DIAGNOSTICS SYSTEMS & RESULTS

on behalf of the Diagnostics Group :

Nicolas Benoist
Friederike Ewald
Eric Plouviez leaving this year
Julien Poitou left
Benoit Roche
Kees Scheidt
Fouhed Taoutaou
Laura Torino left
Franck Uberto leaving this year

BPMs

BLMs

Emittance Monitors

Tune Monitors

Current Transformers

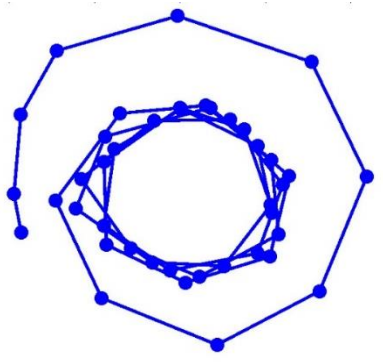
Screen Monitors

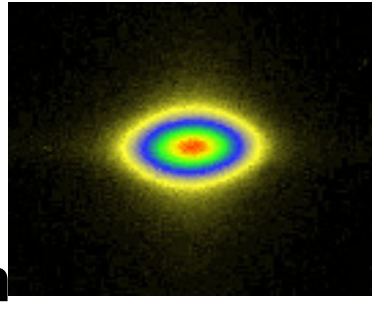
Visible Light extraction

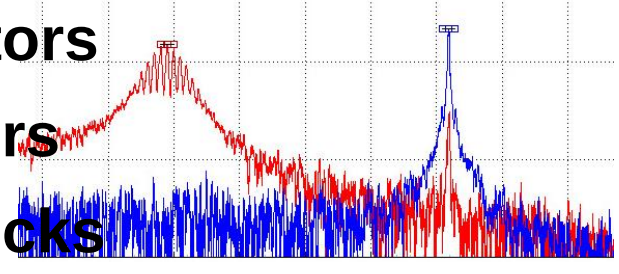
Scrapers, Collimators

Striplines & Shakers

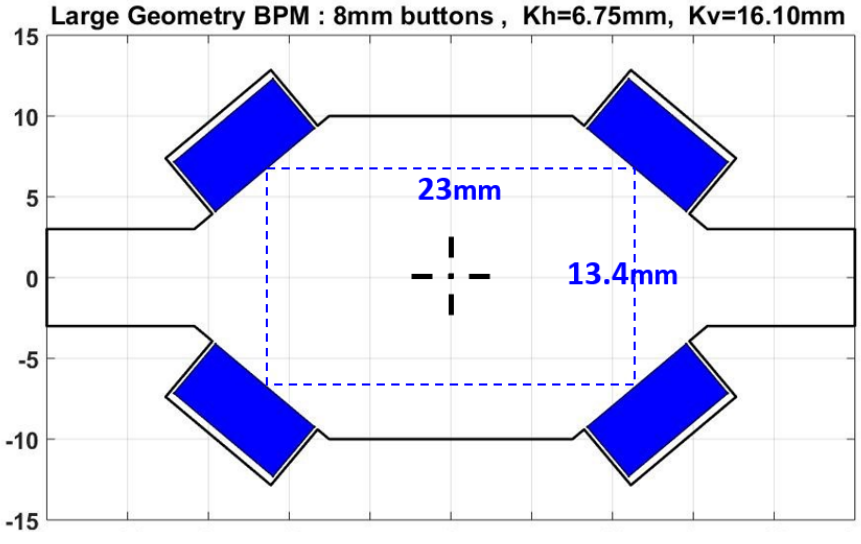
Feedbacks, Interlocks

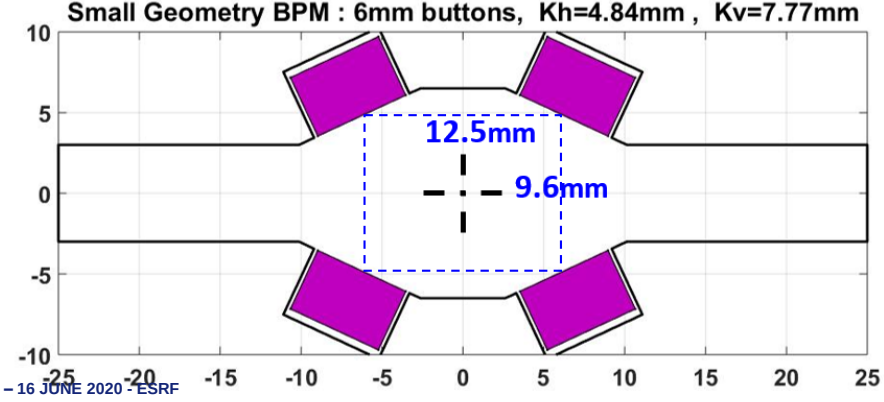






BPM



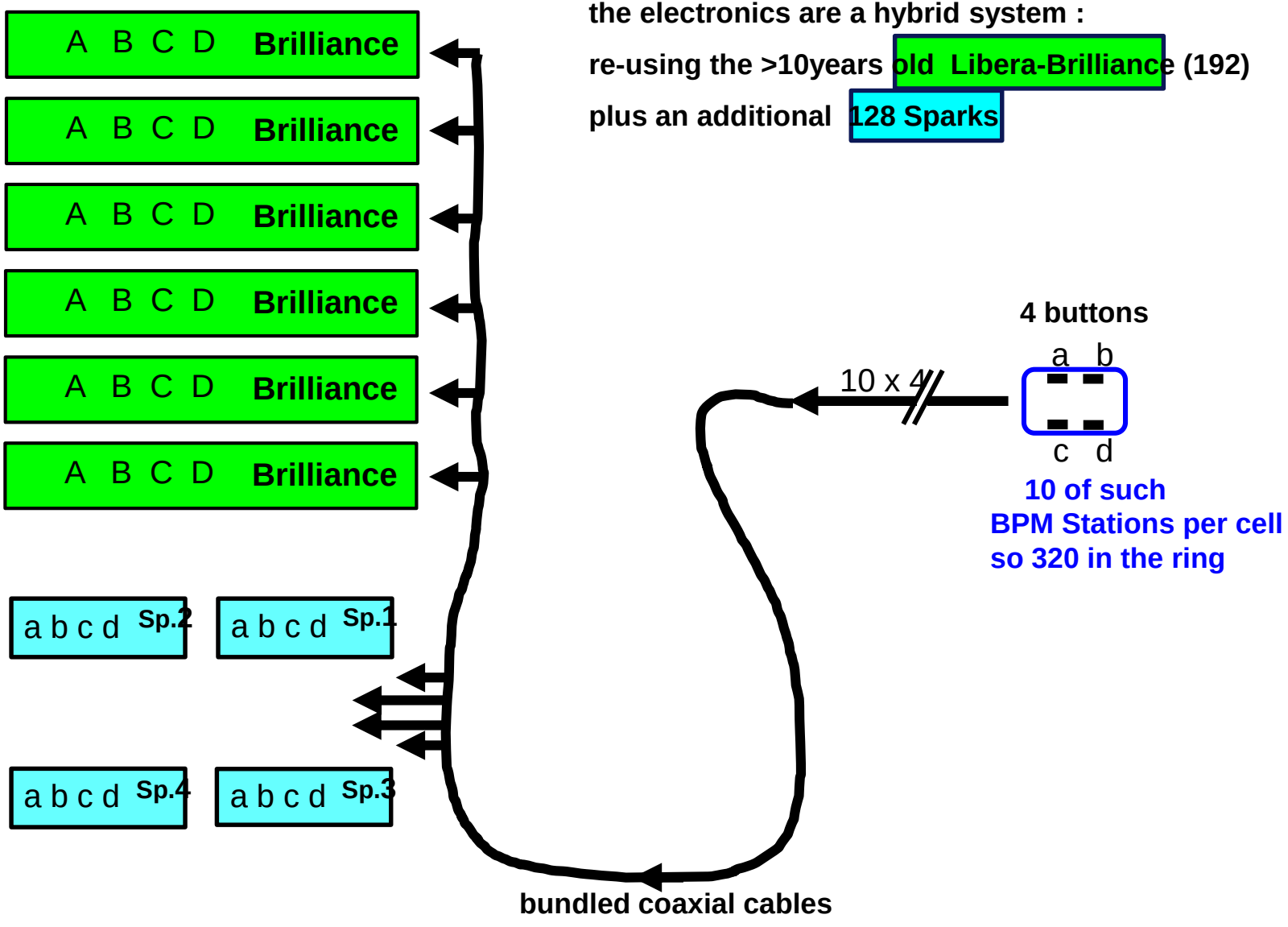


6 Large Geometry BPM Stations per cell

 # 1 2 3 8 9 10

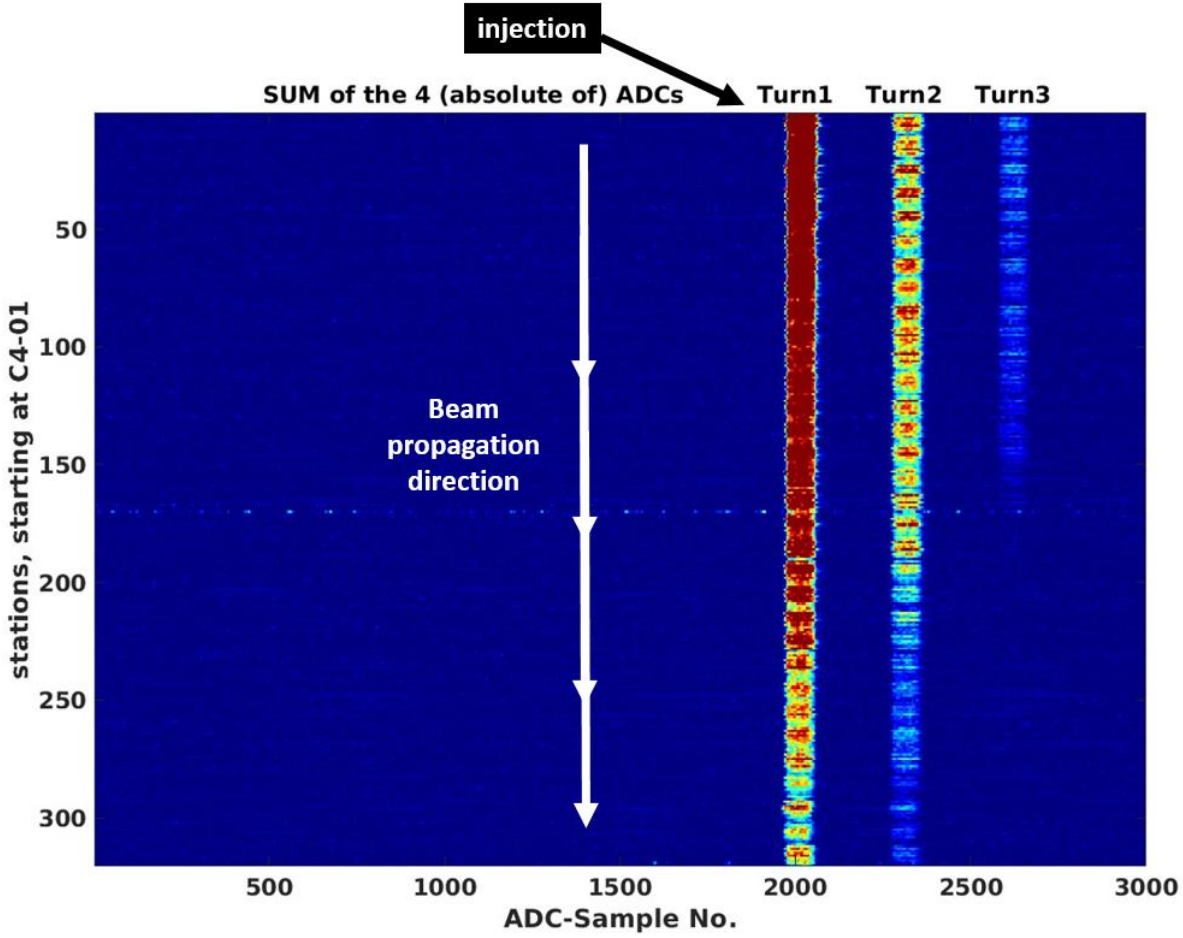
4 small Geometry BPM Stations per cell

 # 4 5 6 7


A B C D Brilliance
A B C D Brilliance
A B C D Brilliance
A B C D Brilliance
A B C D Brilliance
A B C D Brilliance
a b c d Sp.2
a b c d Sp.1
a b c d Sp.4
a b c d Sp.3
the electronics are a hybrid system :
re-using the >10years old Libera-Brilliance (192)
plus an additional 128 Sparks
4 buttons
a b
c d
10 x 4
10 of such
BPM Stations per cell
so 320 in the ring
bundled coaxial cables

