Beam Loss Detector developments :

- optimized for Light Sources (2 to 6GeV)

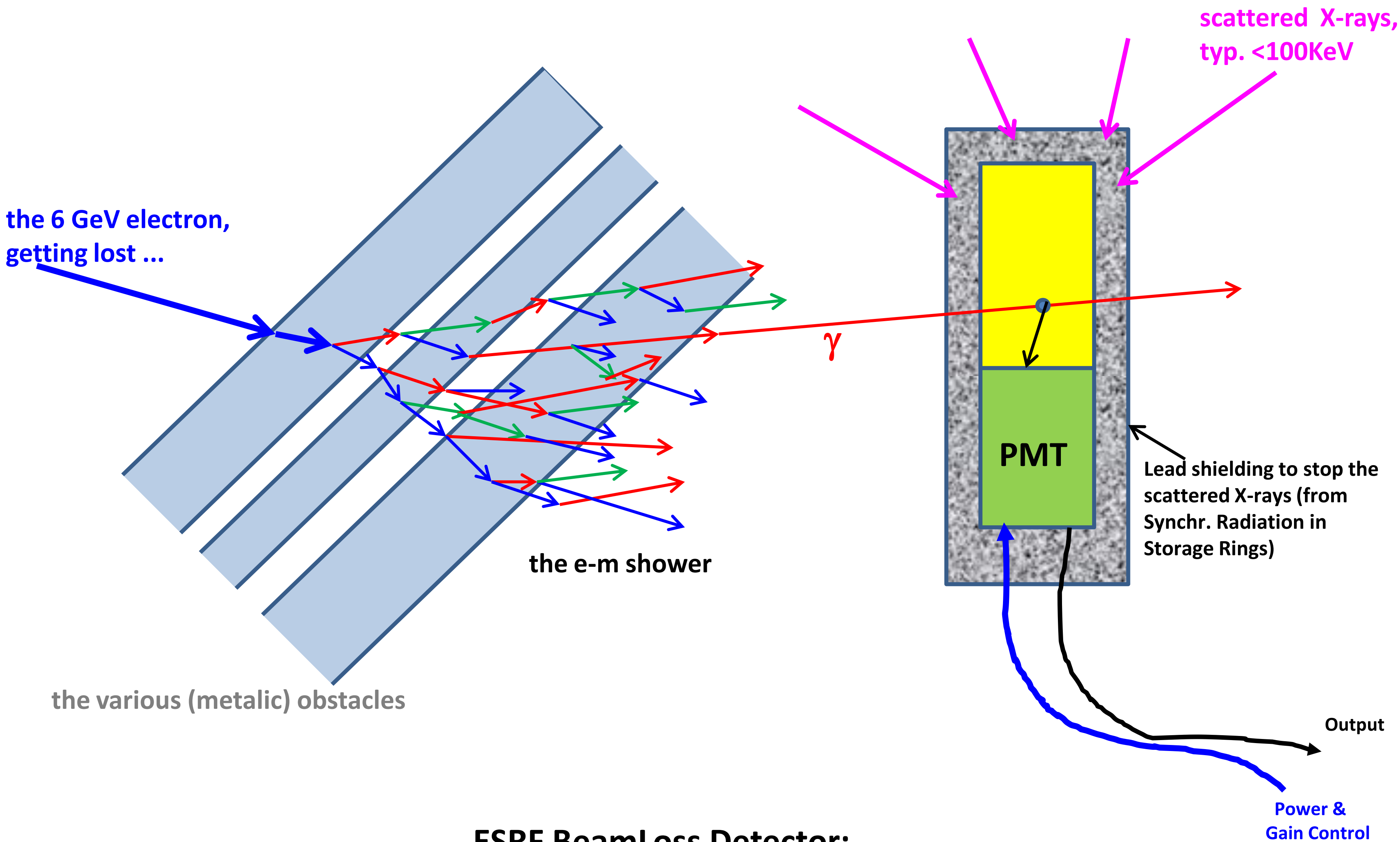
- covering (extreme) different applications → strong & fast losses / → weak & slow losses

- commercially available at reasonable or even low costs :
  → install many, at regular points

- the BeamLoss-Detector (head) and
- the Acquisition Electronics
  should be fully compatible with each other

- so a choice needed to be made on the type of detector (head) :
  ionization-chamber ? semi-conductor ? CVD-sensors ? scintillator/radiator ?

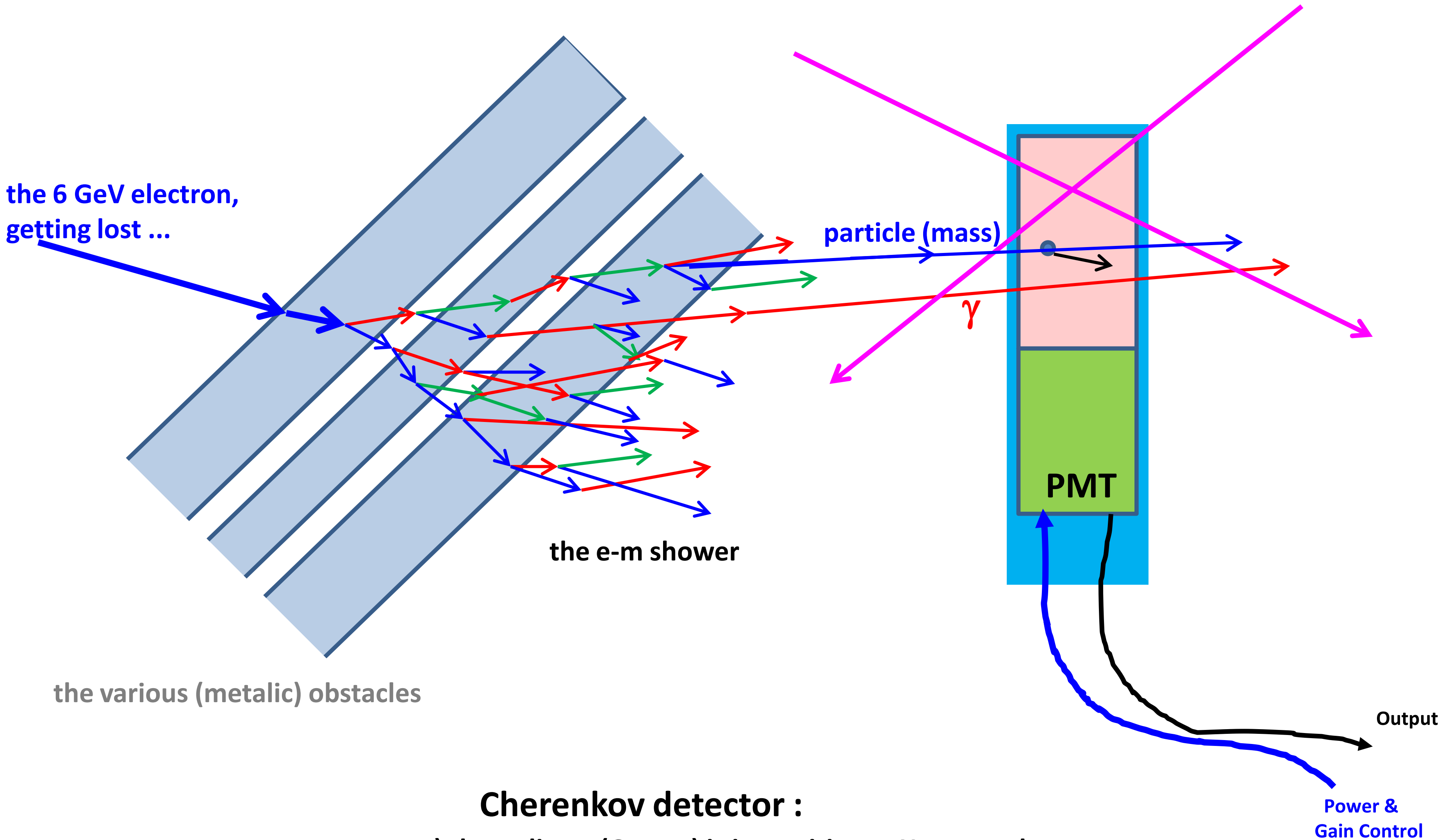
- and the component that produces the electric signal output :
  PMT, photo-diode, MPPC, other ...



