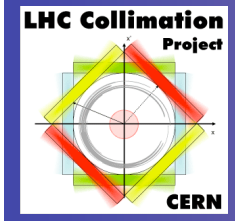

DEC 10 data analysis

V.Previtali

G. Annala, R. Assmann, N. Mokhov,
S. G. Peggs, S. Redaelli, D. Still

Overview of the experiment

- Retract the W target D49, perform a collimator scan
- Insert the crystal: angular scan (2x)
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  - Investigate ‘slope’ region
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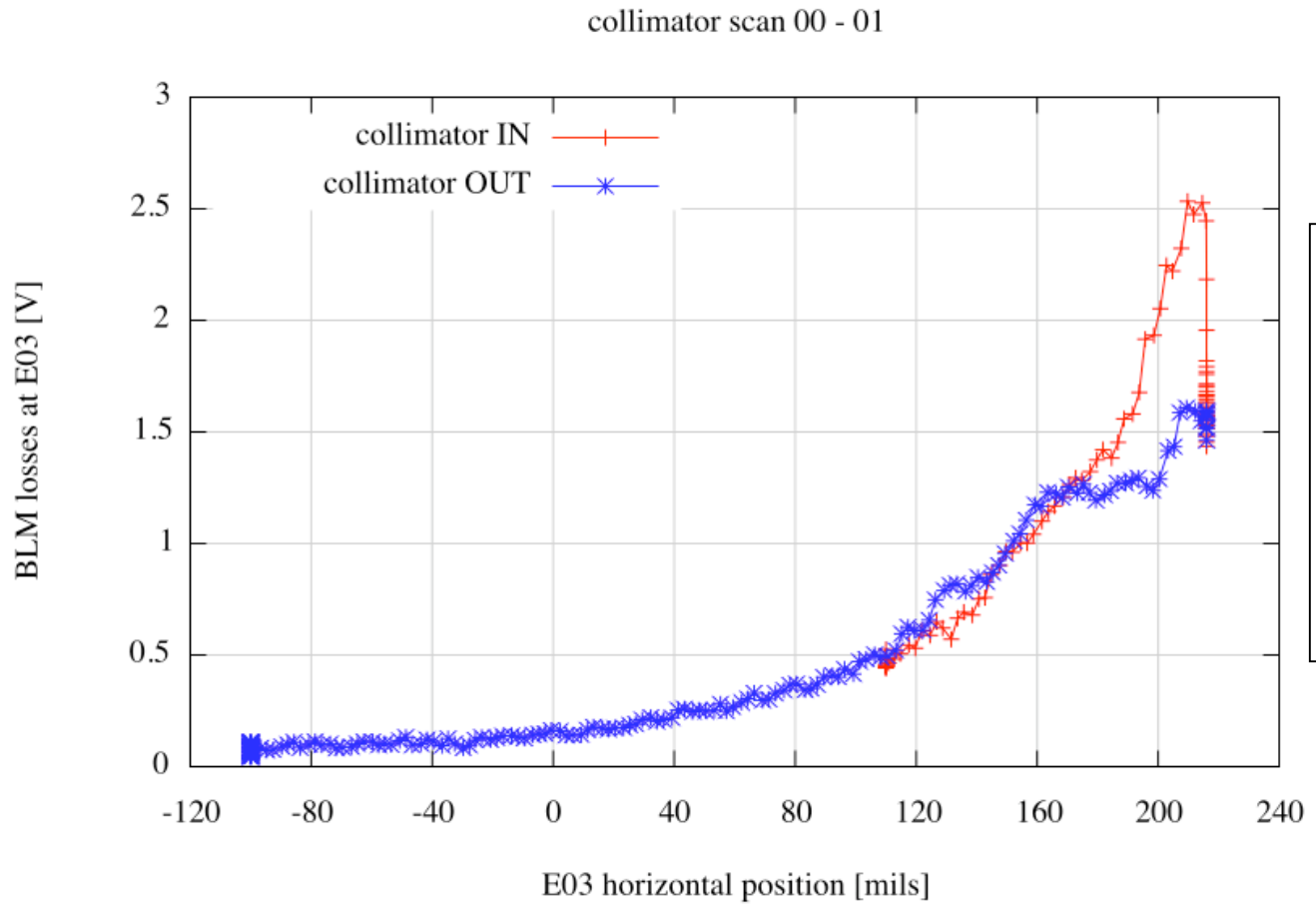
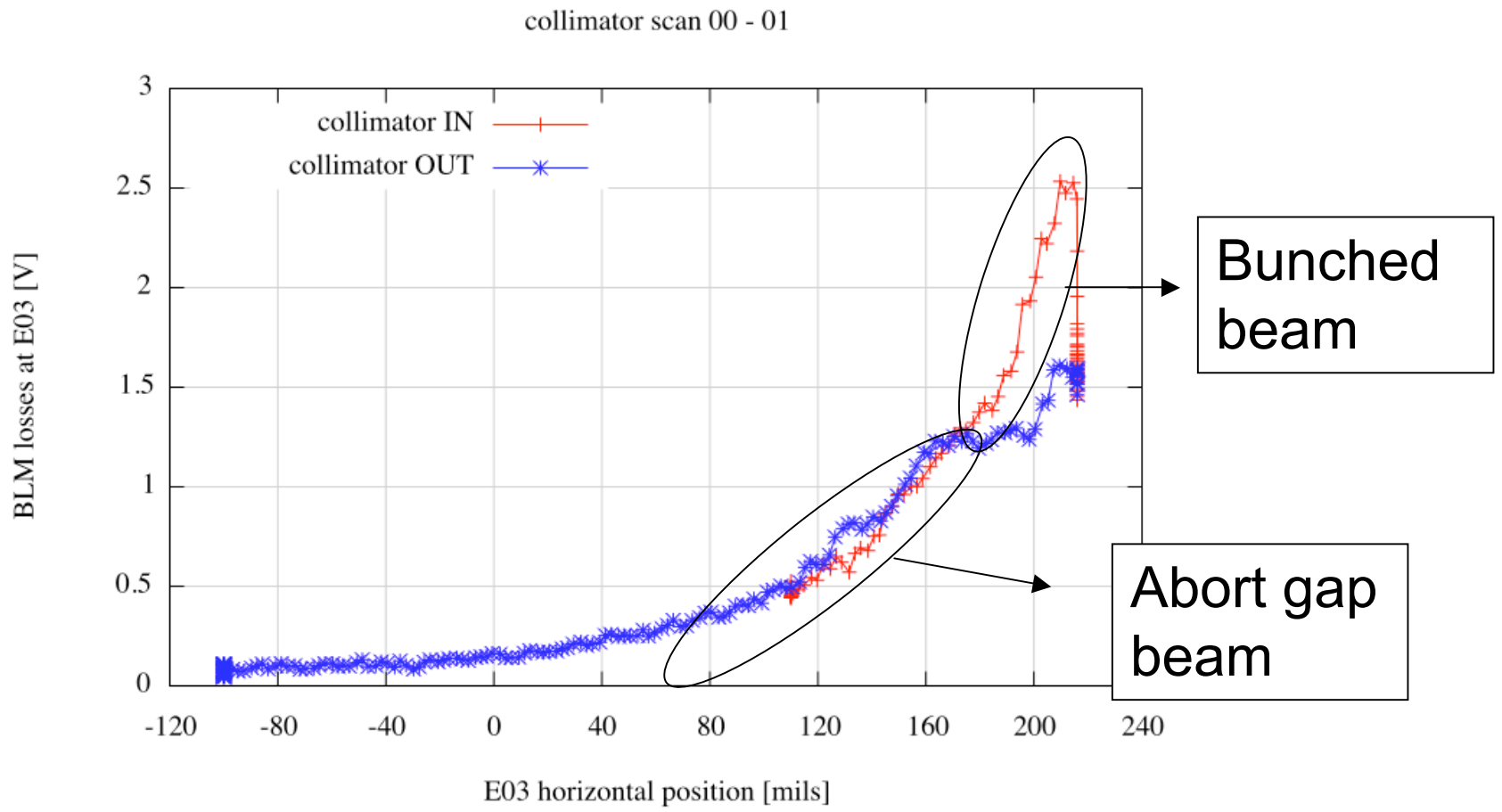
Collimator Scan without the crystal



Why should they be different?
This is something that we do not see when the crystal is inserted!

- Differences for the 2 directions.

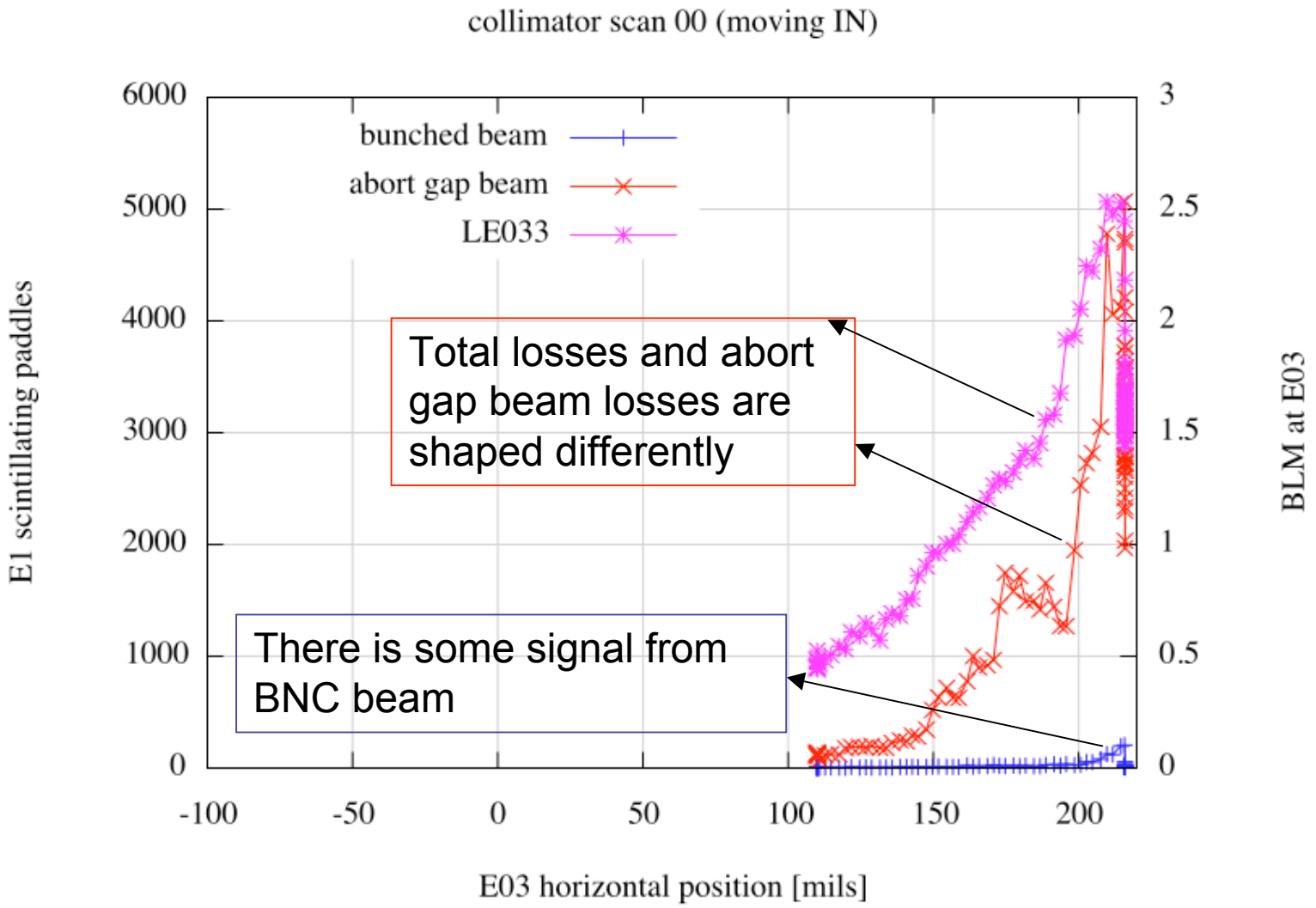
Collimator Scan without the crystal



- Differences for the 2 directions.
  Possible explanation: moving the collimator out we mainly see abort gap beam (for which diffusion rate is much higher)

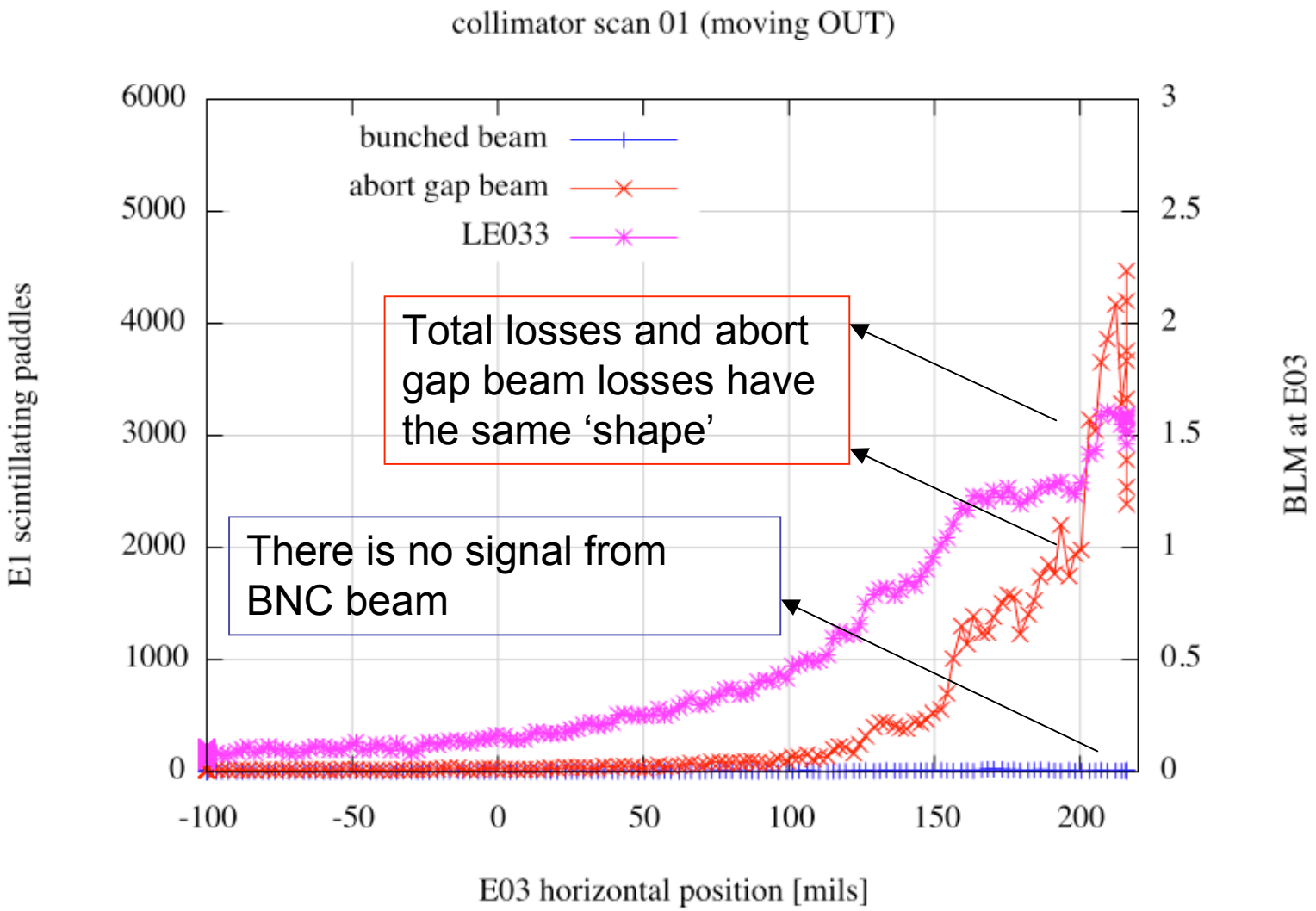
Collimator scan : IN

using the scintillating paddles



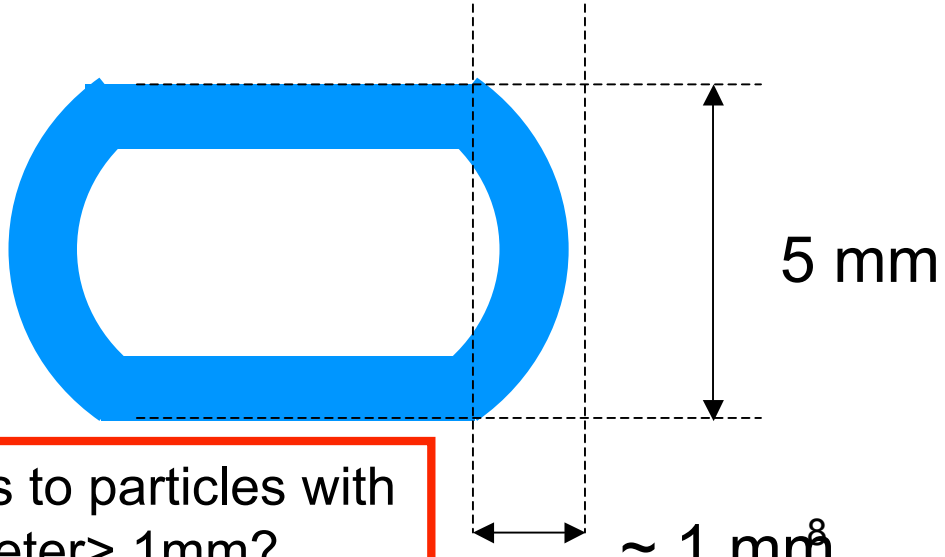
Collimator scan : OUT

using the scintillating paddles



My doubts:

- In the first scan, the bunched beam seems to be a consistent part of the total losses. Why the losses detected with the scintillating paddles are much lower for the bunched beam?
- Can we consider this an indication for the shape of the beam hitting the crystal (rescaling for a different beta function)? Is the impact parameter so high for the off-momentum beam?
- The thickness of our crystal is ~ 1 mm



What happens to particles with impact parameter> 1mm?

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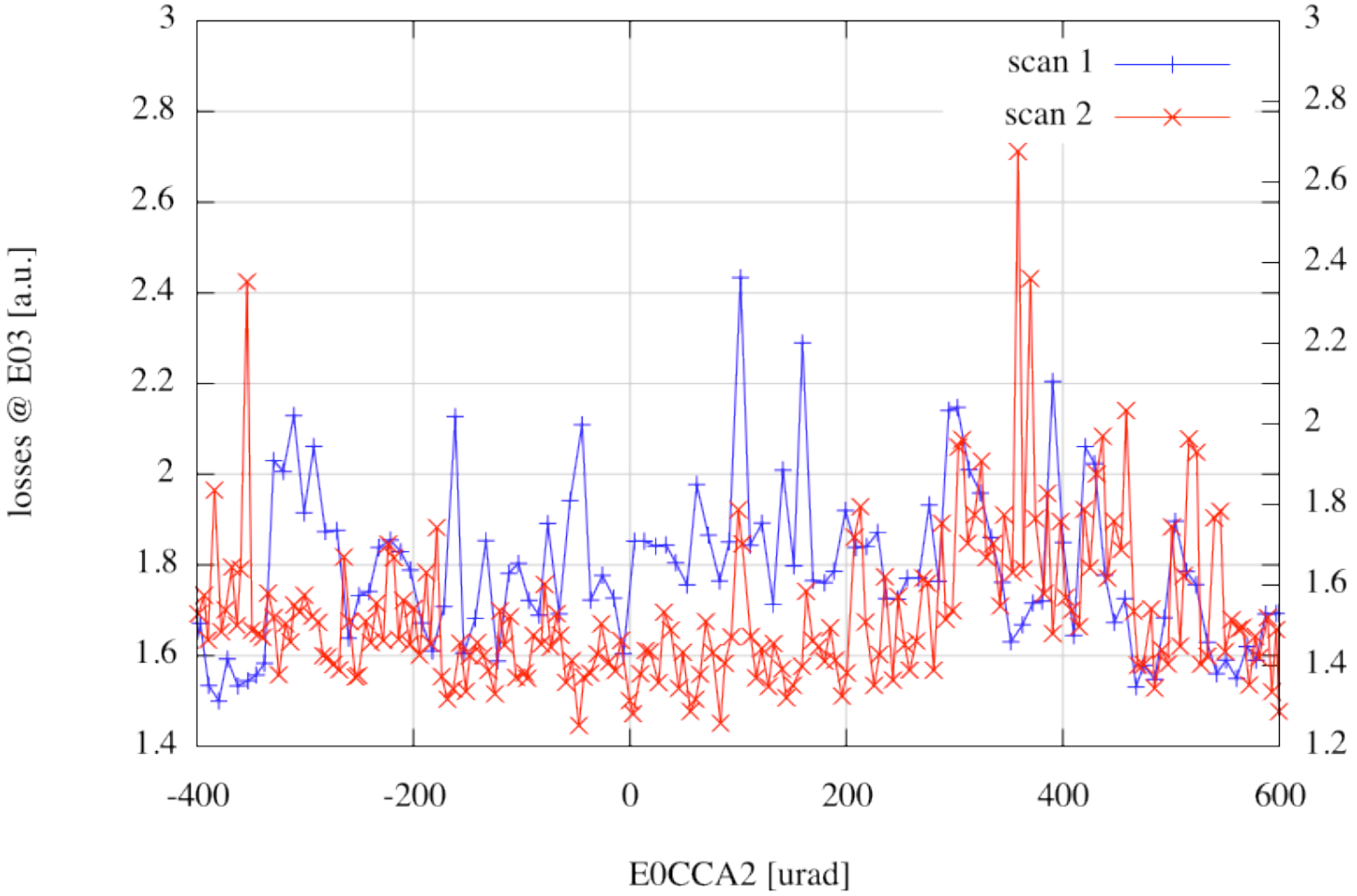
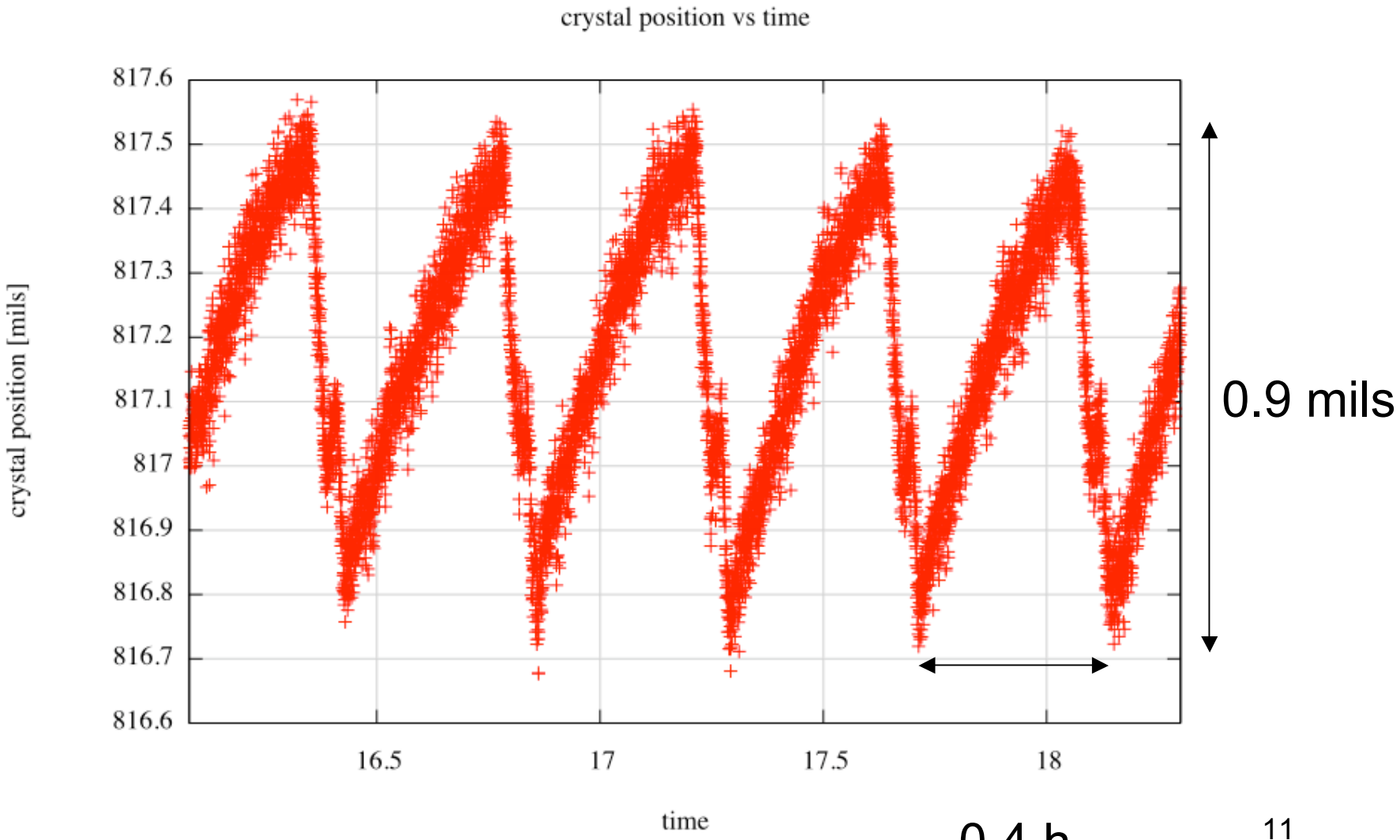
Angular scan

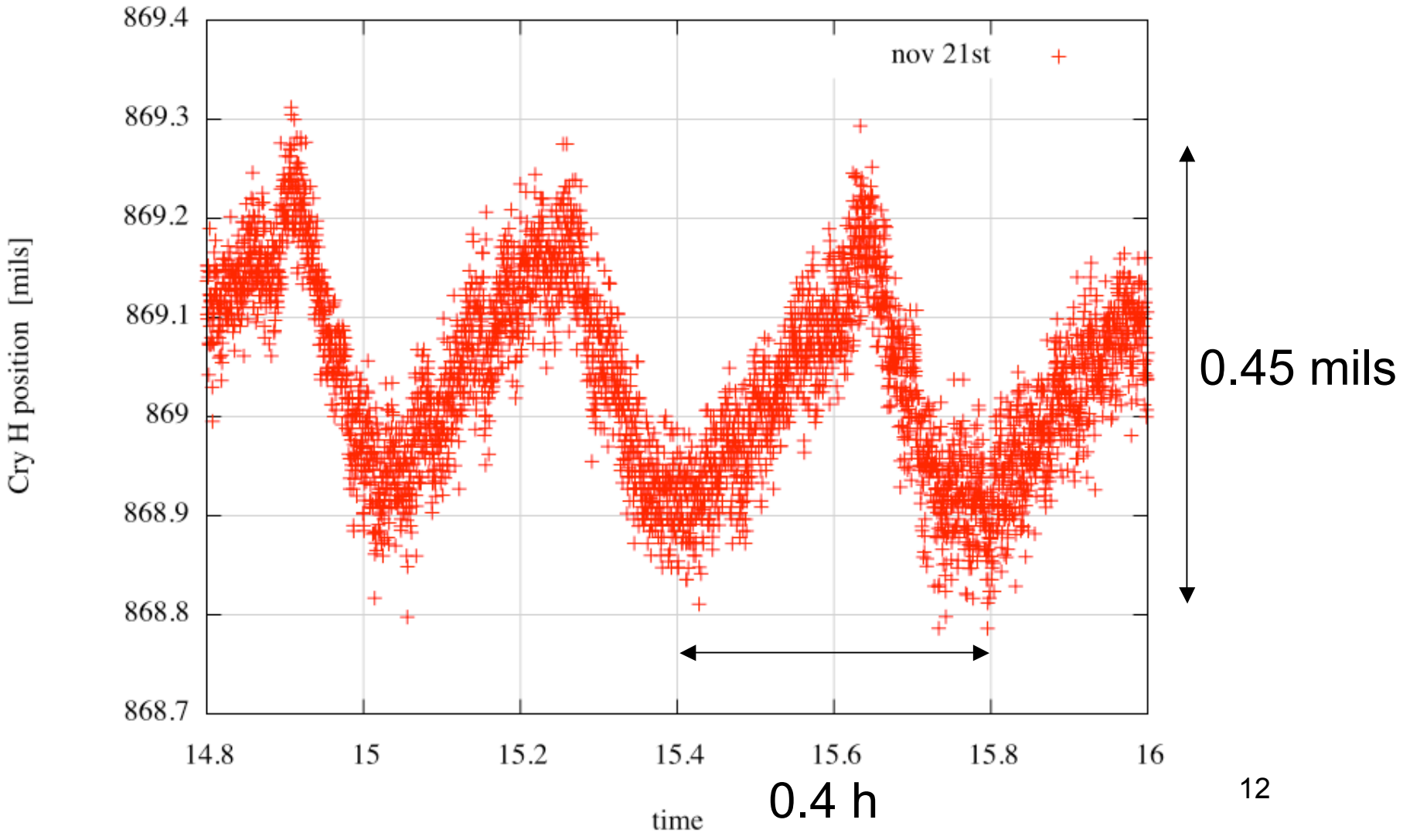


The picture is not clear. Why? (never had this problem before)

