Data reduction and analysis of SPS data

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FOR UA9 COLLABORATION

OUTLINE

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I. Synchronization
II. Alignment procedures
III. Qualitative analysis of dispersive area scans
IV. Conclusions

SYNCHRONIZATION

Problems:

• All the UA9's devices are logged in different ways:
  - ➢ Different acquisition time.

• Logging of machine parameter completely uncorrelated from all other acquisitions.

Solution:

✓ Take all the different files and make like a "tetris":

I. Choose the time range in which all the files have data.
II. Synchronization of the all data by Unix Timestamp.

SYNCHRONIZATION

What the synchronization program does:

- ✓ Starts from the higher initial Timestamp.
- ✓ Writes every parameter in a ROOT file every second.
- ✓ When data are not present, they are replaced with the previous acquisition.
- ✓ Stops at the lower final Timestamp.

File 1	File 2
12:40:00	
12:40:01	12:40:01
	12:40:02
12:40:03	12:40:03

ROOT file

12:40:01	12:40:01	12:40:01
12:40:02	12:40:01	12:40:02
12:40:03	12:40:03	12:40:03

After that we have a synchronized ROOT file containing:

- ➢ Acquisition time.
- ➢ Acquisitions of all the detectors (Scintillators, GEM, BLM,...)
- ➢ Positions of all mobile devices (Crystal, Collimator, Absorber,...)
- ➢ All the SPS parameters (Beam Intesity, Tune, Orbit,...)

We have the complete knowledge of what happened in SPS and in UA9 apparatus: we can make all the correlation plots that we need!

OUTLINE

What we have:
Position measured from garage position

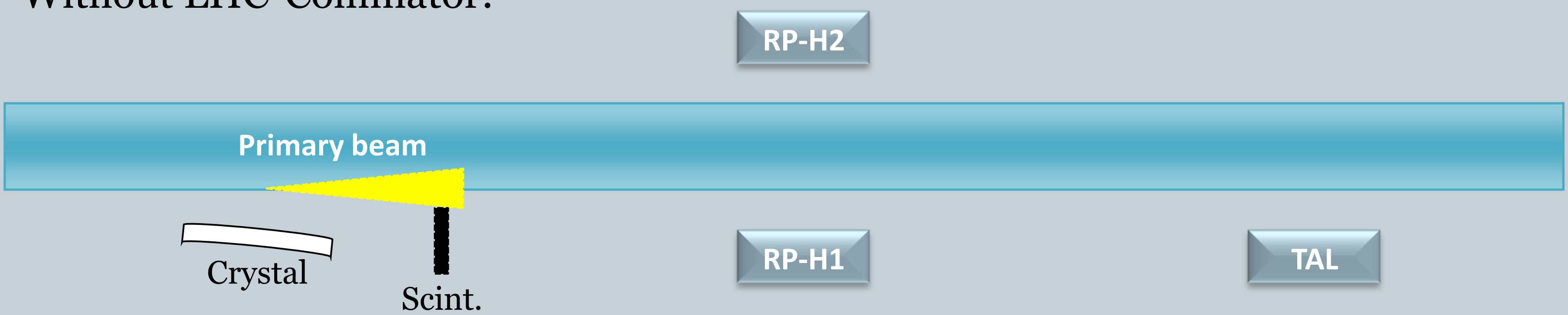
What we want:
Relative position from the beam

Needed a alignment with respect to the beam

ALIGNMENT

Two different procedures depending on the presence or not of the LHC-Collimator.

Without LHC-Collimator:



Go beyond the absorber shadow
↓
Local losses increase

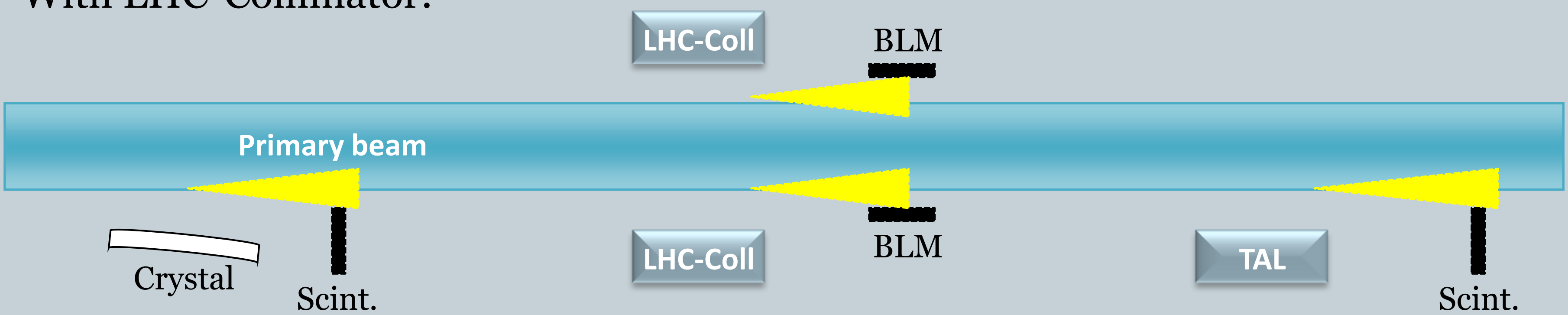
Same picture on Medipix
↓
Same distance from closed orbit