ESRF BeamLoss Detector:

a) the scintillator is (very) sensitive to both X-rays and gammas

so a Lead shielding is needed to stop the X-rays



Cherenkov detector :

a) the radiator (Quartz) is insensitive to X-rays and gamma

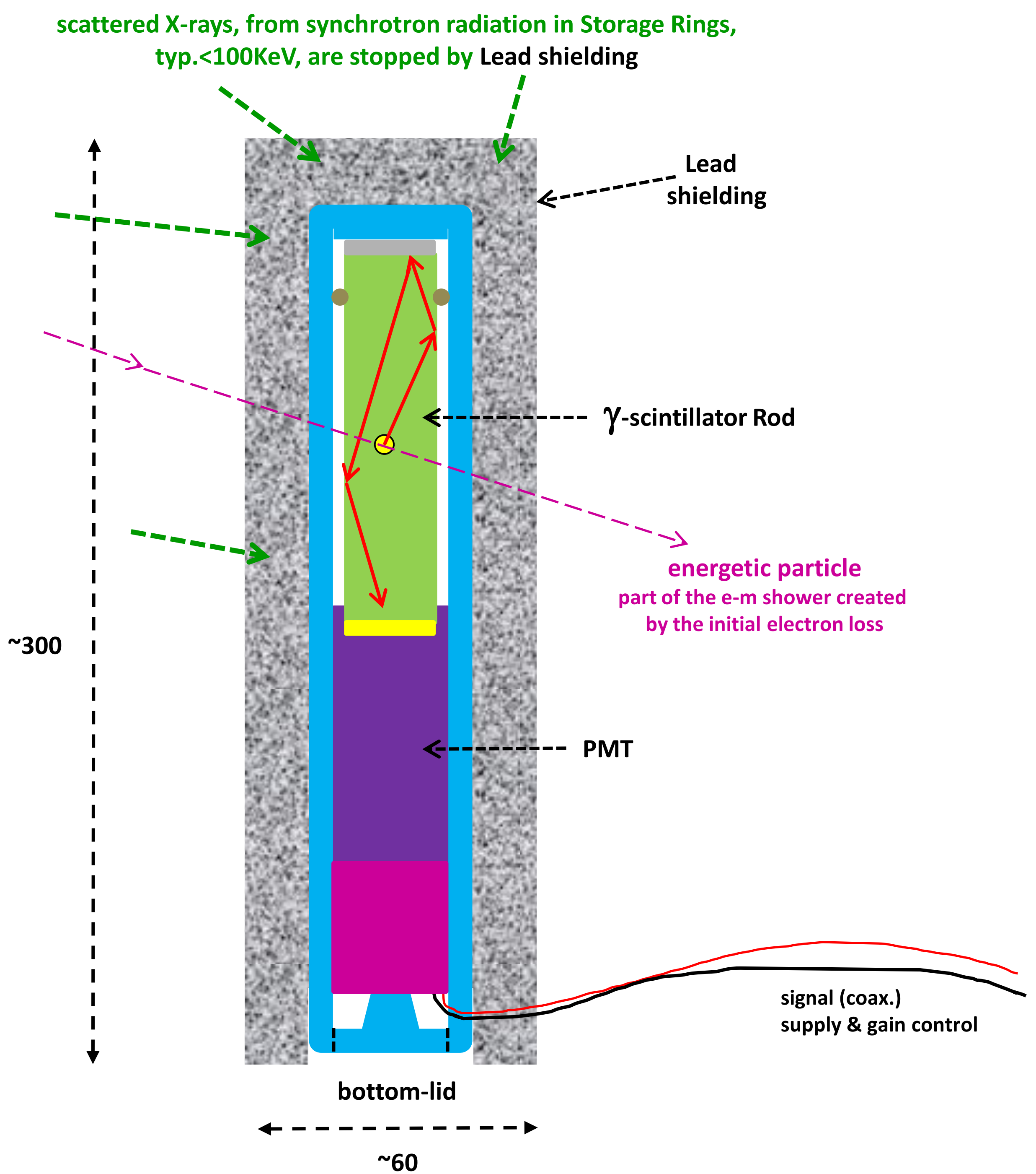
b) only particles with mass and sufficient energy will create visible (blue) light ('Cherenkov')

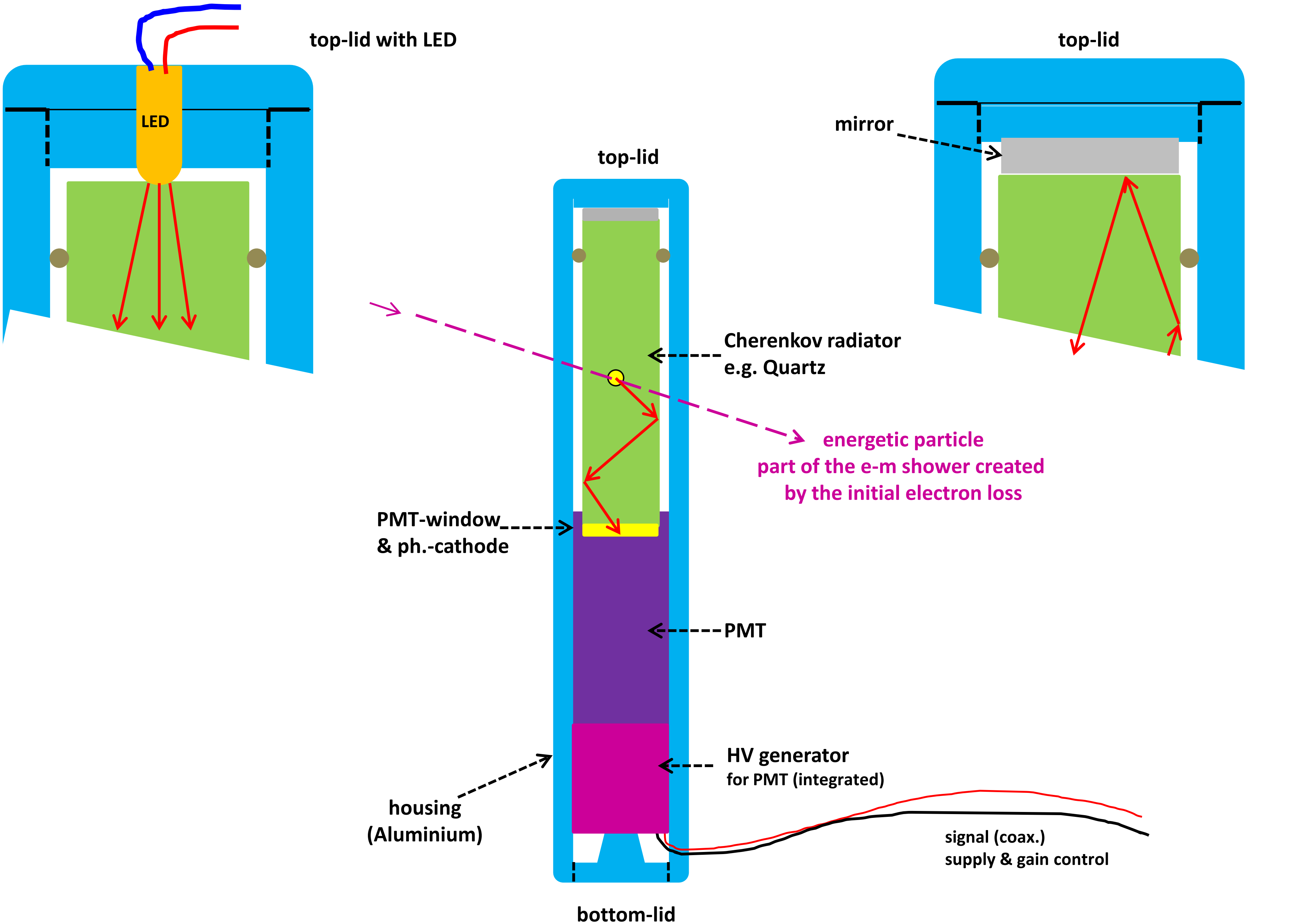
new ESRF housing design :