Maybe crystal movements? DEC 10

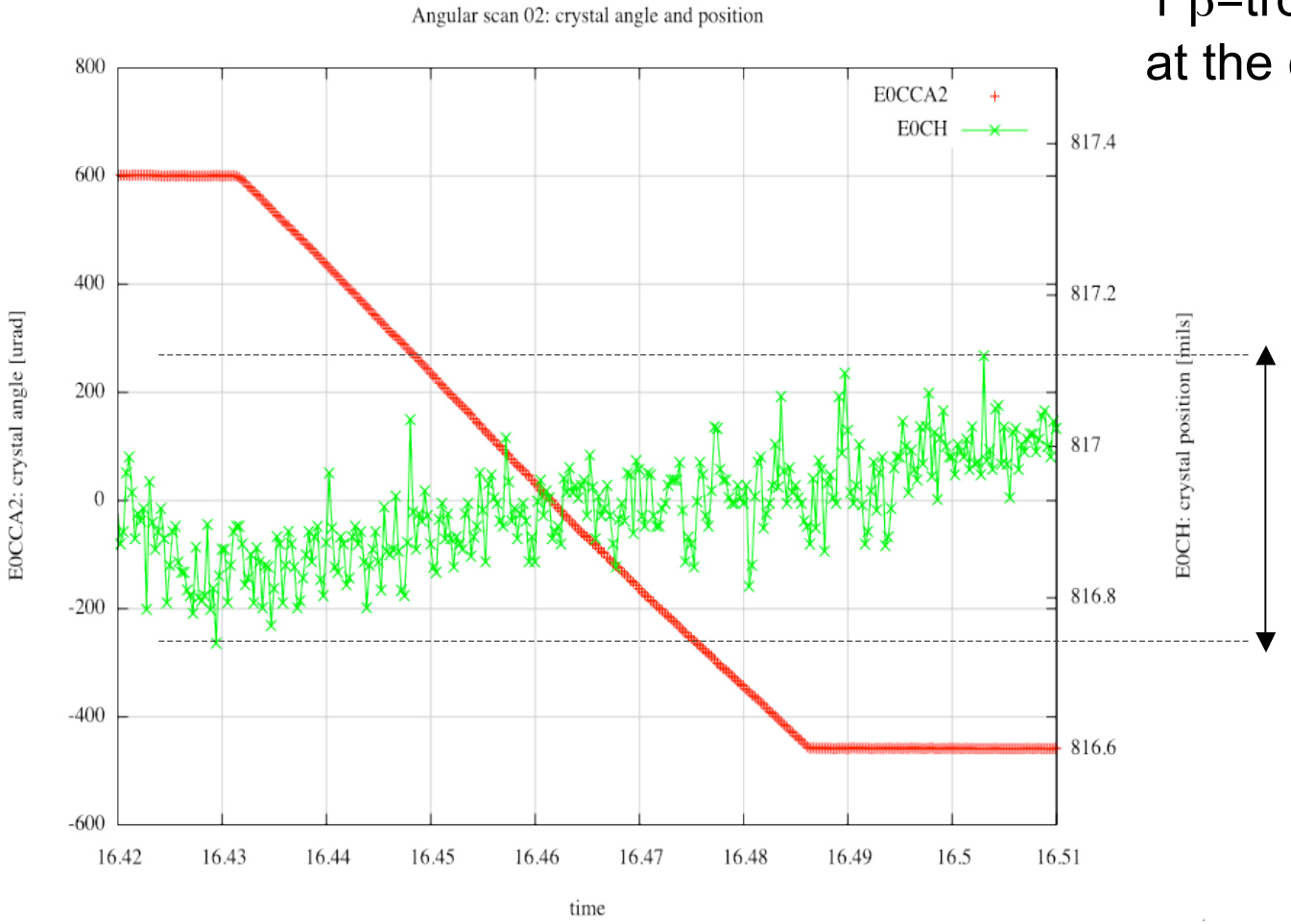


Crystal position on NOV 21st



Typical oscillation during angular scan… DEC 10

- ‘BAD’ angular scan



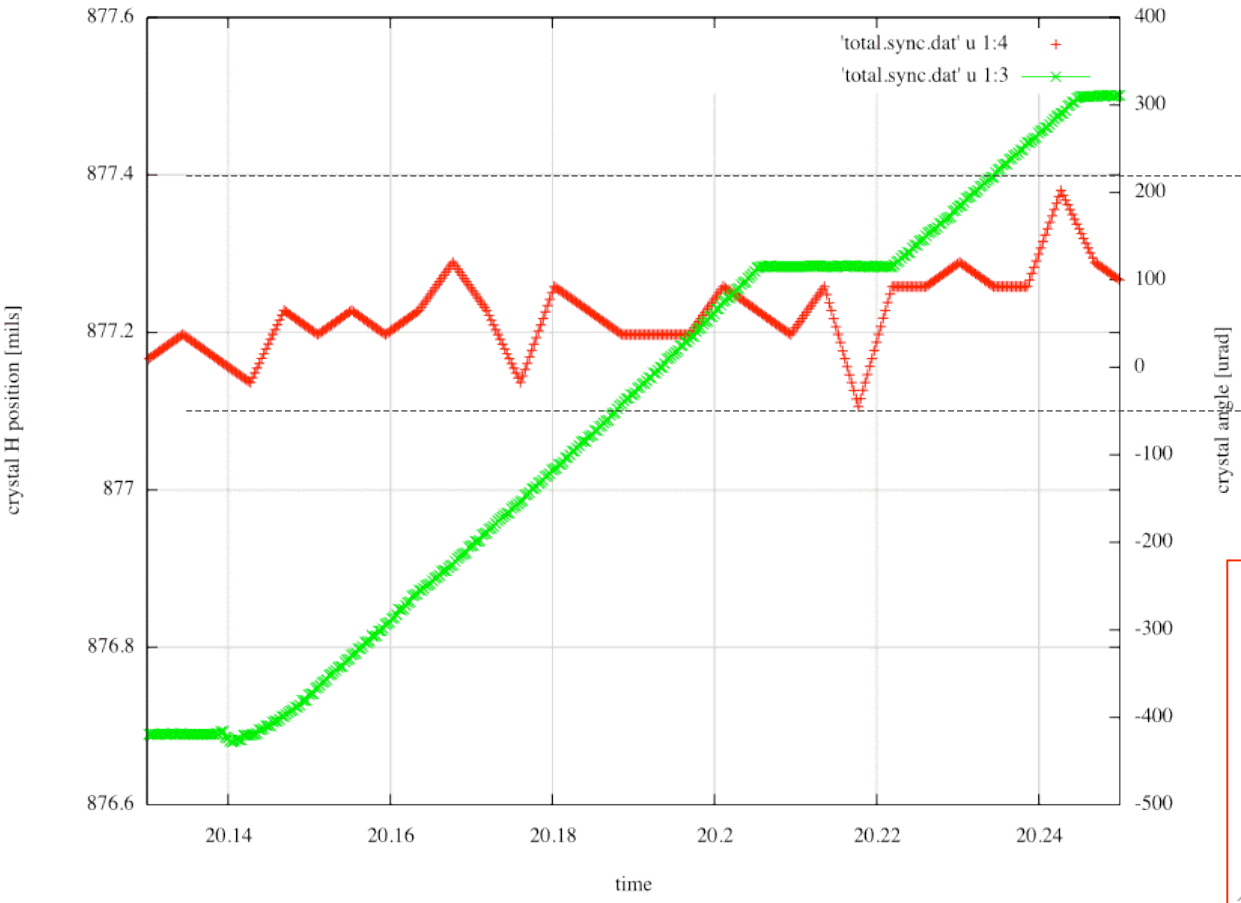
For reference:
1 β–tron σ = 14 mils
at the crystal location

Max variation: 0.5 mils

Typical oscillation during angular scan… OCT 29

- ‘Good’ angular scan, OCT 29th

For reference:
1 β–tron σ = 14 mils
at the crystal location



Max variation: 0.3 mils

The maximum variation is similar. But the position was much less stable on DEC 12. Why? Could this be an explanation?

Or maybe …?

- We were supposed to scan at the same angular velocity or slower. Why **the angular scan is faster**? Need to check the controls.
- Is there a possibility that we **damaged the hardware and/or the crystal** during last quench? E.g.: Is the pin diode really broken?
- Other differences: we made an horizontal closed “bump” at the crystal location (<1 mm). How can this affect the horizontal betatron dynamics? Does it change the dispersion at the crystal/collimation location?

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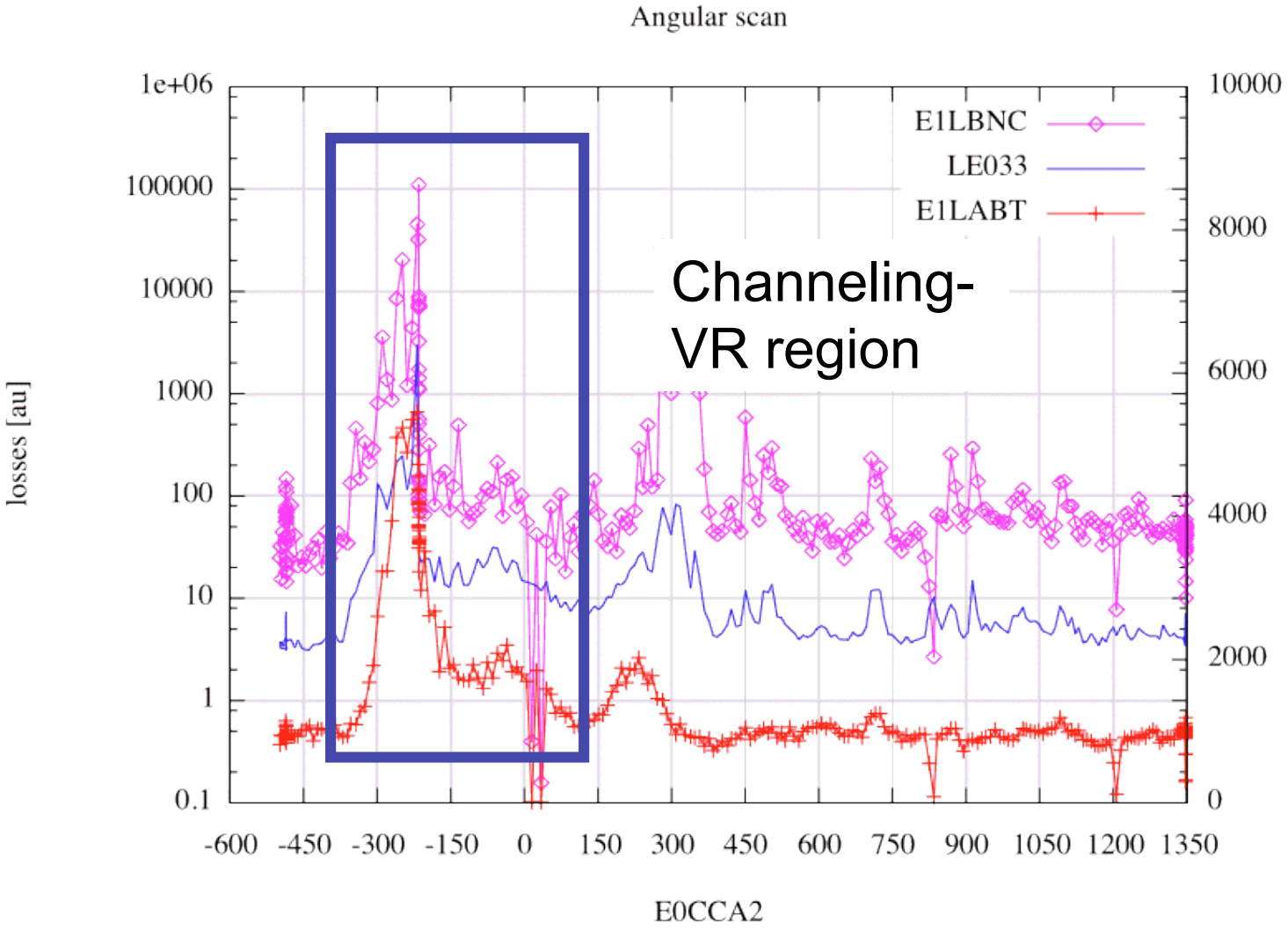
Collimator scans

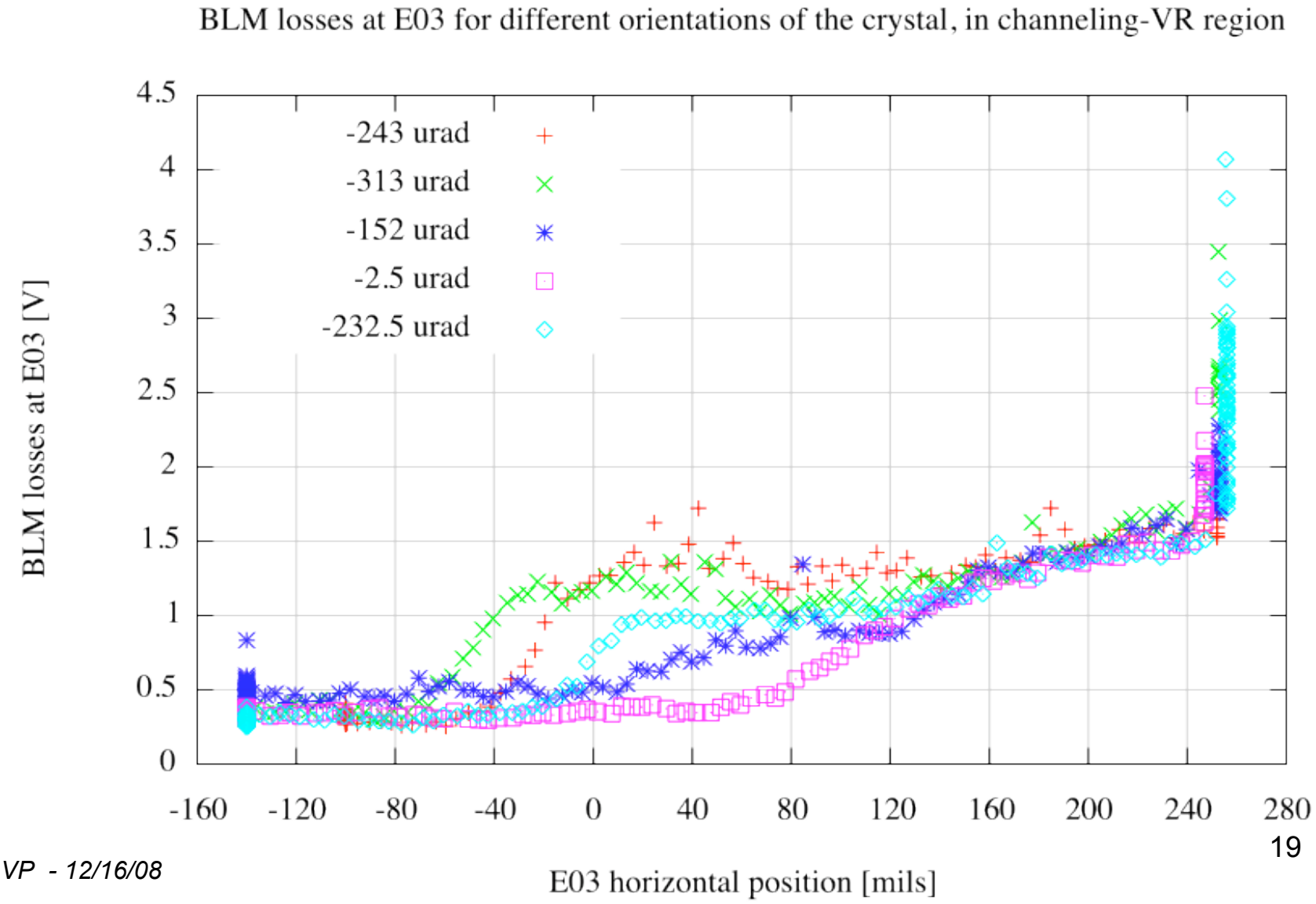
- Even with a unclear angular scan, we tried to position the crystal in the same angular position as NOV 21st (we use as reference the old angular scan).
- Despite of the bad signals for the angular scans, the collimator scans seem to be clear and reproduce very well the data collected during the past experimental runs. For this reason, I would exclude any crystal damage.