See the shadow on Medipix

ALIGNMENT

Two different procedures due to the presence or not of the LHC-Collimator.

With LHC-Collimator:



Same losses
⬇
Same distance from closed orbit

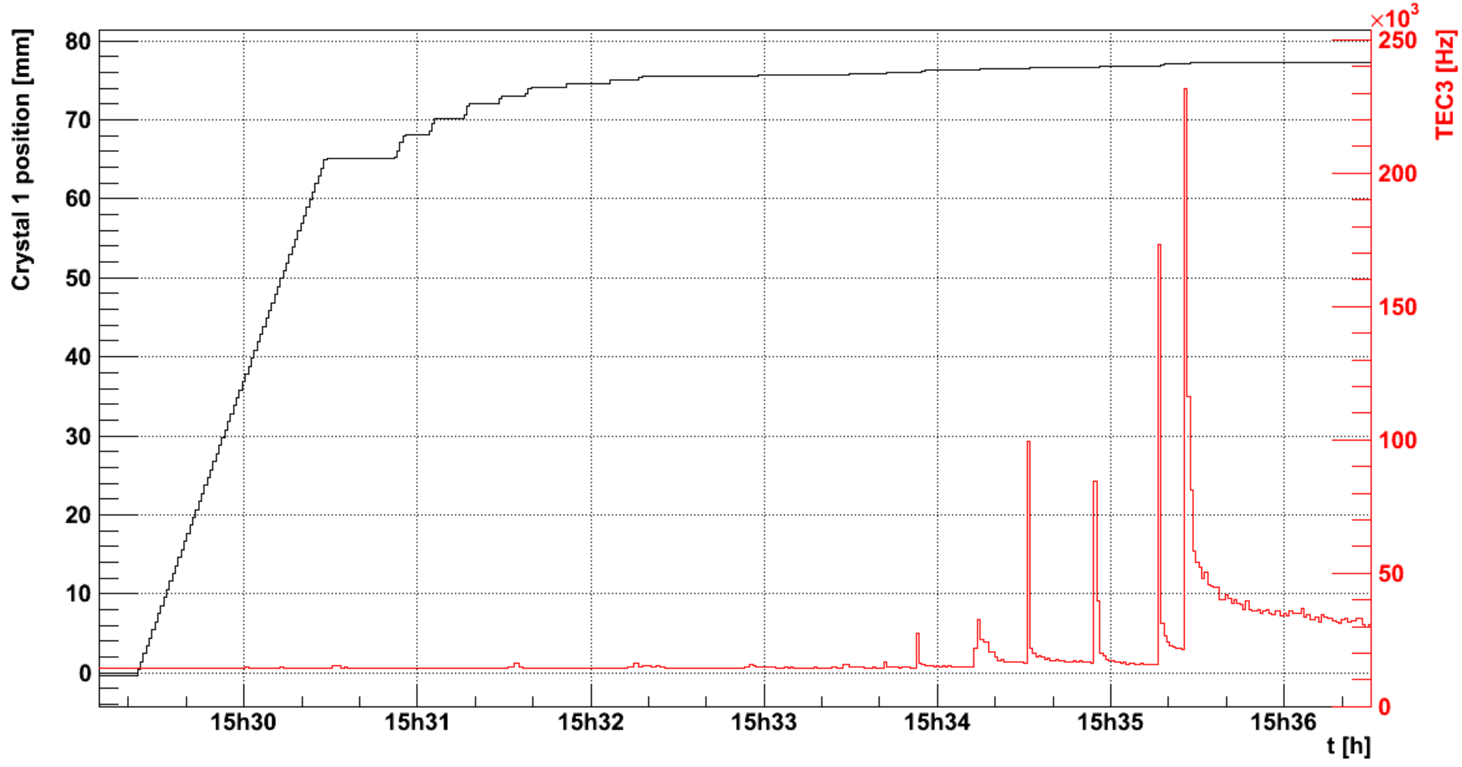
Go beyond the LHC-Collimator shadow
⬇
Local losses increase

Basic configuration after the alignment:

- ➢ Insert crystal 0.5mm inside respect the alignment position.
- ➢ Retract absorber of channeled beam of 1.5mm respect the alignment position.