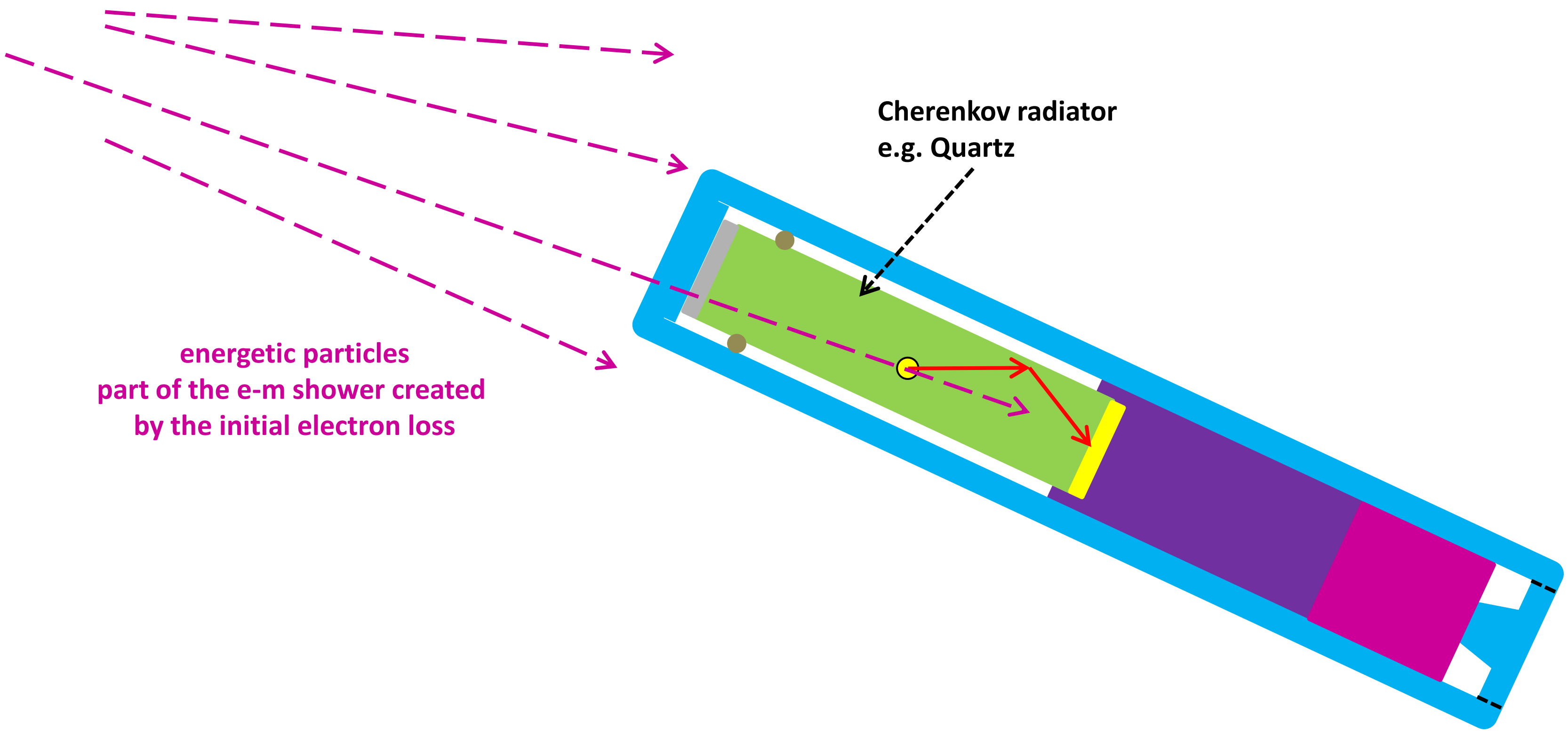
tubular, Aluminium,
accommodates both the
Rod and the PMT
in line, easy to assemble,

lids at bottom & top,
special top lid with LED
can be used for calibration

the Rod can be a :
γ-scintillator or
Cherenkov-radiator (Quartz)




top-lid with LED
LED
top-lid
mirror
top-lid
Cherenkov radiator
e.g. Quartz
energetic particle
part of the e-m shower created
by the initial electron loss
PMT-window
& ph.-cathode
PMT
HV generator
for PMT (integrated)
housing
(Aluminium)
signal (coax.)
supply & gain control
bottom-lid