(old angular scan)

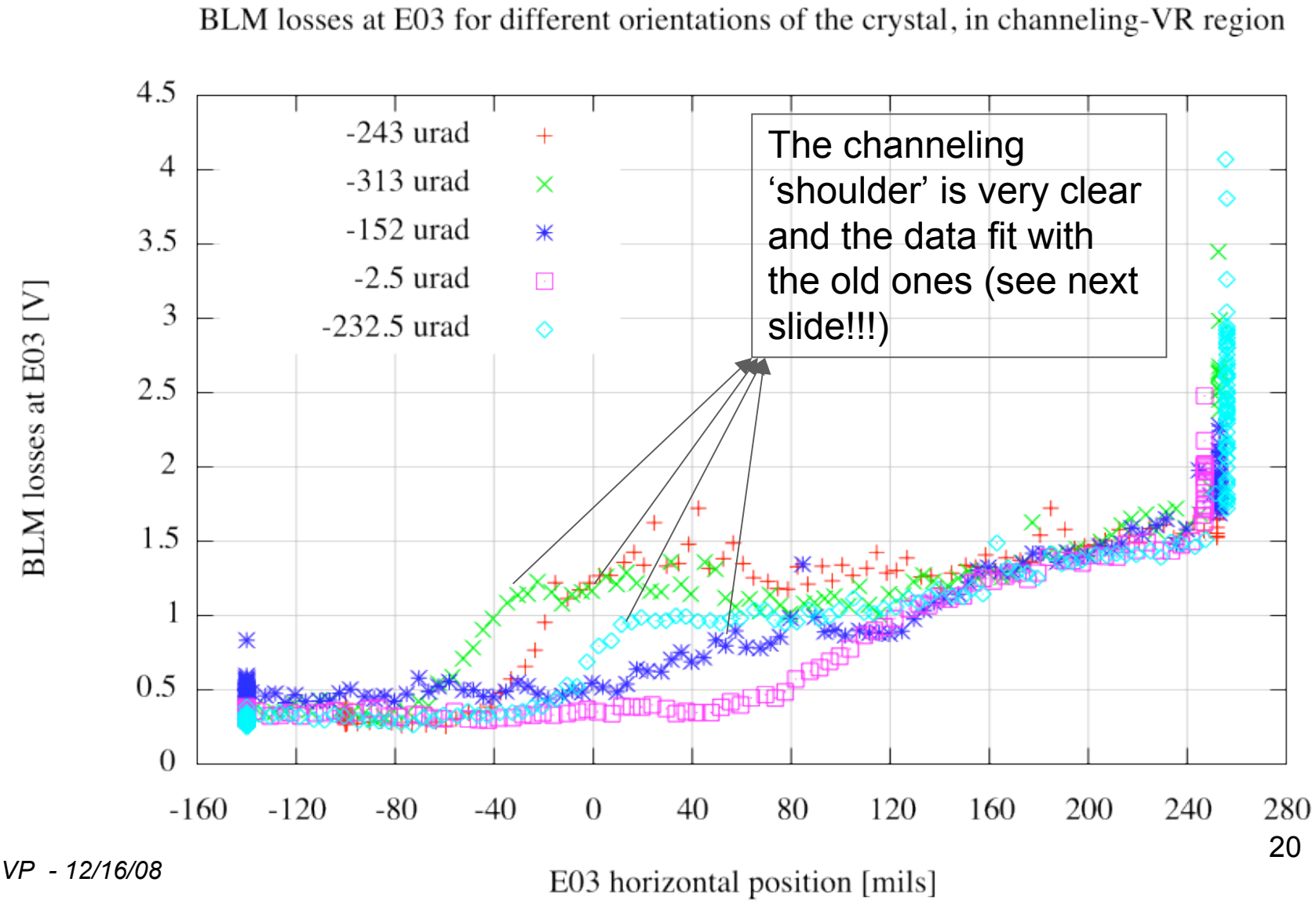


Collimator E03 scans

BLM losses

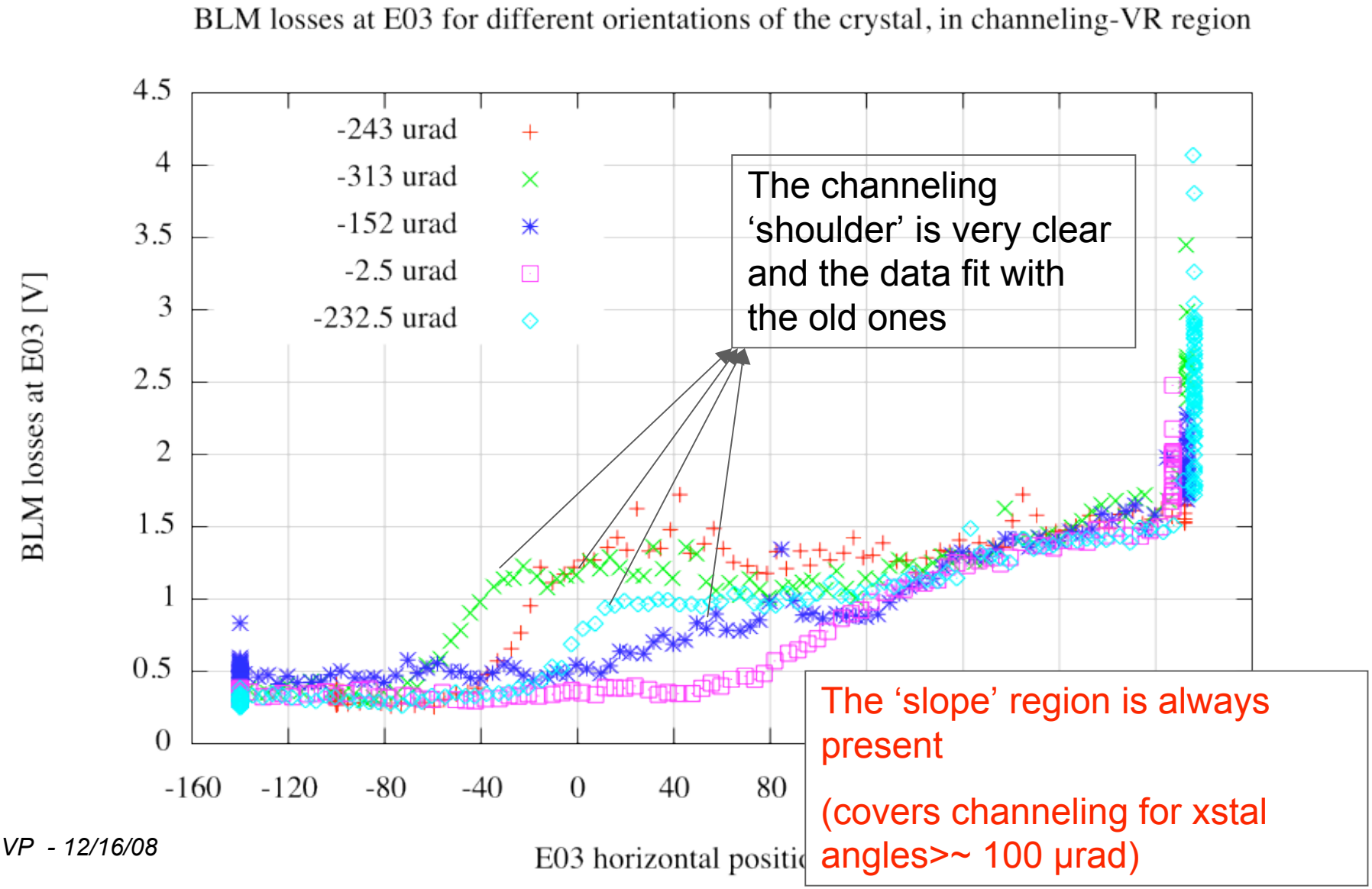


Collimator E03 scans
BLM losses



Collimator E03 scans

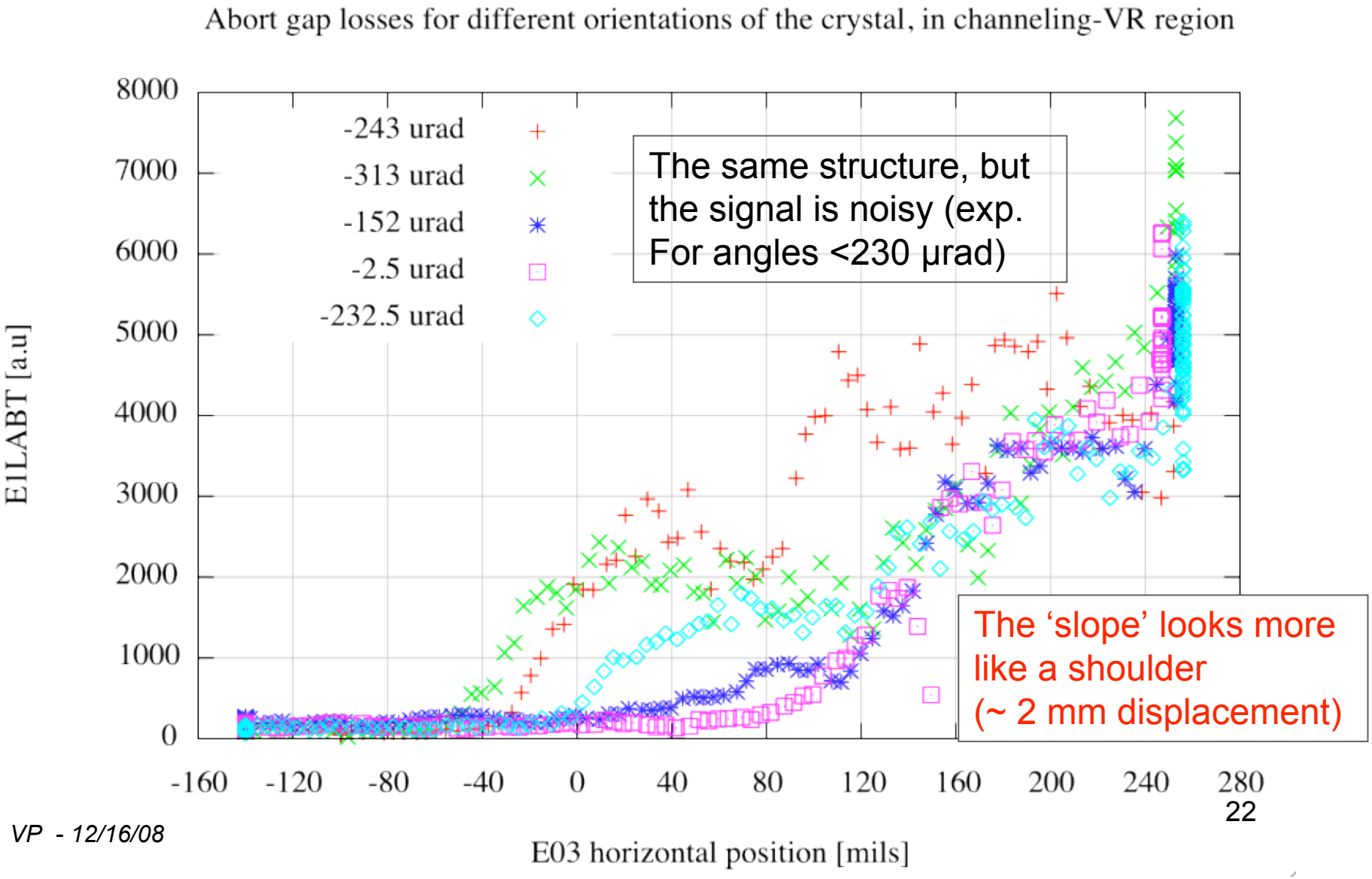
BLM losses



VP - 12/16/08

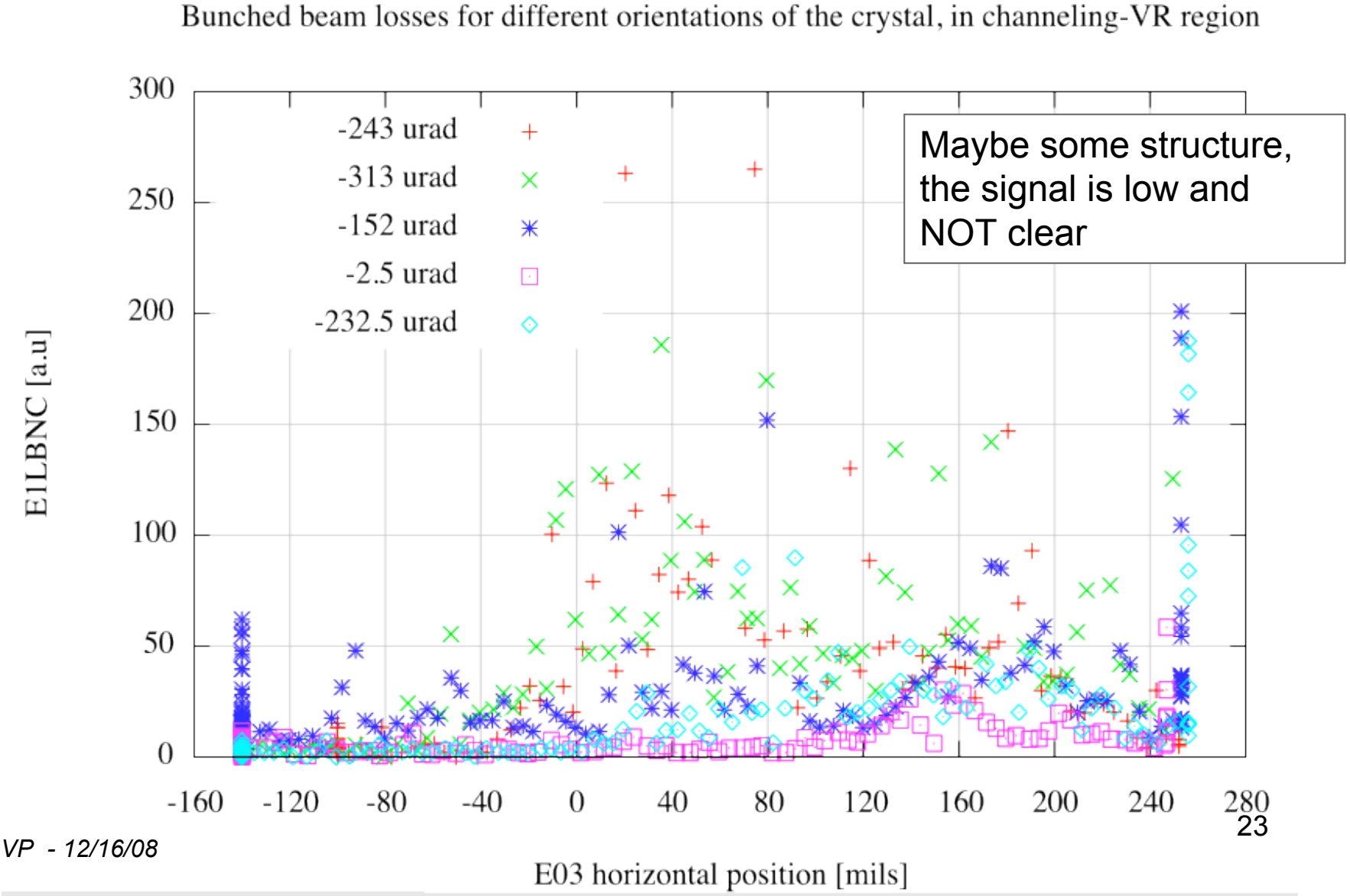
Collimator E03 scans

Abort Gap beam losses



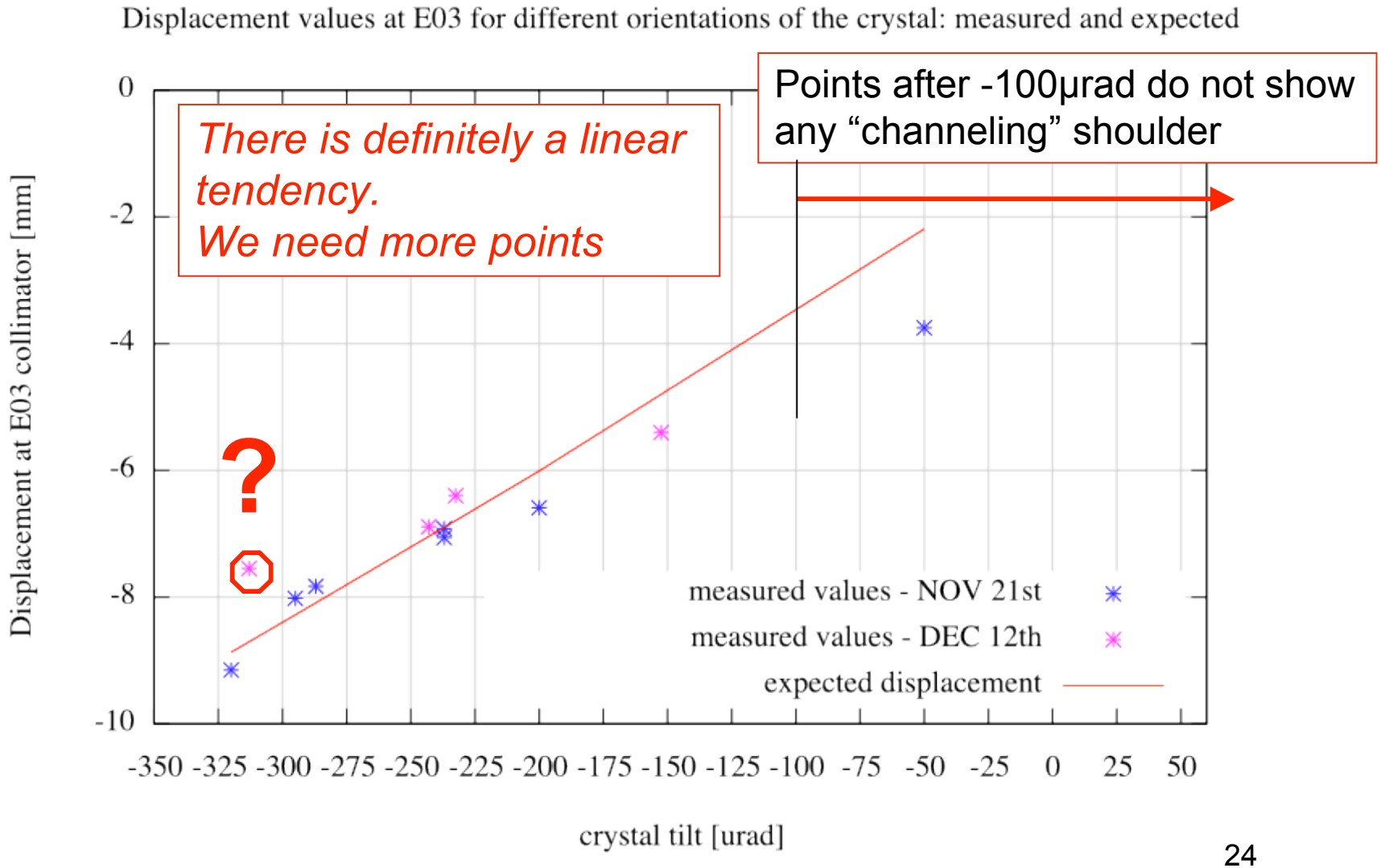
Collimator E03 scans

Bunched beam losses



Maybe some structure, the signal is low and NOT clear

Adding new points…



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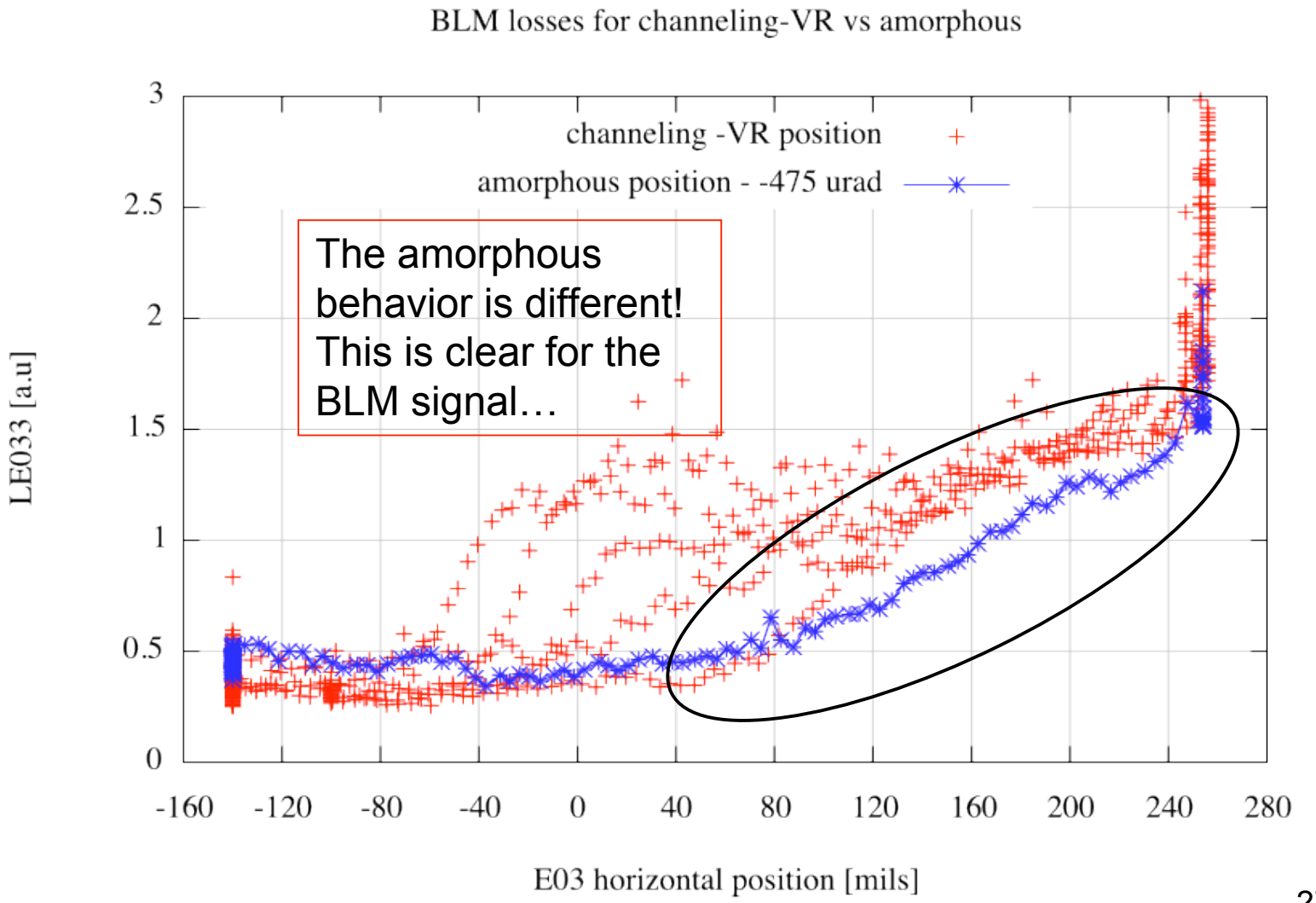
Investigate the '**slope**' region

What is the physical process which cause the 'slope' region at the end of the collimator scans?

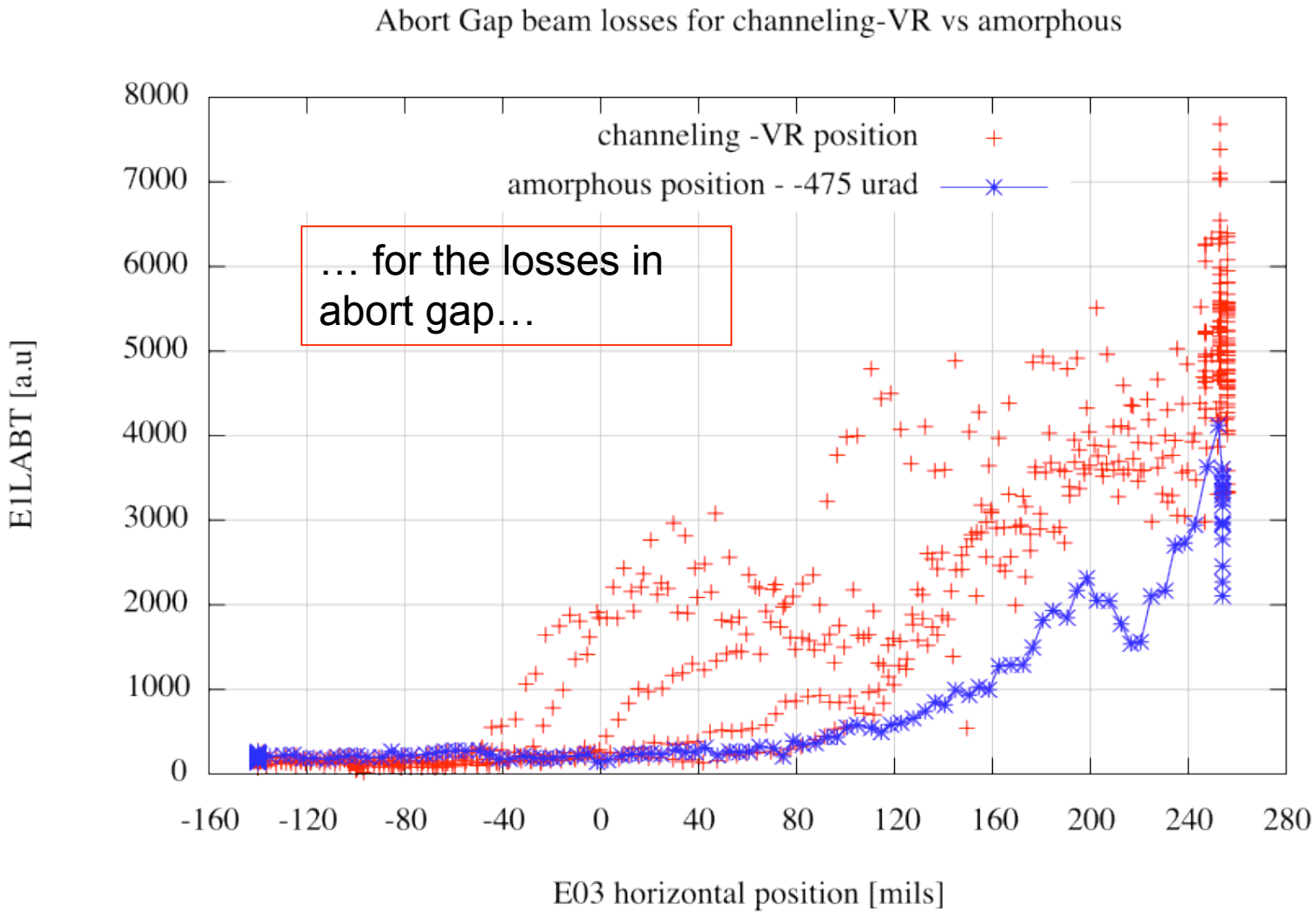
1. Is the 'slope' region due to the **amorphous** behavior of the 'amorphous' layer?