ALIGNMENT

Example of crystal alignment with LHC-Collimator:



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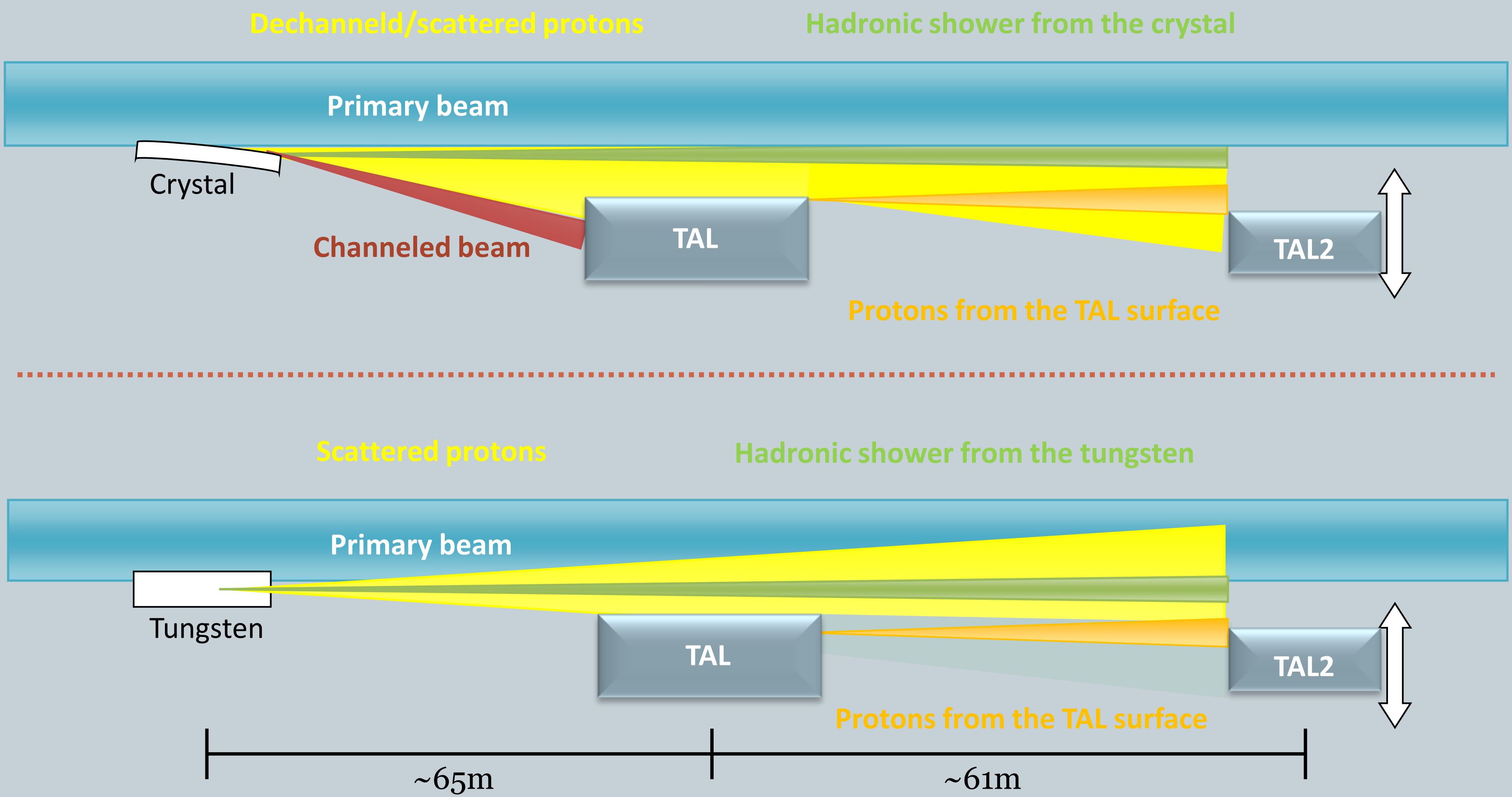
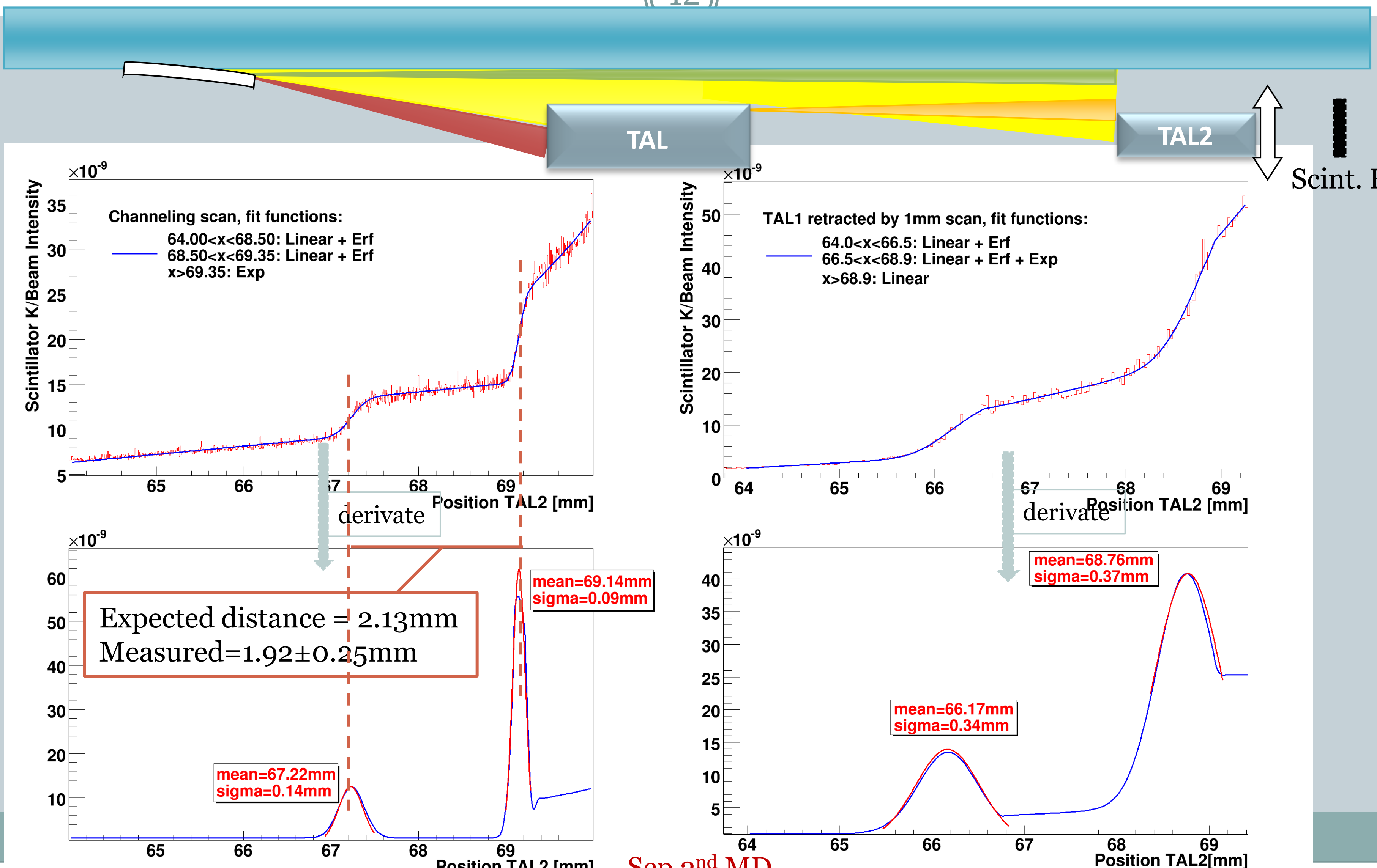
What is the effect of the collimation process, on the shape of beam?