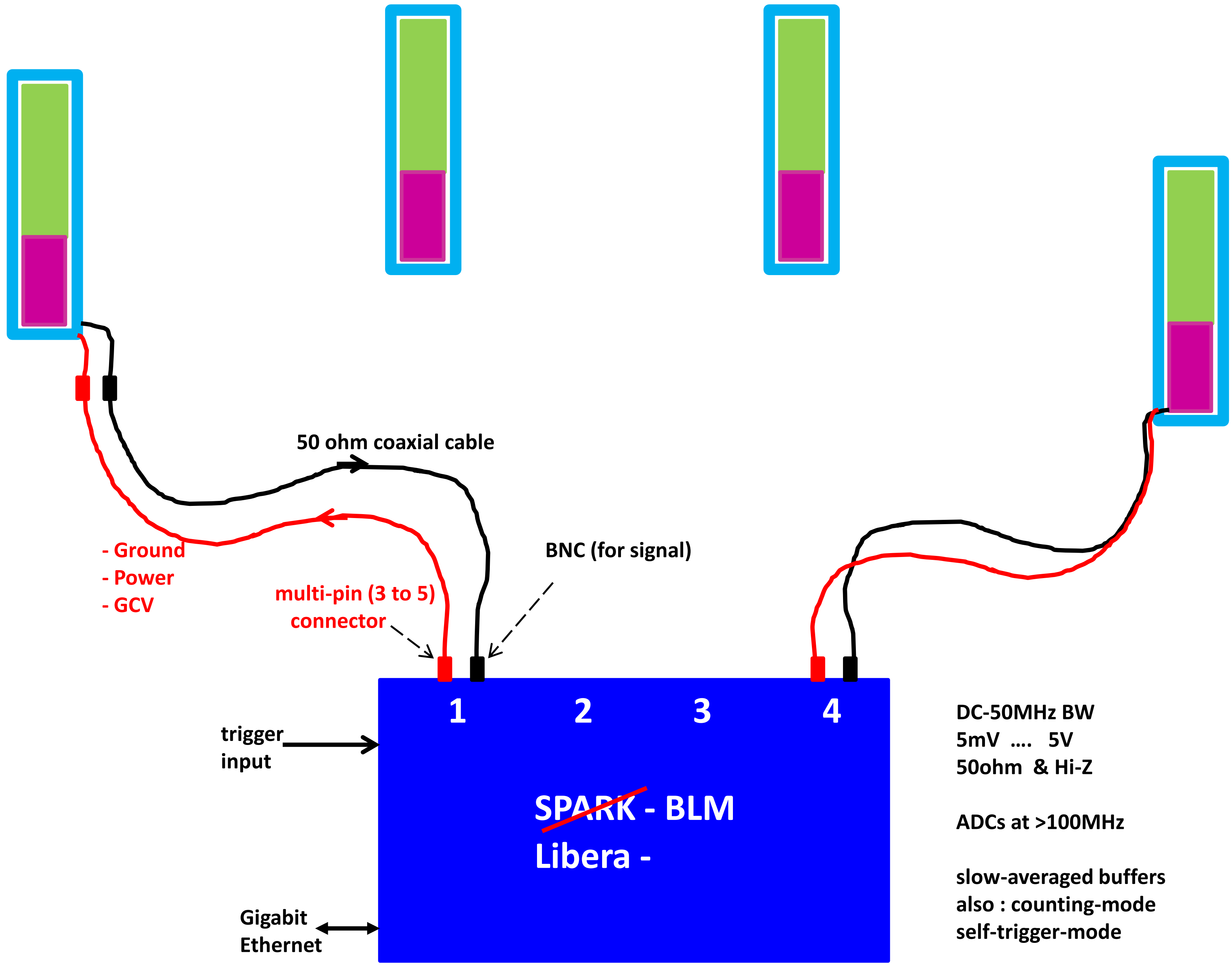


Cherenkov Light is emitted in a cone, and in the same direction as the impinging particle

so orienting the detector head (towards the source of the losses) should improve detection sensitivity

this was not (yet) tested.

anyway, in practice this may not be suitable …


50 ohm coaxial cable
- Ground
- Power
- GCV
multi-pin (3 to 5)
connector
BNC (for signal)
1
2
3
4
trigger
input
Gigabit
Ethernet
SPARK - BLM
Libera -
DC-50MHz BW
5mV 5V
50ohm & Hi-Z
ADCs at >100MHz
slow-averaged buffers
also : counting-mode
self-trigger-mode

224 Units in service for Orbit Correction

and also for Turn-by-Turn Orbit measurements

OLD = PAST but still useful, e.g. tests in Oct. 2014 with DESY

Beam Loss Monitor

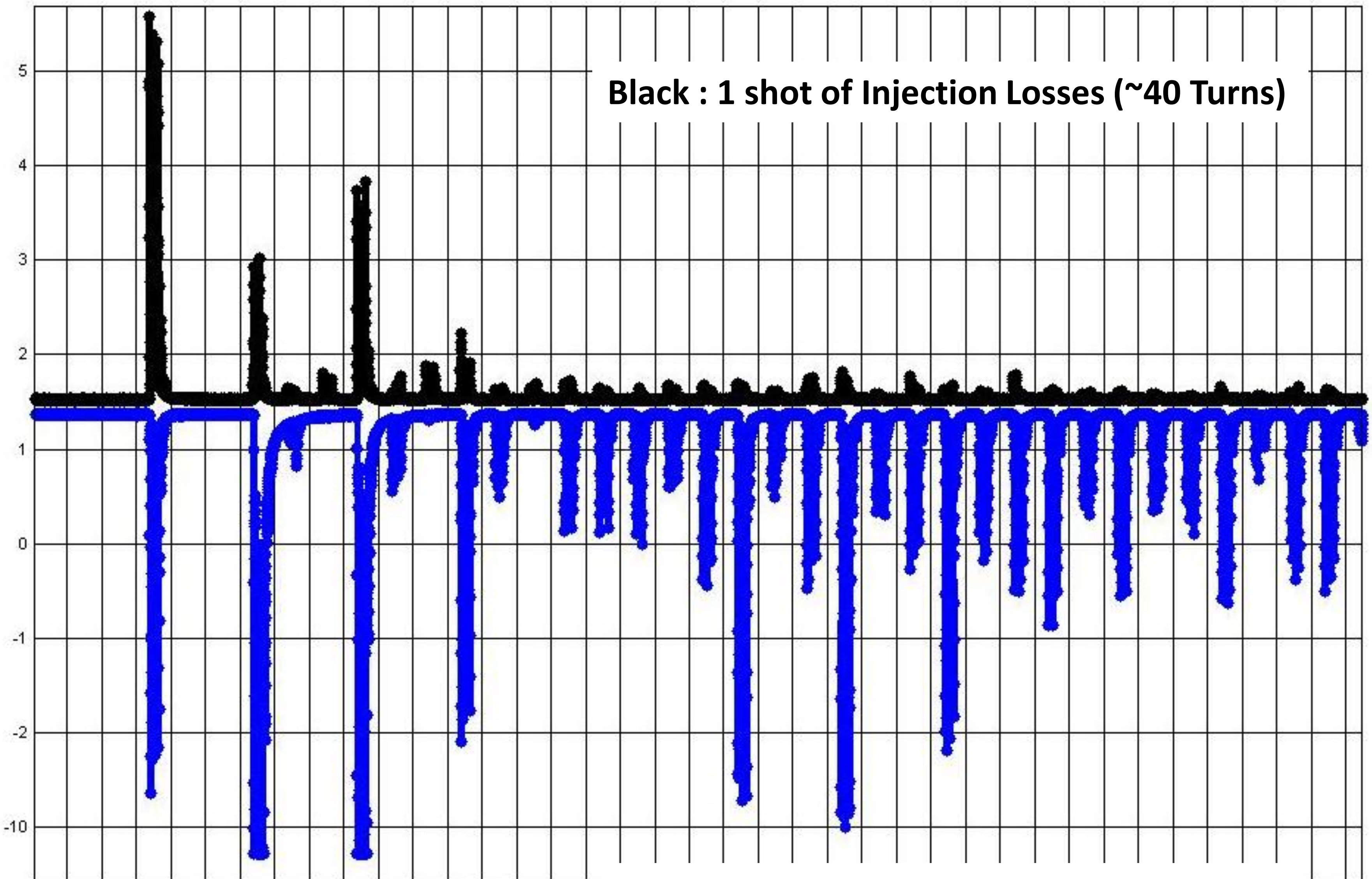
2 units procured & installed (for 8 BLDs)

