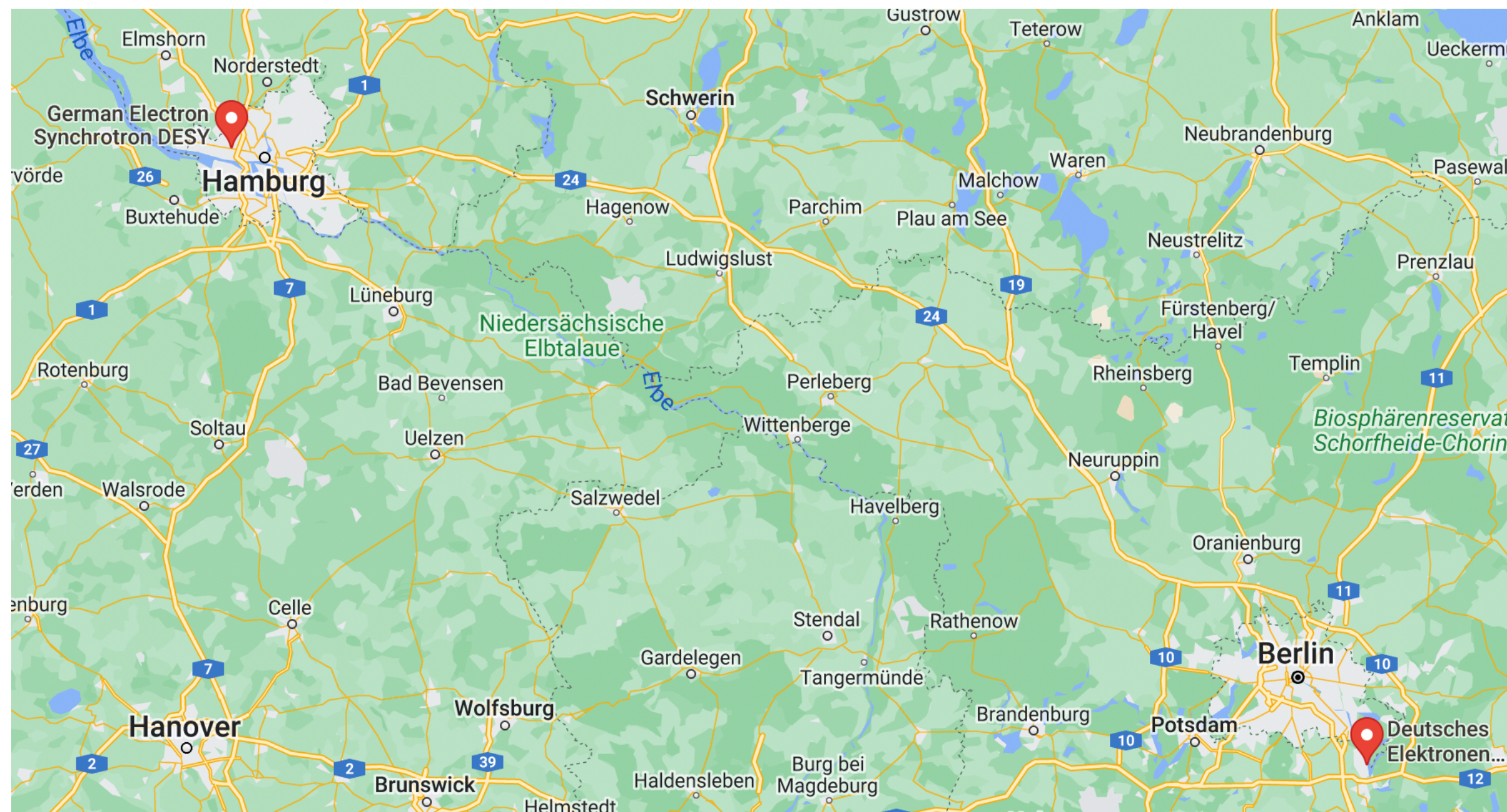


vdM scans ATLAS 2022

ATLAS luminosity team at DESY

ATLAS luminosity team at DESY:

Position	Name	Mail	Main task
Senior	Klaus Mönig	klaus.moenig@desy.de	vdM convener
PhD	Cédrine Hügli	cedrine.huegli@desy.de	vdM scans analyzer
Postdoc	Oliver Majersky	oliver.majersky@desy.de	double gaussian fits, future developments