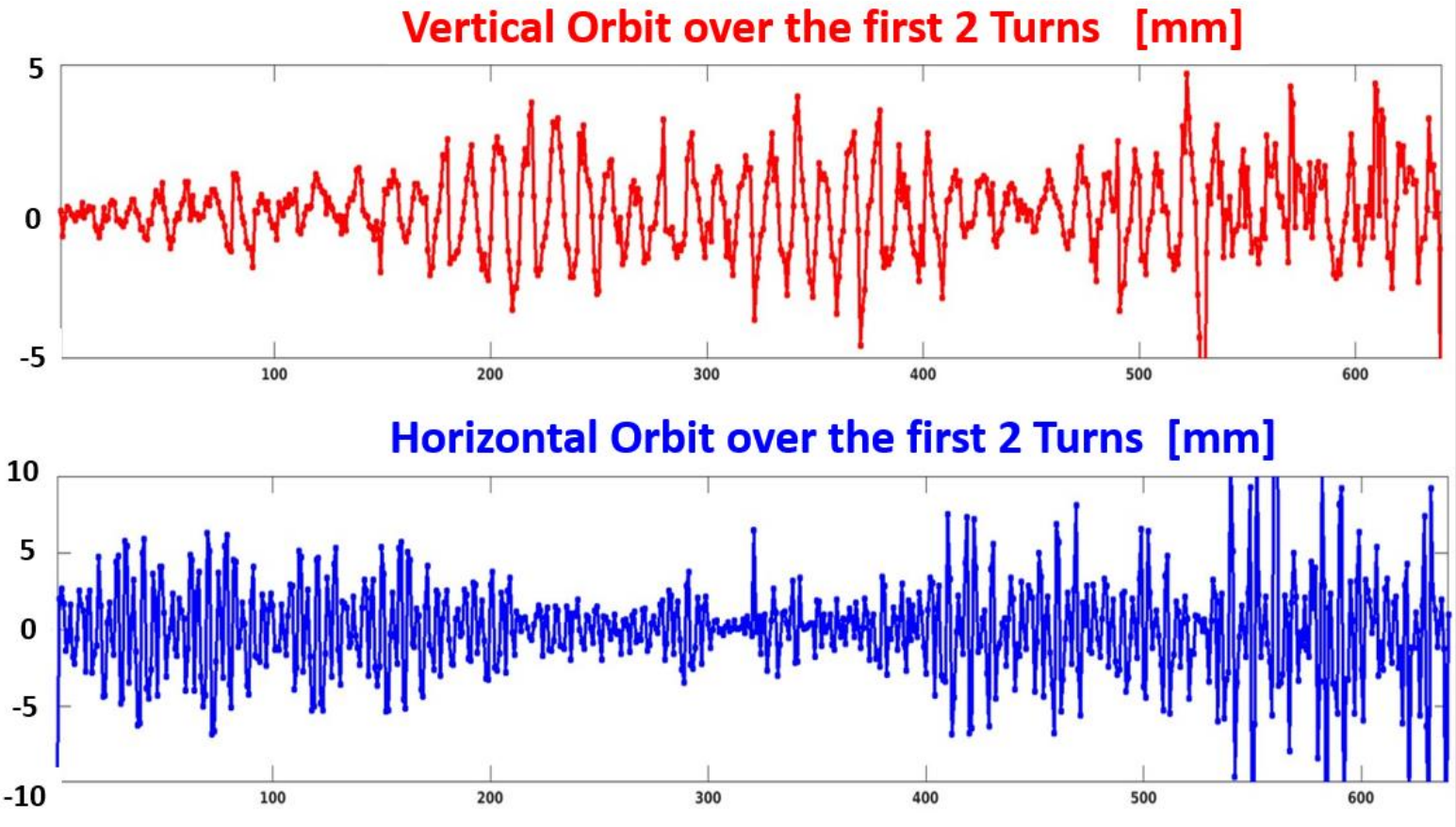
BPMS : PERFORMANCE AT COMMISSIONING AND BEYOND

historic event **: Thursday 28th November → first turns in the ring !!**



BPMS AT EARLY COMMISSIONING : TURN-BY-TURN ORBIT

historic event **: Thursday 28th November → the orbit :**



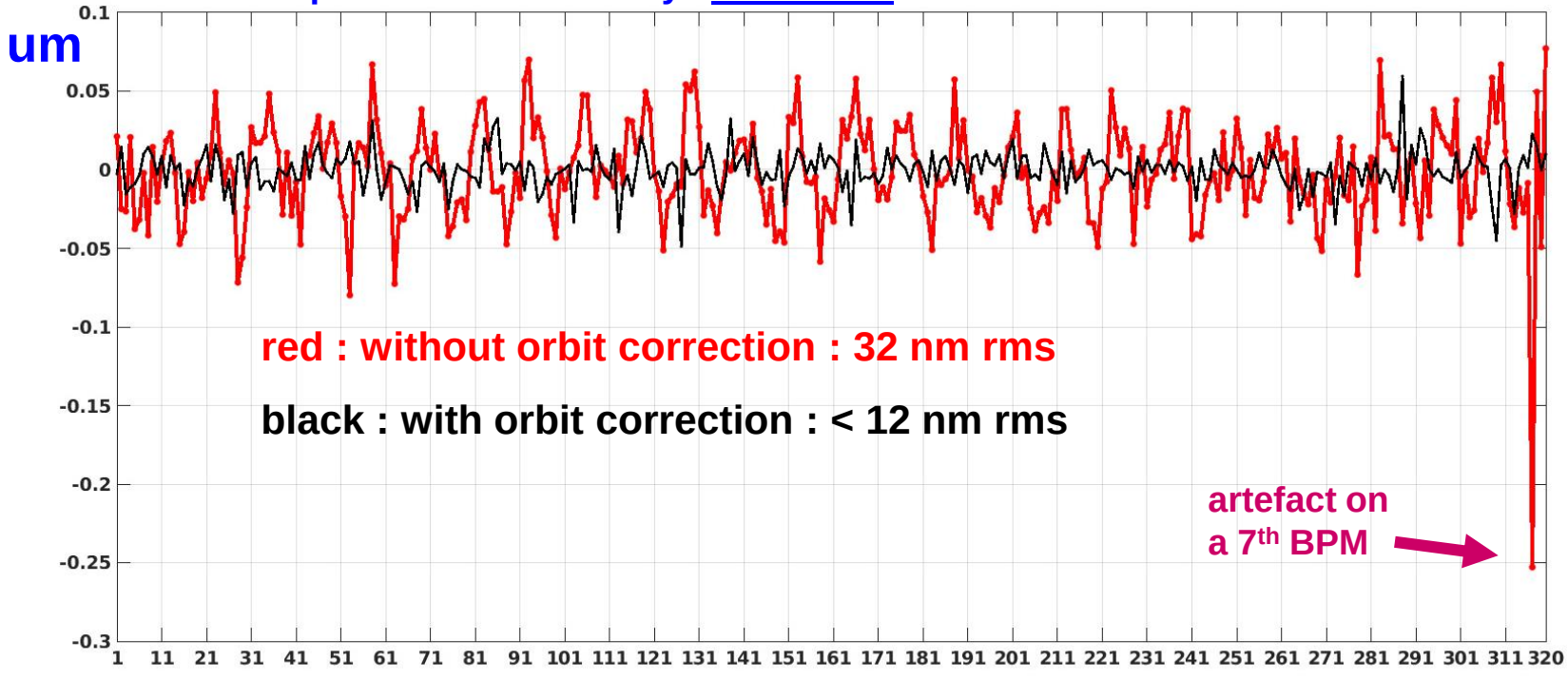
BPMS : OFFSETS, STABILITY, RESOLUTION, REPRODUCIBILITY, RELIABILITY

Beam-Based-Alignment measurements done on all 320 units

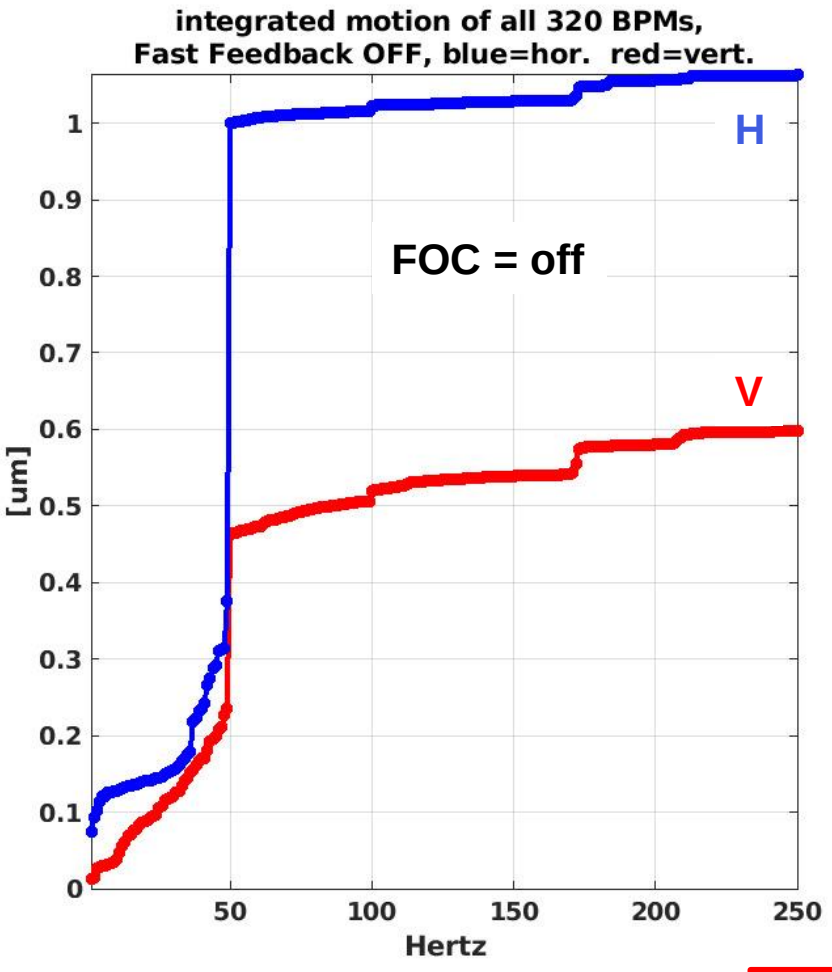
= ultimate offset* measurement of each BPM in both planes →* including all kinds of offsets

