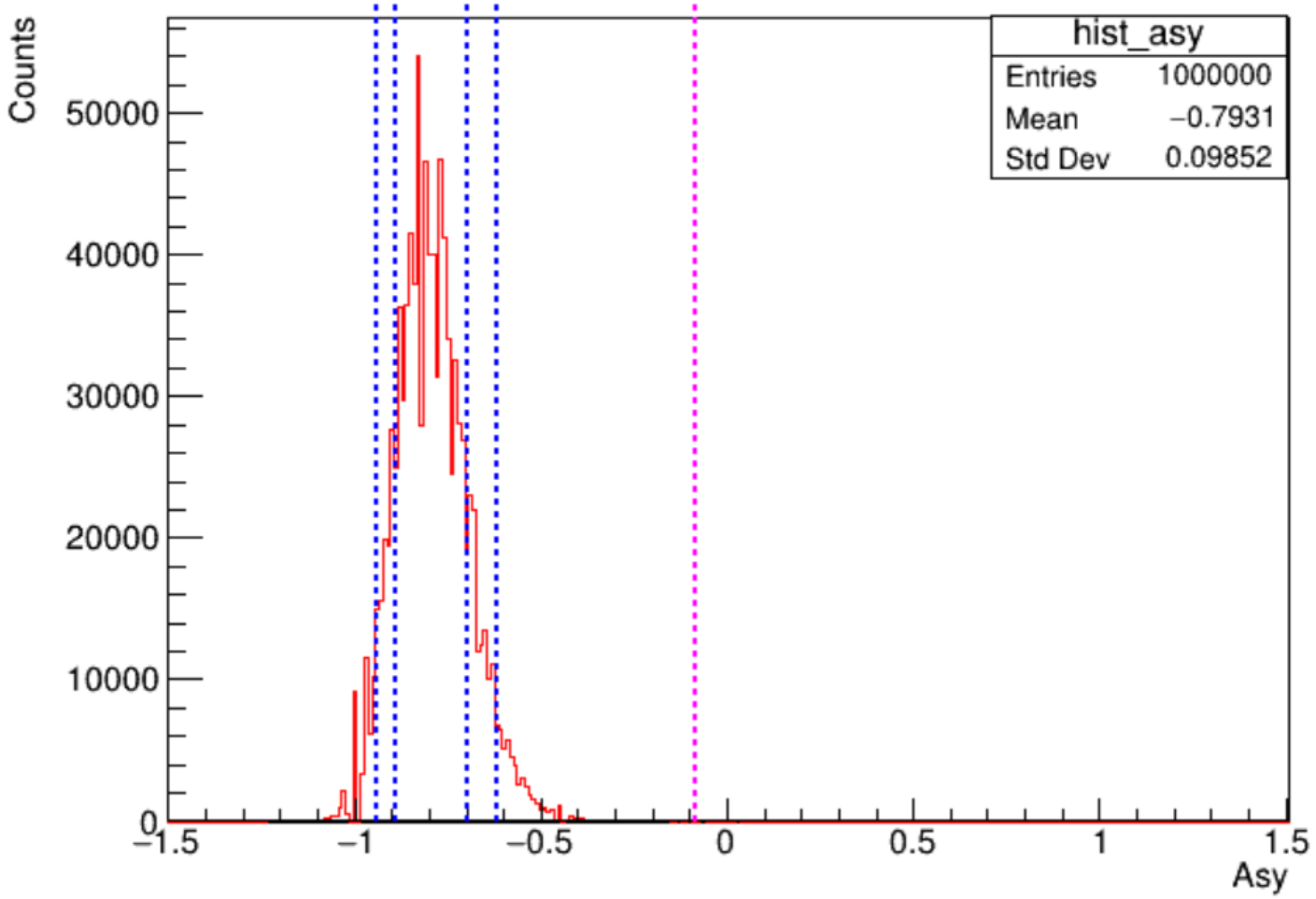
Formulas:

$$Asy = \frac{\frac{n_\nu}{n_{\nu\_pred}} - \frac{n_{\bar{\nu}}}{n_{\bar{\nu}\_pred}}}{\frac{n_\nu}{n_{\nu\_pred}} + \frac{n_{\bar{\nu}}}{n_{\bar{\nu}\_pred}}}$$

$$\begin{cases} N_\nu \sim \dfrac{\left(n_\nu + n_{\nu\_bkg}\right)^{N_\nu}}{N_\nu!} e^{-\left(n_\nu + n_{\nu\_bkg}\right)} \\ N_{\bar{\nu}} \sim \dfrac{\left(n_{\bar{\nu}} + n_{\bar{\nu}\_bkg}\right)^{N_{\bar{\nu}}}}{N_{\bar{\nu}}!} e^{-\left(n_{\bar{\nu}} + n_{\bar{\nu}\_bkg}\right)} \end{cases}$$

$$Asy_{simu} = \frac{\frac{N_\nu - n_{\nu\_bkg}}{n_{\nu\_pred}} - \frac{N_{\bar{\nu}} - n_{\bar{\nu}\_bkg}}{n_{\bar{\nu}\_pred}}}{\frac{N_\nu - n_{\nu\_bkg}}{n_{\nu\_pred}} + \frac{N_{\bar{\nu}} - n_{\bar{\nu}\_bkg}}{n_{\bar{\nu}\_pred}}}$$

Asy = -0.8



- Width of the bin: 0.01
- Range of x: [-1.505, 1.505]
- Center of bin: integer/100-1.51

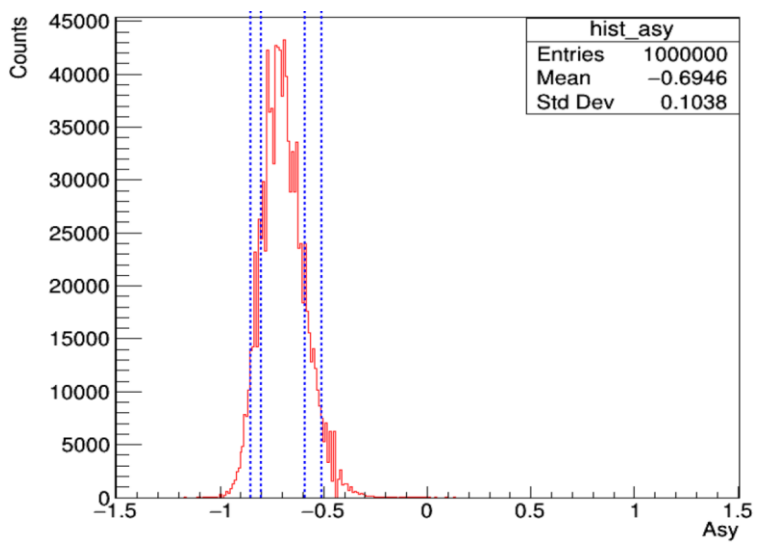
About dashed lines:

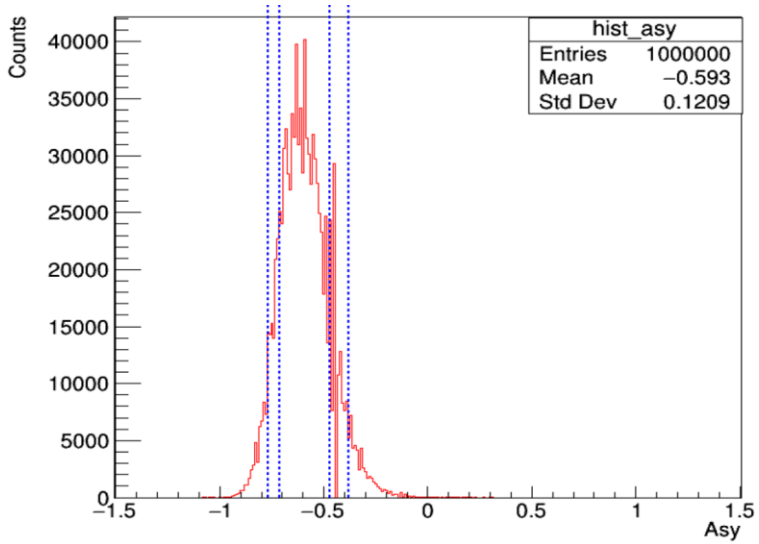
- Blue (From Left to Right):
  5%, 16%, 84%, 95%.
- Purple:
  Asy = -0.087
  (< 10% errors with Real data (0.081))

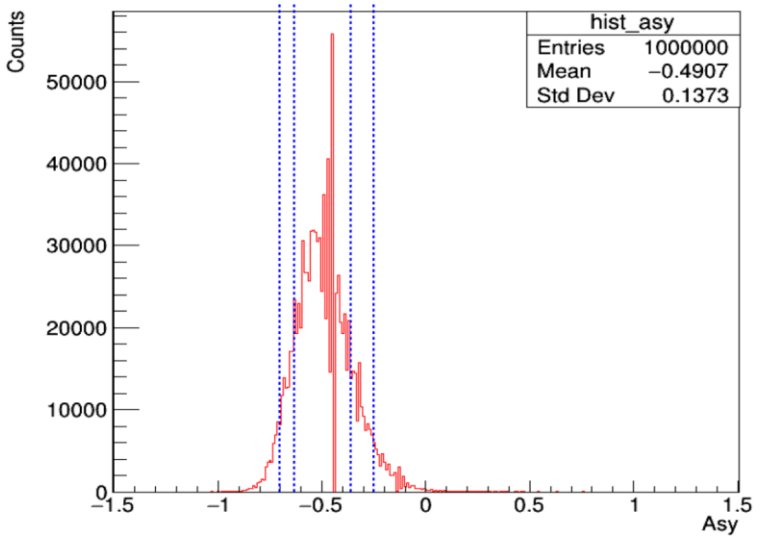
$$\frac{\frac{23}{470}-\frac{10.5}{180}}{\frac{23}{470}+\frac{10.5}{180}} = -0.08760330579$$