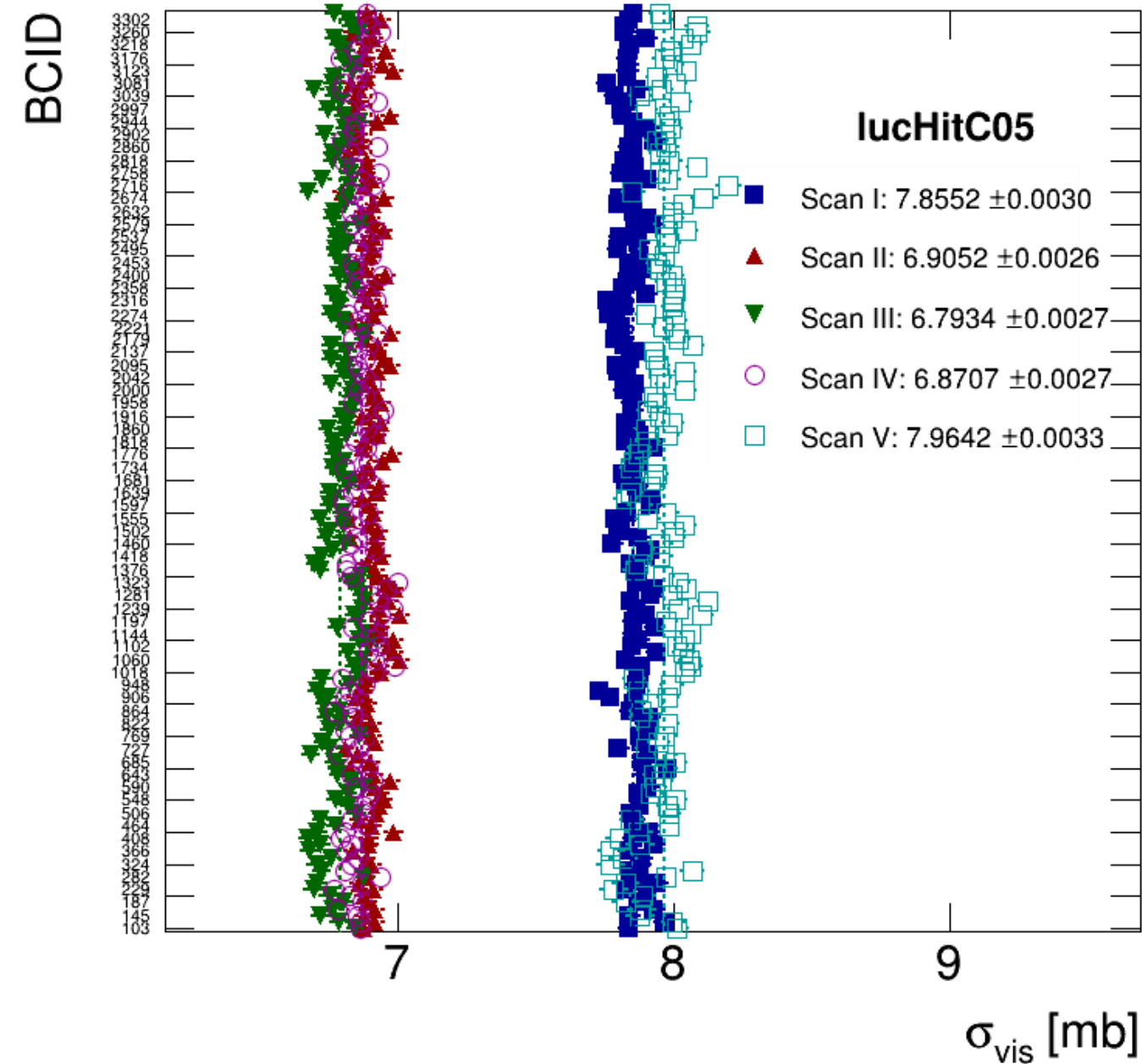
DESY-Zeuthen



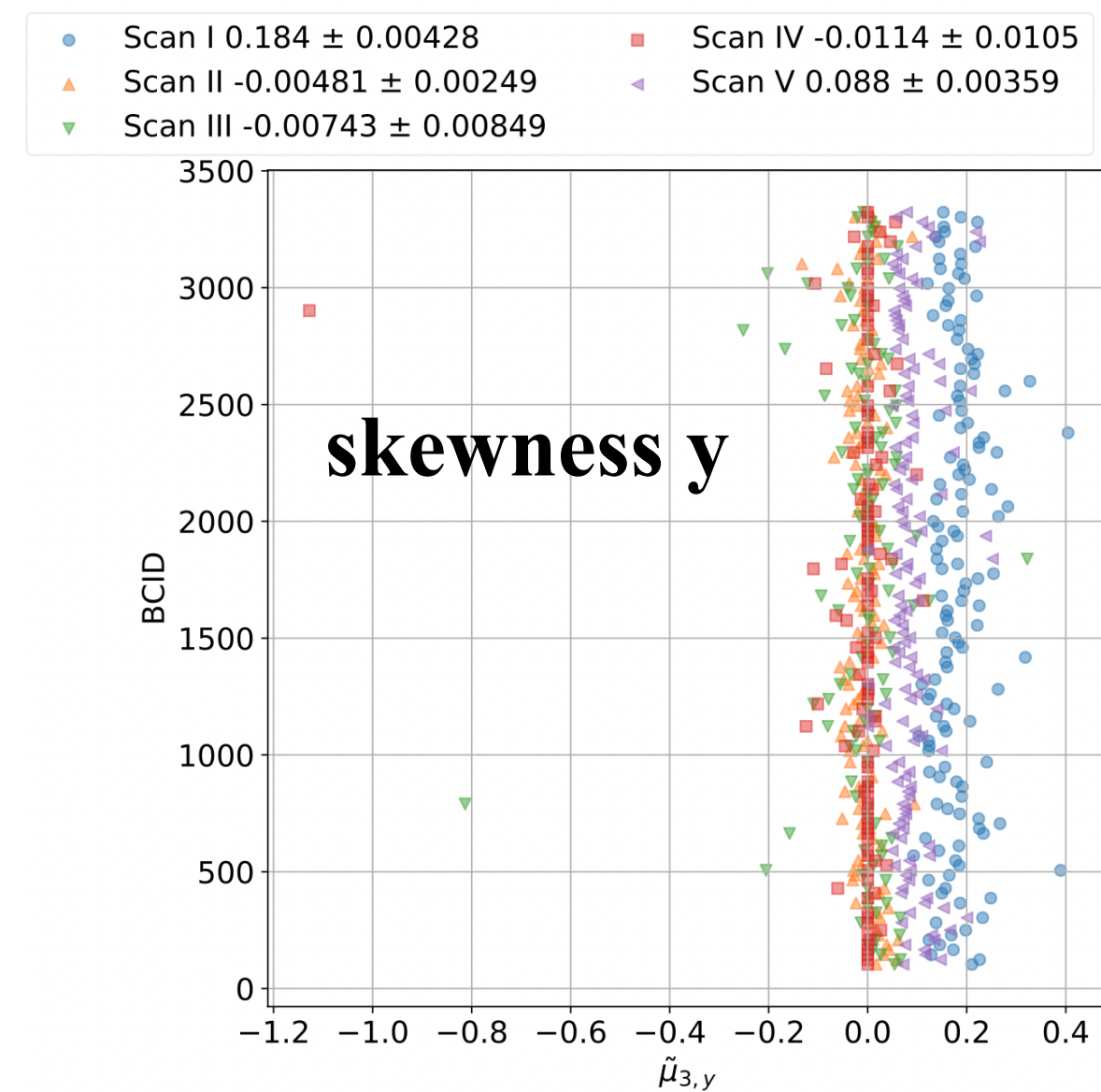
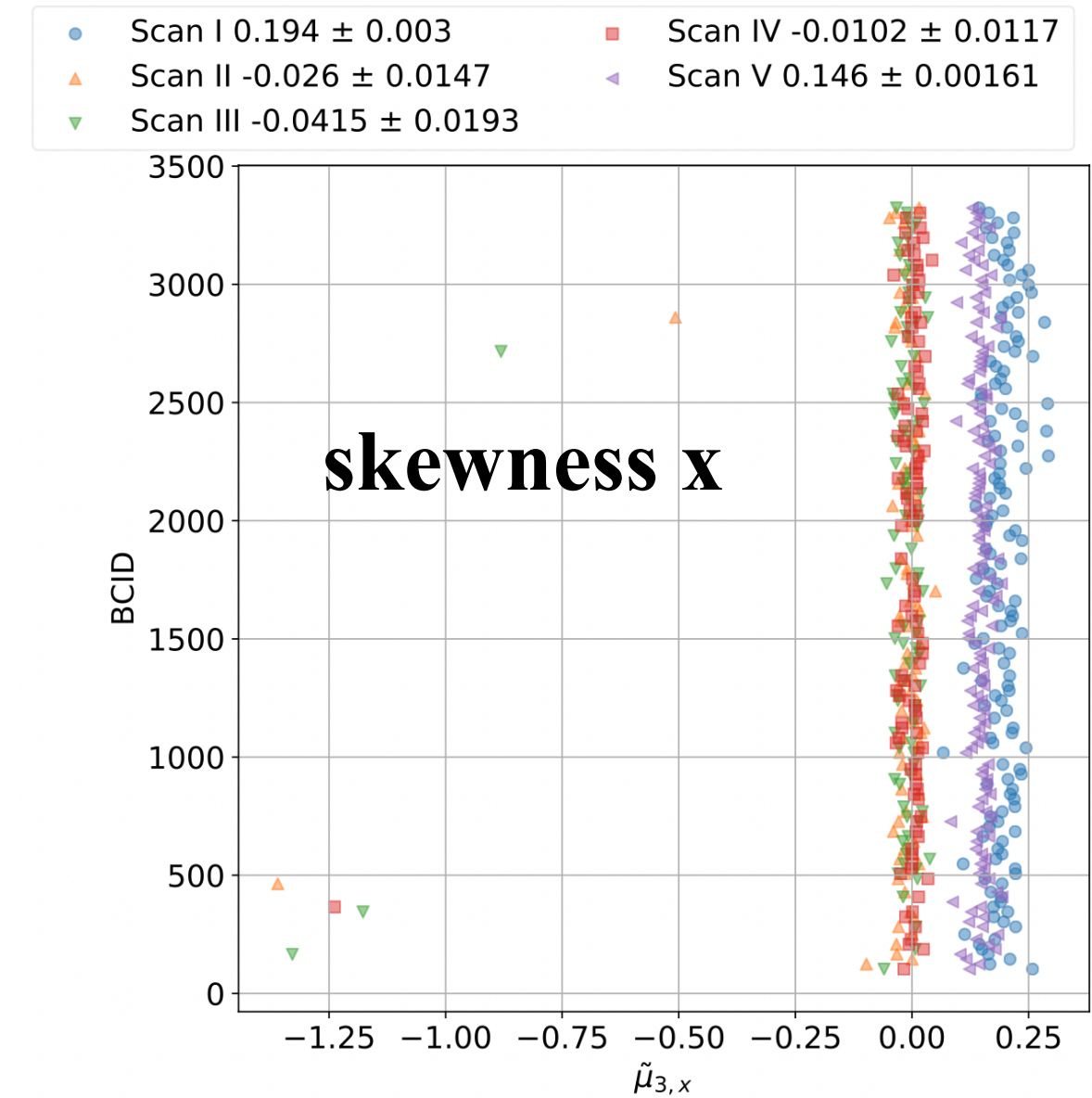