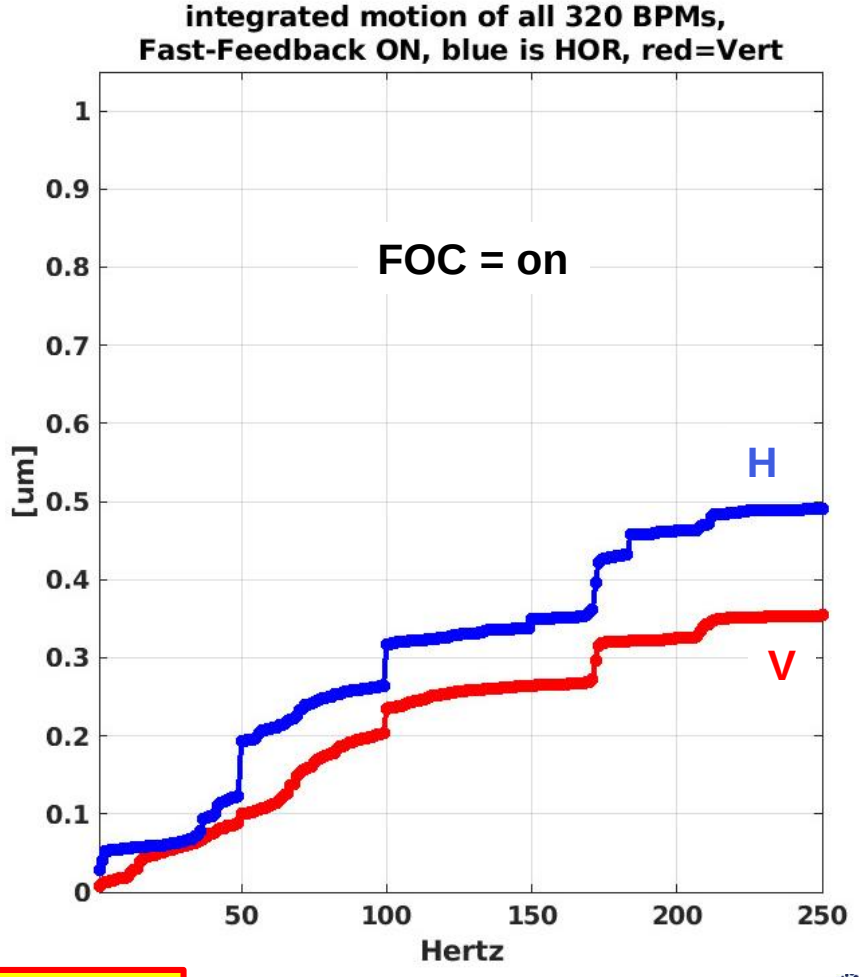
these offsets are *very reasonable* in value : Hor. 170um rms, Vert. 142um rms

example of vertical stability : differential orbit measurement on 20Hz data



BPMS : TODAYS BEAM AC MOTION / STABILITY WITH FOC OFF AND ON



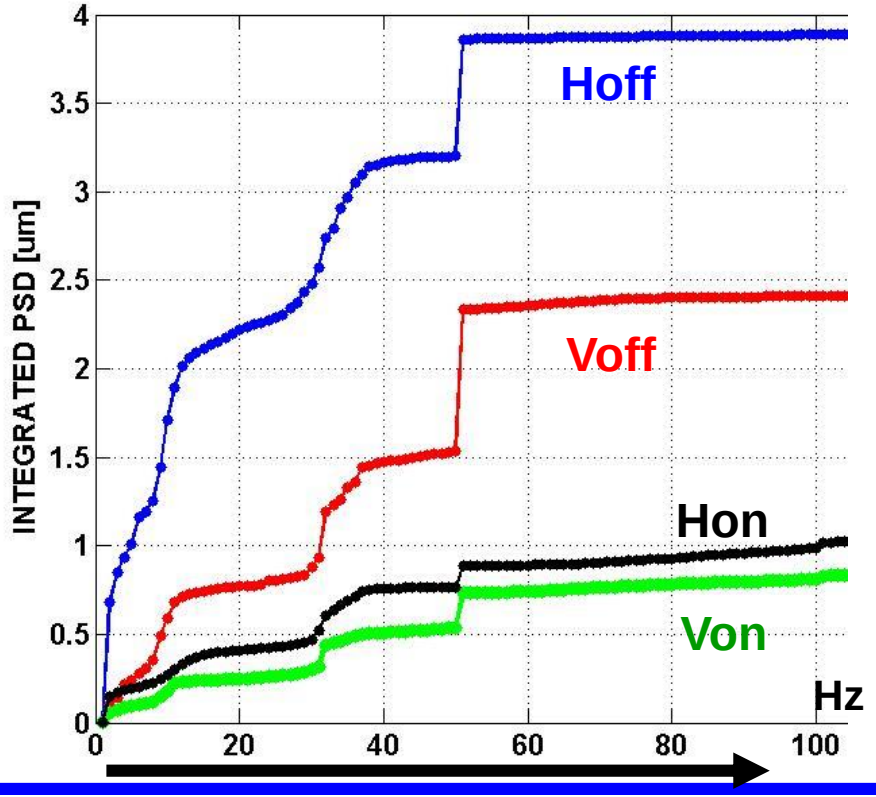


data of May 20

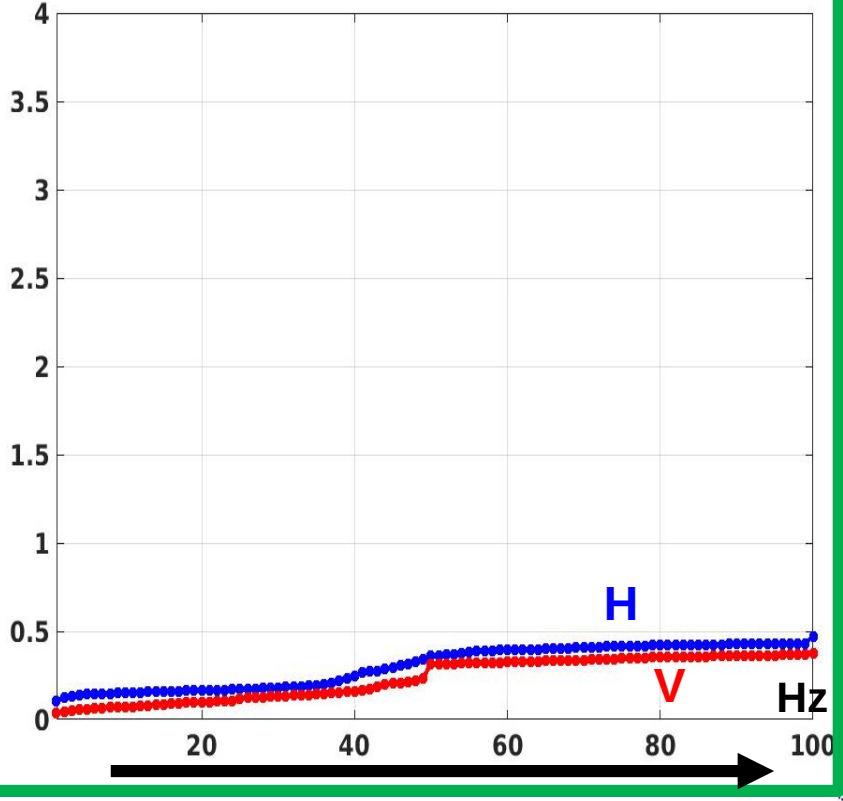
BPMS : AC MOTION : IN OLD RING AND IN EBS

Stability in the low-AC domain (1 – 100Hz)