Comparisons (1)

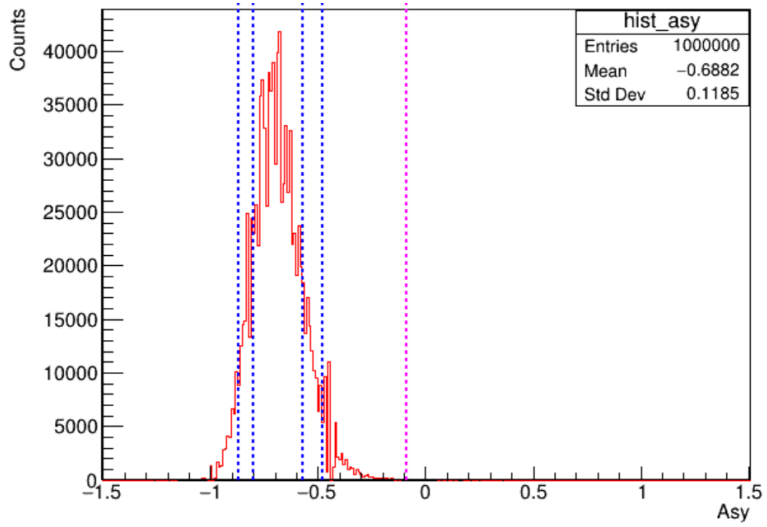
Step 4
Error:

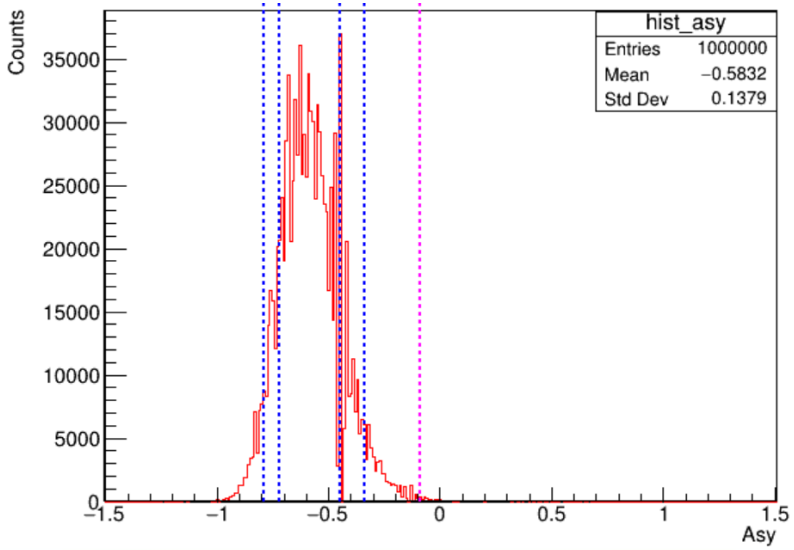


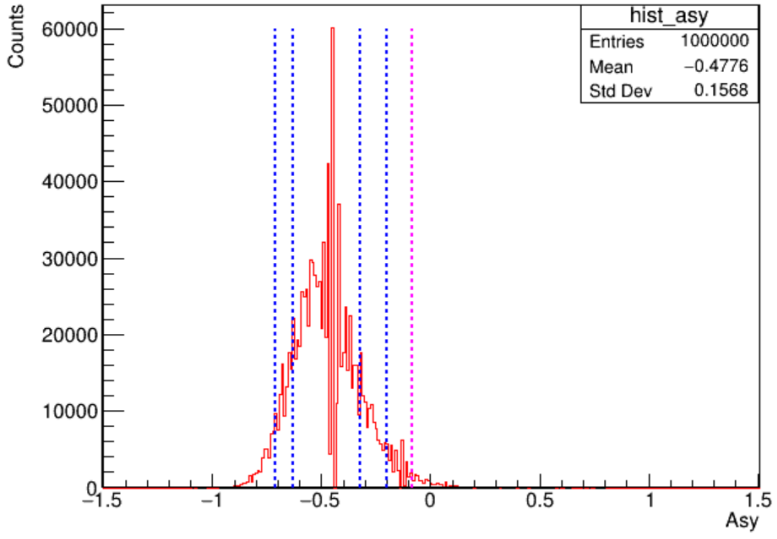




Step 4
Correct:

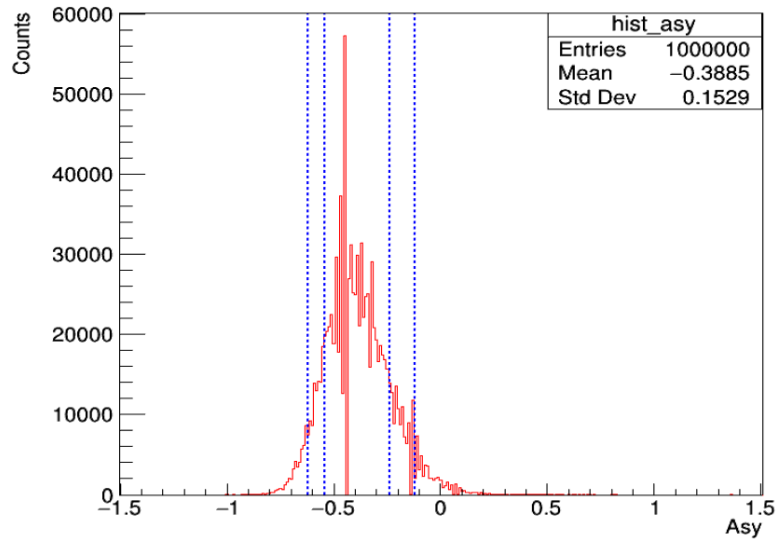


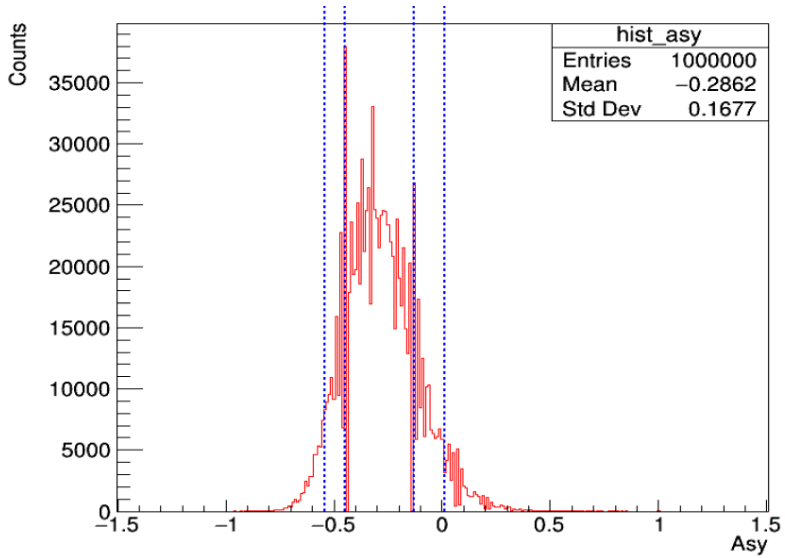


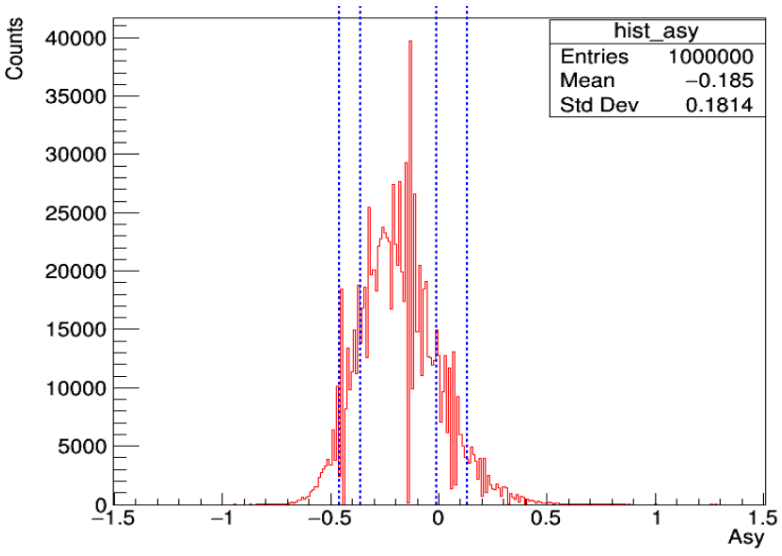


Comparisons (2)

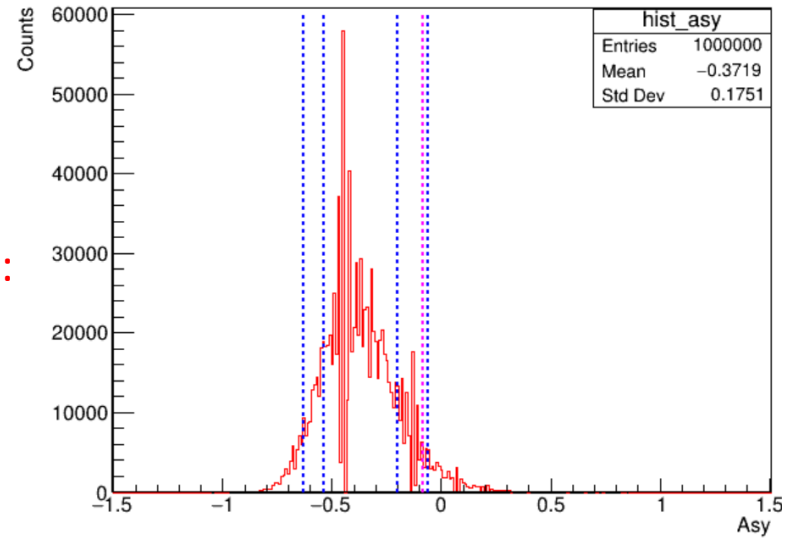
Step 4
Error:

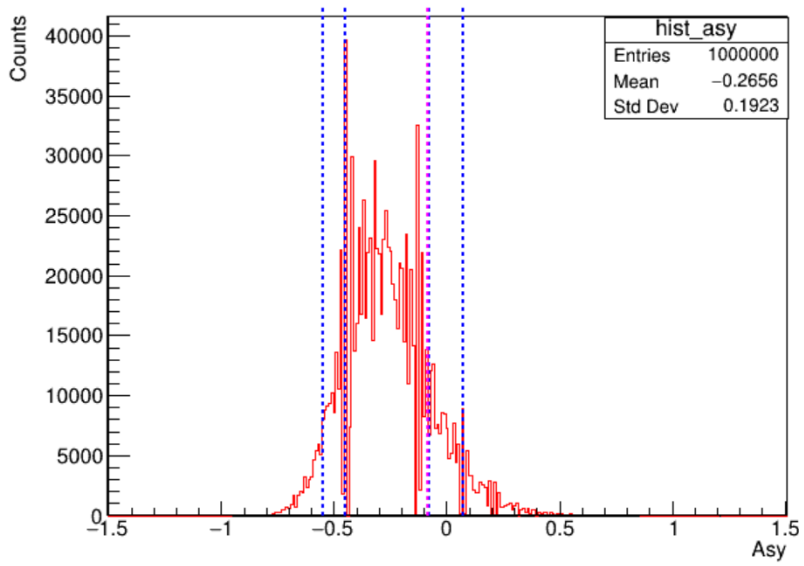


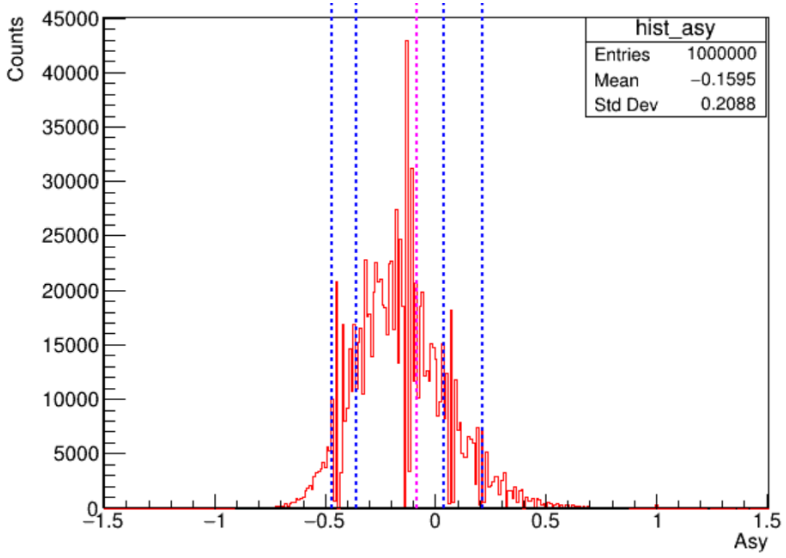




Step 4
Correct:

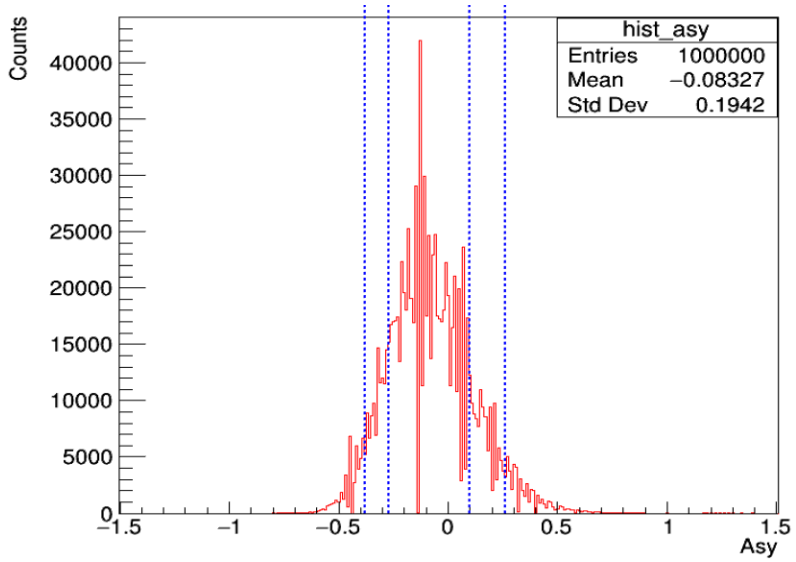




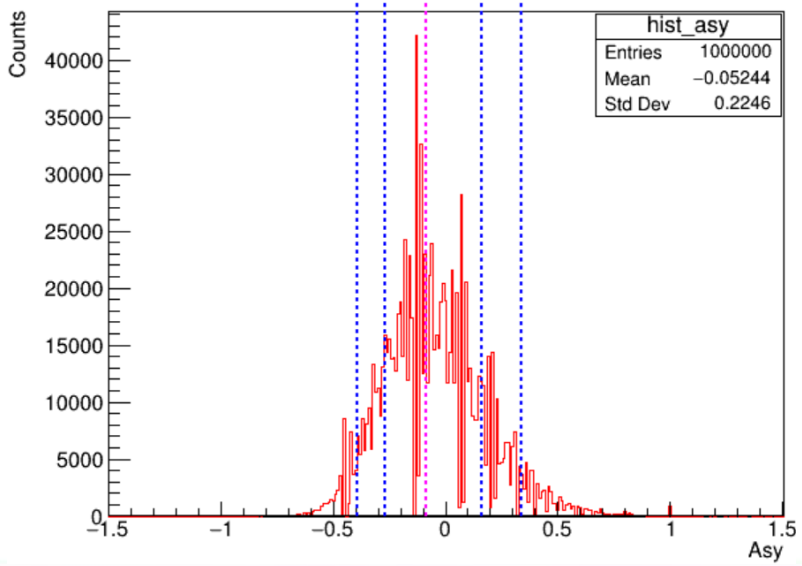


Comparisons (3) – In detail

Step 4
Error



Step 4
Correct

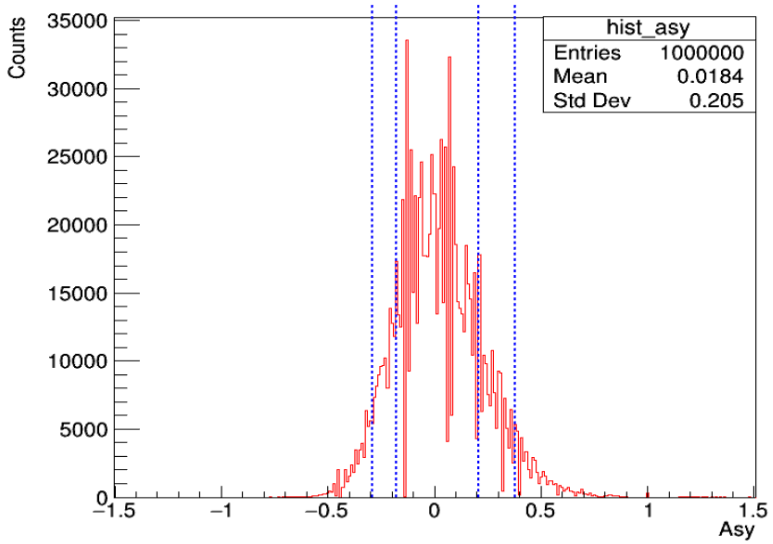


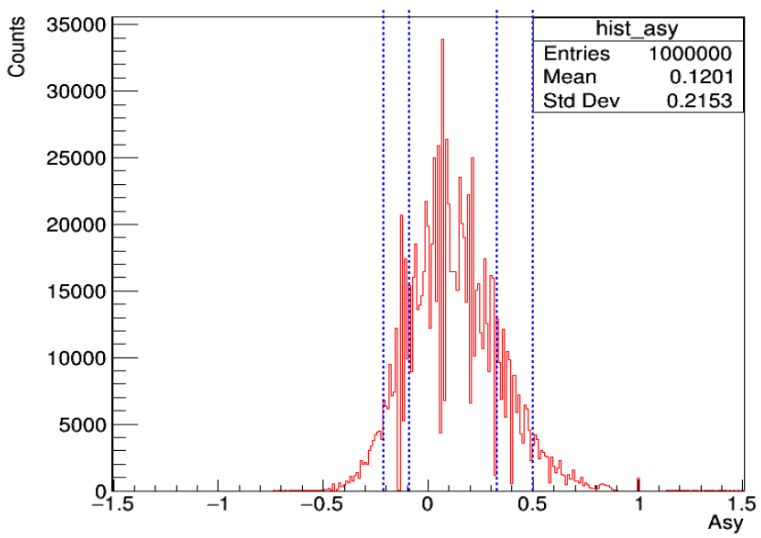
Based on notations in Page 1:

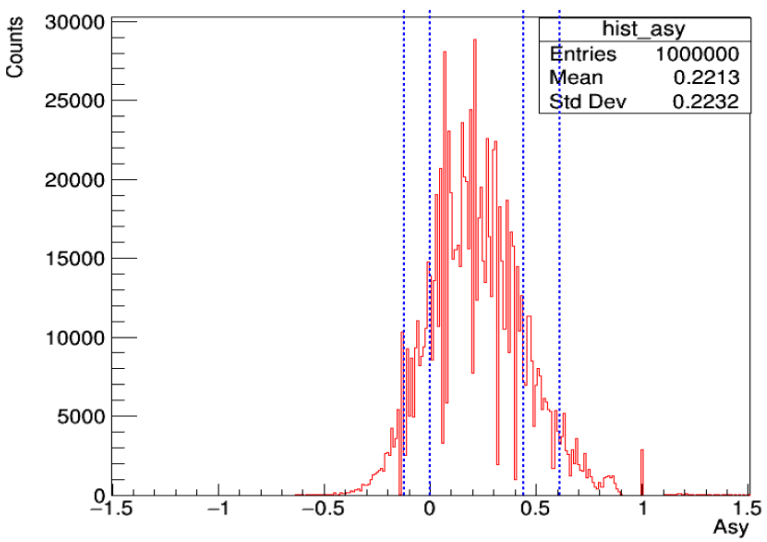
	Step 4 (Error)	Step 4 (Correct)
n_{ν}	25.88	22.82
$n_{\bar{\nu}}$	12.12	10.68
$n_{\nu} + n_{\bar{\nu}}$	38	33.5
n_{ν_bkg}	4	5
$n_{\bar{\nu}\_bkg}$	2	2.5
$Asy_{initial}$	-0.1	-0.1
Asy_{simu}	-0.08	-0.05244

Comparisons (4)

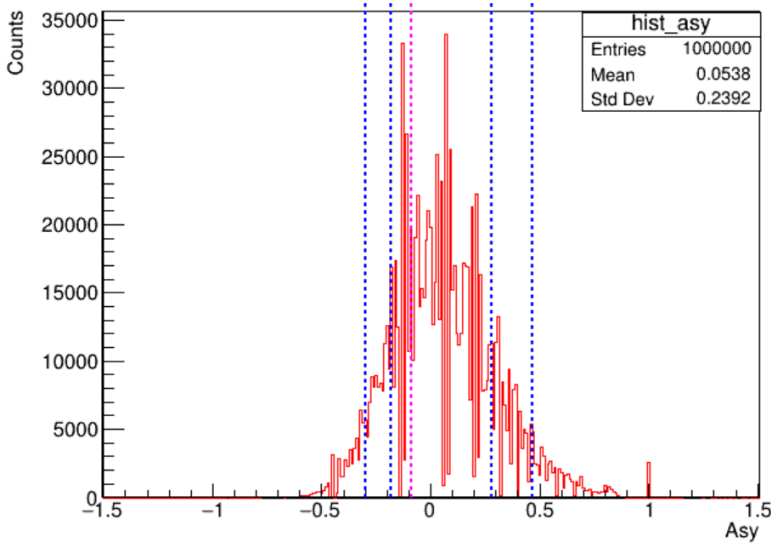
Step 4
Error:

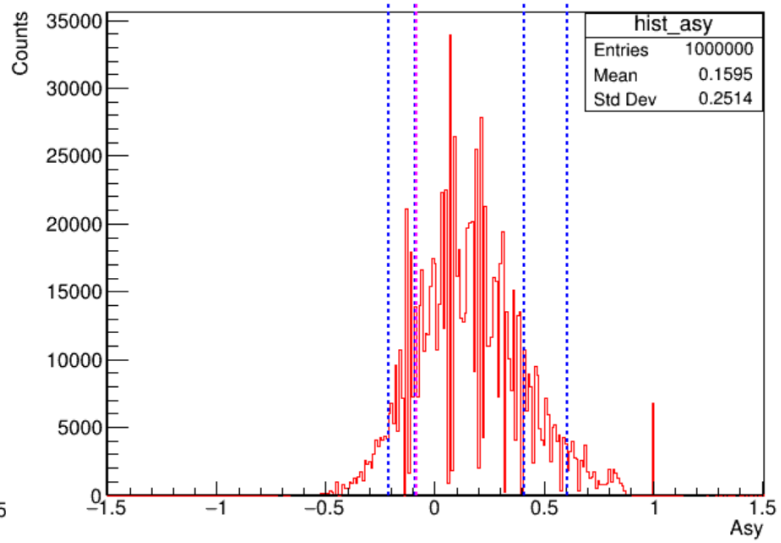


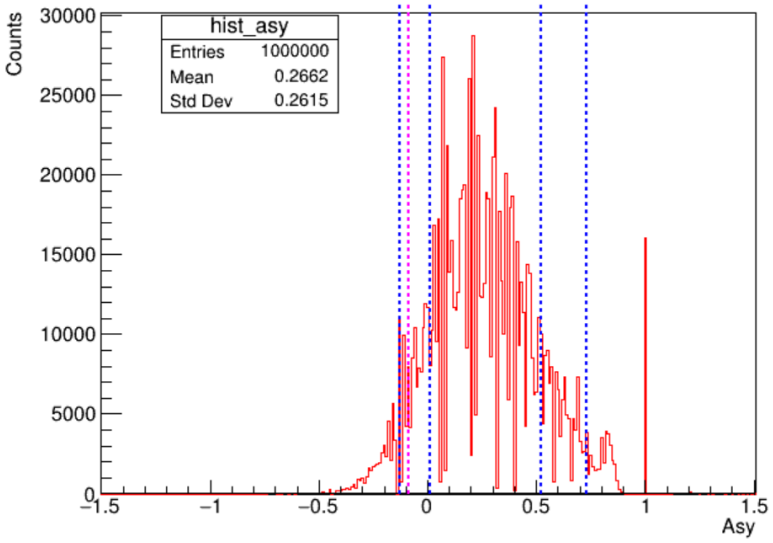




Step 4
Correct:

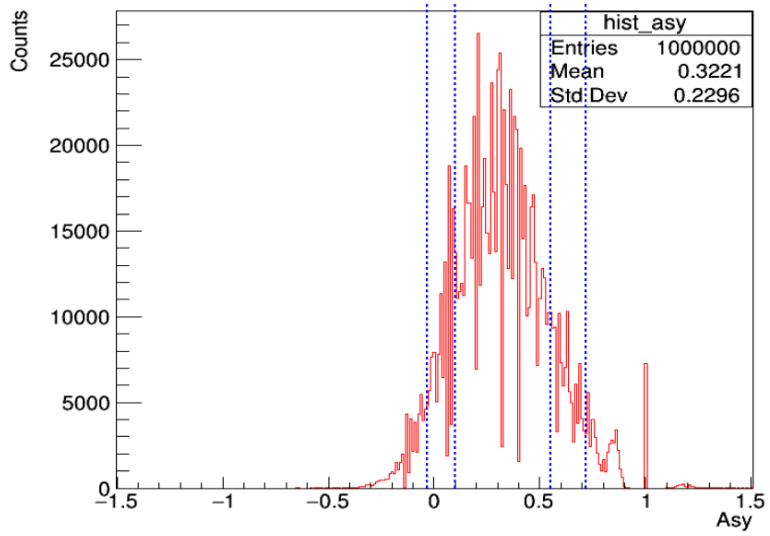


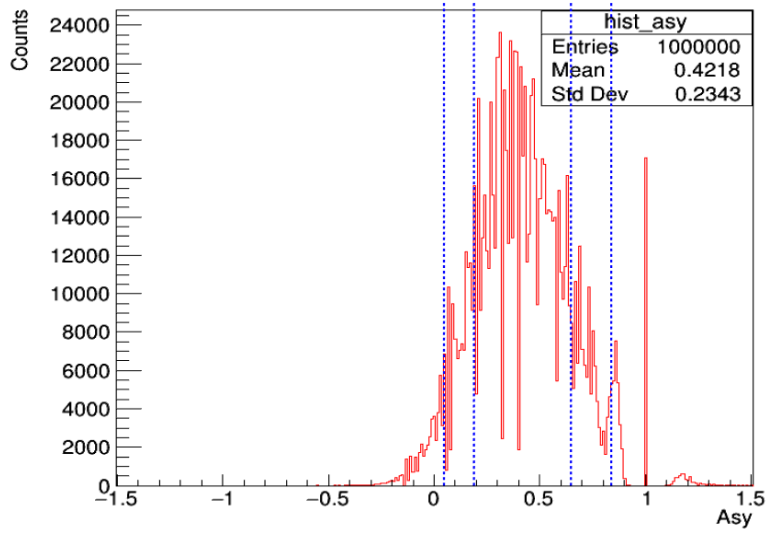


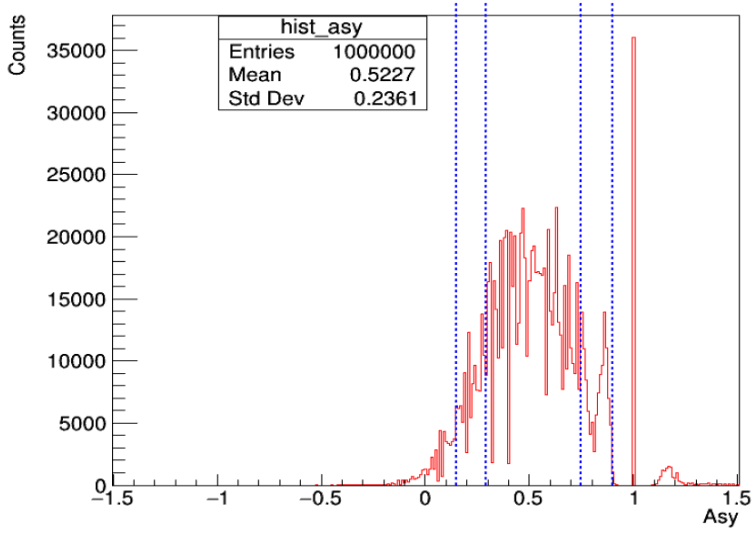


Comparisons (5)