   - In this case, and according to the model of our crystal, the amorphous region should be larger for the crystal closer to 'pure channeling' position -> this is in contraddiction with our data.
2. Cannot be **channeling**: we have detected the channeling 'shoulder'!
3. Cannot be **dechanneling**: the dechanneling kick cannot be larger than the channeling kick!
4. Cannot be **single volume reflection**: the kick is too large (average of ~100 μrad)
5. Could it be **multiple volume reflection**?

Investigate the 'slope' region
BLM losses



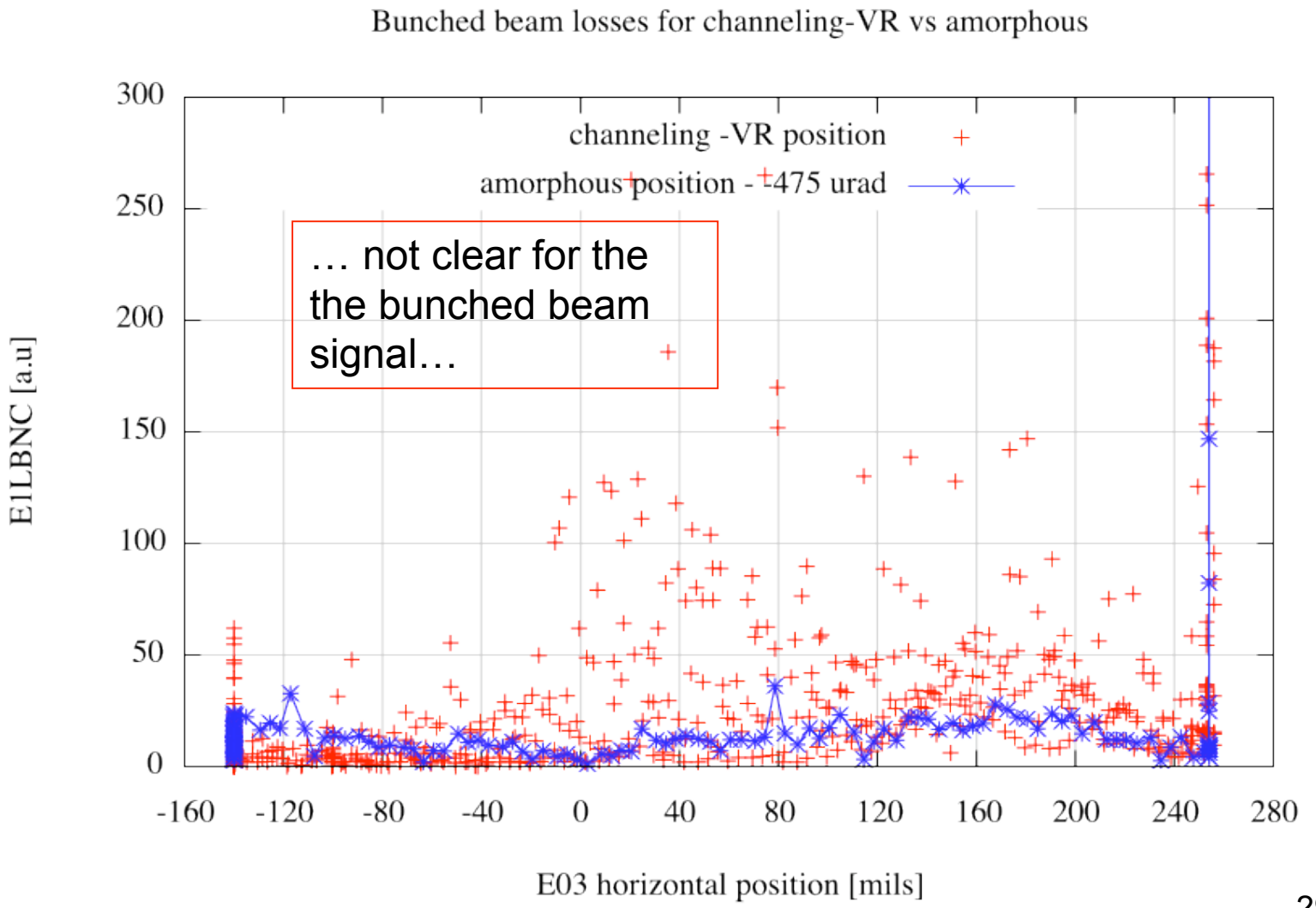
Investigate the 'slope' region

Abort gap beam losses



Investigate the 'slope' region

Bunched beam losses



conclusions

- The effect is clearly different from the amorphous scattering!
- The only hypothesis left is multiple volume reflection
- How to validate it?
  - Experimentally? (maybe verified by F172 collimator scan - see later in the presentation)
  - With simulations?