and also for Turn-by-Turn Loss measurements

but ...
50Ω was 85Ω
1MΩ was 10KΩ

€ € €

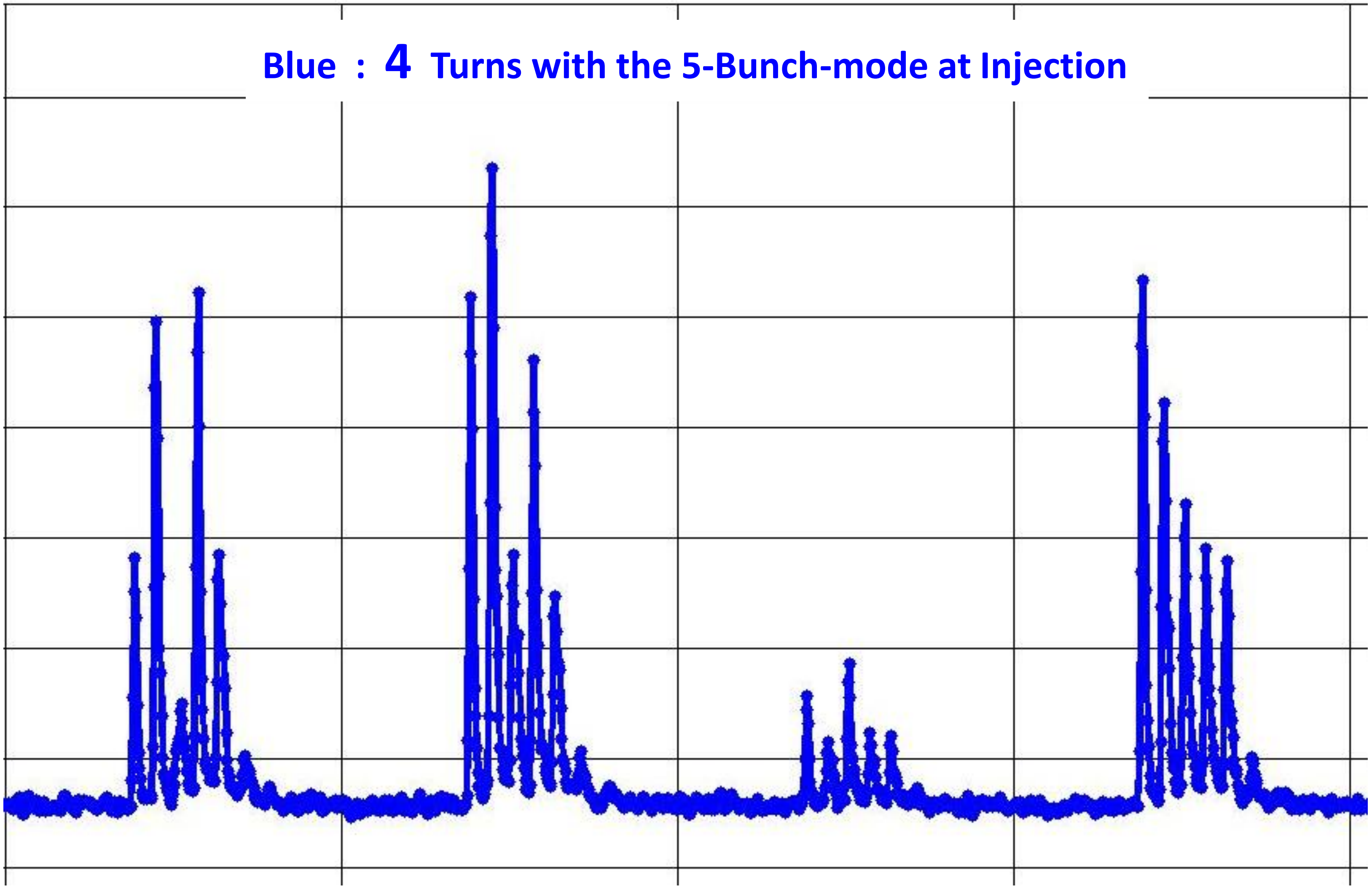
on a “Fast-Compact BLD” on 1rst dipole C4



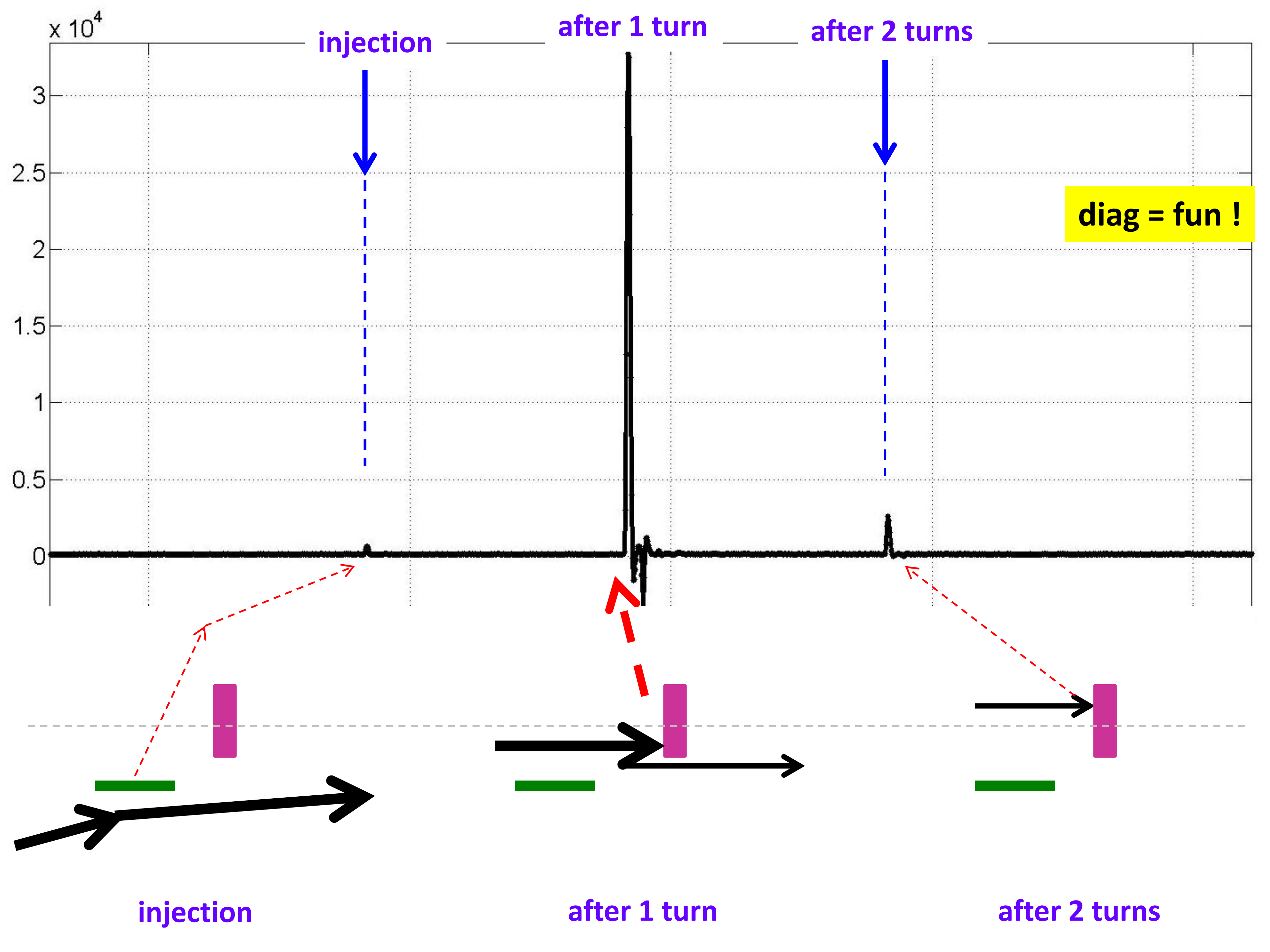
Black : 1 shot of Injection Losses (~40 Turns)