→ Beam tails scan

DISPERSIVE AREA SCANS

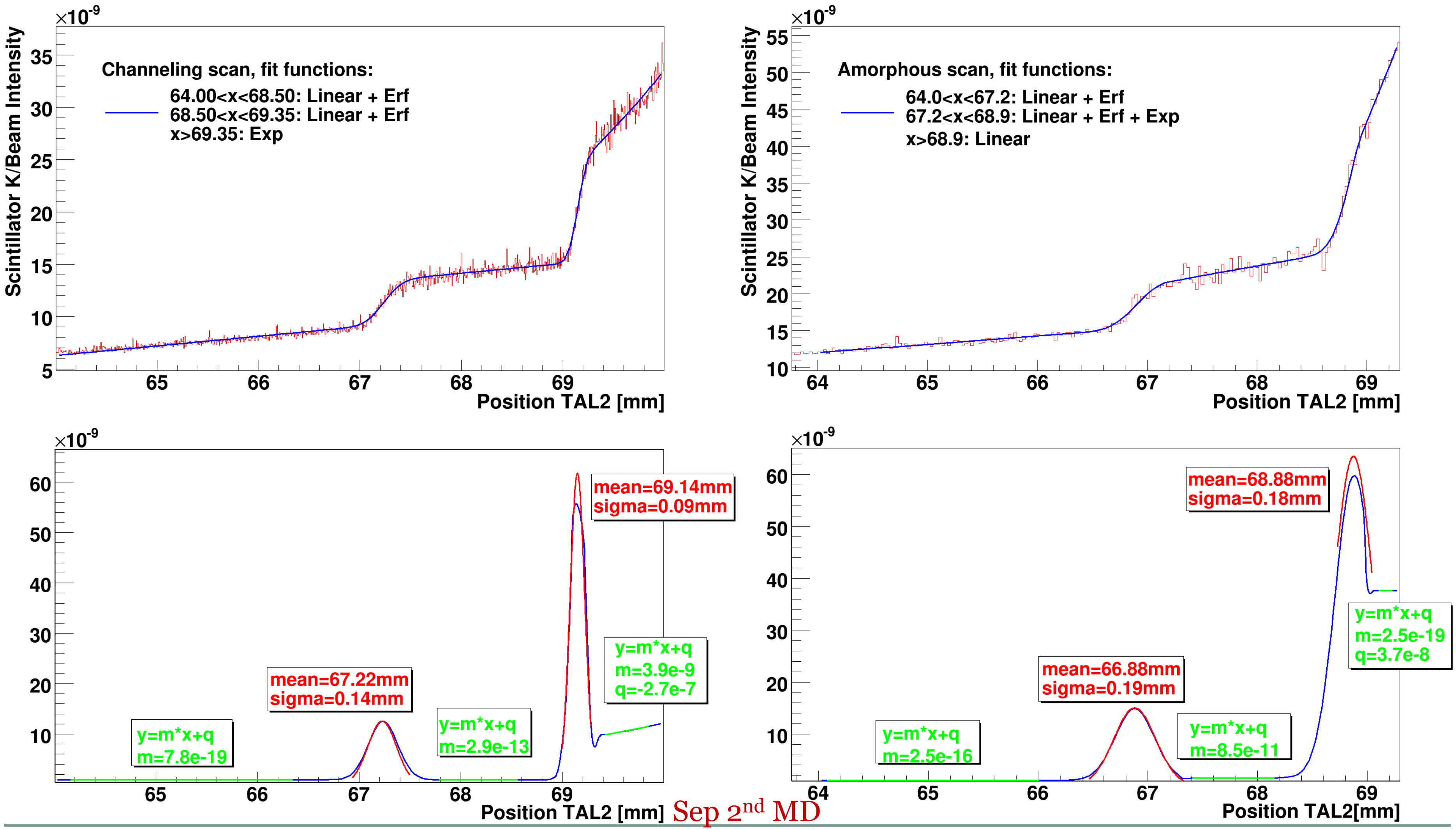


DISPERSIVE AREA SCANS



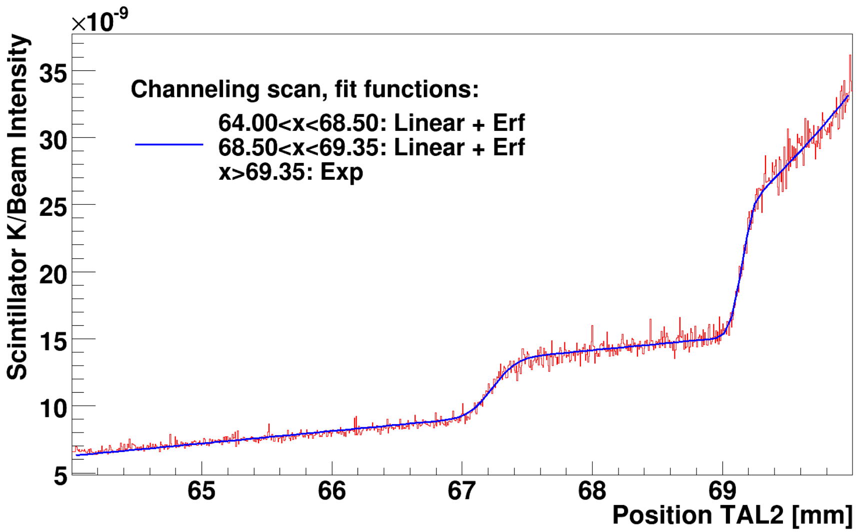
Sep 2nd MD

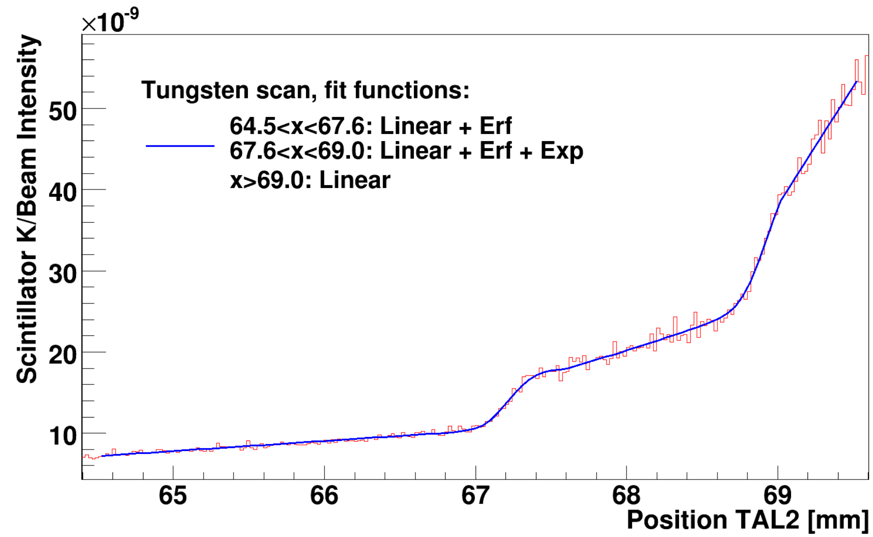
DISPERSIVE AREA SCANS

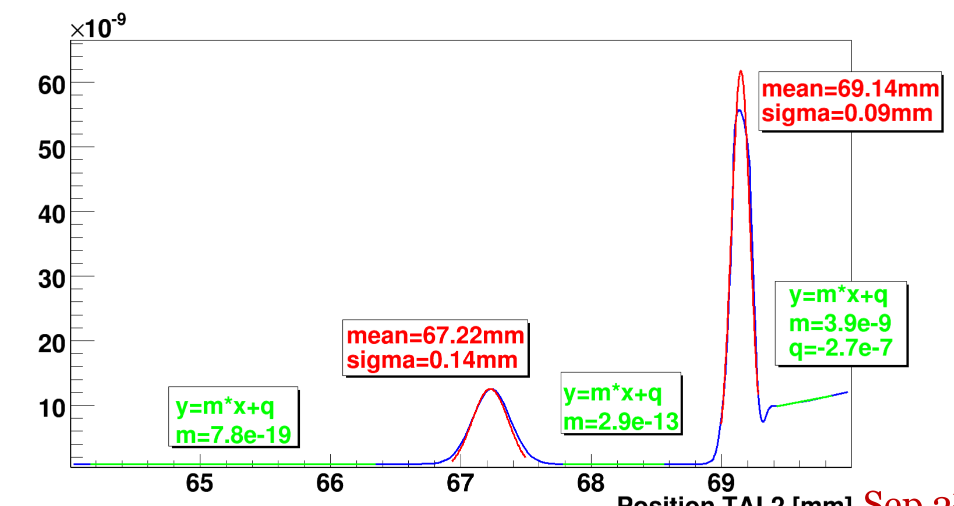


Sep 2nd MD