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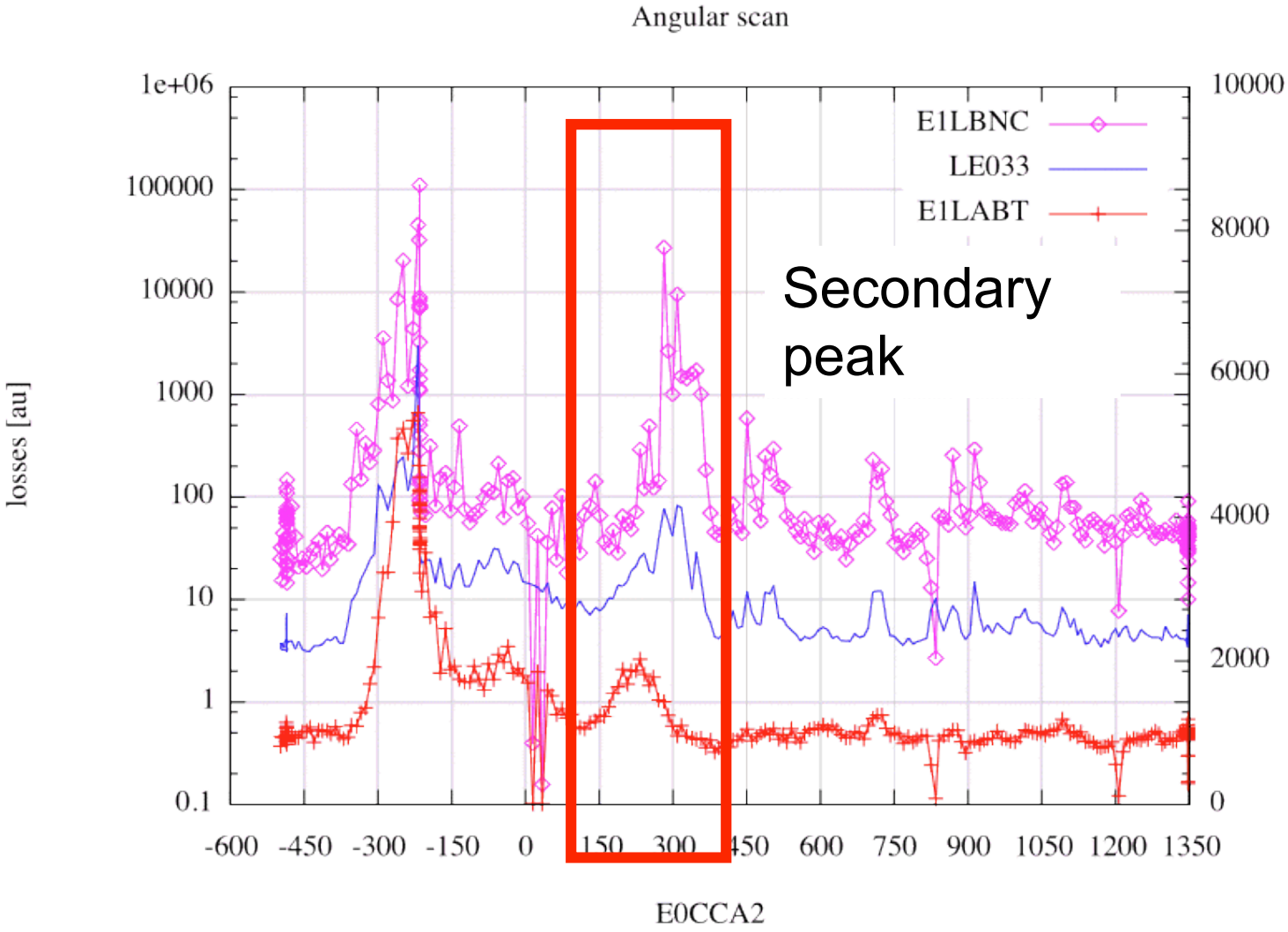
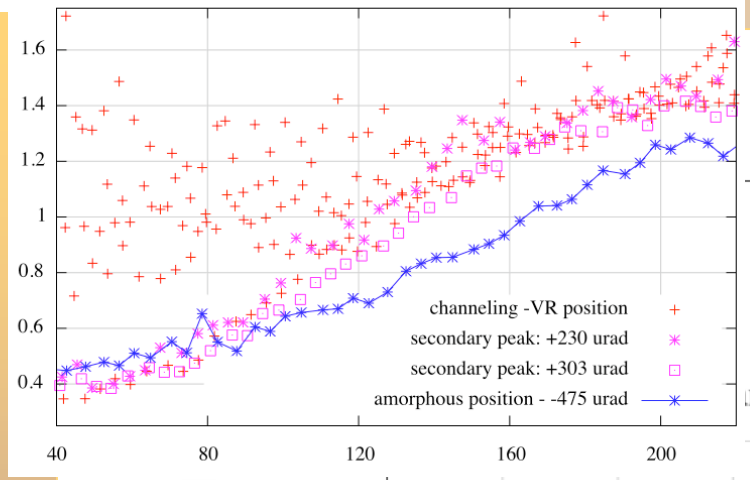
(old angular scan)

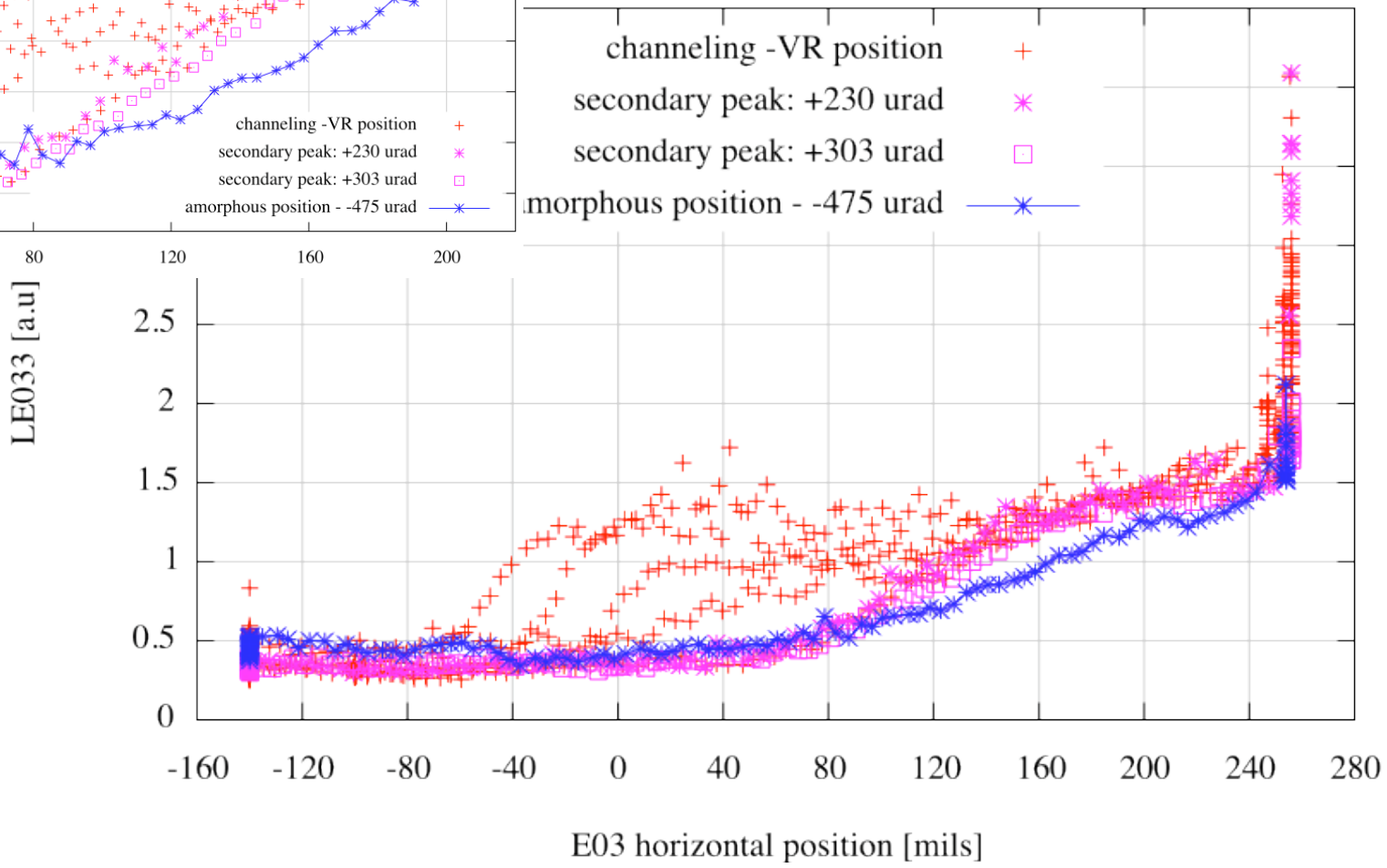


Investigate the secondary peak

E03 coll scan: BLM losses



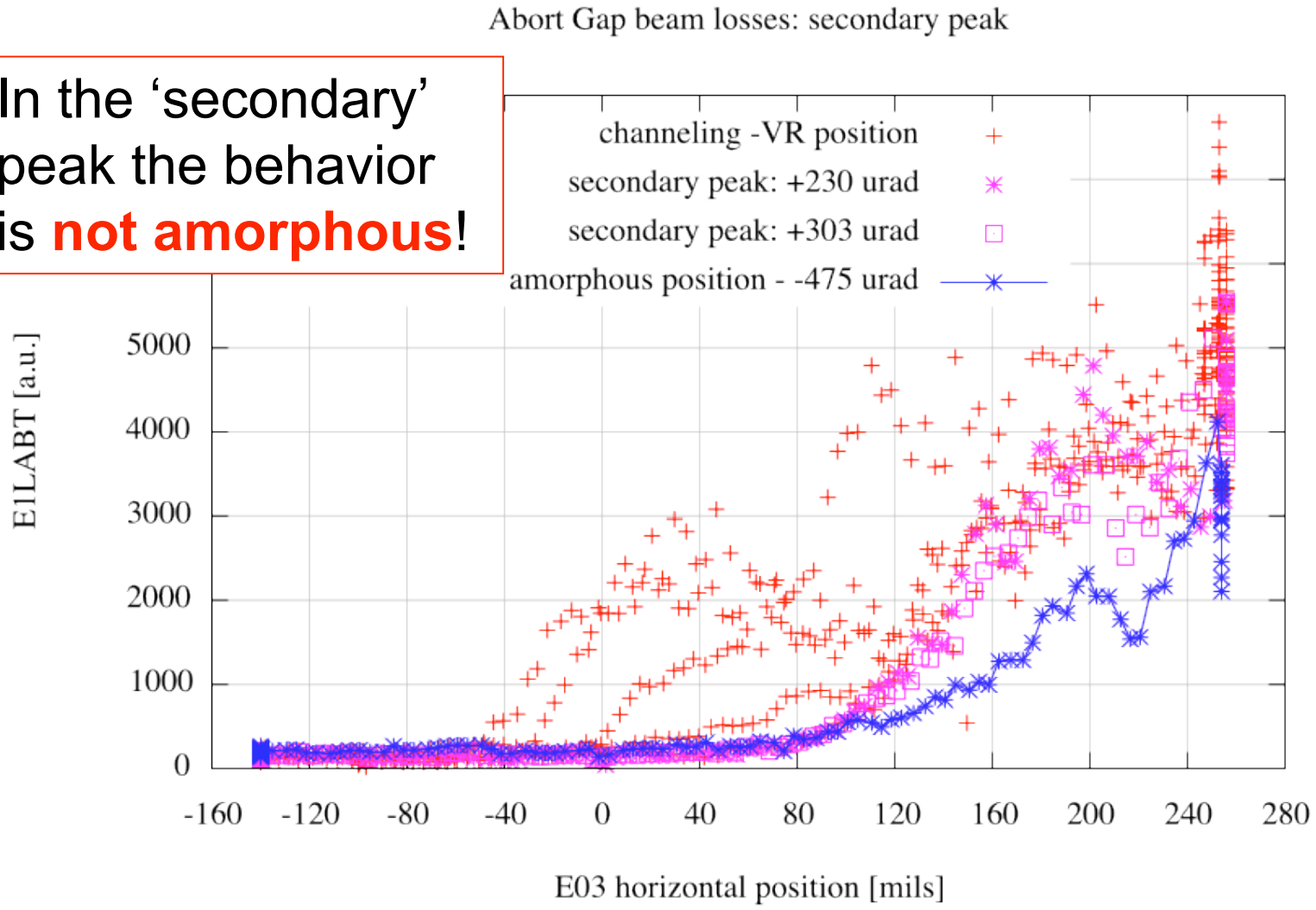
BLM losses: secondary peak



Investigate the secondary peak

E03 coll scan: DC beam losses

In the ‘secondary’ peak the behavior is **not amorphous**!



conclusion

- In the secondary peak at ~300 μrad there is evidence of some coherent effect in the crystal.
- Cold it be a secondary channeling peak? (with angle < 100 μrad, then covered by multiple VR)
- Is the VR region larger than expected? How is this possible? -> we need an exact geometrical description of the crystal.
- What happens in the middle? (between where we believe is the end of VR and the secondary peak). This should be investigated.

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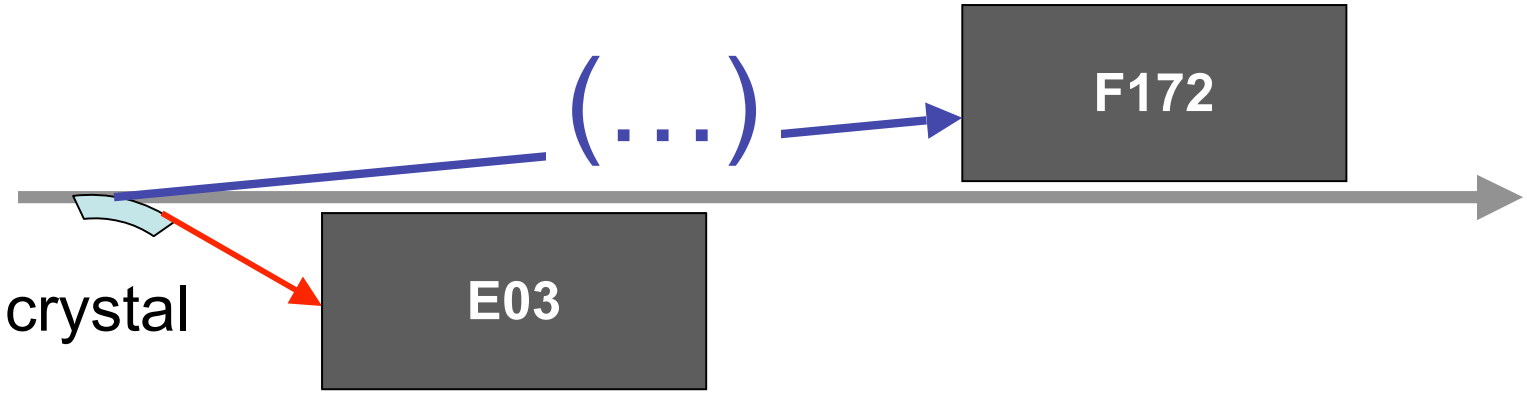
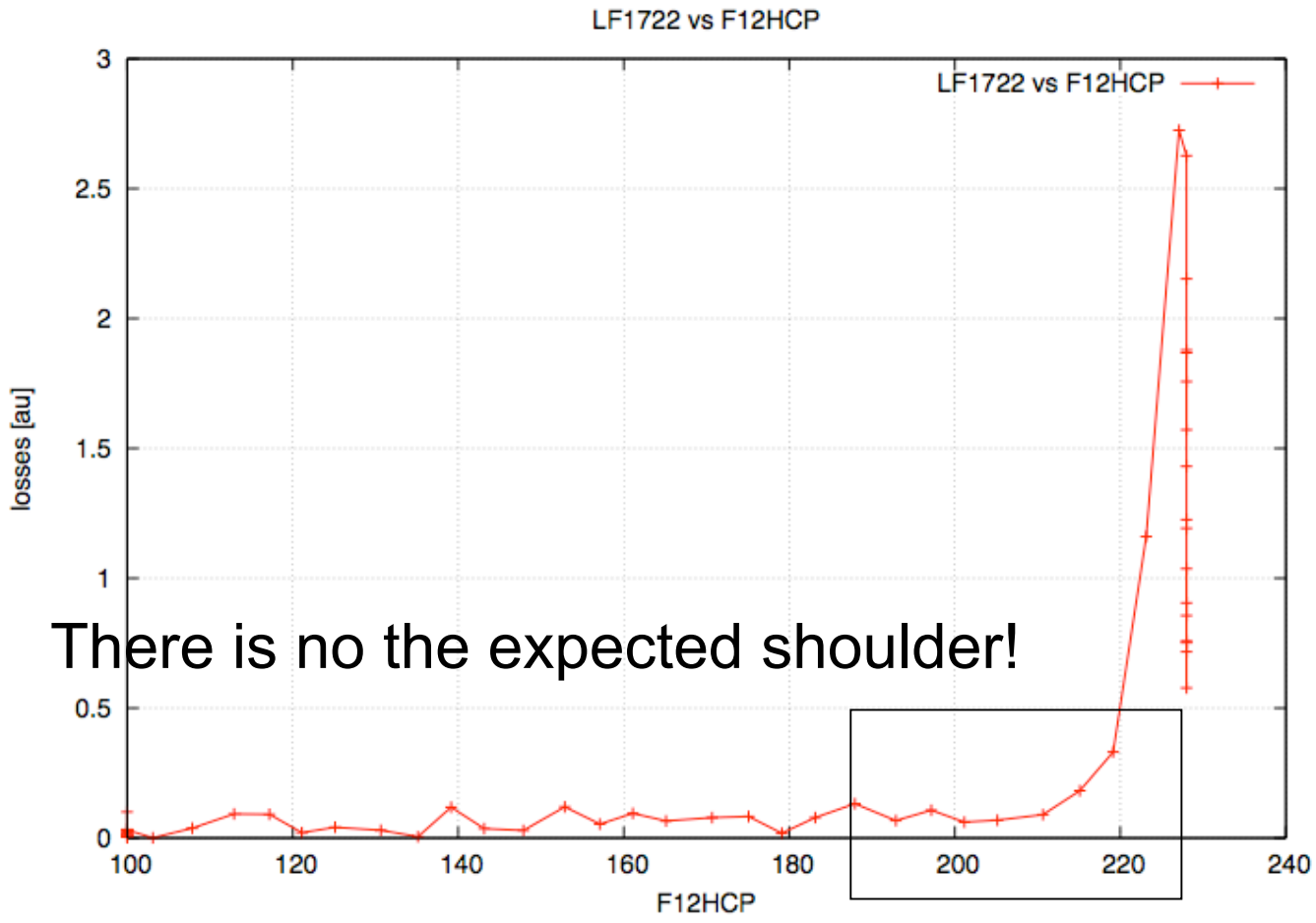
F172 collimator scan