old ring 2010, FOC On & Off

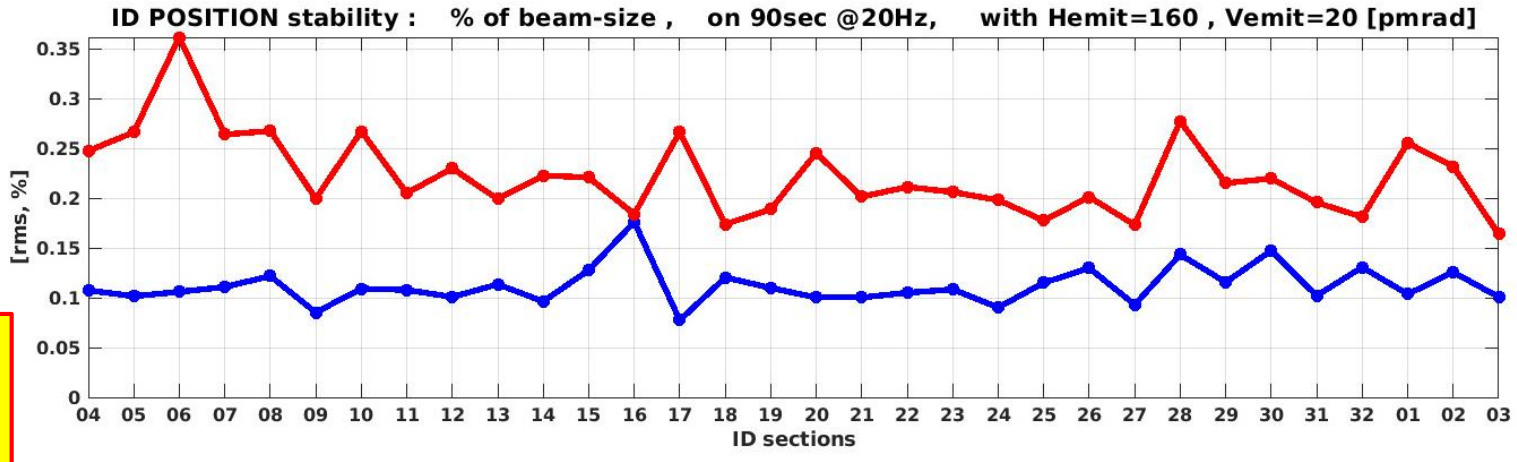


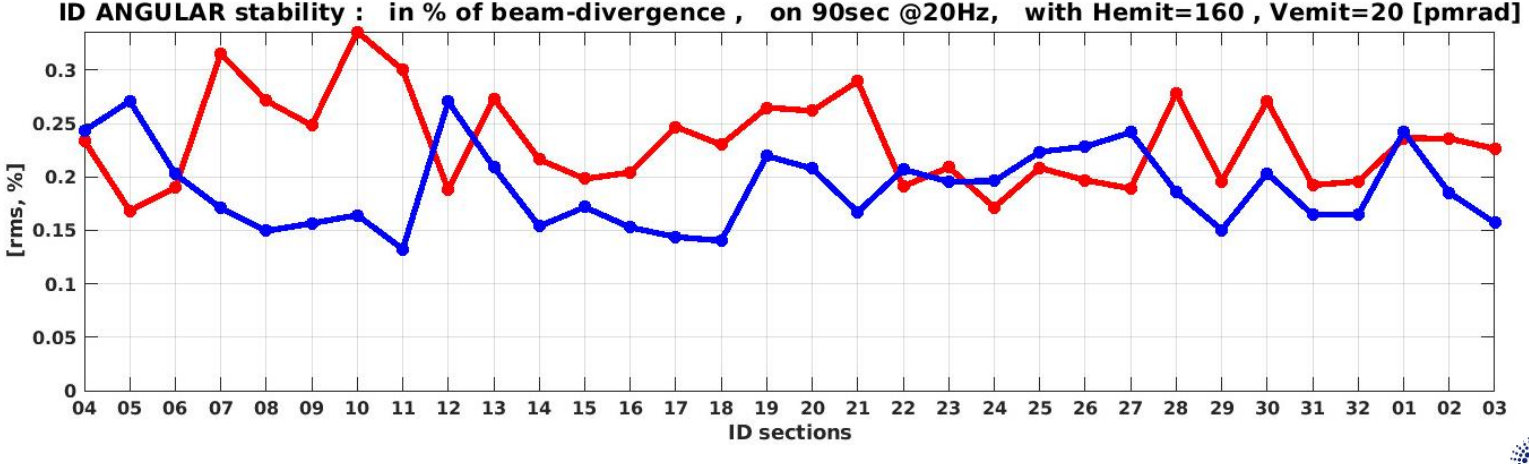
new ring, no FOC



BPMS : MID-TERM (90SEC) STABILITY IN THE ID-SECTIONS

we easily achieve stability <0.5% of beam size / divergence





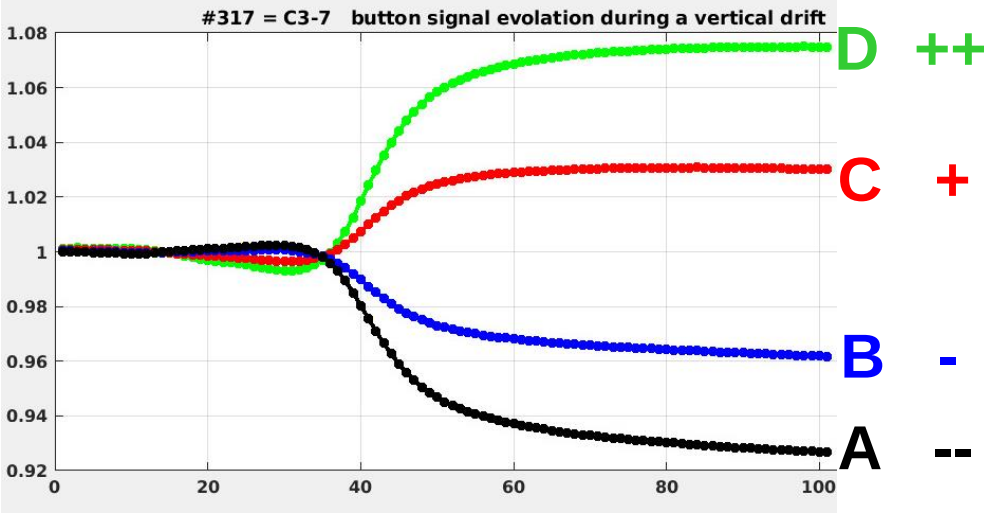
BPMS : PLANS

1) carry-out a hardware patch on the electronics, by iTech
   removal / re-installation of all 320 units, during shutdowns, throughout 2020 (21 ?)
   * LNCF patch (see iTech presentation last year)
   * Tantalum capacitor replacement

2) occasional shot-circuits on BPM-buttons, but easy to detect, and easy to remedy,
   in total 20 cases so far (on 1300 buttons), this (well-known) issue is now waning off

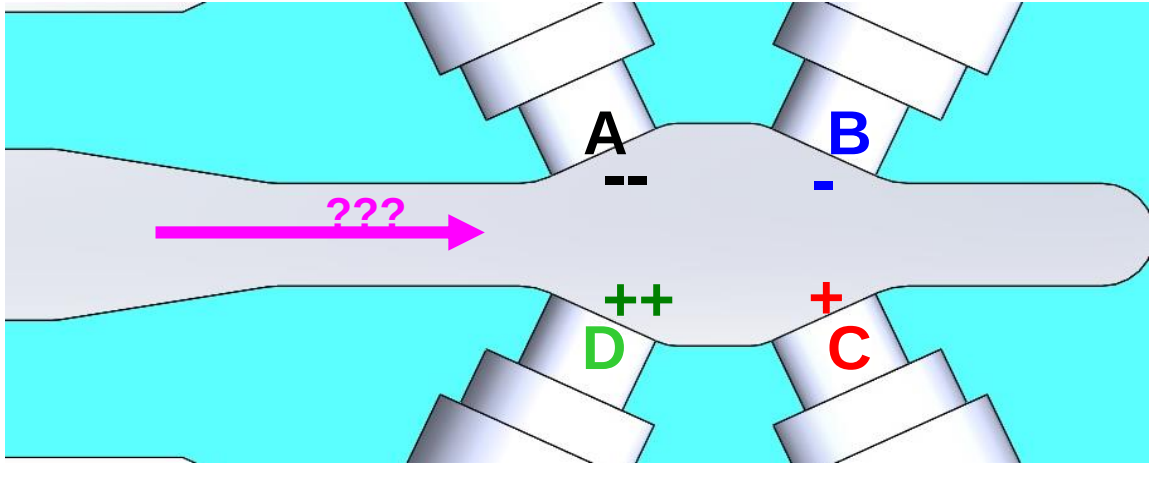
3) strange behavior (instability) on some 7th BPMs, only in vertical plane, under investigation
   is not a problem for operation, these few stations can be discarded

STRANGE BEHAVIOR ON SOME 7TH BPMS



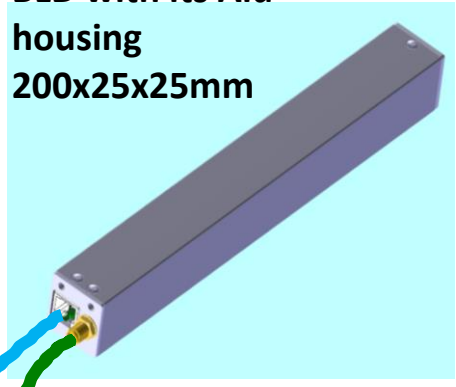
this is NOT coherent … !
i.e. it can NOT be explained by
neither beam motion
nor block motion

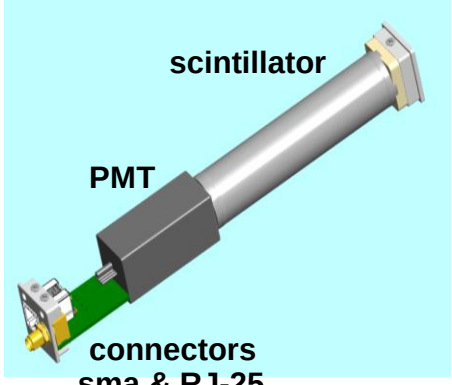
RF mode coupled to the buttons?
adding to buttons' signals with different phases and amplitudes