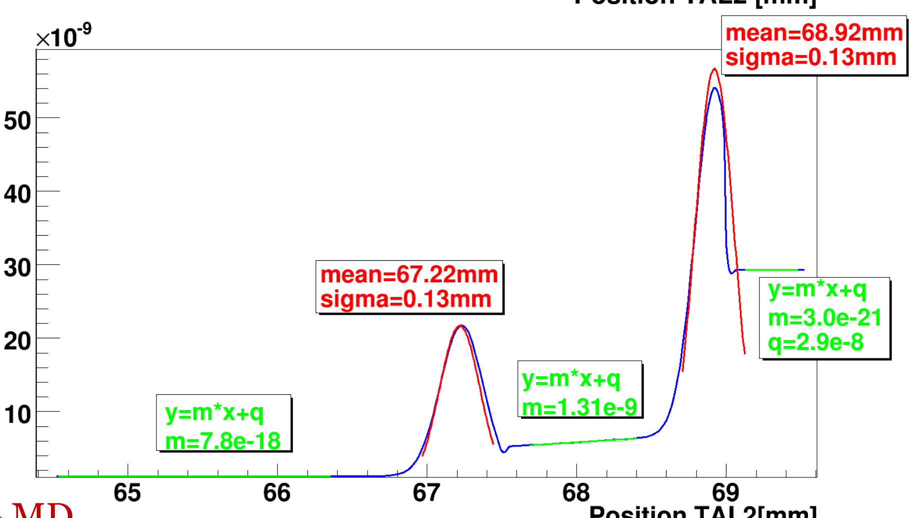
DISPERSIVE AREA SCANS







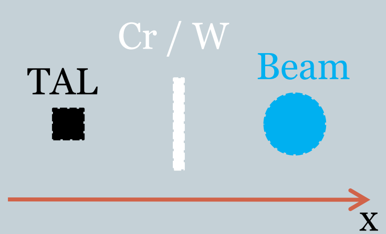
Sep 2nd MD



DISPERSIVE AREA SCANS

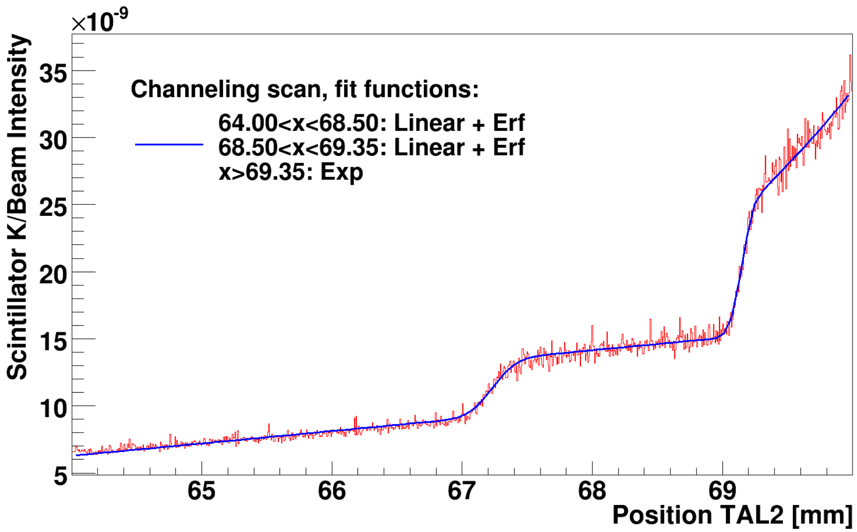
Derivative slope %	Before TAL	Between TAL & Crystal	Between Crystal & Beam