Blue : another shot of Injection Losses . . . .

in same injection, 5 bunch mode



Observations : - Losses vary strongly from Turn-to-Turn
- Losses vary strongly between the 5 bunches
- Losses vary strongly from shot to shot


x 10^4
injection
after 1 turn
after 2 turns
3
2.5
2
1.5
1
0.5
0
diag = fun !
injection
after 1 turn
after 2 turns

from Gero's presentation :

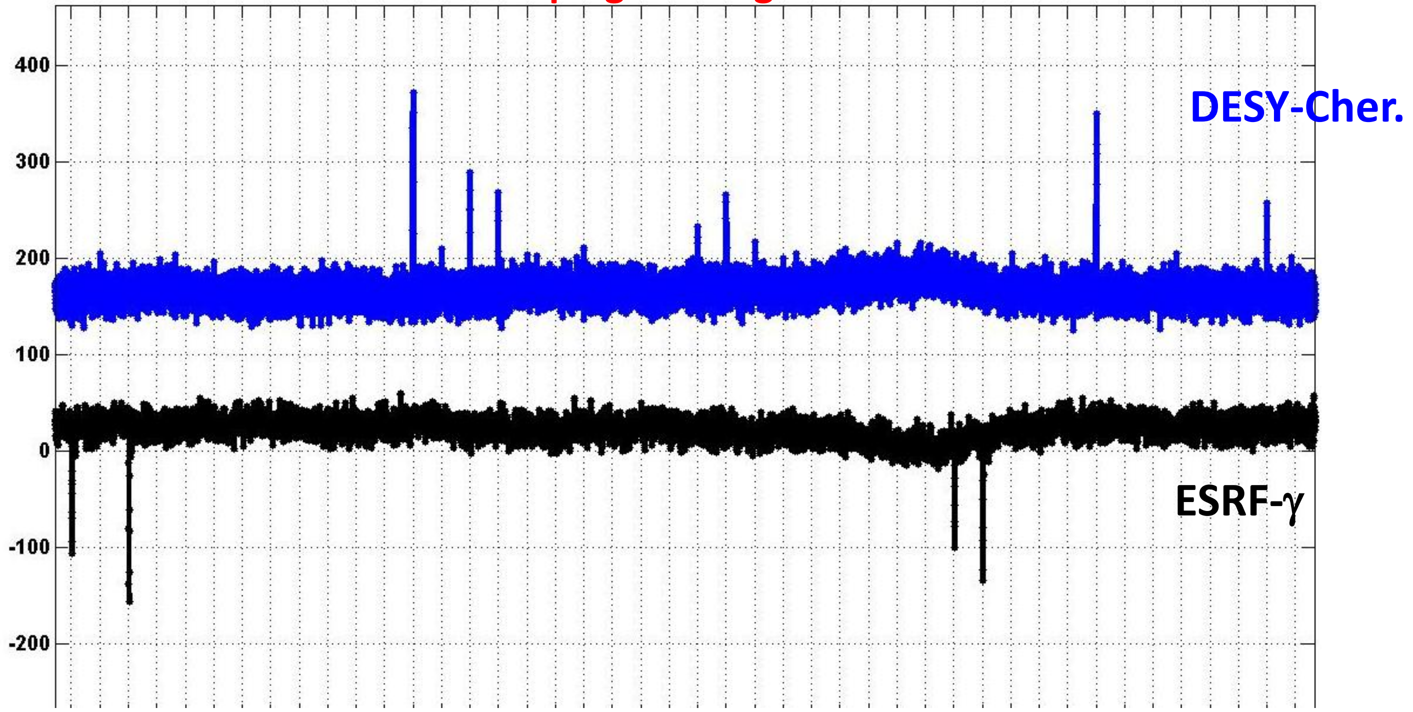
<u>discrepancy</u> between : the loss rate from the BLMs, and that of the lifetime (current monitor)

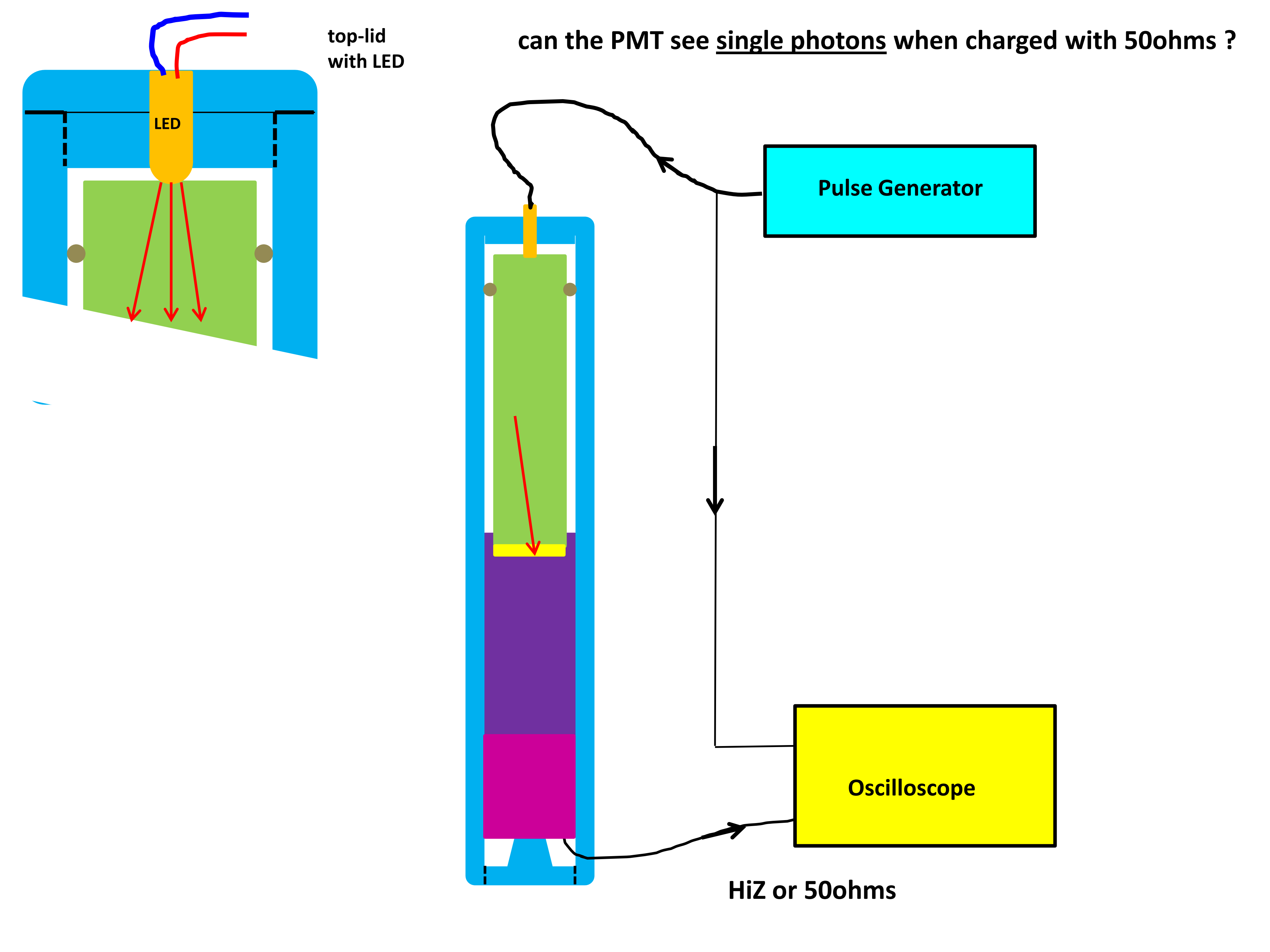
→ measured loss rate (scraper induced) is <u>much smaller</u> than expected from the lifetime reduction