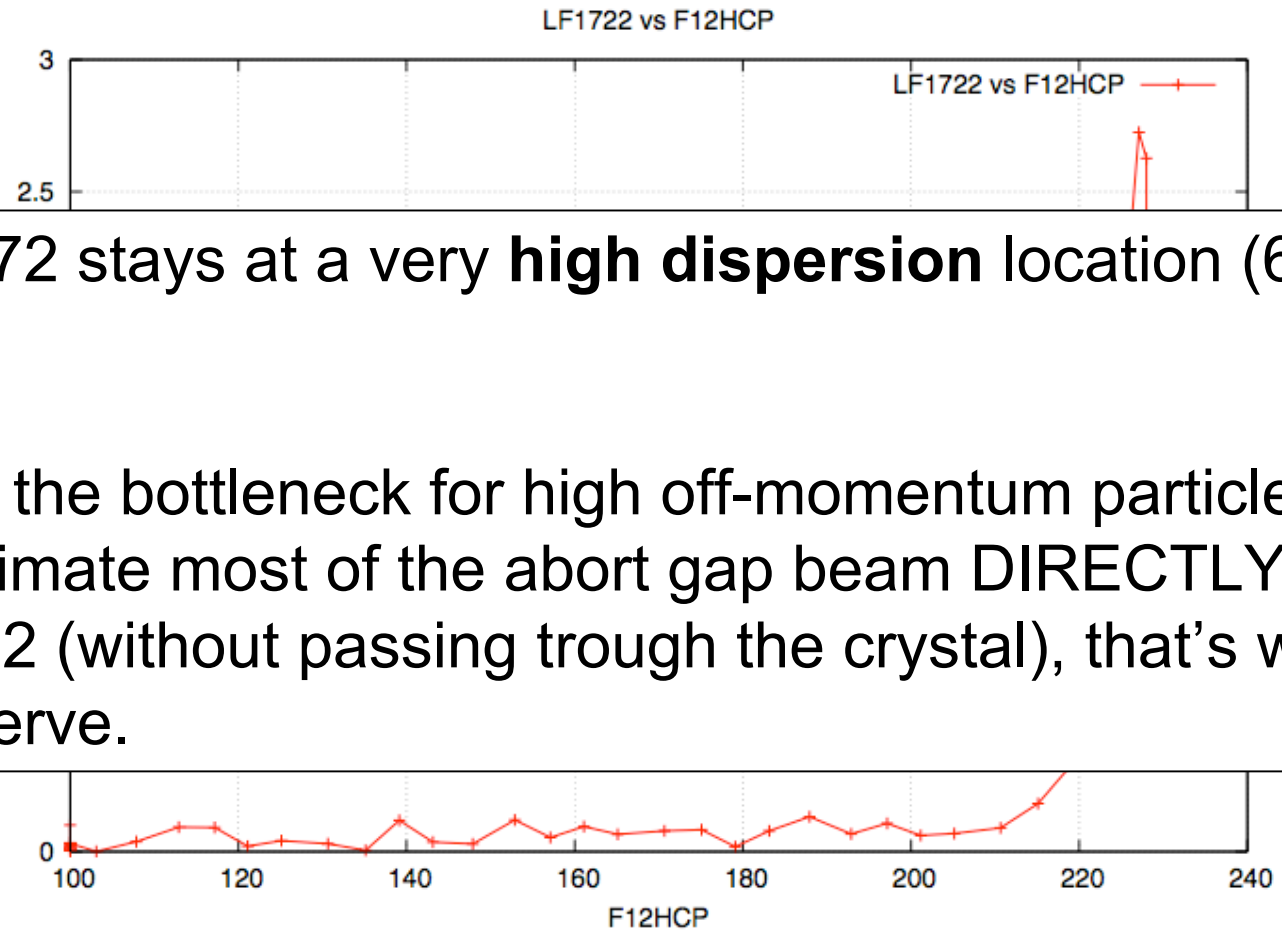
- In principle: try to collimate
  - the **channeled/volume captured** beam with E03
  - the **single VR beam** with F17
- The expected displacement at F17 for the VR beam is ~0.5-1mm
- We expected to see a decrease for losses in CDF: we actually saw an increase

F172 scan: results



There is no the expected shoulder!

F172 scan: results



The F172 stays at a very **high dispersion** location (6m!!)

$\Rightarrow$

F172 is the bottleneck for high off-momentum particles. We collimate most of the abort gap beam DIRECTLY with the F172 (without passing trough the crystal), that's what we observe.

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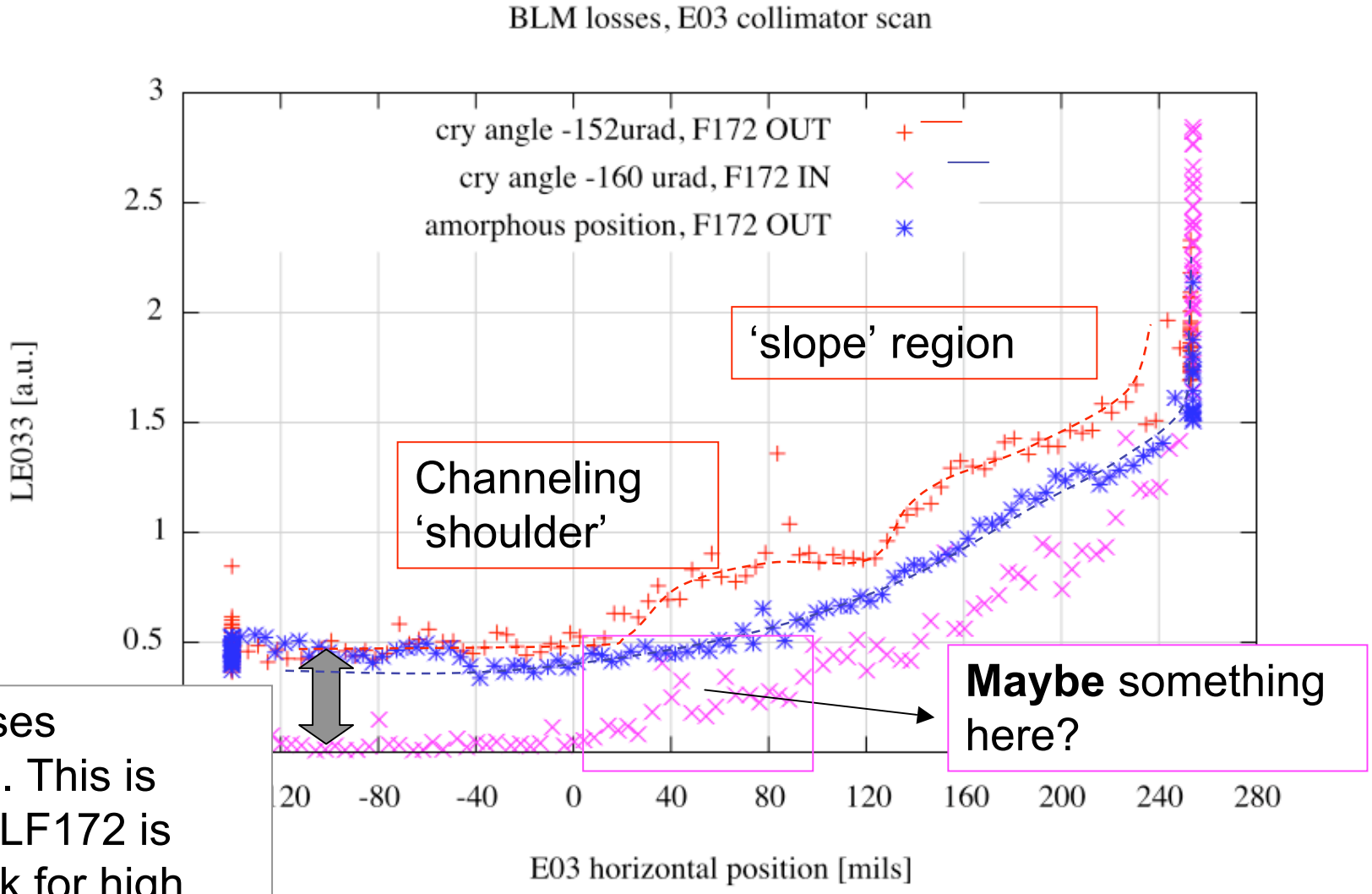
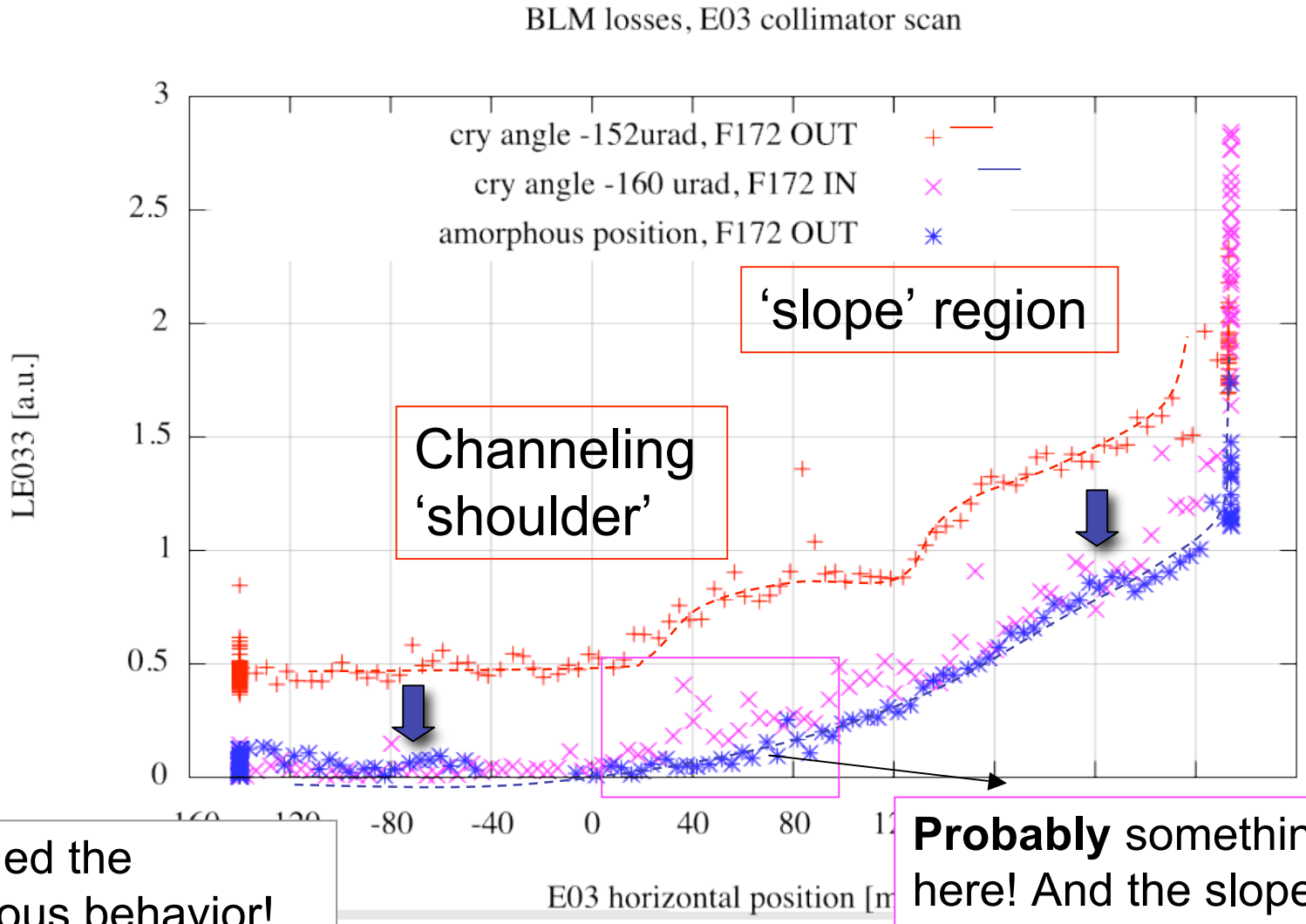
E03 collscan: F17 in/out



Total losses decrease. This is because LF172 is bottleneck for high off-momentum beam!

E03 collscan: F17 in/out



I re-scaled the amorphous behavior! (subtract the baseline)

Probably something here! And the slope-region disappeared.

Why this difference?

- Again: we collimate most of the abort gap beam DIRECTLY with the F172 (without passing trough the crystal).
  This would explain:
  - Why we it is much more difficult to see channeling
  - Why we see an increase of the losses in CDF
  - The pin diode seems to confirm this hypothesis!
    - F172 out: pin diode losses ~2500
    - F172 in: pin diode losses ~ 700
- Anyway, the slope region disappear! Probably it IS a multiple VR effect.