Channeling	$< 10^{-9}$	$3 \cdot 10^{-4}$	3.9
Amorphous	$< 10^{-6}$	0.1	$< 10^{-9}$
Tungsten	$< 10^{-8}$	1.3	$< 10^{-11}$

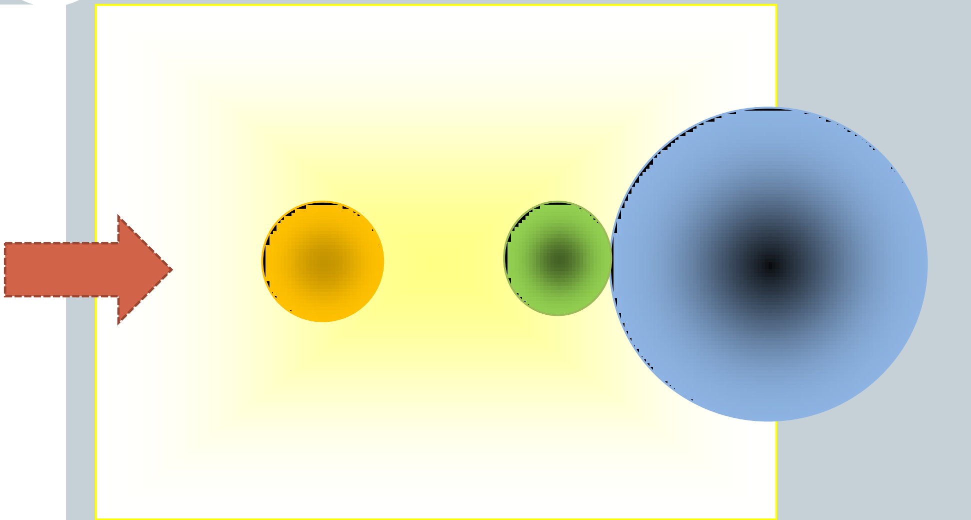
Normalized particles density (10^{-9})	Before TAL	After TAL	After Crystal
Channeling	0.9	0.9	10
Amorphous	1	1.5	37
Tungsten	1.2	5.4	29