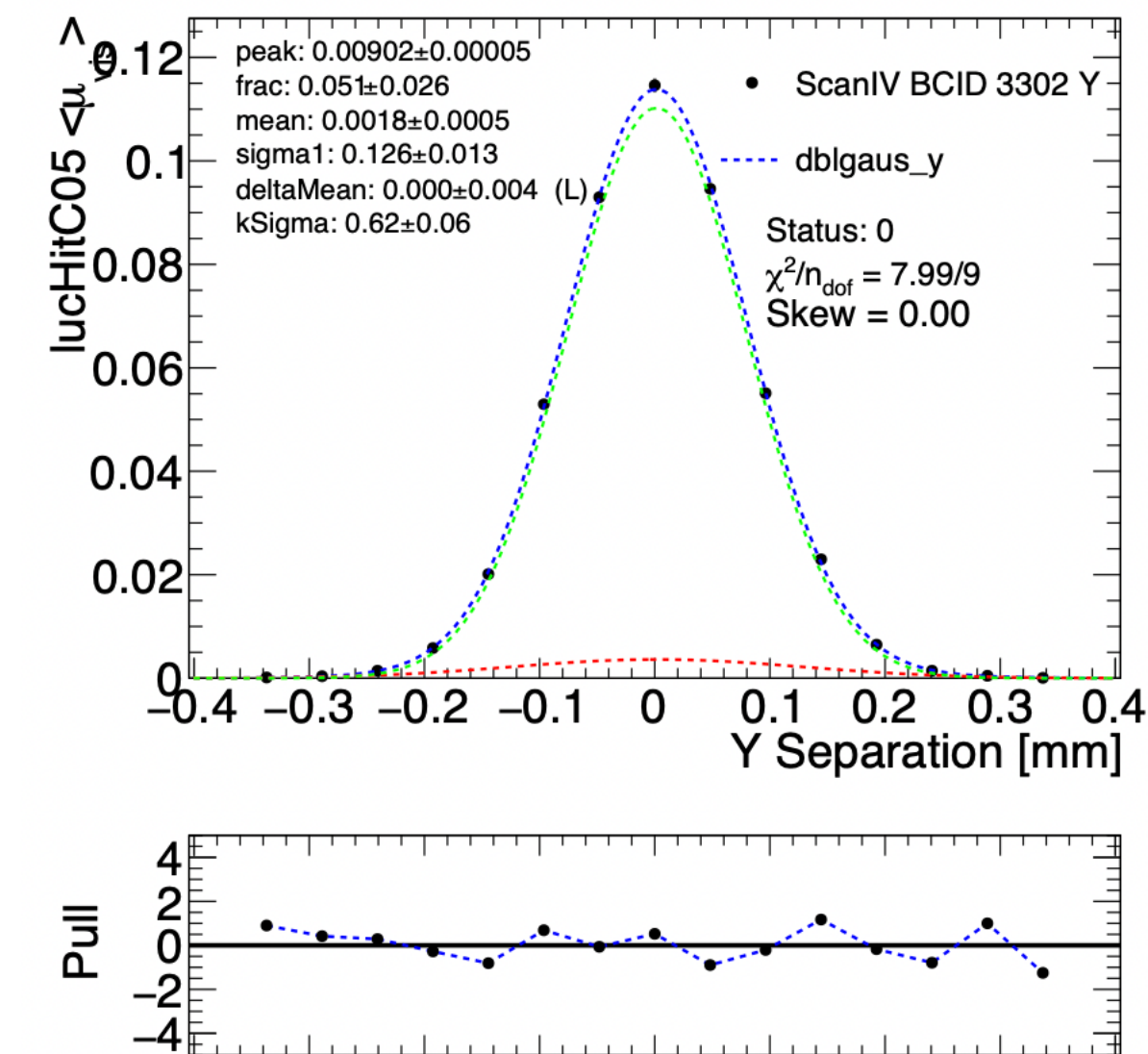
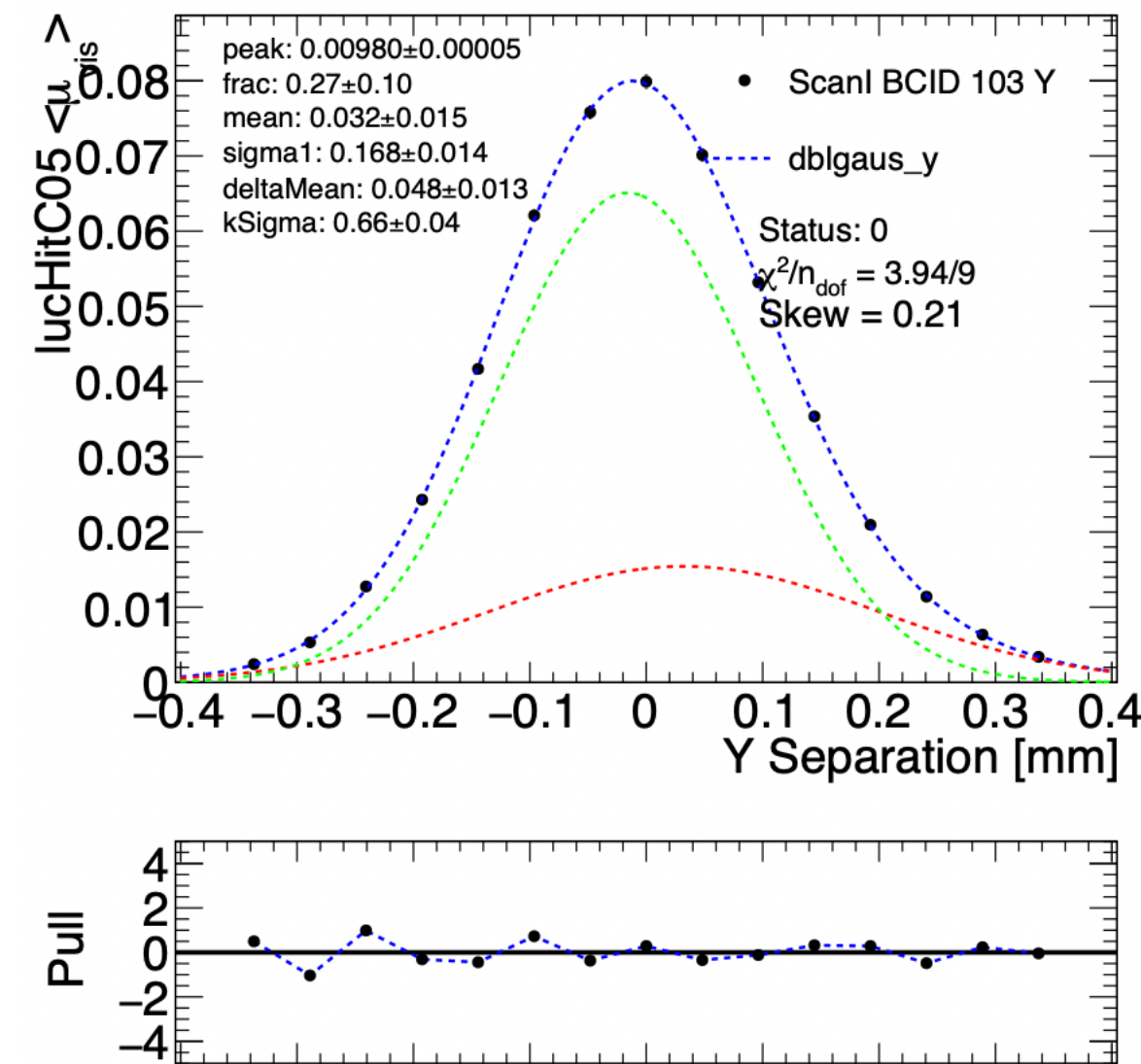
run 3 calibration of luminosity