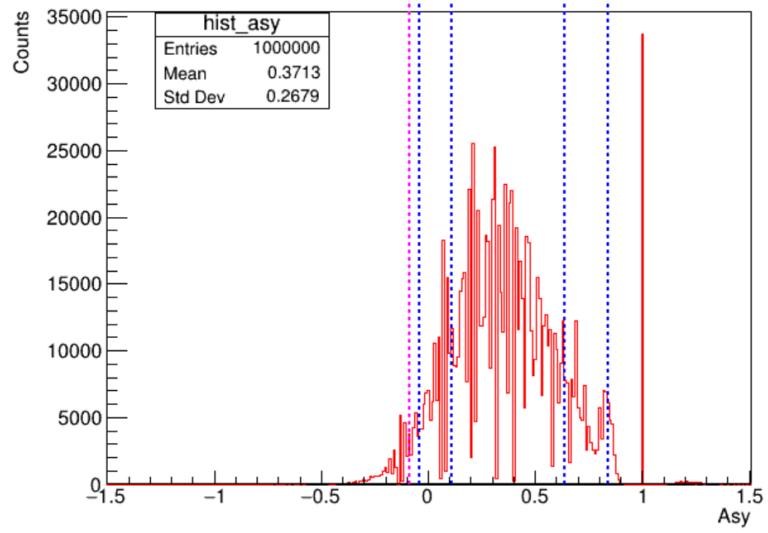
Step 4
Error:

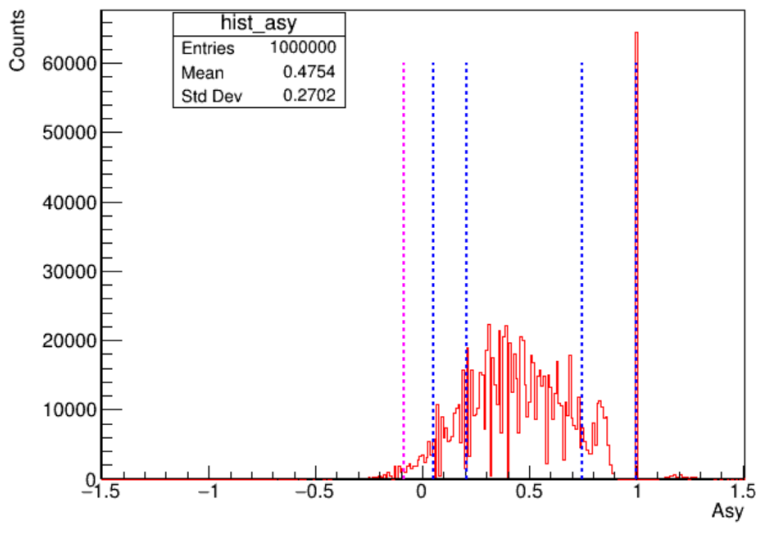


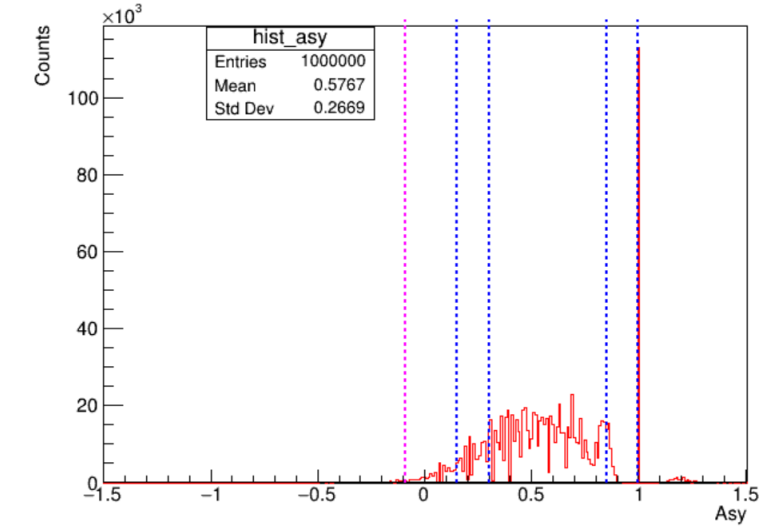




Step 4
Correct:

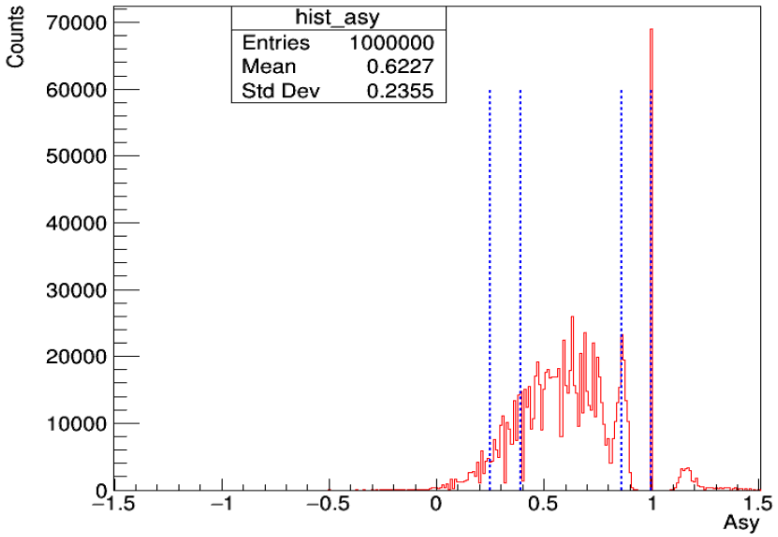


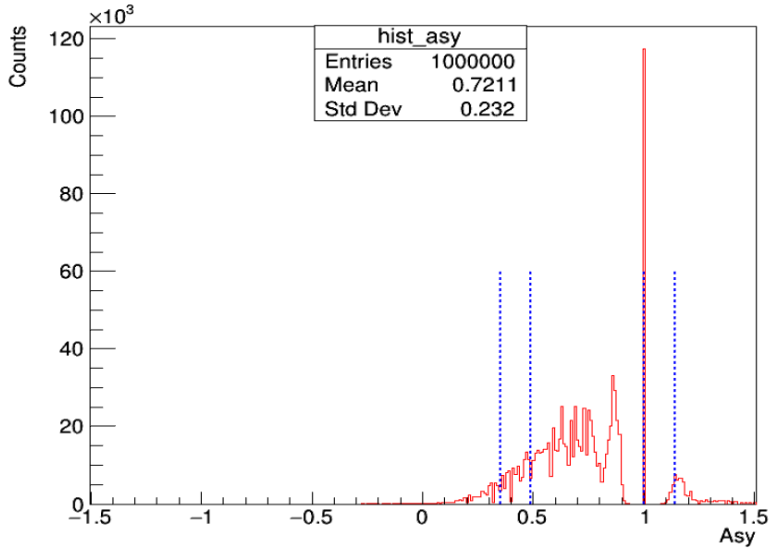


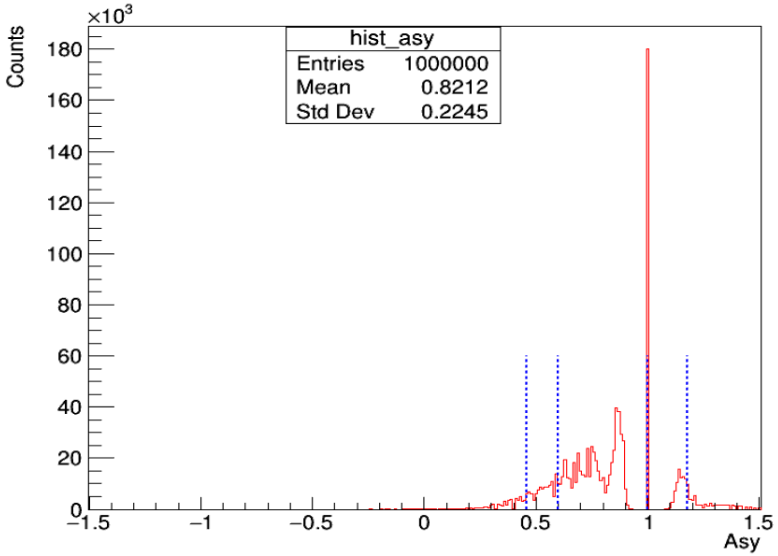


Comparisons (6)

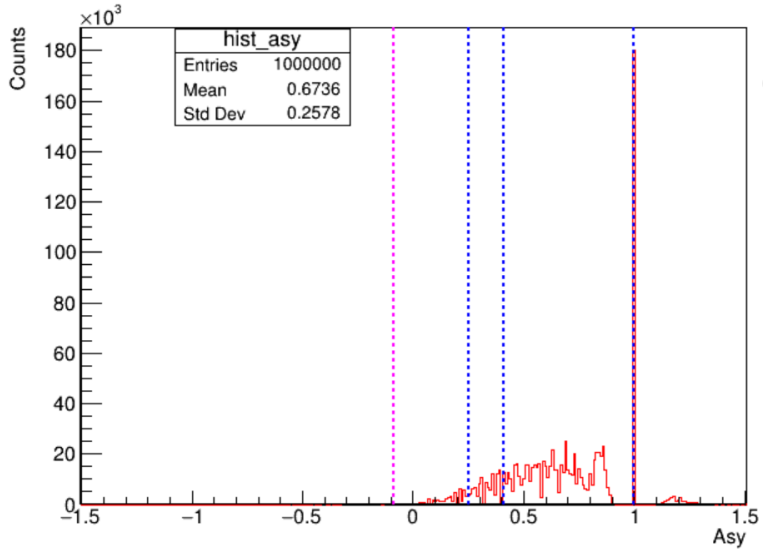
Step 4
Error:

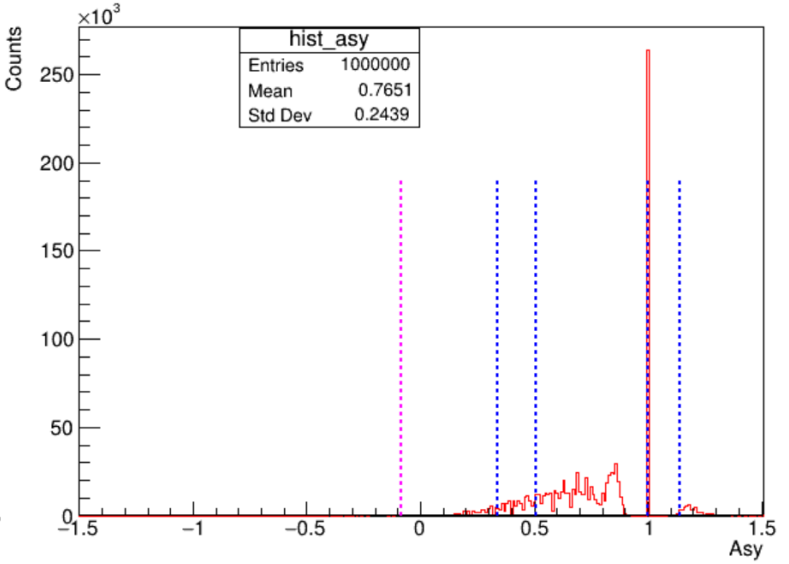


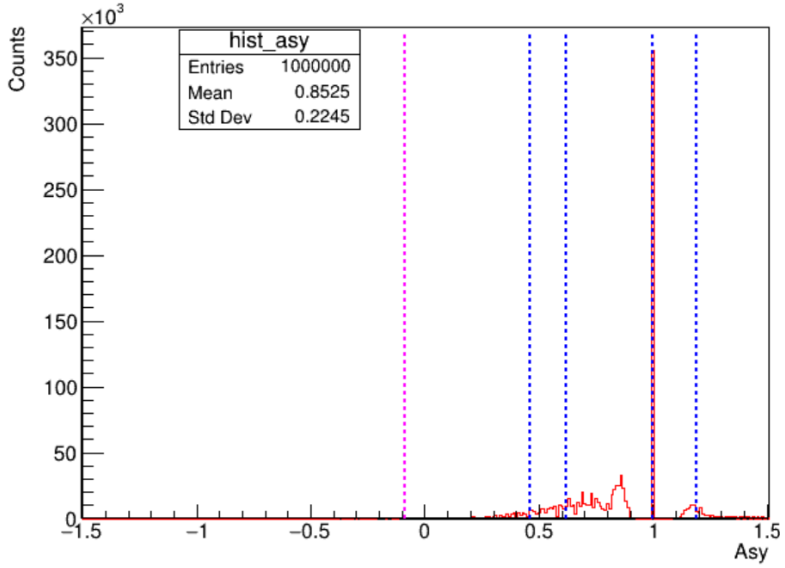




Step 4
Correct:

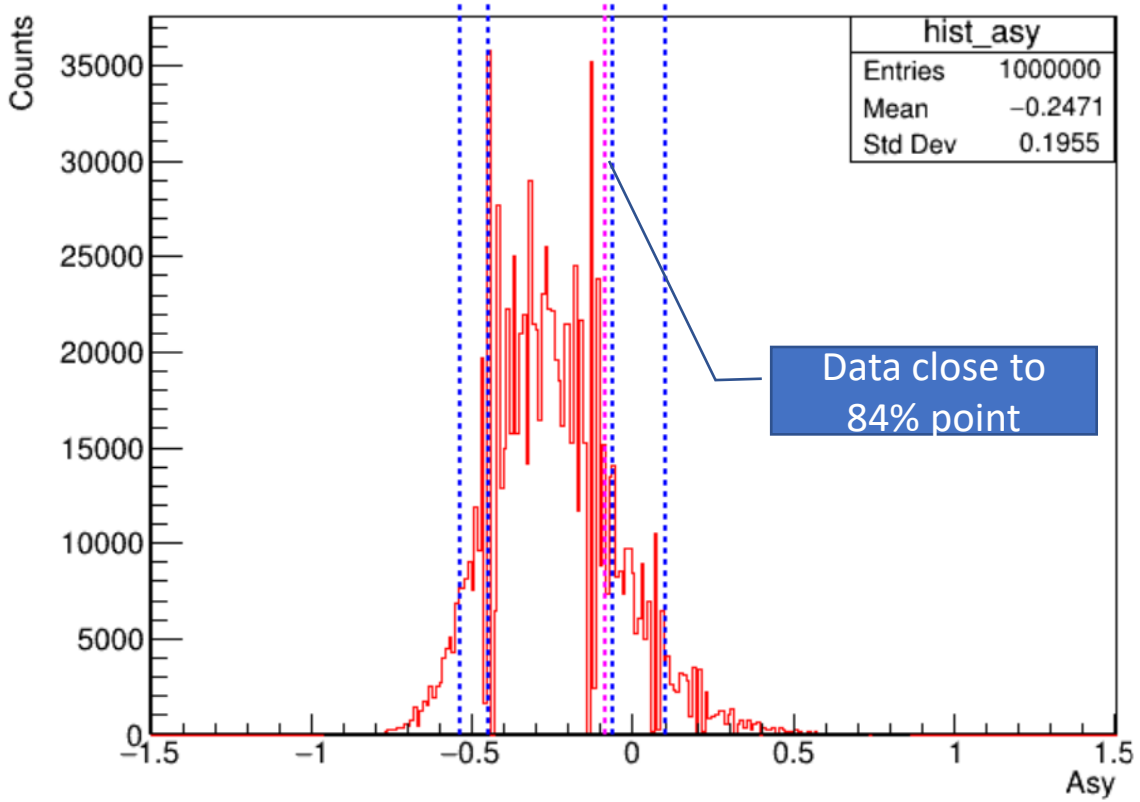






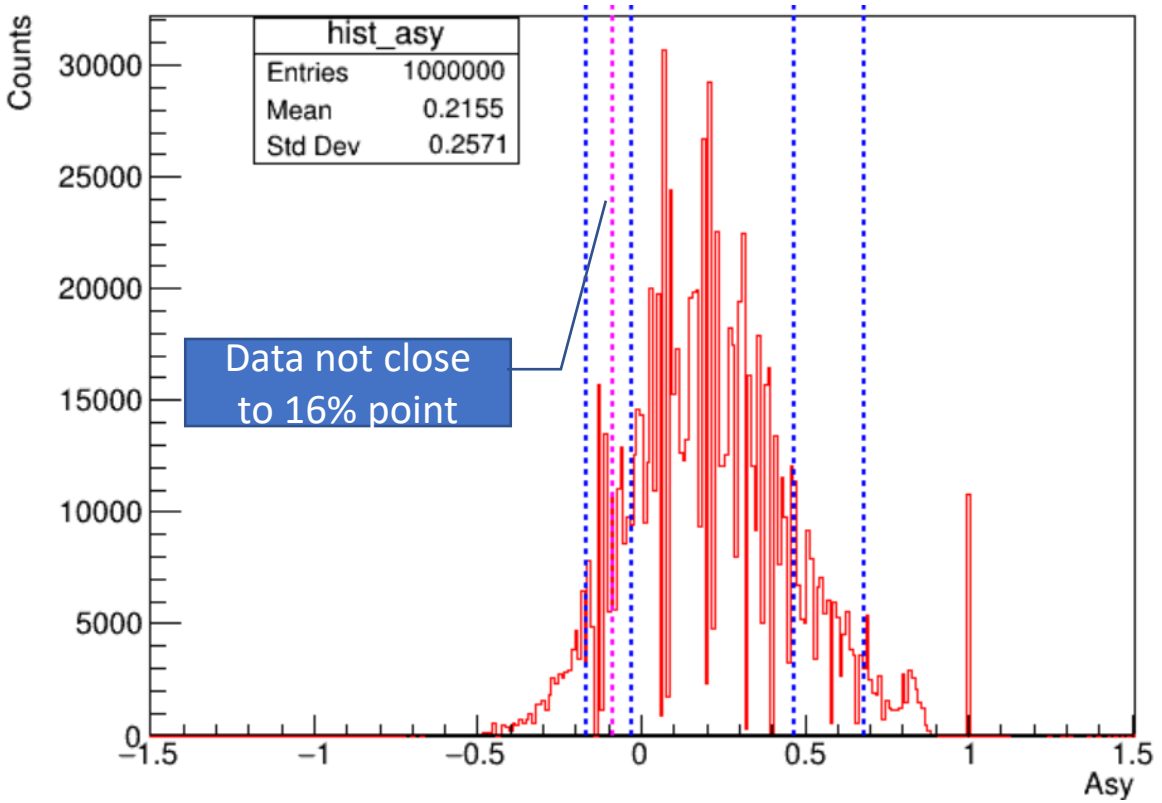
Near 1 σ Range of Data:

Data: -0.081, ±1 σ: [-0.282, +0.152]



For Asy=-0.282:

$n_\nu = 19.89, n_{\bar{\nu}} = 13.61$



For Asy=+0.152:

$n_\nu = 26.13, n_{\bar{\nu}} = 7.37$

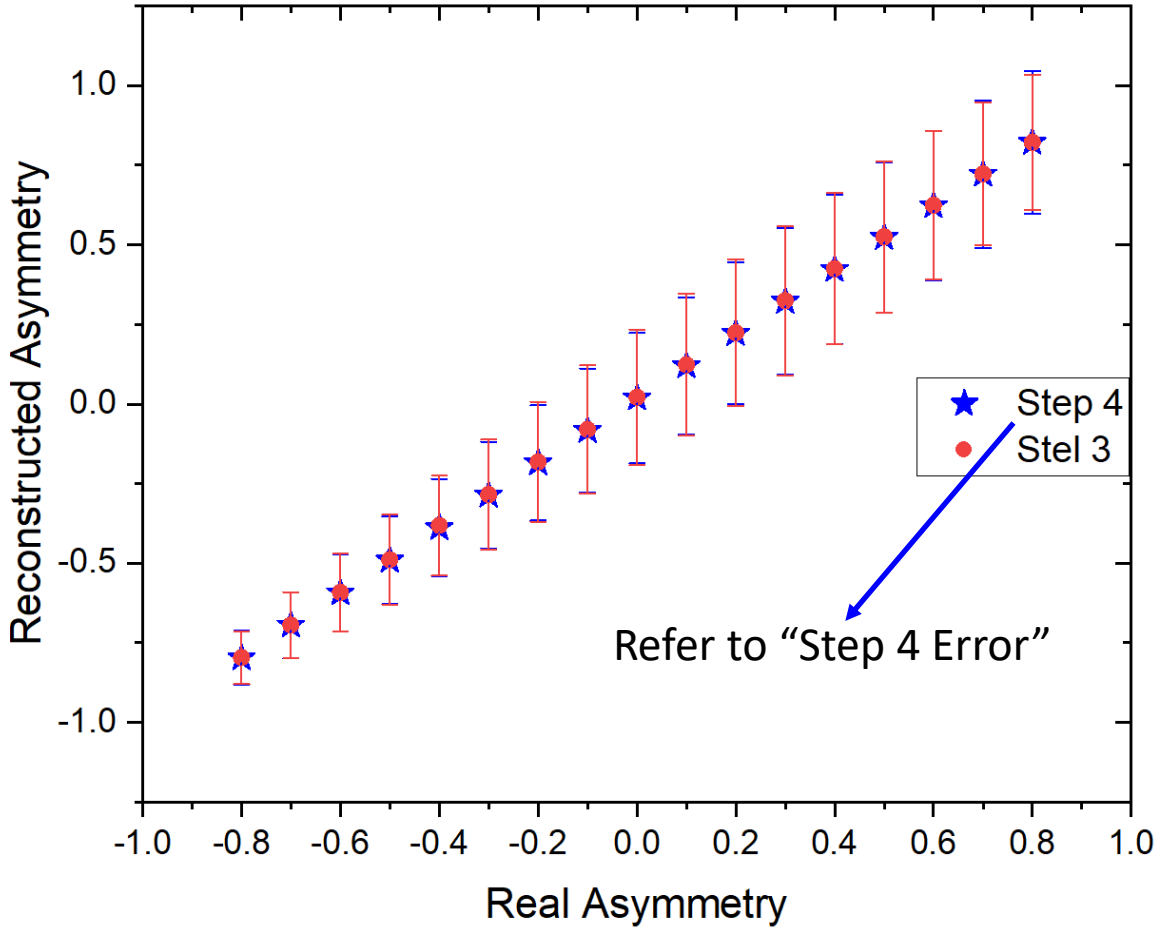
Statistical Results (1)

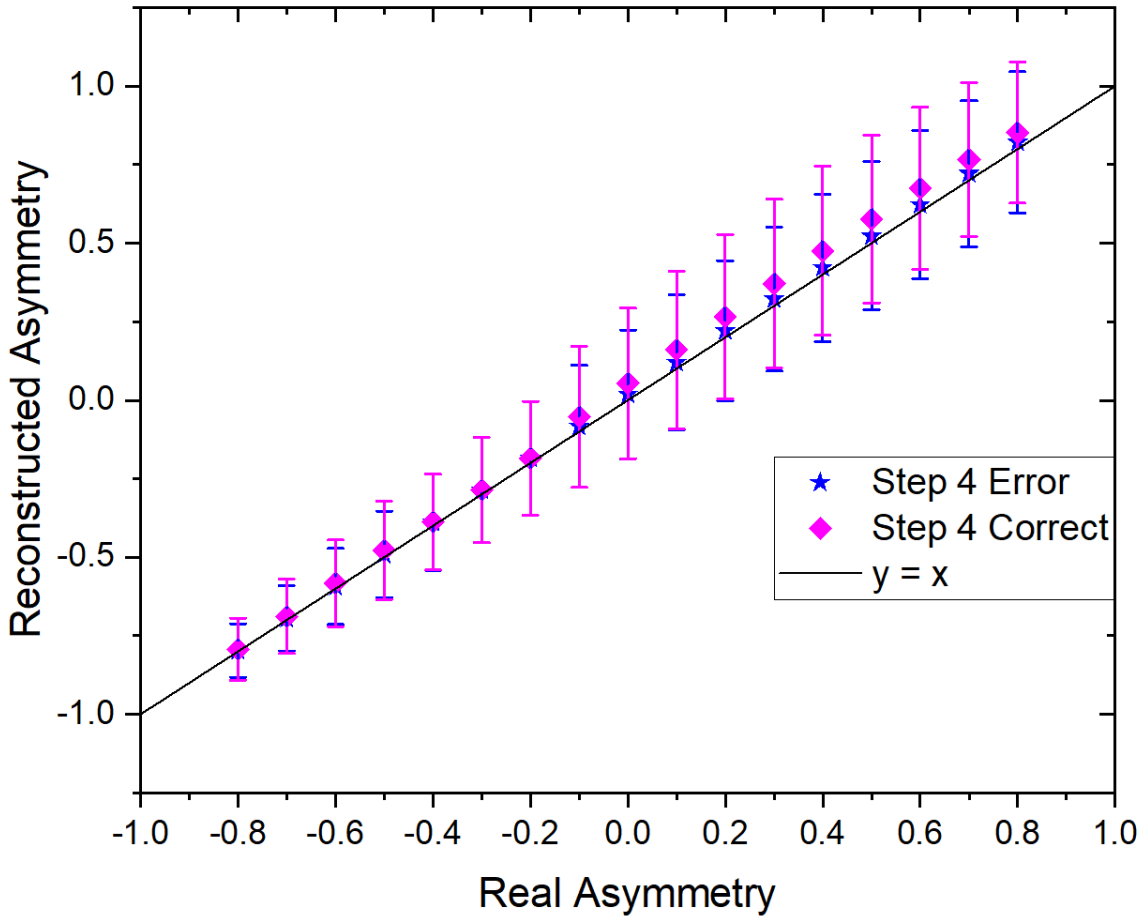
Theoretical (True Value)			Statistical Result of Asy							
Asy	n_ν	$n_{\bar{\nu}}$	mean	median	Std Dev	5%	16%	32%	84%	95%
-0.8	7.54	25.96	-0.793	-0.80	0.09852	-0.94	-0.89	-0.84	-0.70	-0.62
-0.7	10.57	22.93	-0.688	-0.70	0.1185	-0.87	-0.80	-0.75	-0.57	-0.48
-0.6	13.23	20.27	-0.583	-0.59	0.1379	-0.79	-0.72	-0.65	-0.45	-0.34
-0.5	15.59	17.91	-0.478	-0.49	0.1568	-0.71	-0.63	-0.56	-0.32	-0.20
-0.4	17.69	15.81	-0.372	-0.39	0.1751	-0.63	-0.54	-0.47	-0.20	-0.06
-0.3	19.58	13.92	-0.266	-0.28	0.1923	-0.55	-0.45	-0.37	-0.08	0.07
-0.2	21.28	12.22	-0.160	-0.18	0.2088	-0.47	-0.36	-0.27	0.04	0.21
-0.1	22.82	10.68	-0.0524	-0.07	0.2246	-0.39	-0.27	-0.17	0.16	0.34

Statistical Results (2)

Theoretical (True Value)			Statistical Result of Asy							
Asy	n_ν	$n_{\bar{\nu}}$	mean	median	Std Dev	5%	16%	32%	84%	95%
0	24.22	9.28	0.0538	0.03	0.2392	-0.30	-0.18	-0.07	0.28	0.47
0.1	25.50	8	0.160	0.14	0.2514	-0.21	-0.09	0.03	0.41	0.61
0.15	26.10	7.4	0.213	0.19	0.2567	-0.18	-0.04	0.08	0.46	0.67
0.2	26.68	6.82	0.266	0.25	0.2615	-0.13	0.01	0.13	0.52	0.73
0.3	27.76	5.74	0.371	0.35	0.2679	-0.04	0.11	0.23	0.64	0.84
0.4	28.77	4.73	0.475	0.46	0.2702	0.05	0.21	0.34	0.75	1.00
0.5	29.70	3.8	0.577	0.57	0.2669	0.15	0.30	0.44	0.85	1.00
0.6	30.56	2.94	0.674	0.68	0.2578	0.25	0.41	0.54	1.00	1.00
0.7	31.36	2.14	0.765	0.79	0.2439	0.34	0.51	0.65	1.00	1.14
0.8	32.12	1.38	0.853	0.87	0.2245	0.46	0.62	0.75	1.00	1.19

Statistical Results (5)