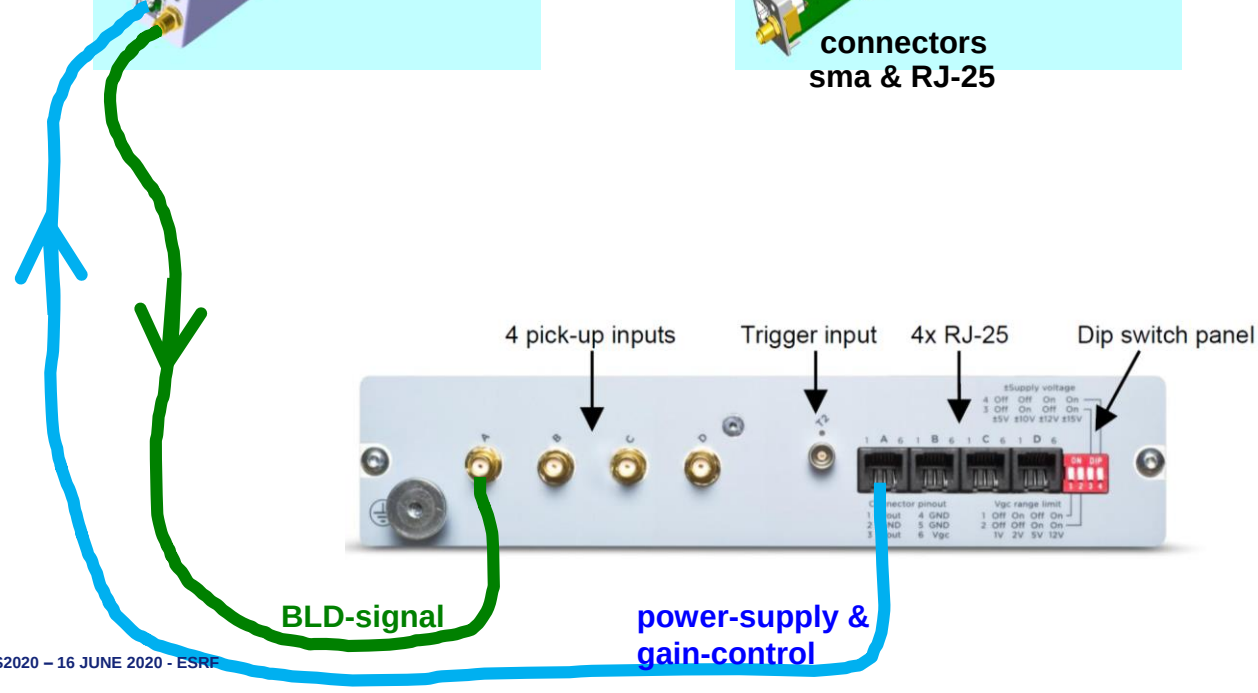


BLMS

BLD with its Alu housing 200x25x25mm

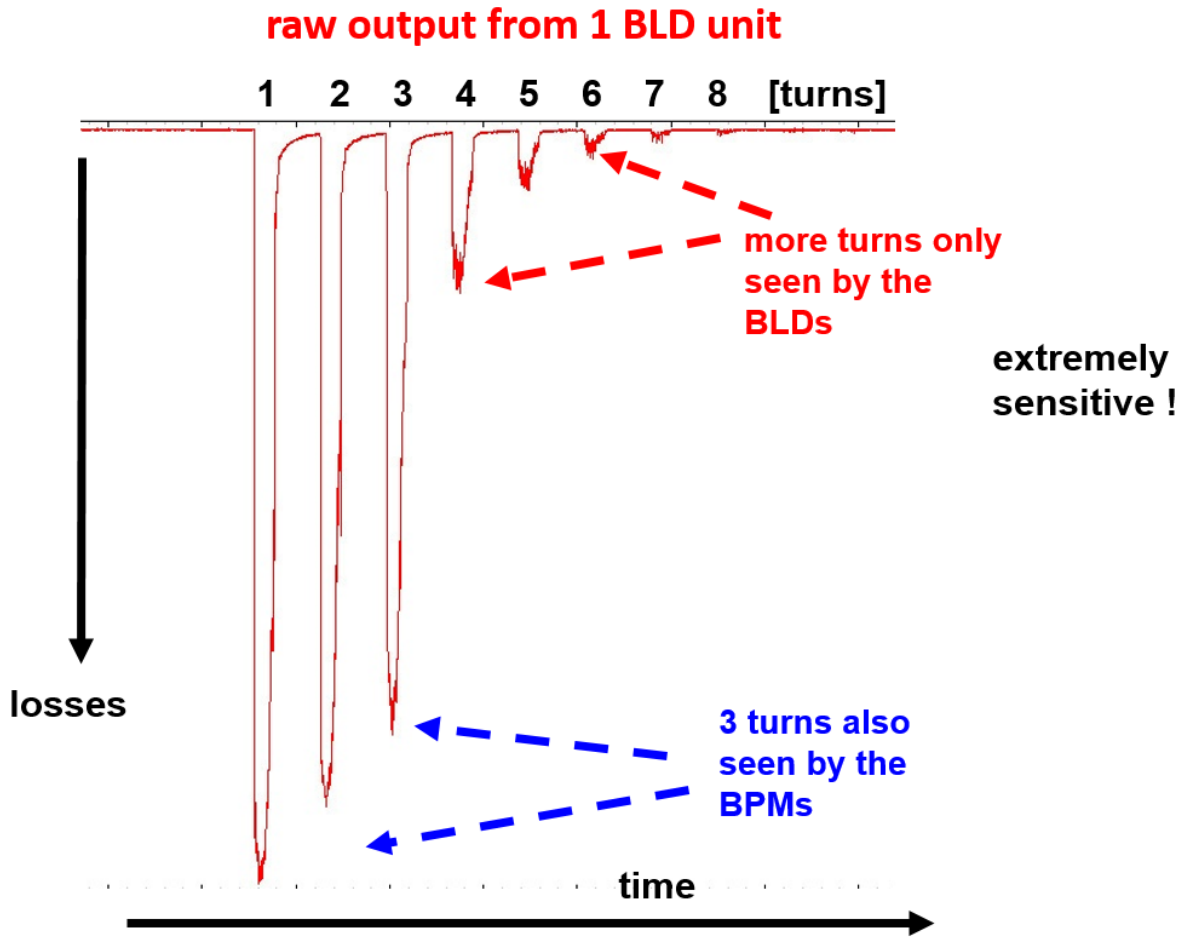






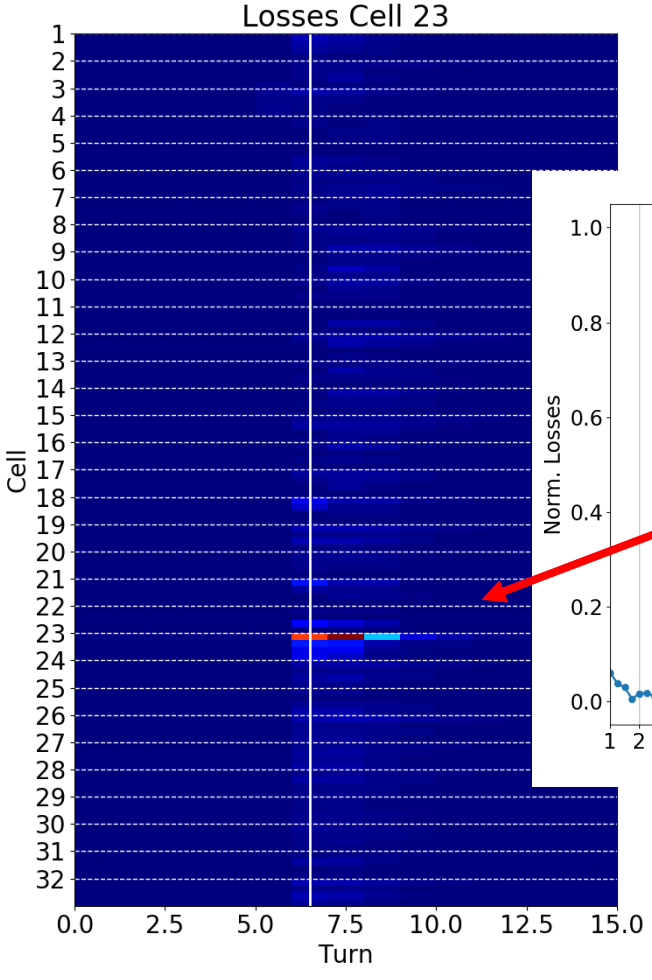
BLMS : FIRST TURNS DETECTION

historic event : Thursday 28th November → first turns in the ring !!

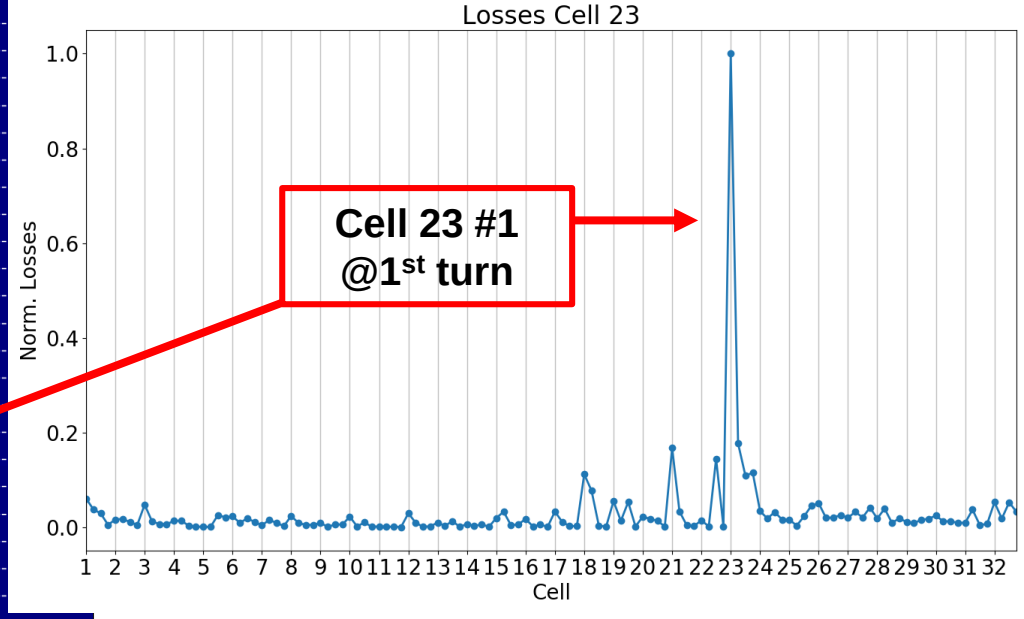


128 BLDs around the ring : very useful to detect *obstacles* … !

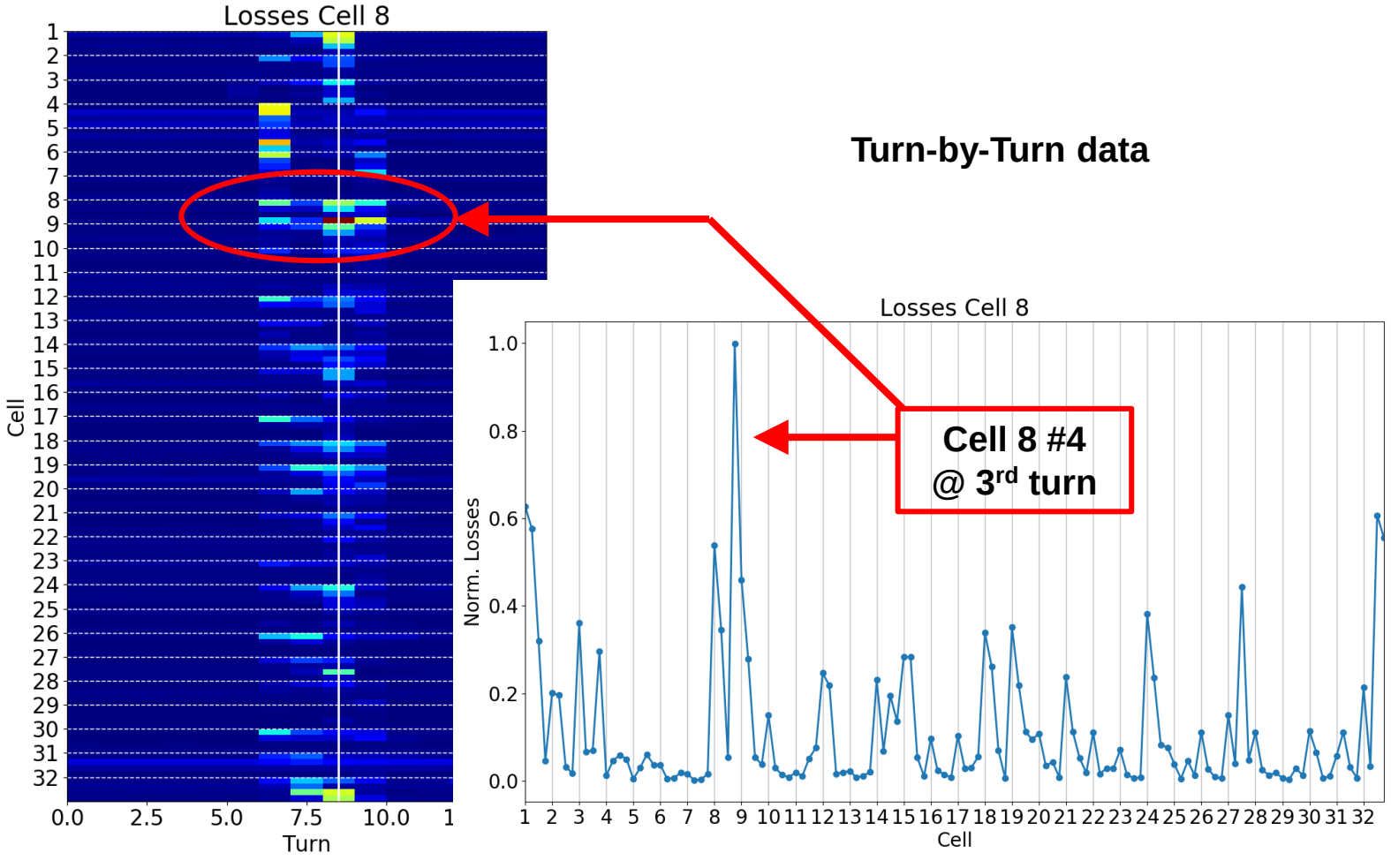
obstacle #1 : ID-chamber 23 : a piece of cable