- The current luminosity calibration is based on the emittance scans in vdM conditions of 31.05.2022
- We have 1 algorithm (PMT) which is kept the same as 2018 to allow comparisons: does not agree well with 2018
- Luminosity differences between ATLAS and CMS $\Rightarrow$ study emittance scans
- Problem with emittance scans: physics conditions
- LHCf scans are close to vdM conditions: we see strange asymmetries in the first and the last scan in the same fill

LHCf scans - strange asymmetries

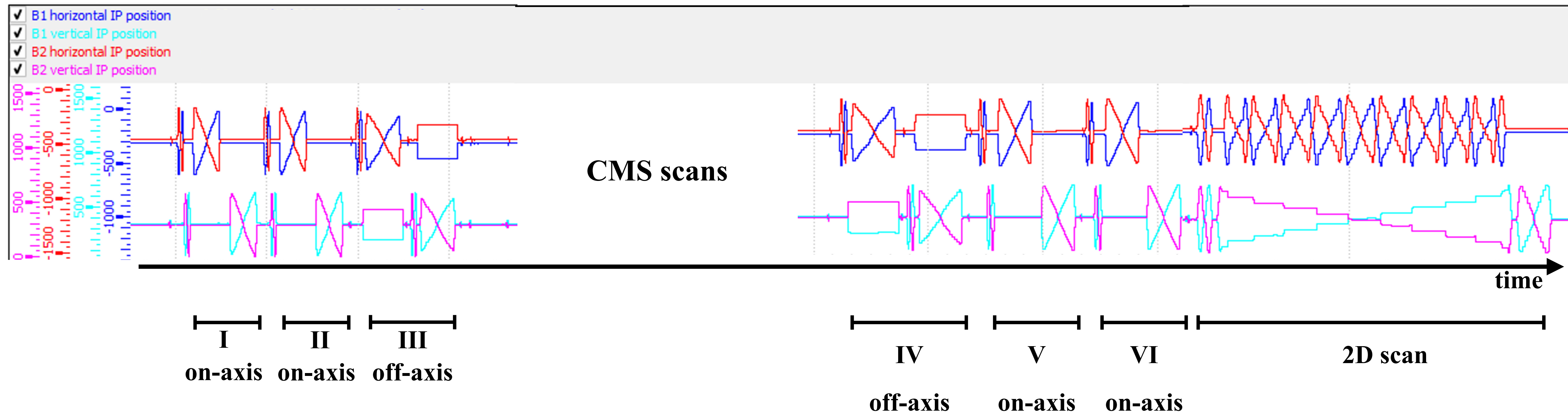


study the asymmetries using double gaussians with different means

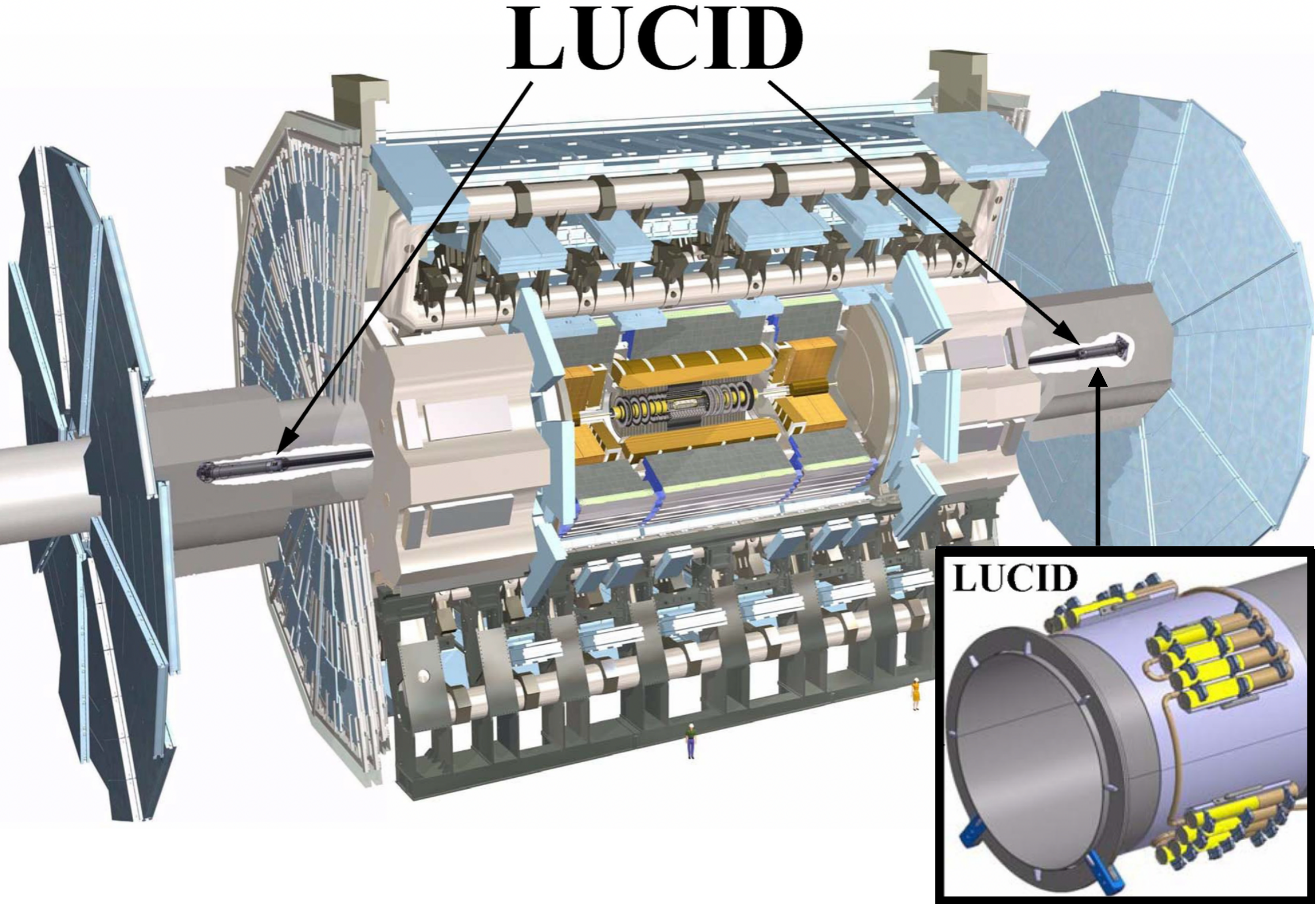


vdM scan program overview

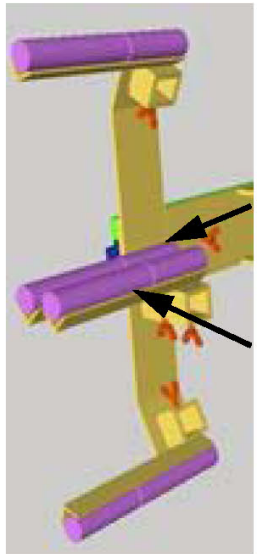
- Date: 10-11.11.2022
- fill 8381
- run 439428
- number of colliding bunches: 144
- no crossing angle
- low mu
- β^* : 19.2 m
- Beam energy: 6.8 TeV