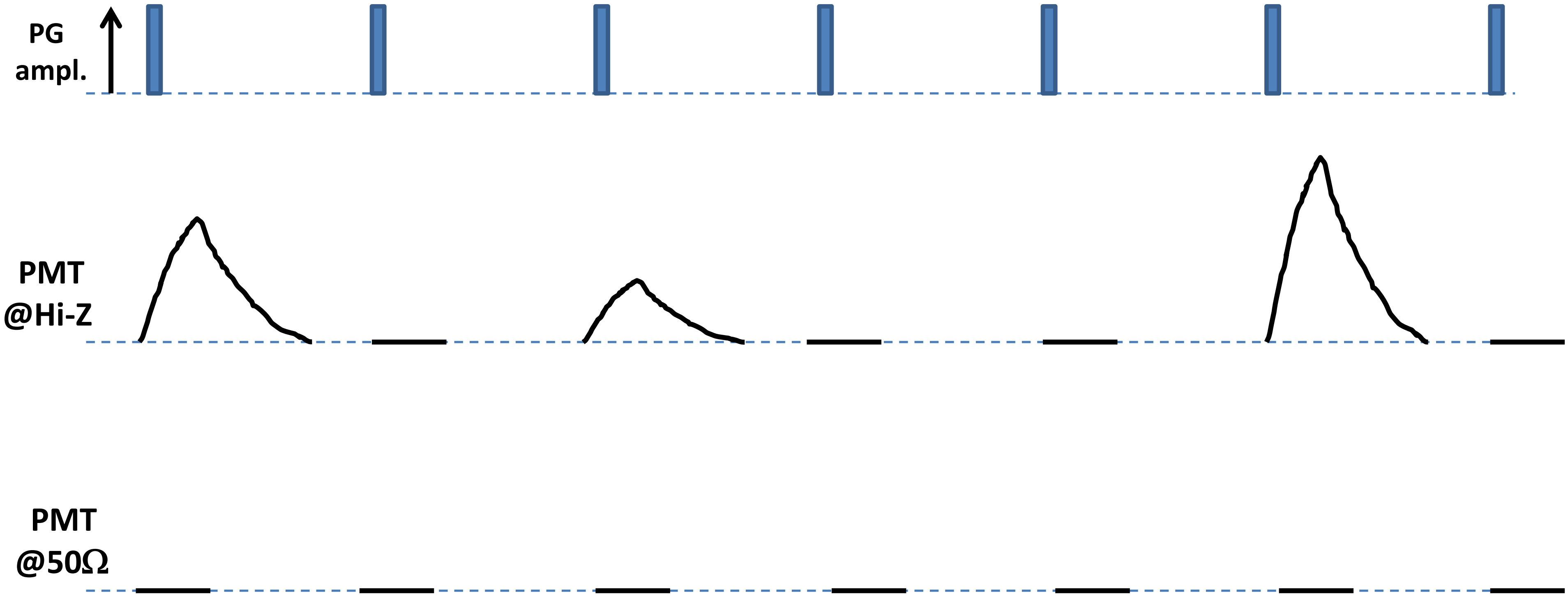
small signals are not detected @ 50Ω,
i.e. high input impedance advantageous

- influence of loss geometry (?)

scraping the single bunch




can the PMT see single photons when charged with 50ohms ?
top-lid
with LED
LED
Pulse Generator
Oscilloscope
HiZ or 50ohms



50Ω is needed for the (spectacular) fast-time-resolved losses,
but single-photons are not detectable (with the PMTs),

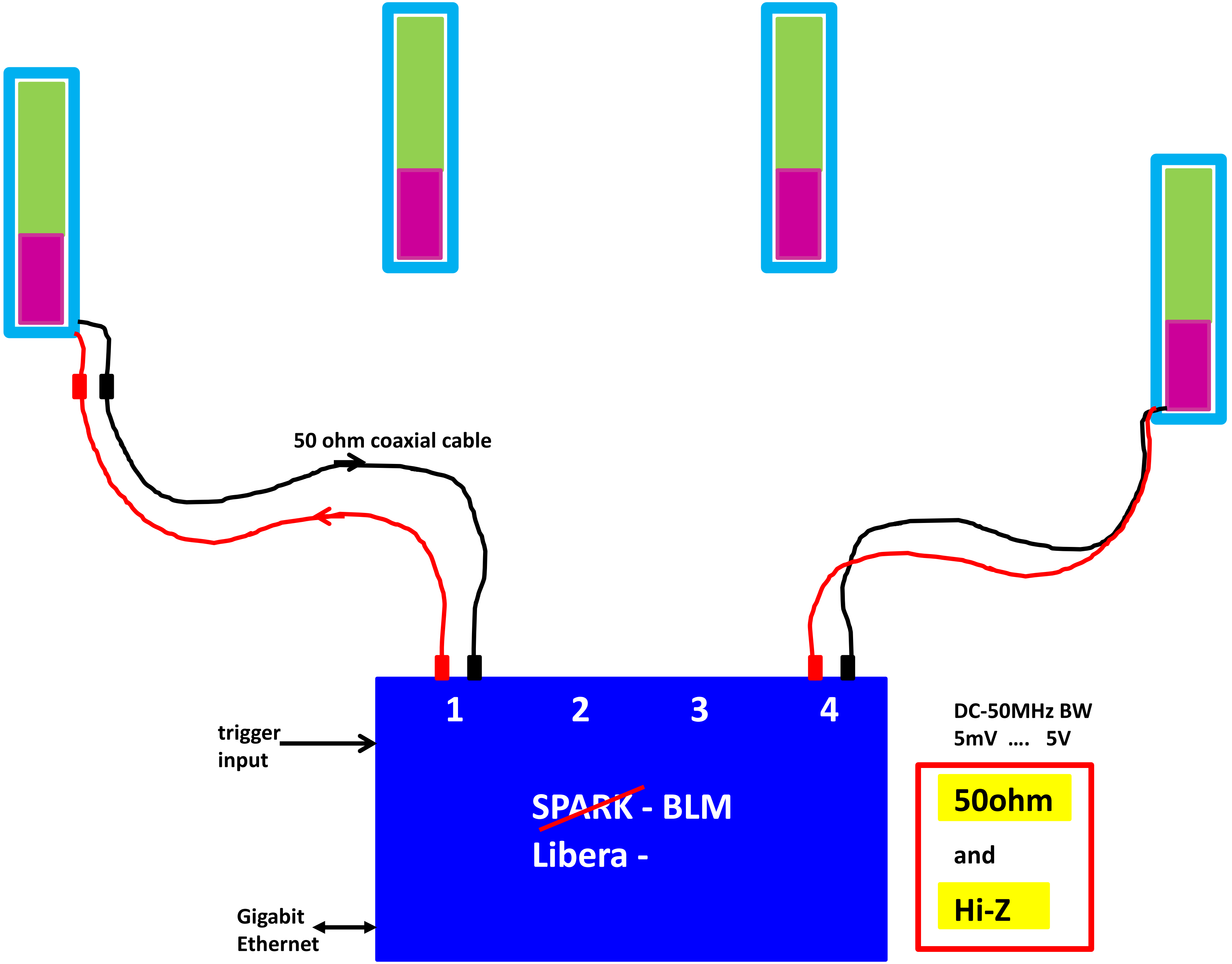
so can a single-electron losses be detected ? YES and NO !!