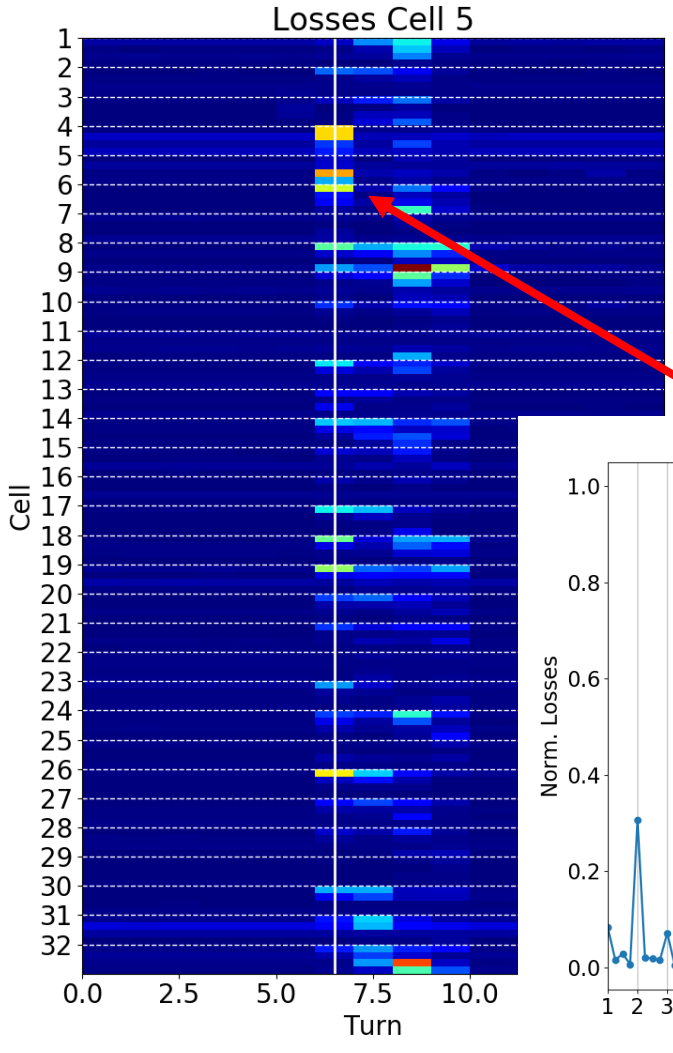
Turn-by-Turn data



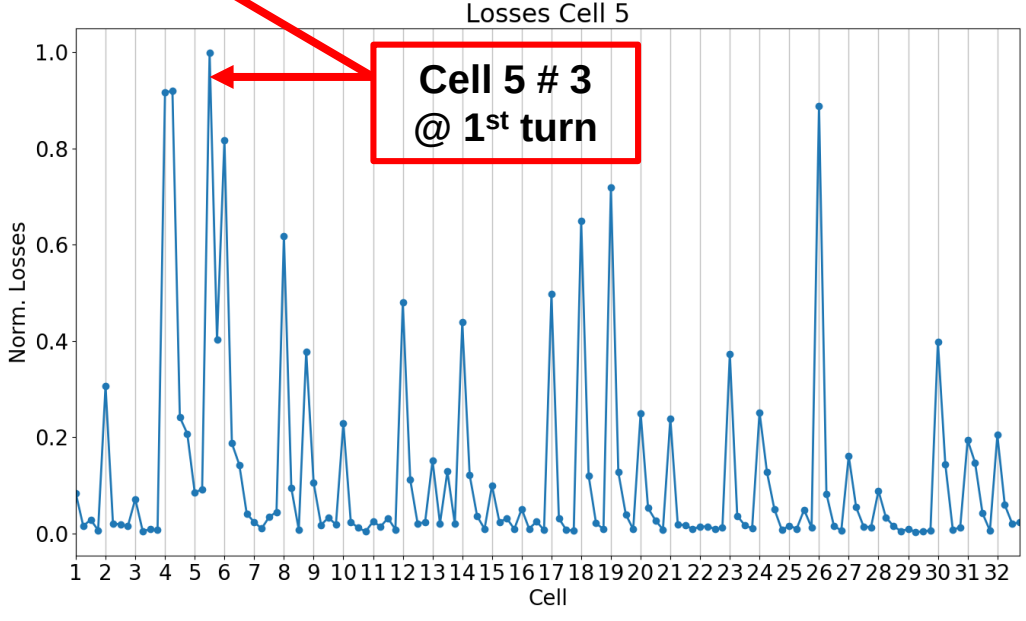
obstacle #2 : cell-8 : wrongly mounted chamber #10



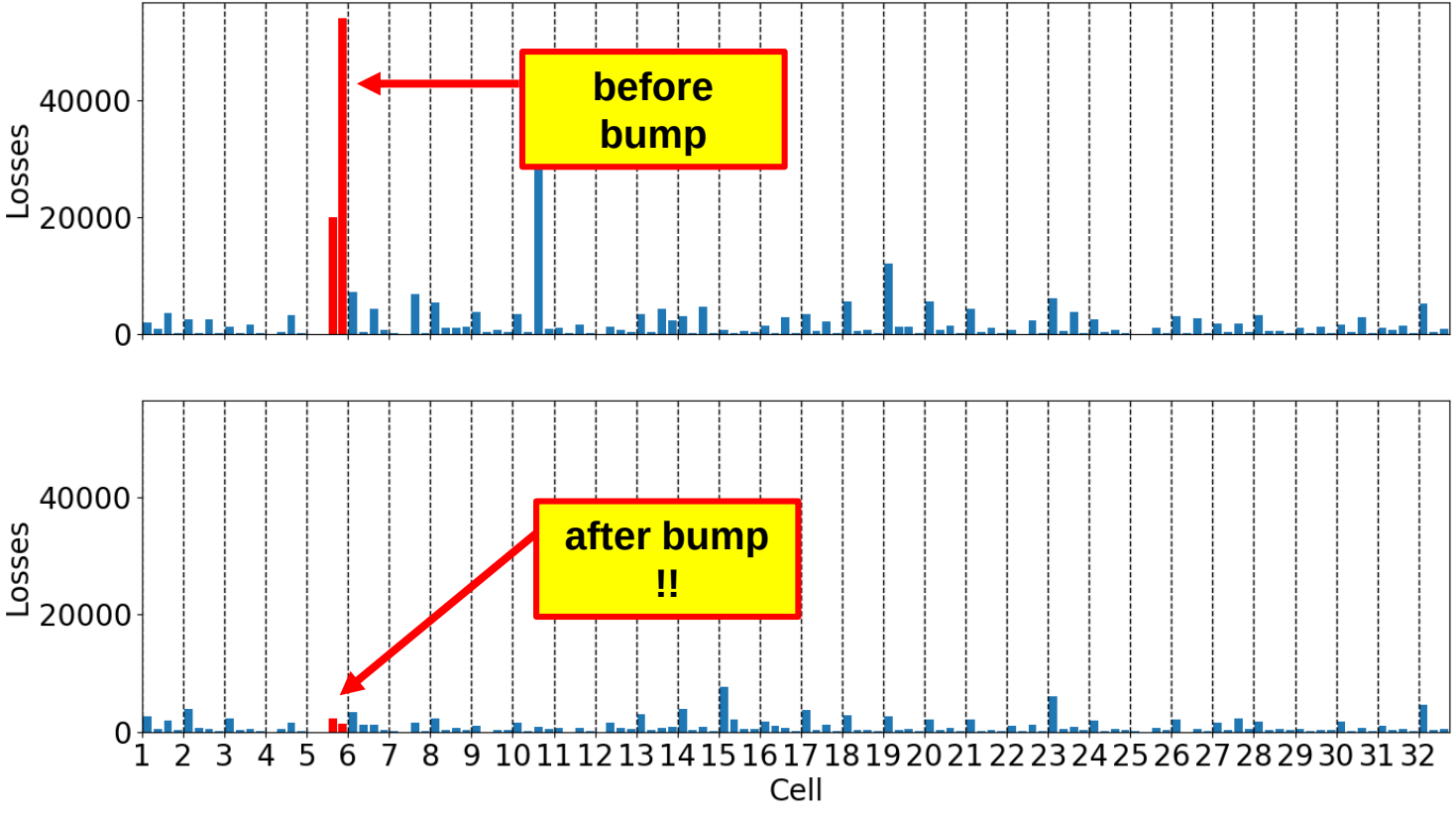
obstacle #3 : cell-5 : a piece of aluminium foil



Turn-by-Turn data



obstacle #3 : cell-5 : a piece of aluminium foil



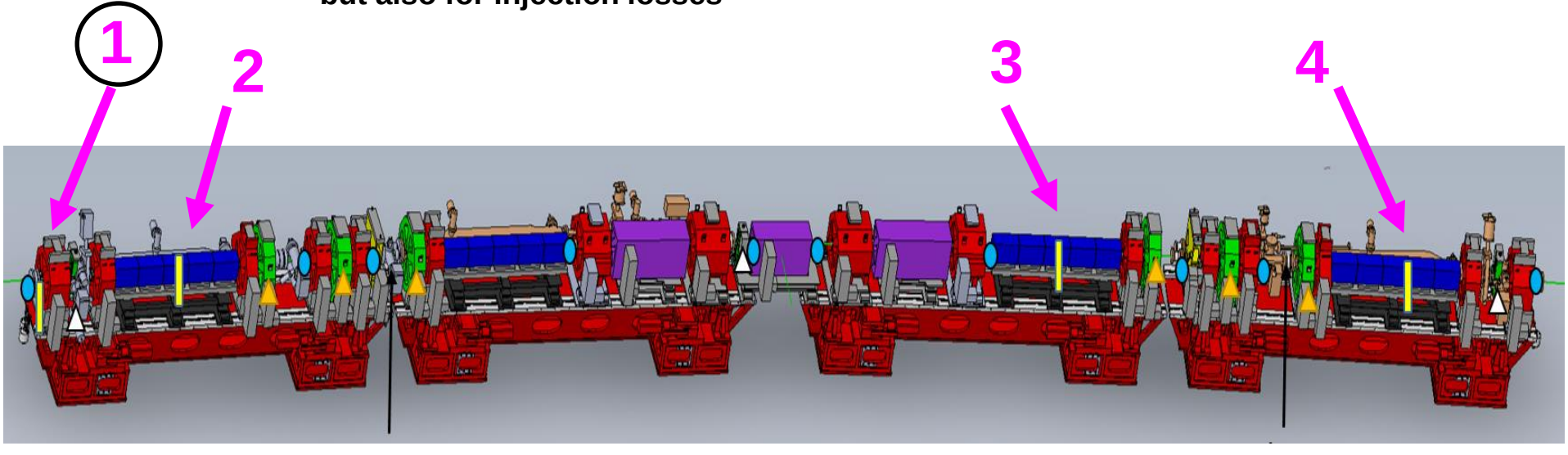
BLMs **L = Losses**

L = Listen to me …

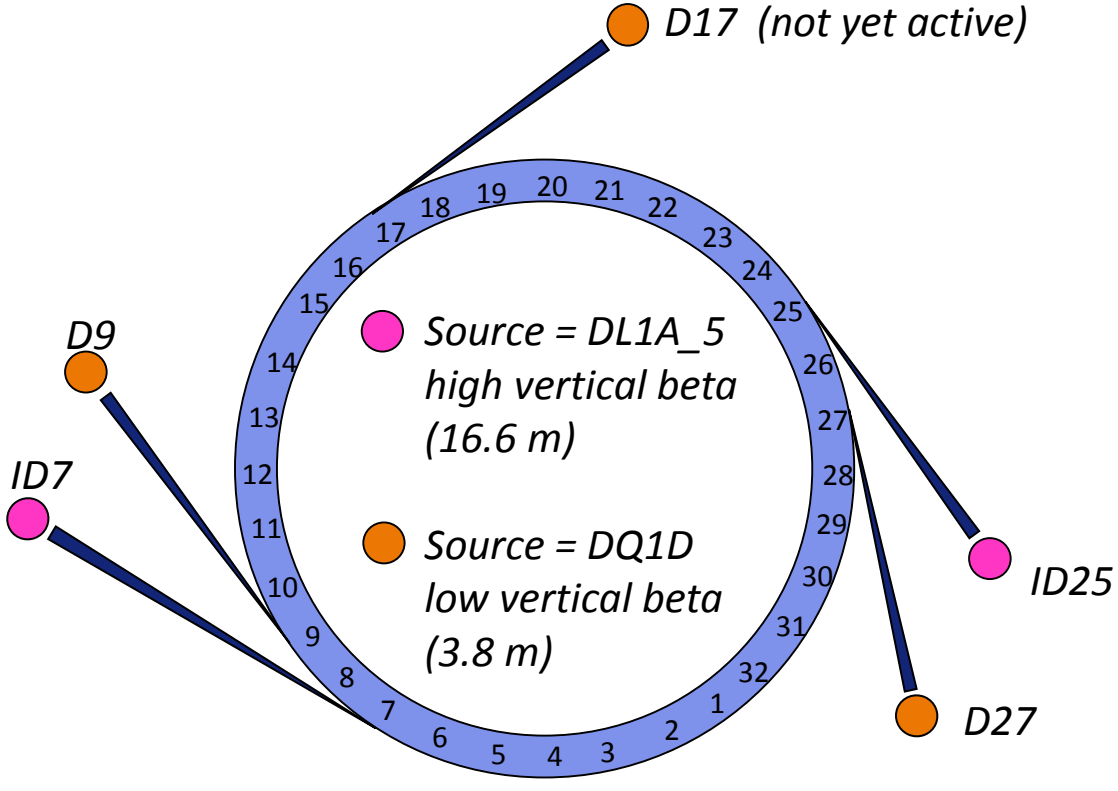
BLMS : SERVING STUDIES OF LOCAL LOSSES AT IDS