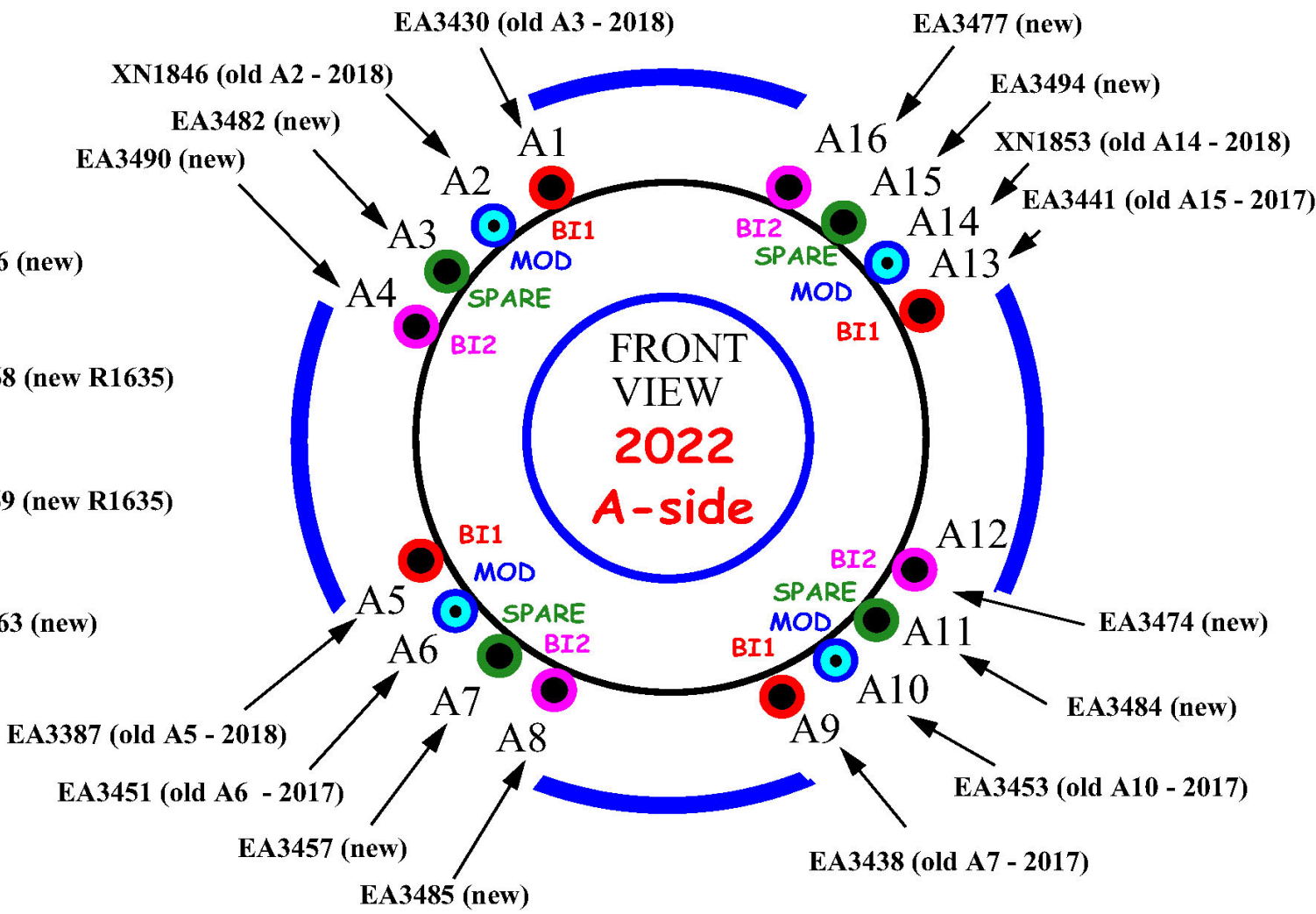
luminosity algorithms



A17 EA3487 (new) JN-A1
A18 EA3461 (new) JN-A2

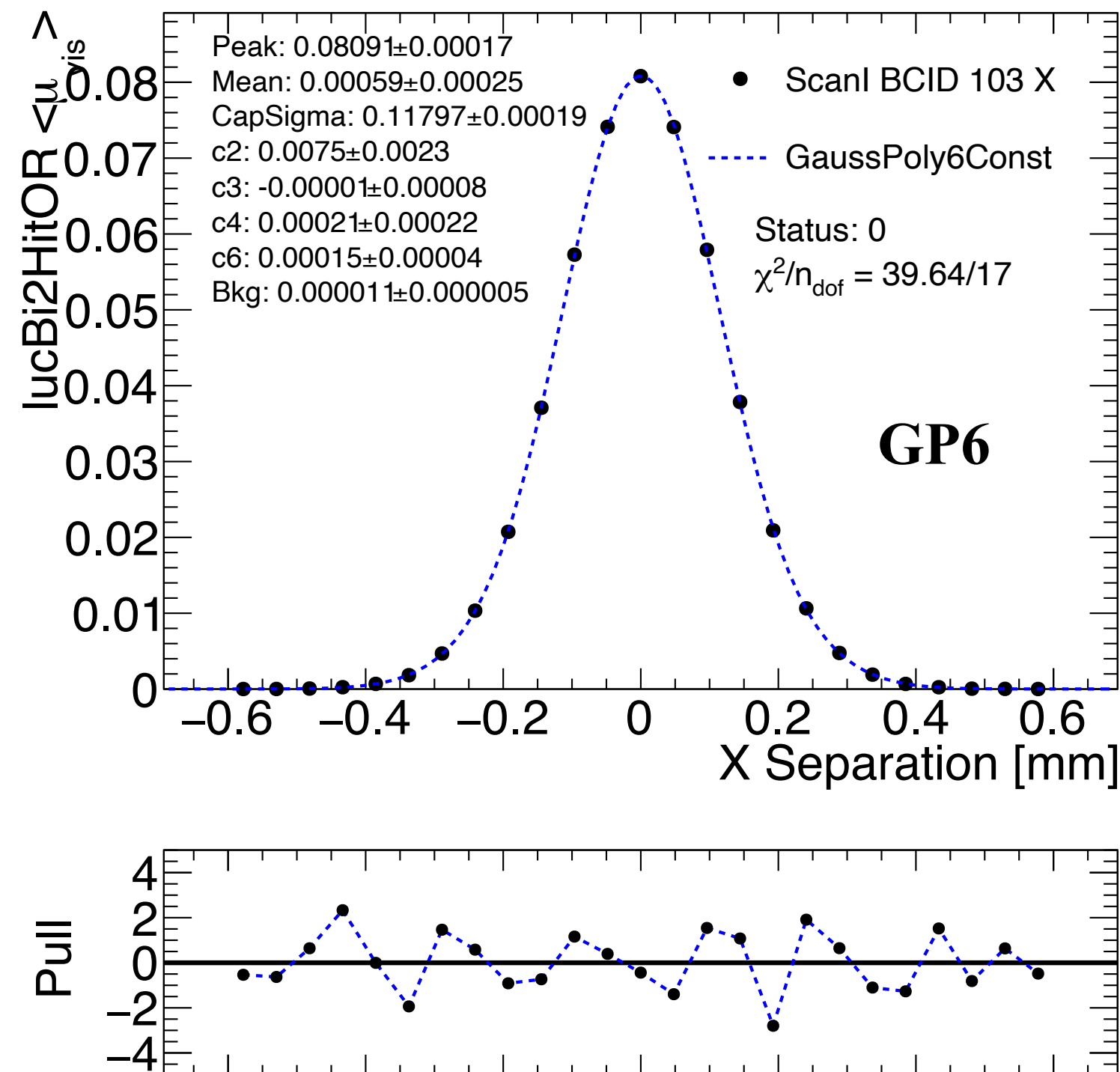


A21 EA3456 (new)
JF-A3
A19 ZU5468 (new R1635)
JF-A1
A20 ZU5469 (new R1635)
JF-A2
A22 EA3463 (new)
JF-A4