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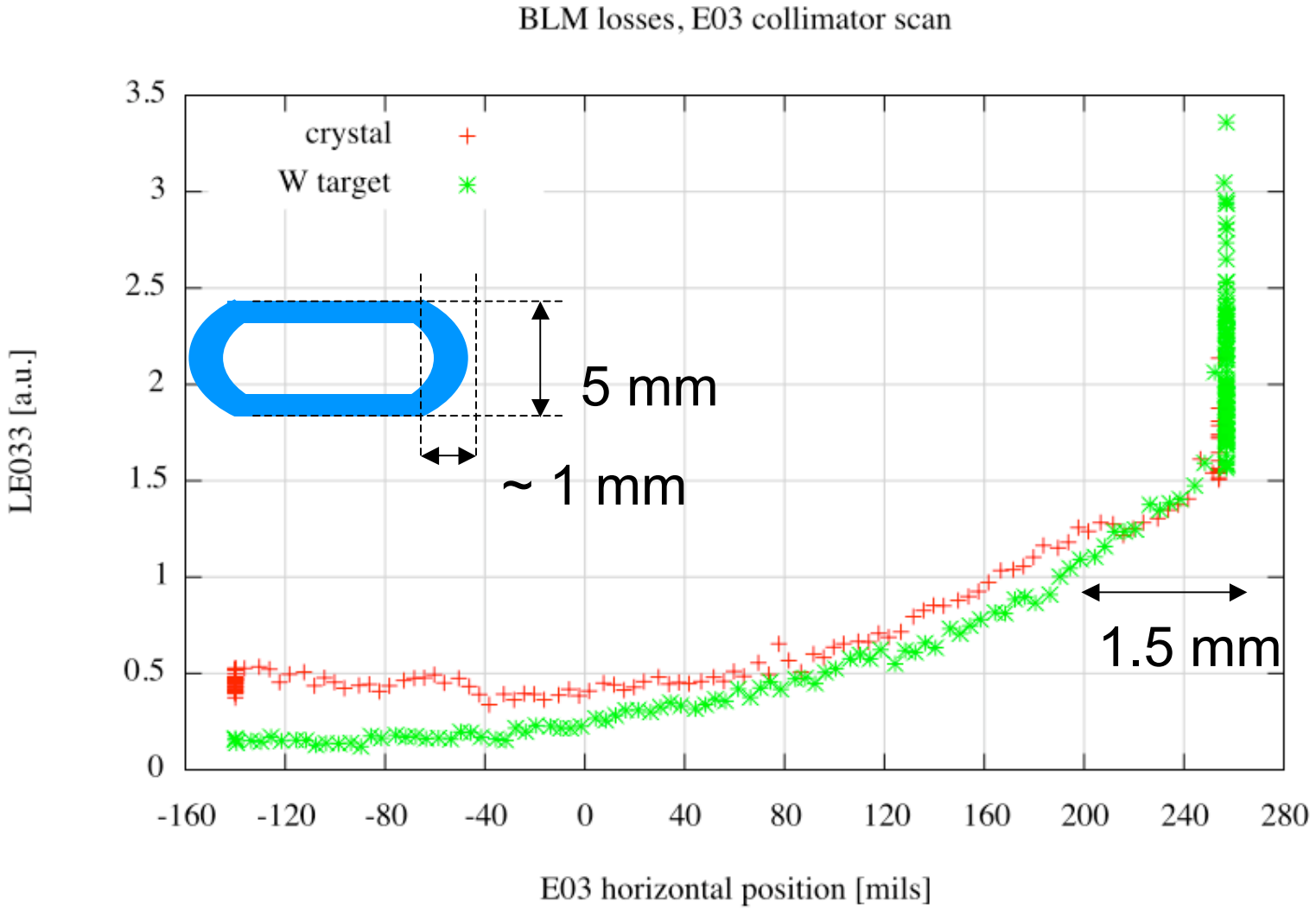
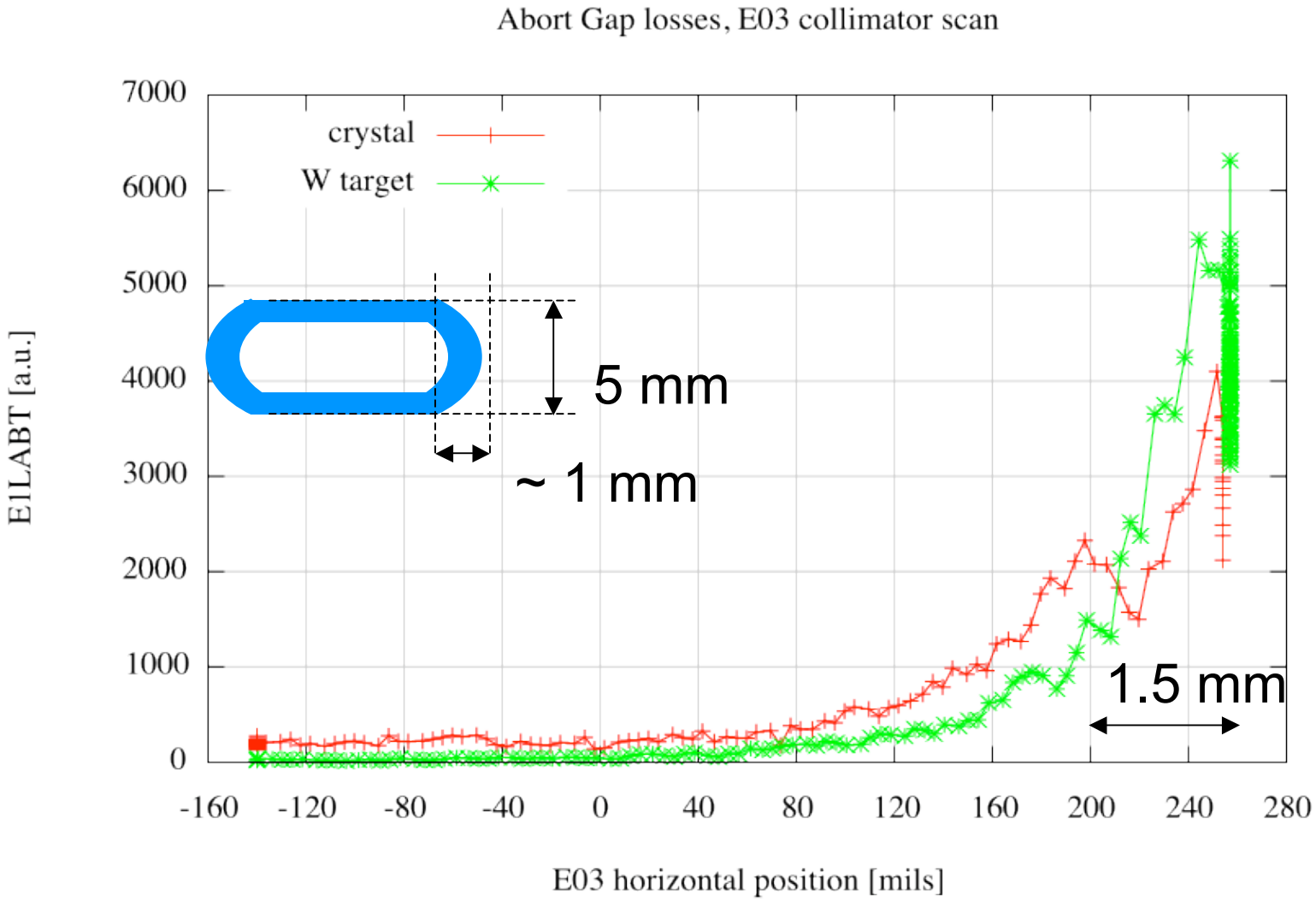
Amorphous: comparison Si-W



Amorphous: comparison Si-W



Yet to be done…

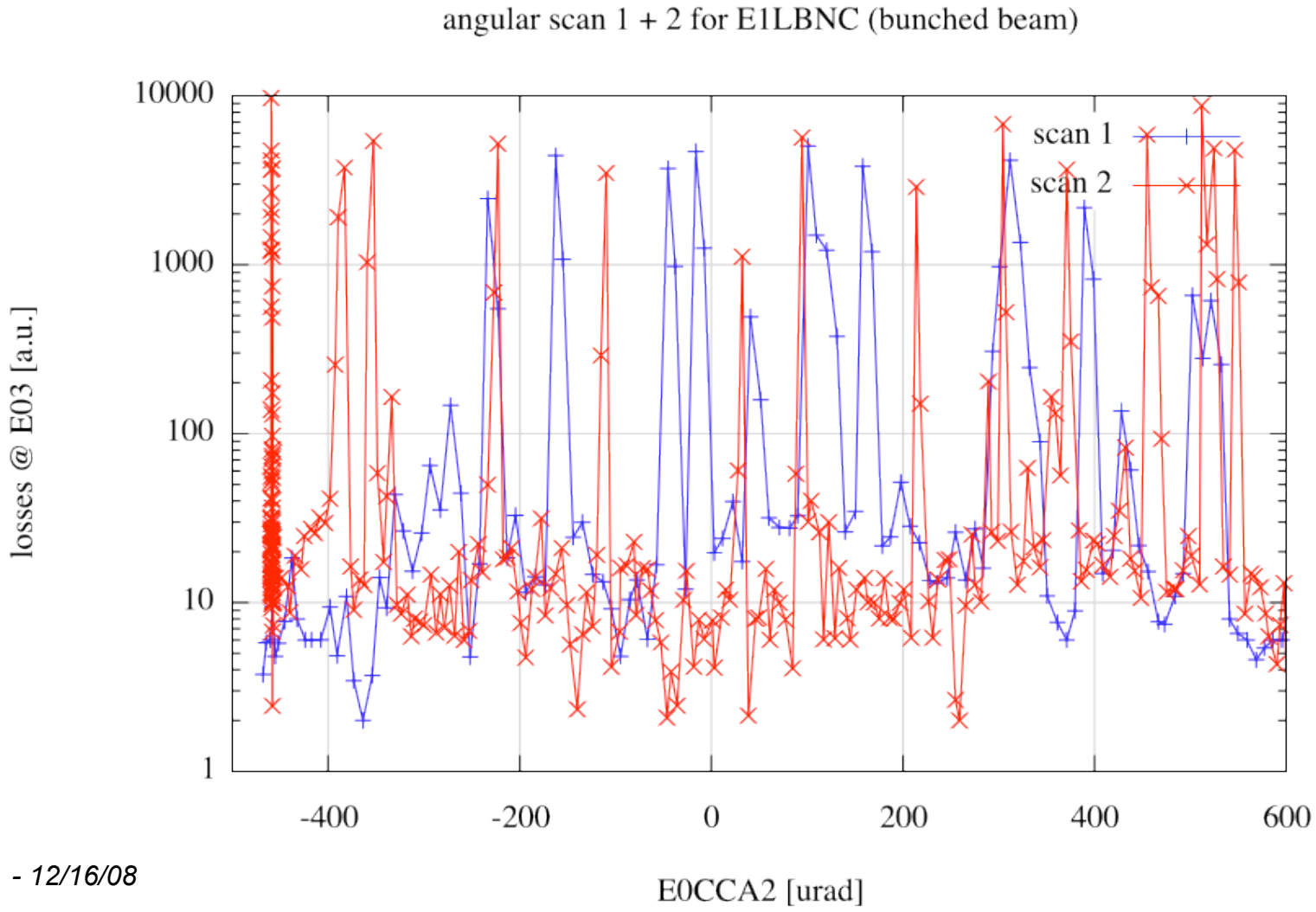
- Wider angular scan, check the velocity and the crystal position
- Some more points to complete and verify the angle-displacement curve
- Try again to insert F172 and make a collimator scan IN the maximum of channeling peak
- Switch off the elens and scrape the beam with E03
- Angular scan and collimator scan (if time with elens off)

… but most of all ...

- We need complete simulations to understand WHAT we observe and WHY. Possibly with syncrotron oscillation and the electron lens (or some kind of heating for abort gap beam) included…

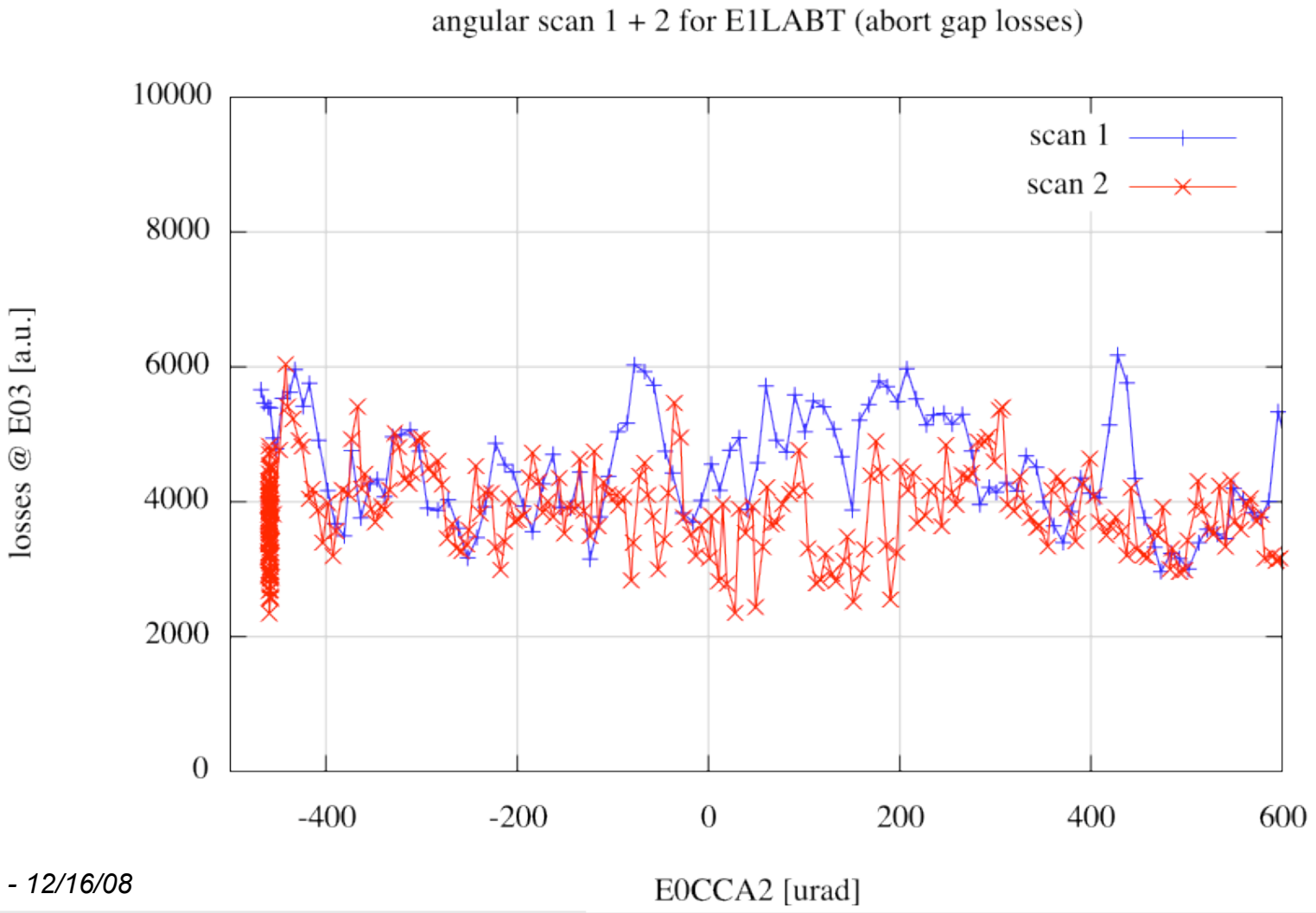
Angular scan - E1LBNC

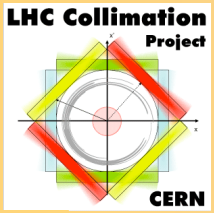
- These are the losses for the bunched beam…

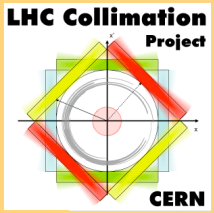


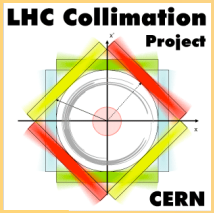
Angular scan - E1LABT

- And for the abort gap beam…




LHC Collimation
Project
CERN


LHC Collimation
Project
CERN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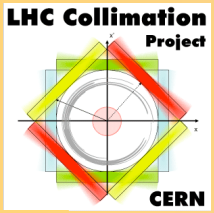
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CERN