<u>this 1rst unit</u> is positioned behind the Insertion Device

and now serves more and more in the comparative (i.e. with 2018, old ring) studies of local losses in the IDs
- both for these permanent, slow losses
- but also for injection losses

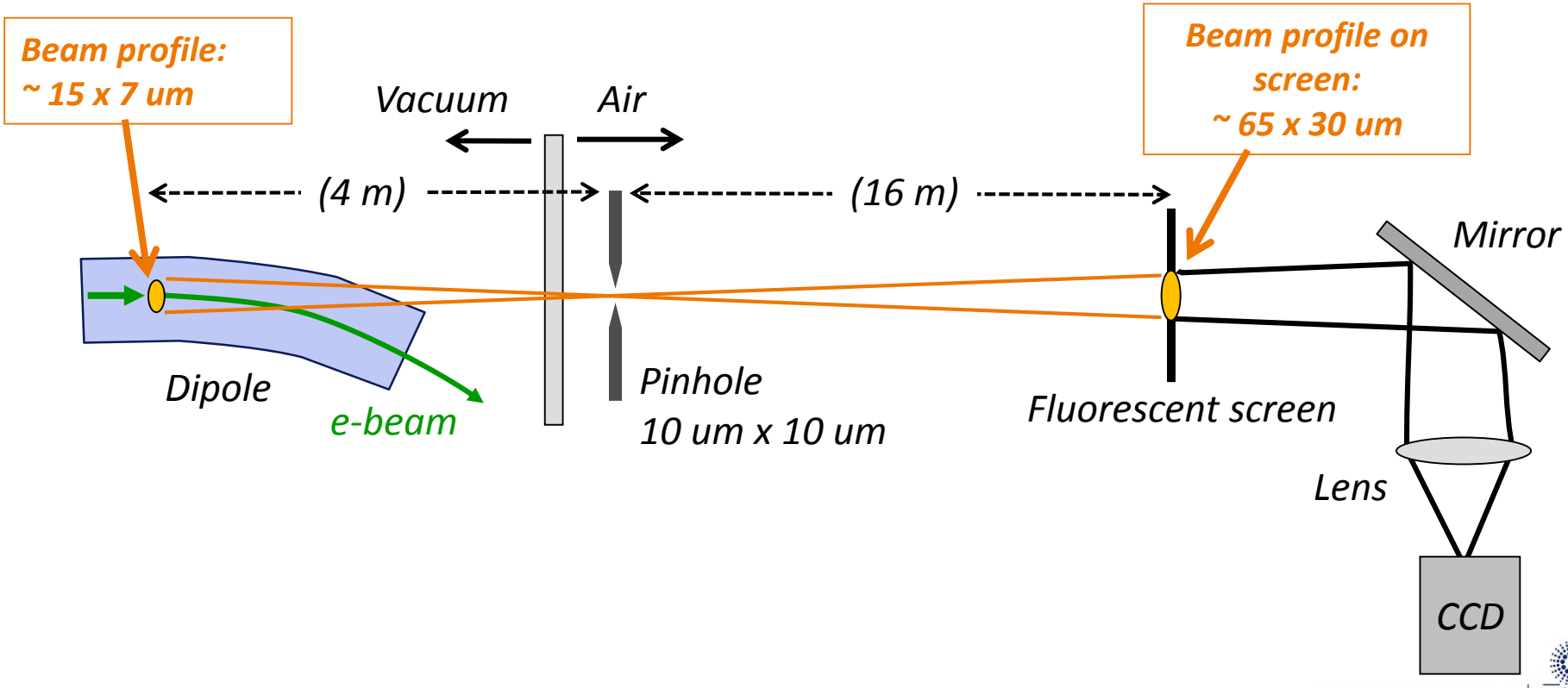


EMITTANCE MONITORS : X-RAY PINHOLE CAMERA SYSTEMS



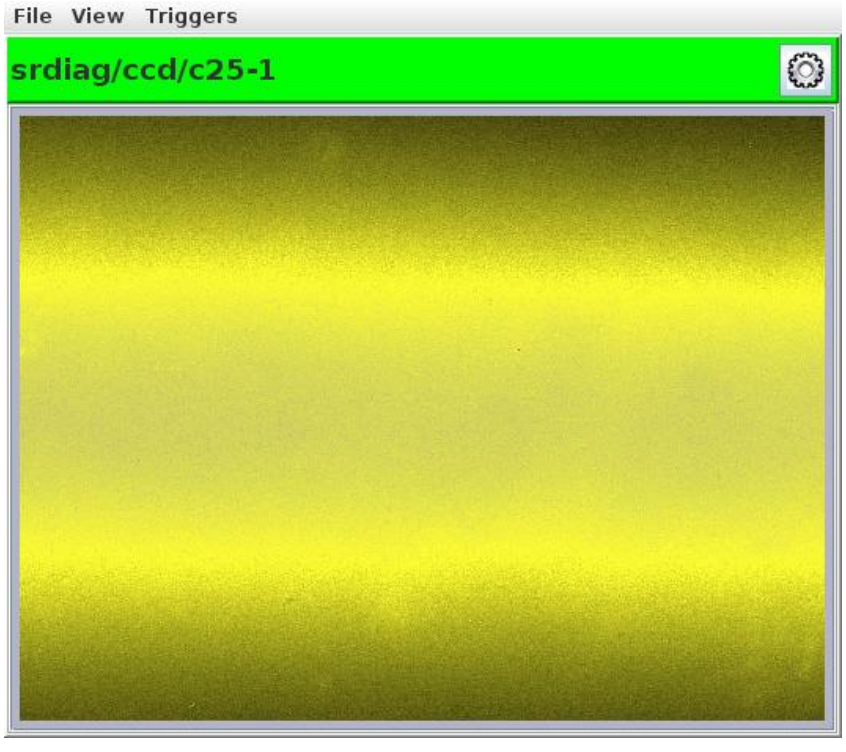
X-RAY PINHOLE CAMERA : SET-UP , PRINCIPLE , TYPICAL DIMENSIONS

$$\varepsilon = \sigma_{source}\,\sigma'_{source} \qquad \varepsilon = \sigma_{source}^{2}/\beta$$

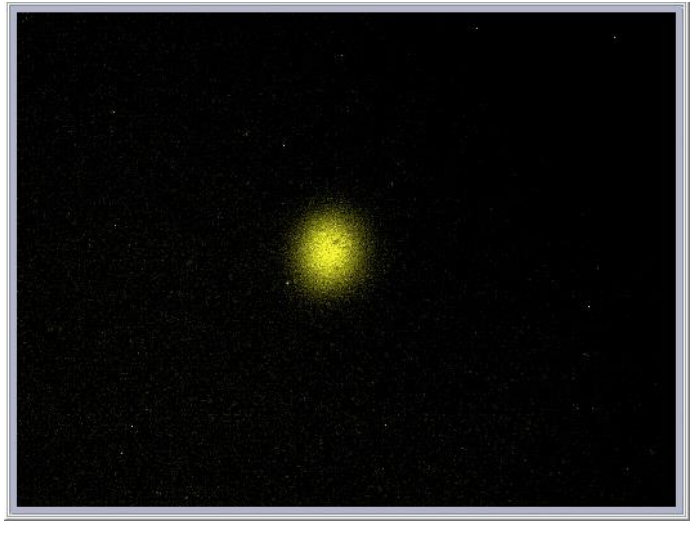


EMITTANCE MONITORS : EARLY AVAILABILITY

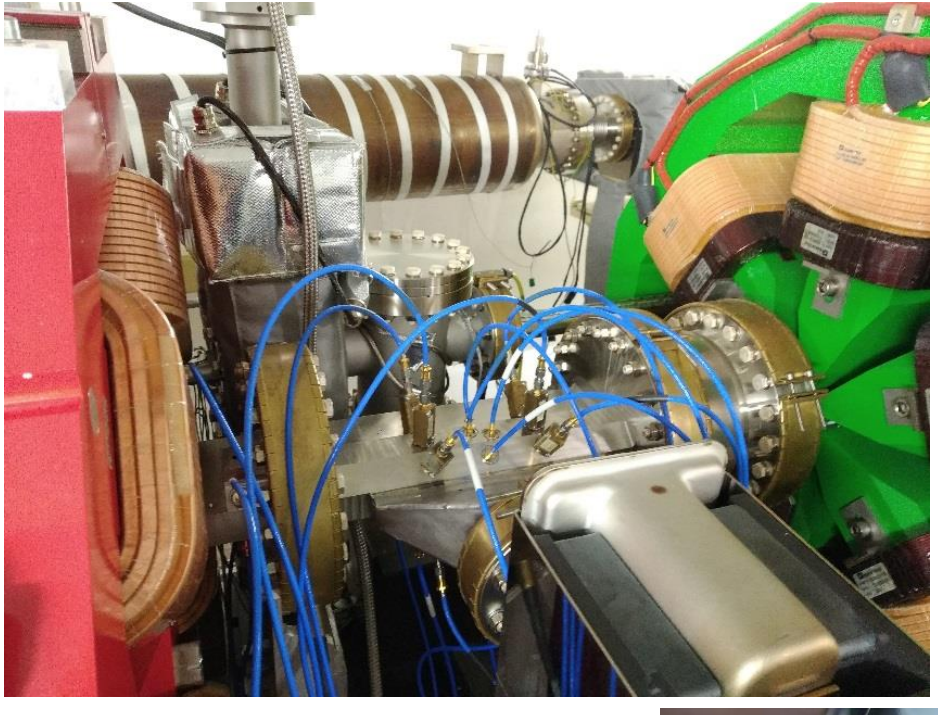
6. December 2019 14h22, a few microAmps, NO pinhole inserted