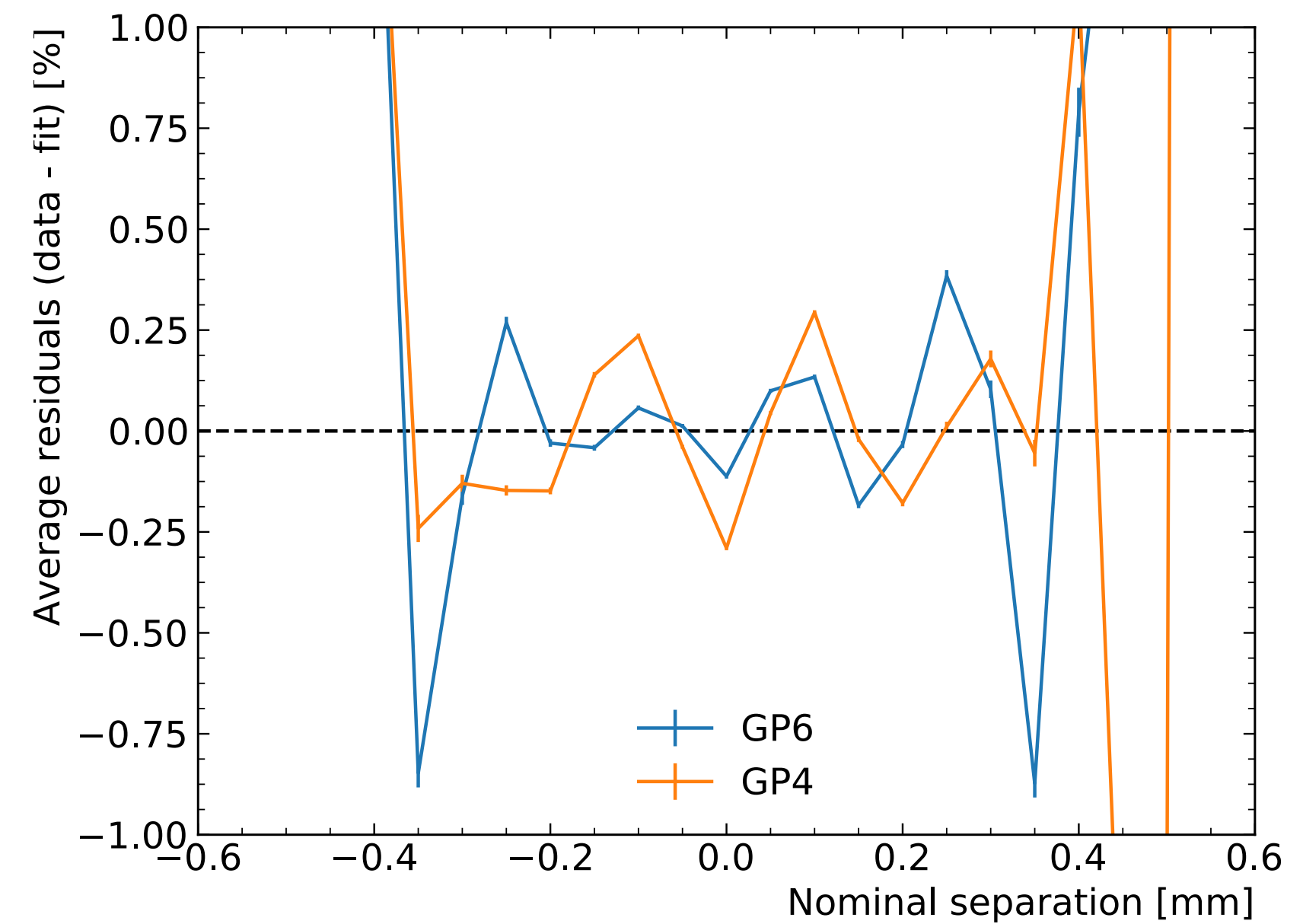
Fit model

Example of a GP6 fit to the scan curve



No obvious asymmetry in the scan curves and stable fits

Fit residuals 13.6 TeV 2022

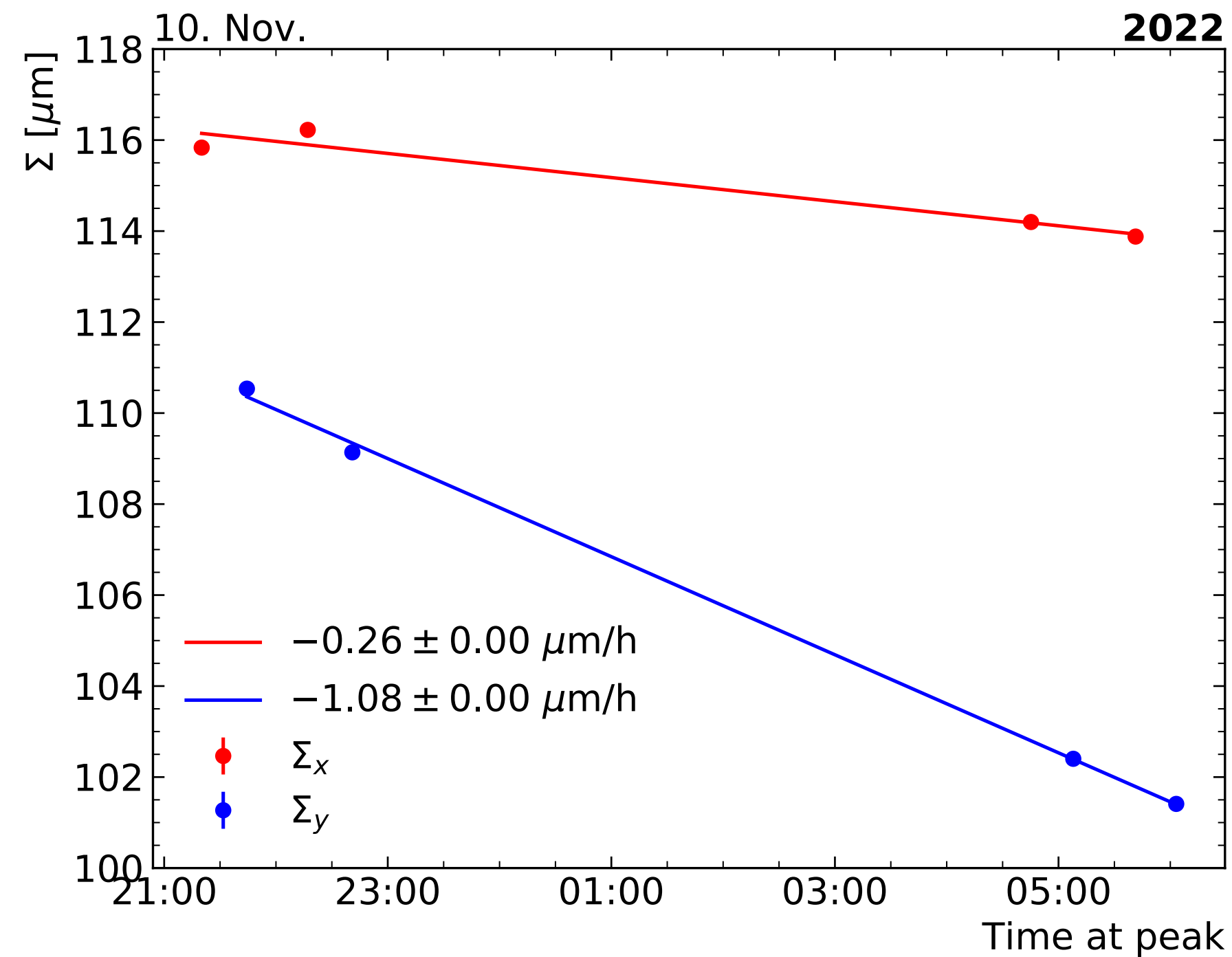


The central points are the most important ones

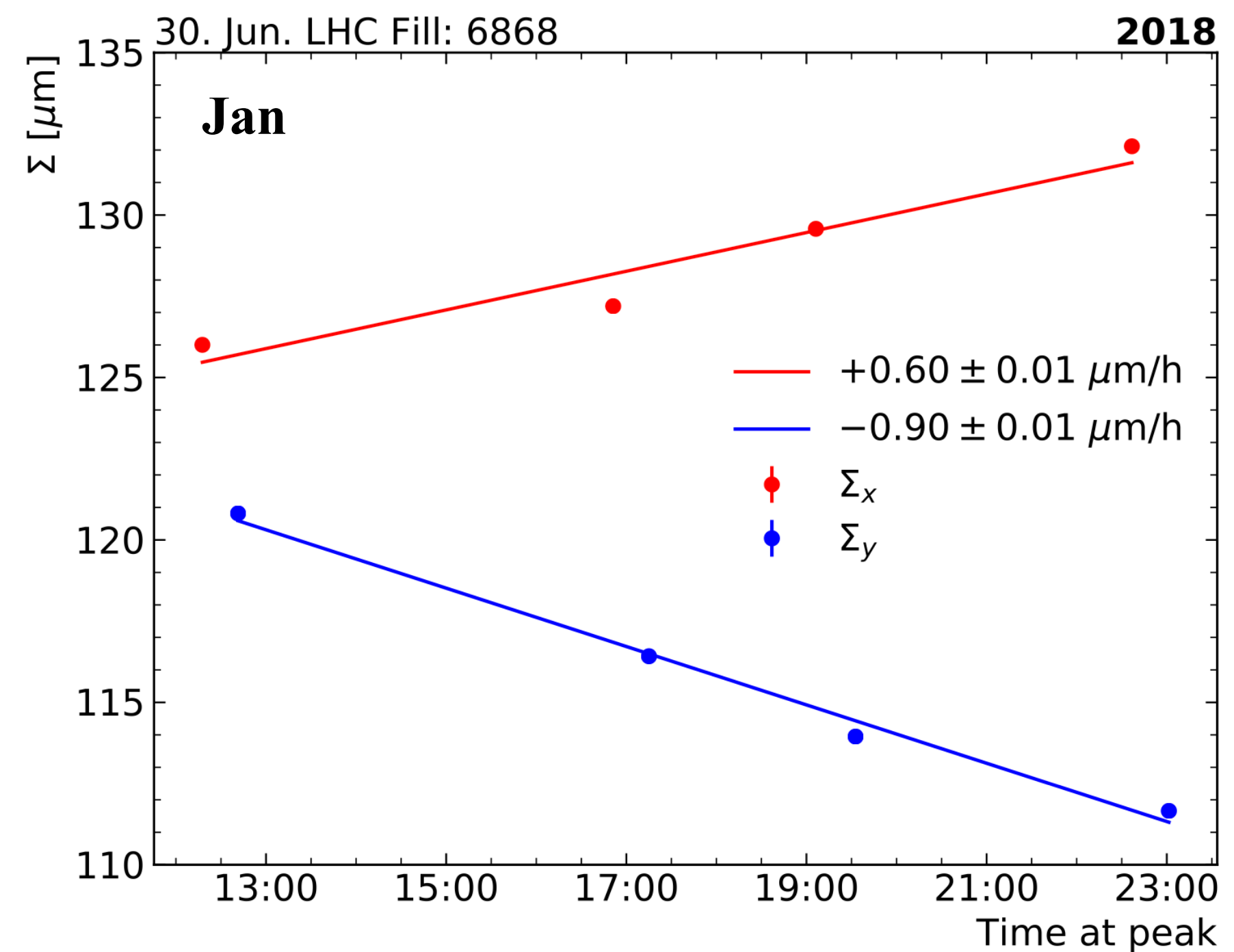
GP6 models the peak shape better than GP4

⇒ use GP6 as the default fit model

Emittance growth



Σ evolution in time for 13.6 TeV 2022 vdM scans



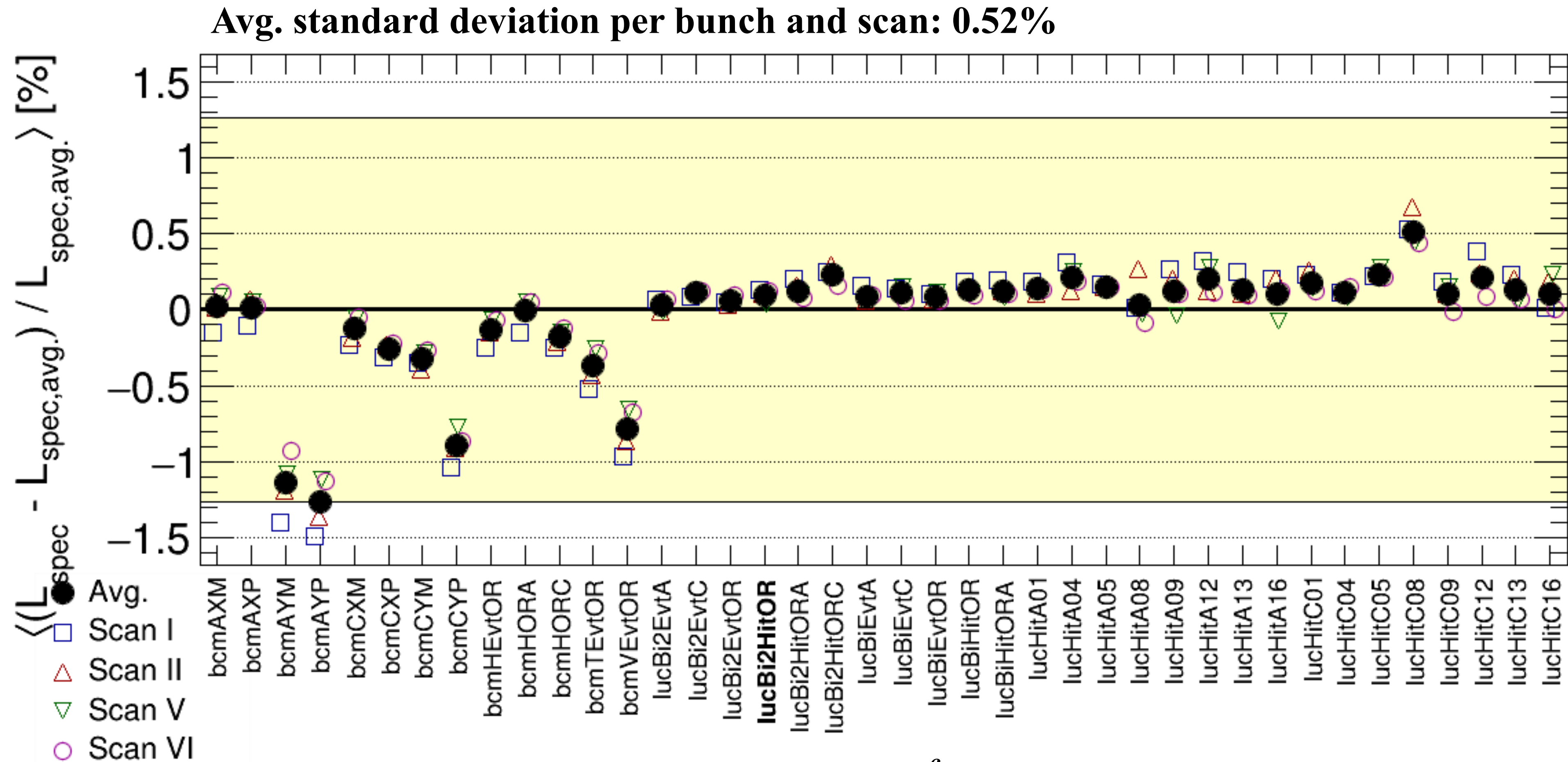
Σ evolution in time for 13 TeV 2018 vdM scans