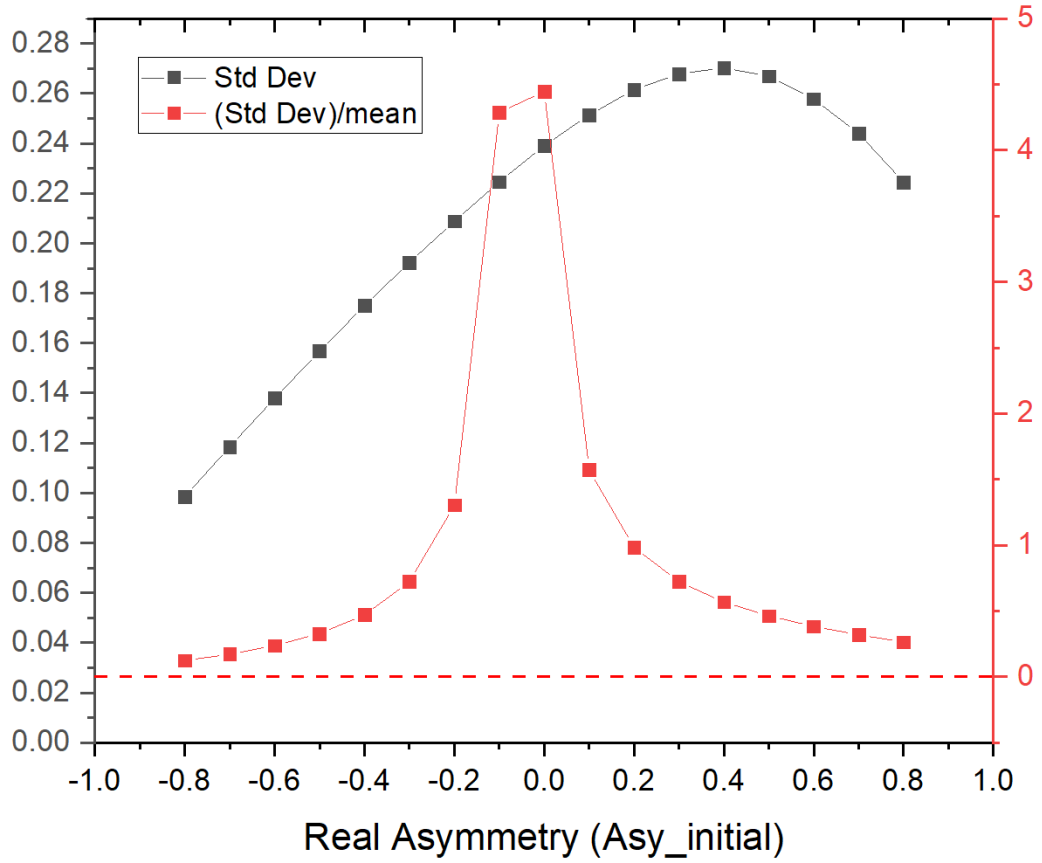




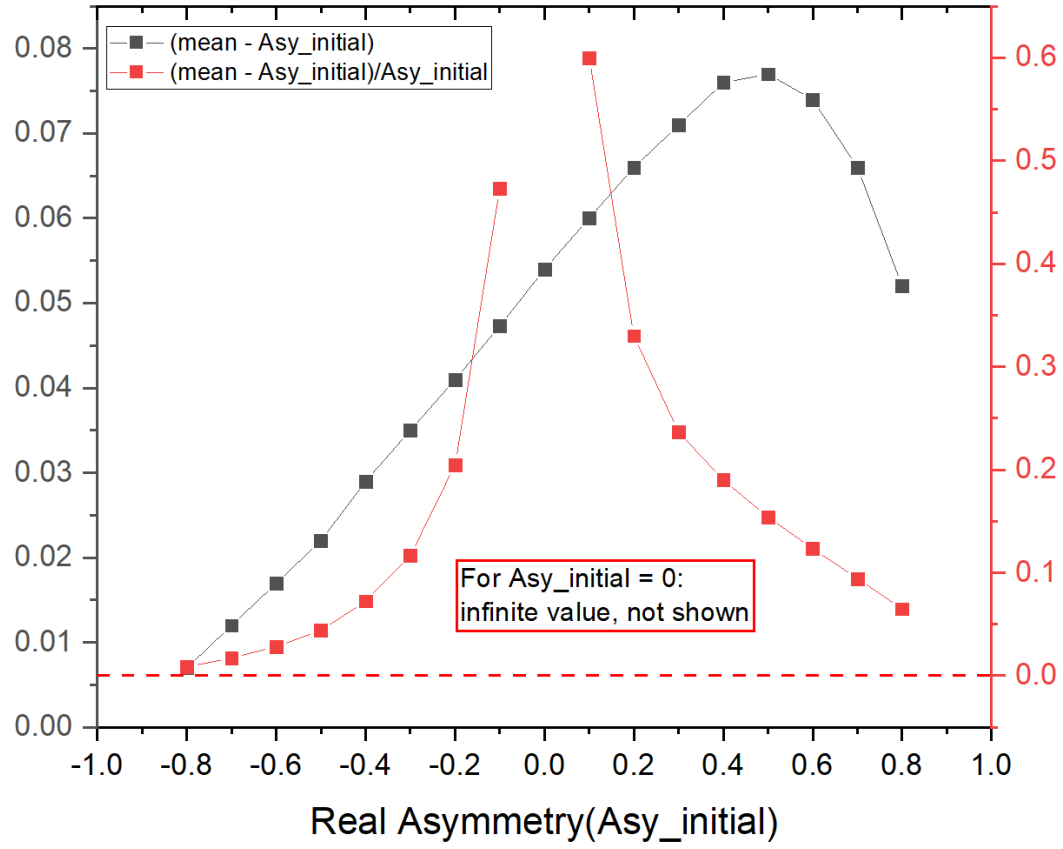
Statistical Results (5)

Fluctuation is important in the region we care (~ -0.1)!

Distribution of Standard Deviation:



Difference between mean and Asy_inital:



Conclusions

-- Initial comparisons with result from Liudmila

Data: Mean value: -0.081; 1 sigma region: [-0.282, +0.152]

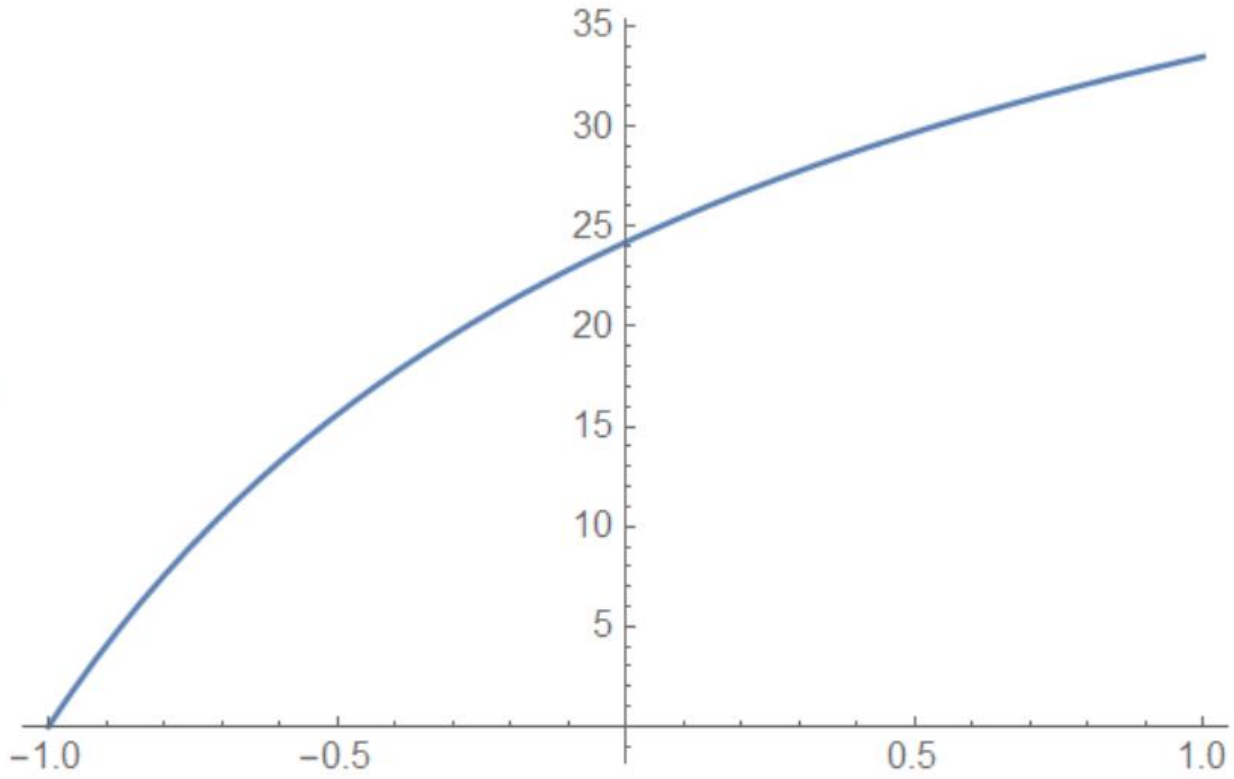
	Liudmila	This simulation
1 sigma region (Frequentist approach)	[-0.4, 0.2]	[-0.3, 0.1] or [-0.3, 0.15]
Consistence between Median and Asy_initial	Bad	Bad

Backup 1:

Calculation of n_v:

In[1]:=
$$\text{Plot}\left[\frac{0.186 * (1 + \text{Asy})}{0.00768 + 0.00343 * \text{Asy}}, \{\text{Asy}, -1, 1\}\right]$$

Out[1]=



Backup