6 December 2019 16h15,
20 uA with pinhole IN



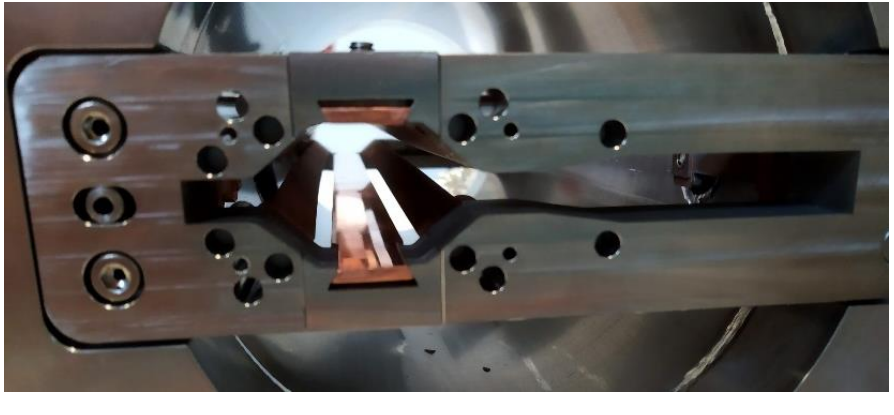
Tune Monitors



all components in the system optimized to yield the maximum sensitivity

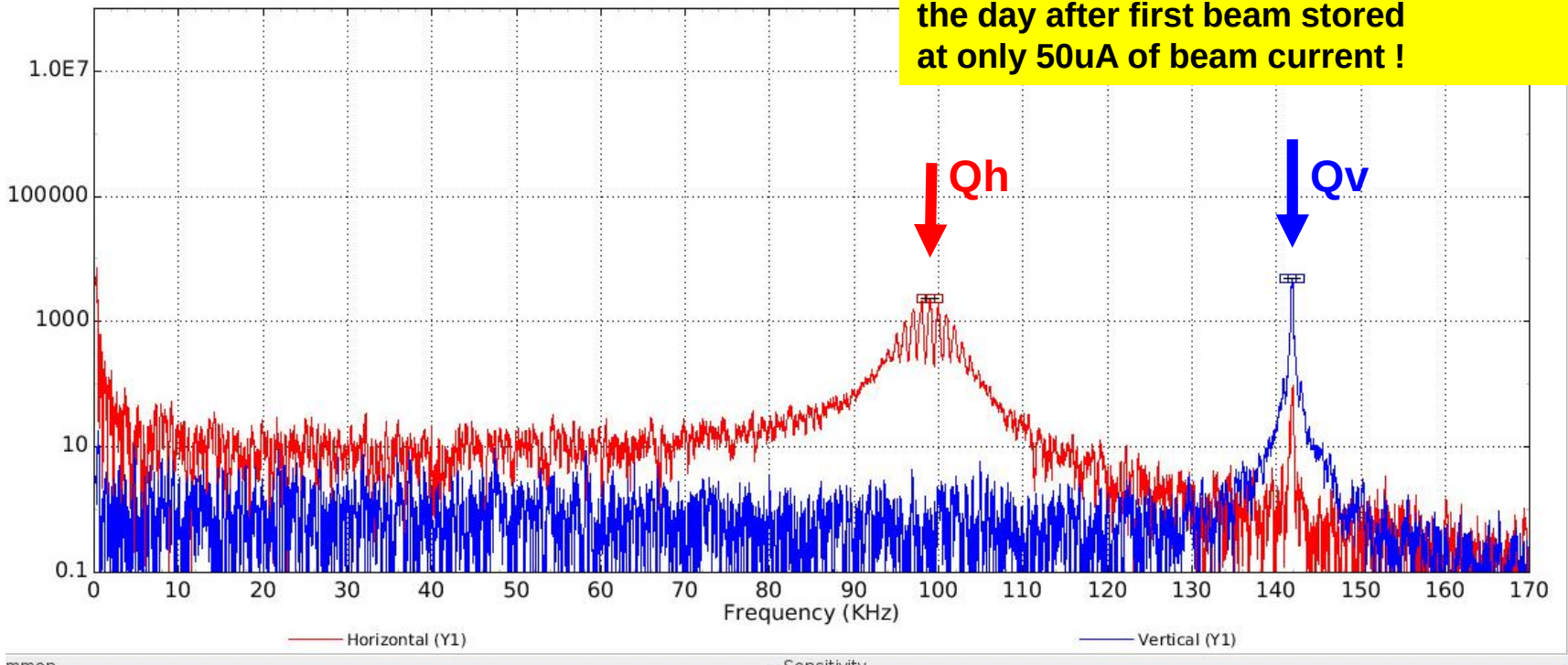
horizontal stripline to <u>excite</u> the beam

diagnostic chamber Ch12 with pick-up buttons to <u>measure the response</u>

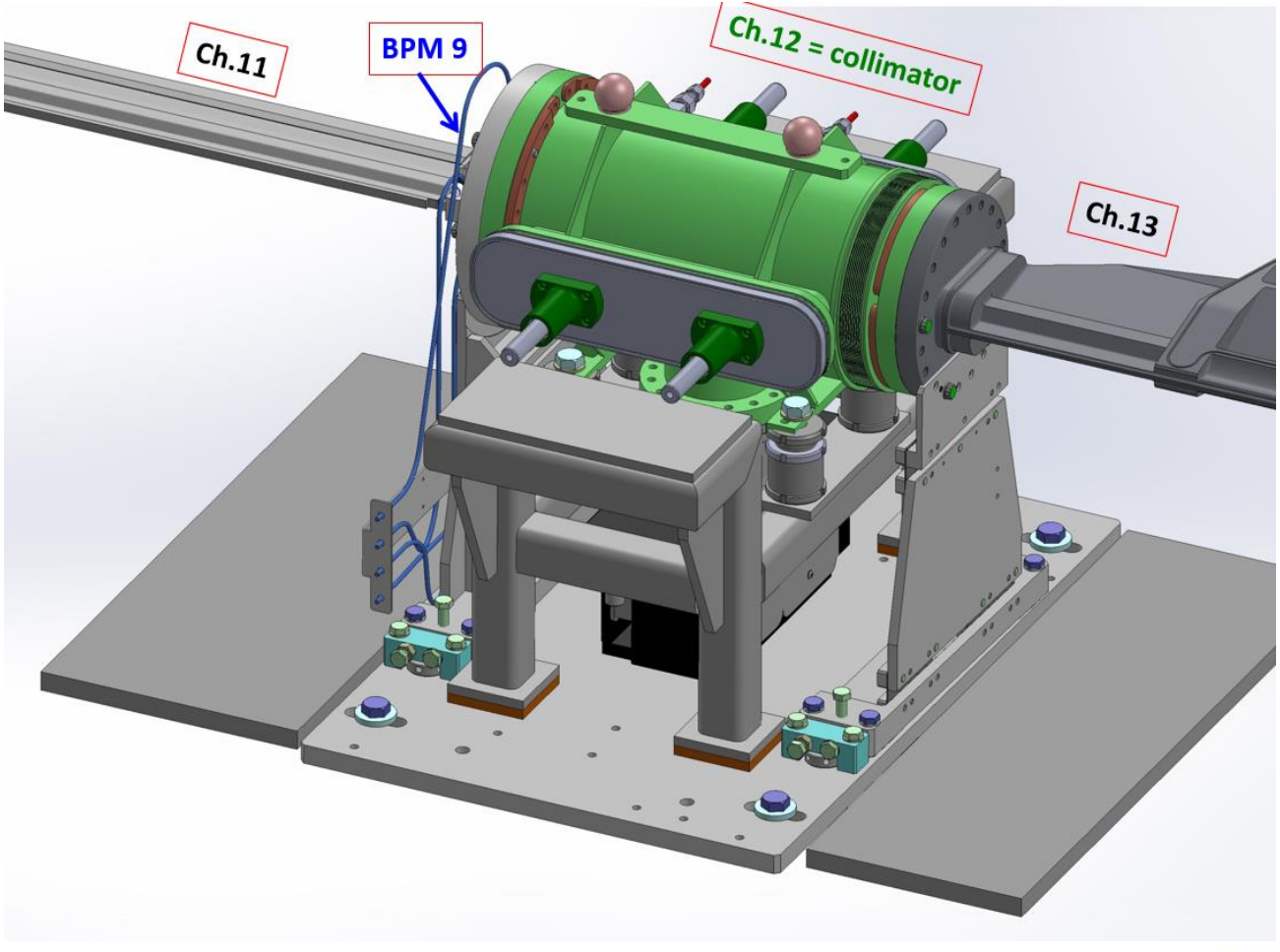


TUNE MONITORS : TWO INDEPENDENT UNITS

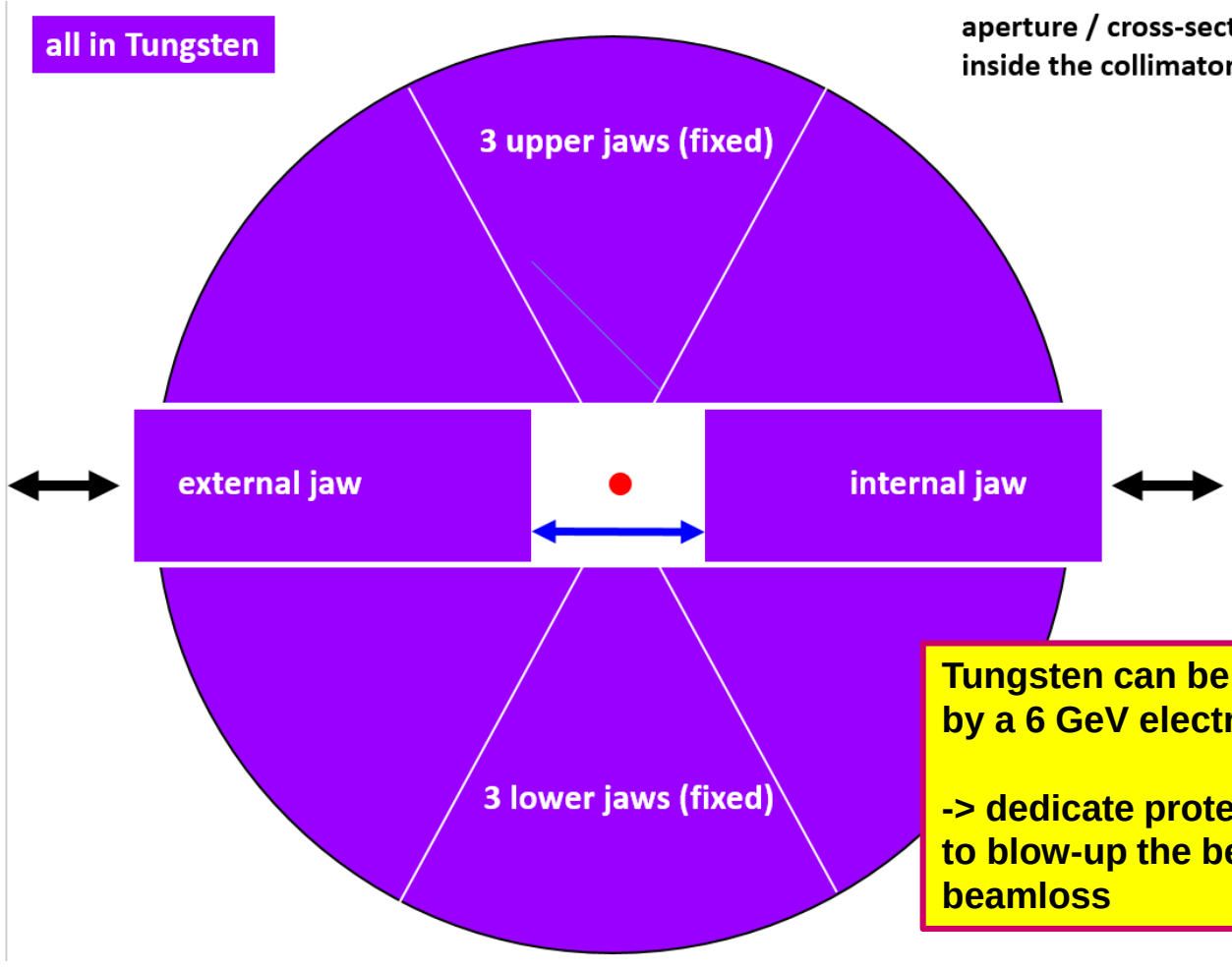
tunes measured the 8th of December, the day after first beam stored at only 50uA of beam current !



COLLIMATORS : 2 UNITS INSTALLED CELL 13 AND CELL 24



COLLIMATORS : INSIDE CROSS-SECTION , STATUS



Tungsten can be damaged by a 6 GeV electron beam loss

-> dedicate protection system to blow-up the beam before beamloss

MANY THANKS FOR YOUR ATTENTION