Σ_x^{2022} is decreasing

the difference between slopes in x and y is important for the correction

⇒ we will probably have a smaller emittance growth correction than 2018 (~0.25%)

L_{spec} comparison for different algorithms

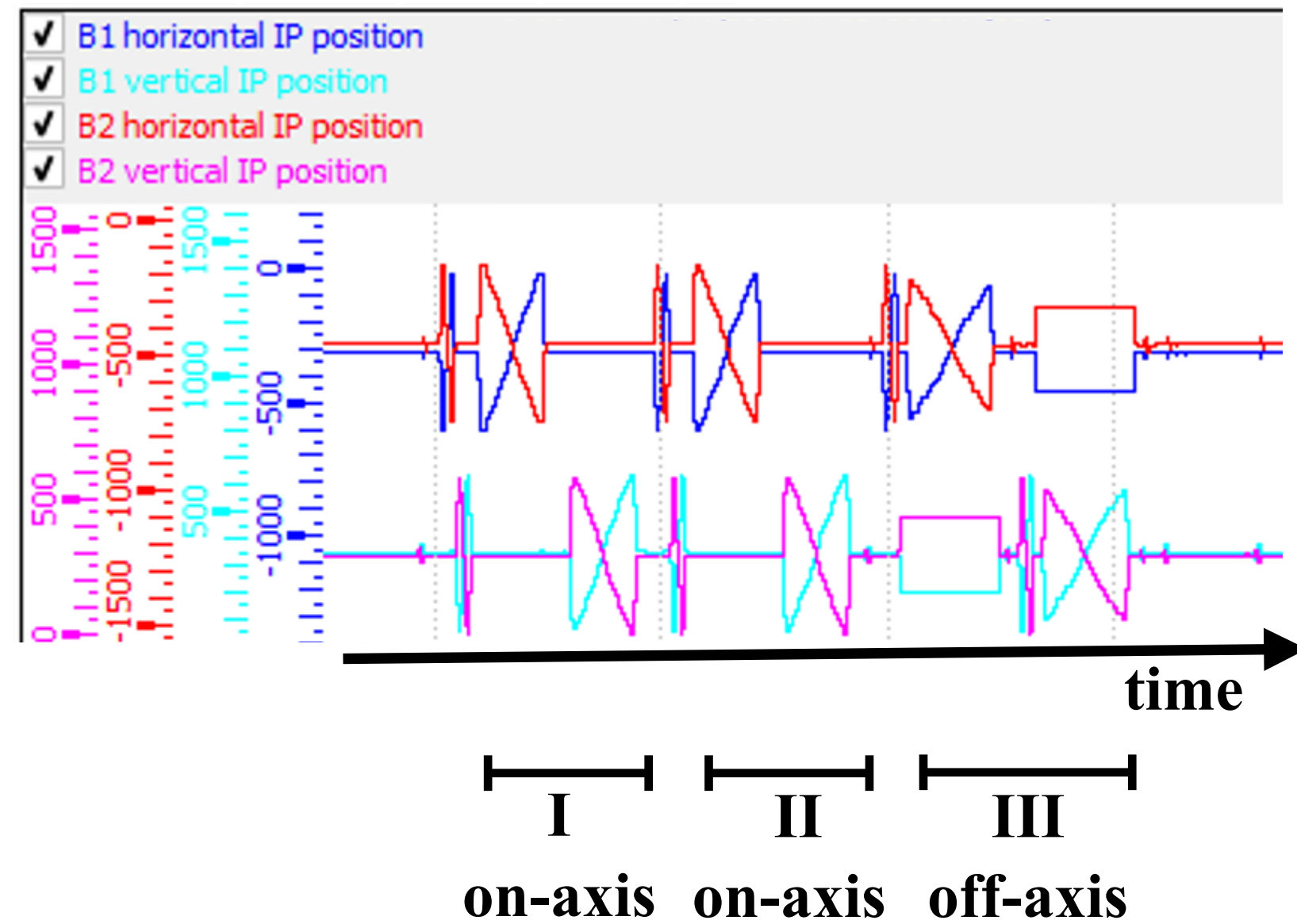


$$L_{spec} = \frac{f_r}{2\pi\Sigma_X\Sigma_Y}$$

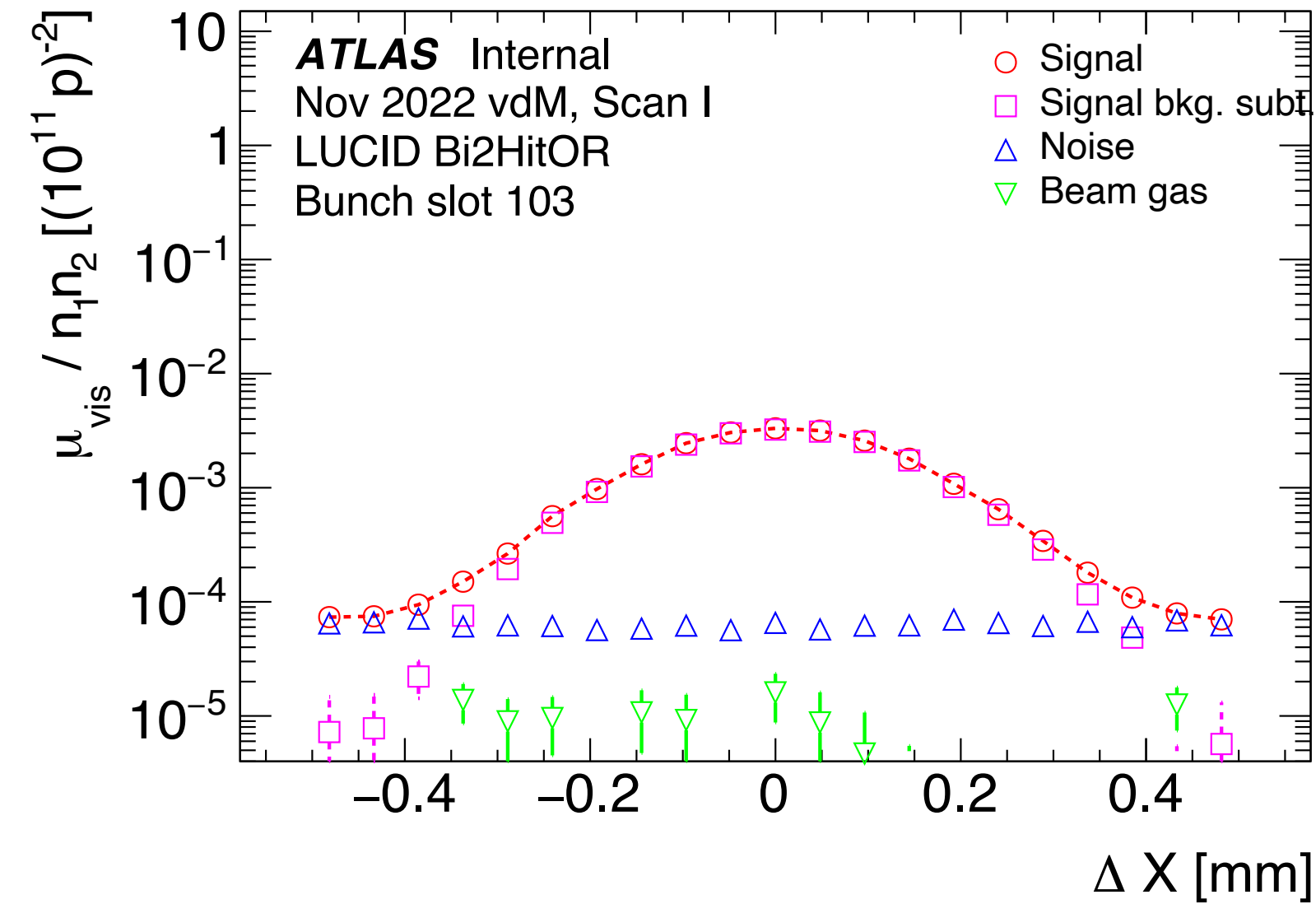
bcm and lucid have the biggest disagreement