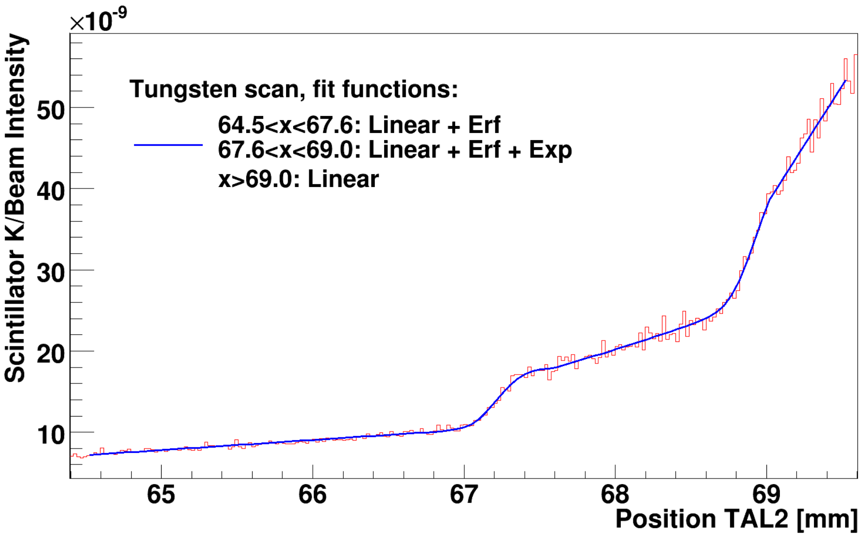


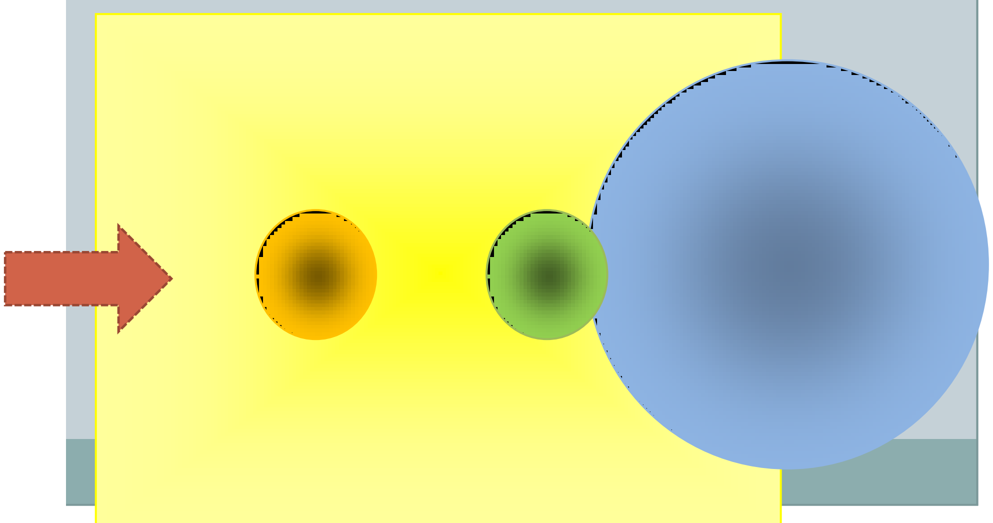
Normalized counts after Crystal (10^{-9})	
Channeling	25
Amorphous	40
Tungsten	40

DISPERSIVE AREA SCANS









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CONCLUSIONS

✓ With this synchronization program, we have the complete picture of what happen during the run, second by second.

✓ The alignment procedure is crucial and challenging: we developed two methods (with or without LHC-Collimator) to align the devices with a good precision in every condition.

✓ First qualitative analysis of the dispersive area scans, shows that with crystal collimation we seems have a more clean and definite beam, with respect to amorphous collimation.

For the future:

➢ Do an online synchronization during data taking.
➢ Collect more dispersive area scans, also with a larger range.
➢ Do a FLUKA simulation for dispersive area scans.

ALIGNMENT

Two different procedures due to the presence or not of the LHC-Collimator.

Without LHC-Collimator:

1. Close both sides (one at time) of the Roman Pot.
2. Close the absorber of channeled beam.
3. Open both Roman Pot sides. Absorber stays in the same position.
4. Approach the beam with one mobile device.
5. Retract the device.
6. Repeat points 4 & 5 for each mobile device.

Same picture on Medipix

↓

Same distance from closed orbit

See the shadow on Medipix

Cross the absorber shadow

↓

Local losses increase

Basic configuration after the alignment:

- Insert crystal 1mm inside respect the alignment position.
- Retract absorber of channeled beam of 2mm respect the alignment position.

ALIGNMENT

With LHC-Collimator:
1. Close both jaws (one at time) until they touch the beam.
2. LHC-Collimator stays closed.
3. Approach the beam with one mobile device.
4. Retract the device.
5. Repeat points 3 & 4 for each mobile device.
6. Open completely both jaws of LHC-Collimator.

Same losses

Same distance from closed orbit

Cross the LHC-Collimator shadow

Local losses increase

For a better estimation of the alignment position during the offline analysis we need few little steps (~100μm) after touching the beam.