off-axis scans

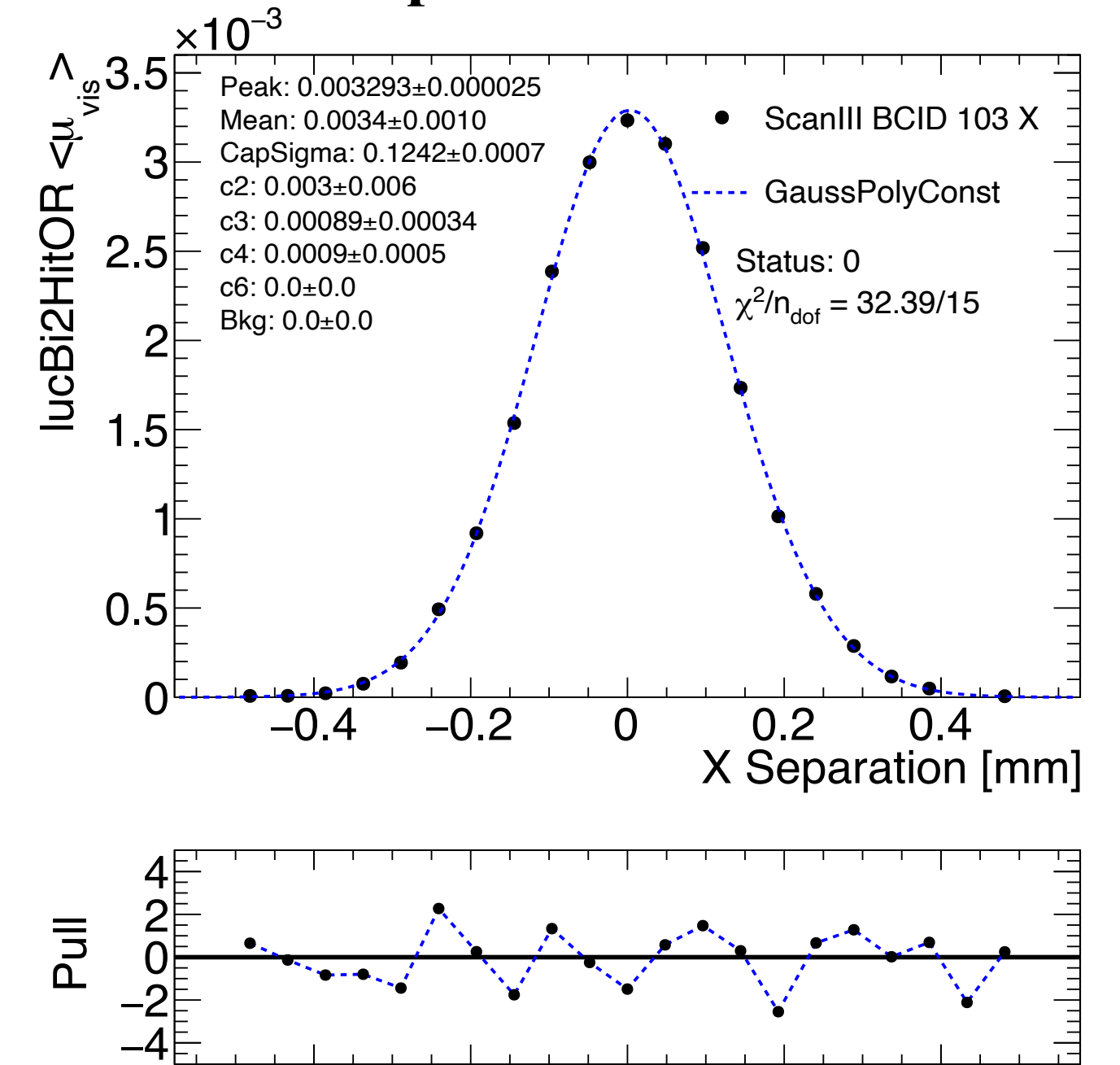
Beam positions during the scans



Example of a scan curve



Example of a scan curve fit

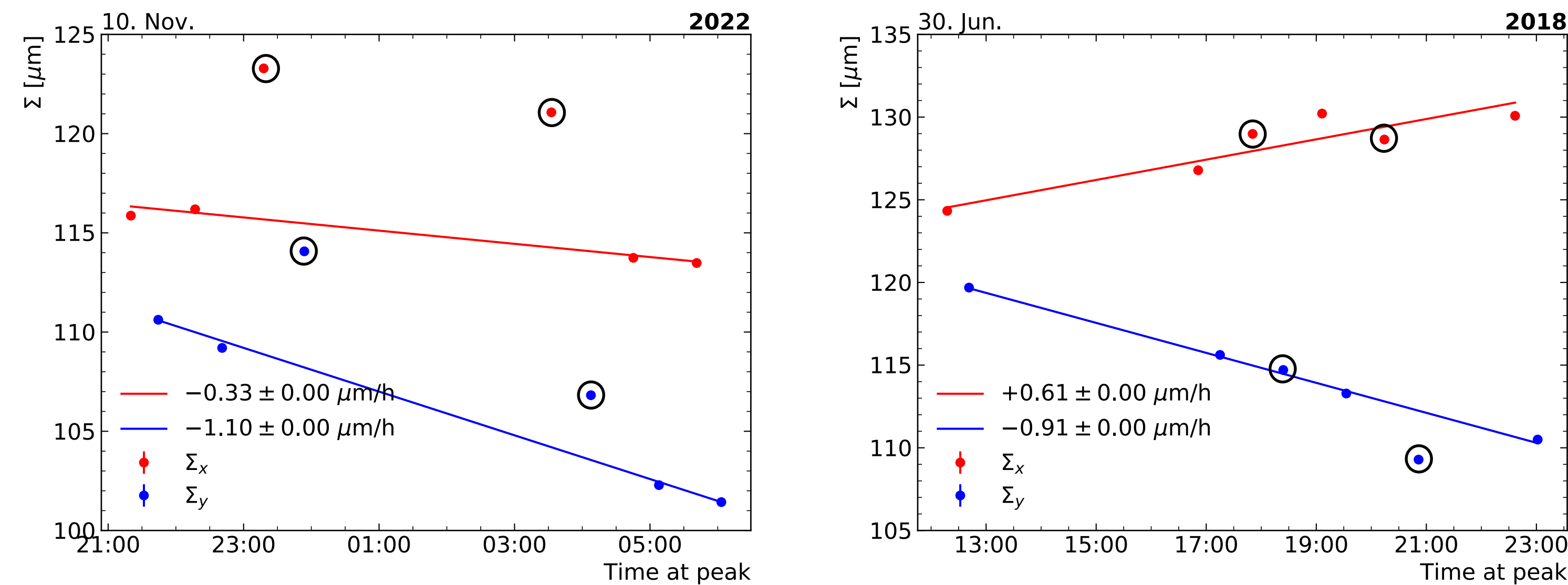


the off-axis scans are used to estimate the non-factorisation effects

the rates are 1-2 order of magnitudes lower than for the on-axis scans

Non-factorisation effect

If the non-factorisation effects are small $\Rightarrow \Sigma$ agree between off-axis and on-axis scans



2022, GP4 with BG==0, BGsub, lucBi2HitOR				off/on	
		capsigmaX	capsigmaY	x	y
I	on axis	115.867	110.619	6.1%	4.5%
II		116.186	109.201		
III	off-axis	123.29	114.07	6.4%	4.4%
IV		121.07	106.82		
V	on-axis	113.741	102.285		
VI		113.481	101.429		

2018, GP4, BGsub, lucBi2HitOR				off/on	
		capsigmaX	capsigmaY	x	y
I	on axis	124.329	119.688	1.7%	-0.8%
II		126.785	115.617		
III	off-axis	128.98	114.71	-1.3%	-3.5%
IV	on axis	130.215	113.285		
V	off-axis	128.64	109.29		
VI	on axis	130.078	110.499		

The non-factorisation effects are significantly bigger than in 2018

lucBi2HitOR, GP4+BG==0, BGsub

Summary

- ATLAS-DESY luminosity team: small, in Zeuthen
- current online calibration is based on 31.05.2022 emittance scans in vdM conditions $\Rightarrow$ plan on updating it soon
- strange asymmetrical behaviour of beams in LHCf scans $\Rightarrow$ origin unclear
- vdM scans 2022:
 - 4 on-axis scans, 2 off-axis scans and an experimental 2D scan
 - lower emittance growth effects than 2018
 - stronger non-factorisation effects than 2018