it depends on the geometry : → distance BLD_loss-point , size BLD

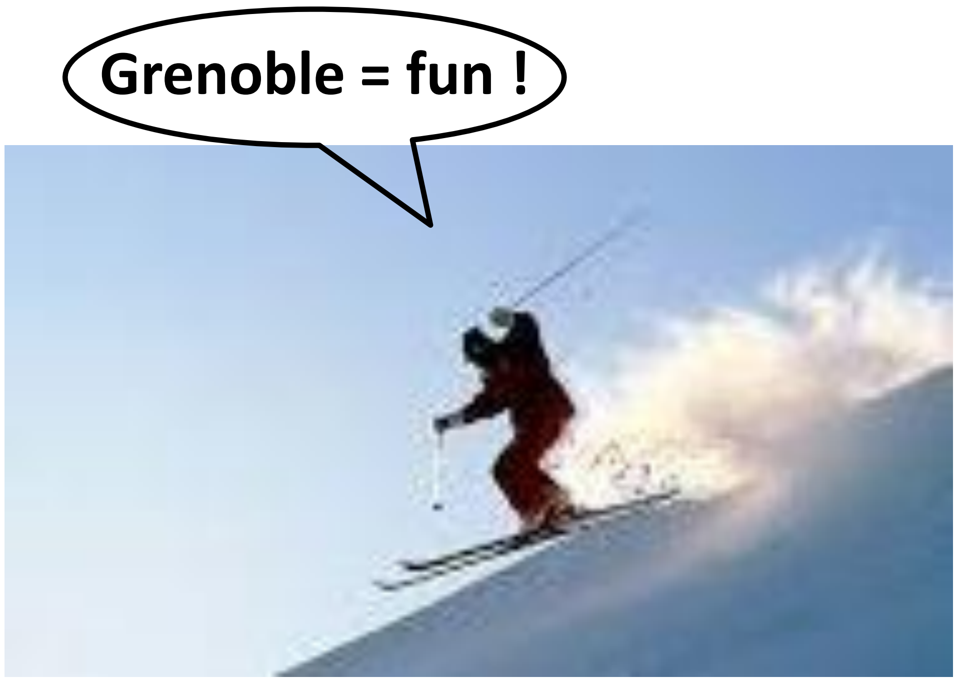
is NOT a problem : the losses are HUGE anyway (e.g. Injection)

strong & fast losses : 50Ω needed to see the time-structure
depending on size & geometry the BLD will
(probably) NOT see/detect every single electron-loss
so when scraping and then comparing the loss-rate
seen by the BLD and seen by the current monitor (lifetime)
the current monitor is more sensitive

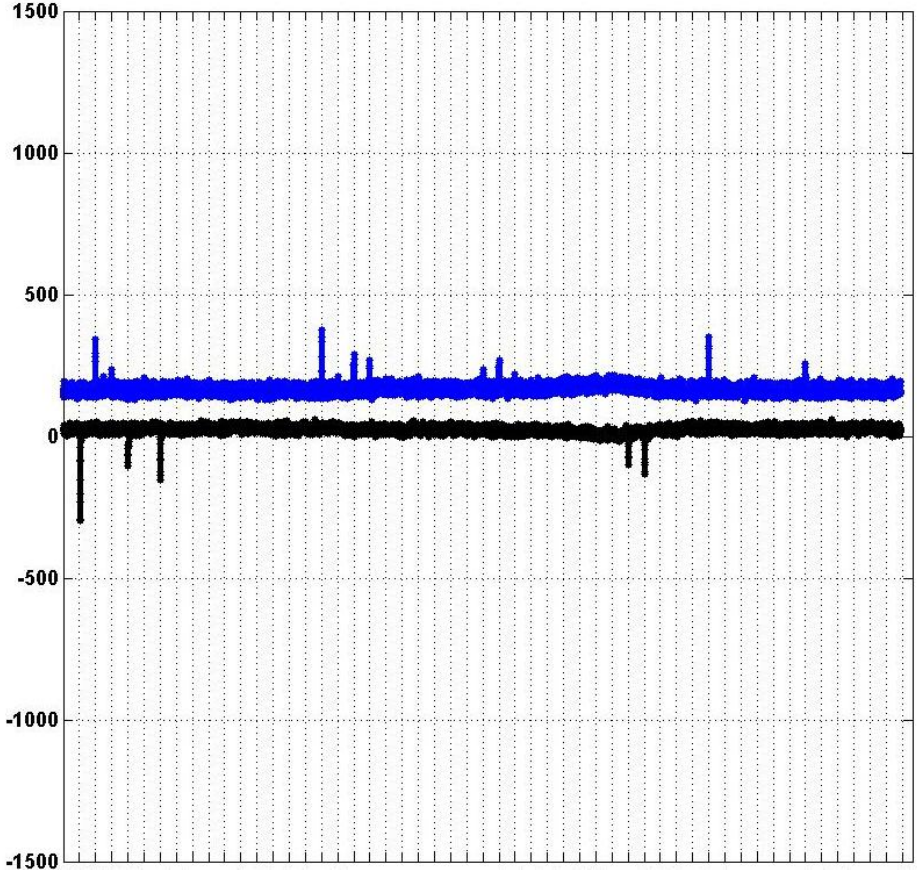
weak & slow losses : no time-structure → no need for 50Ω
put Hi-Z → now see extremely small loss variations
that your current monitor (lifetime) can NOT see


50 ohm coaxial cable
1
2
3
4
trigger input
SPARK - BLM
Libera -
Gigabit Ethernet
DC-50MHz BW
5mV 5V
50ohm
and
Hi-Z

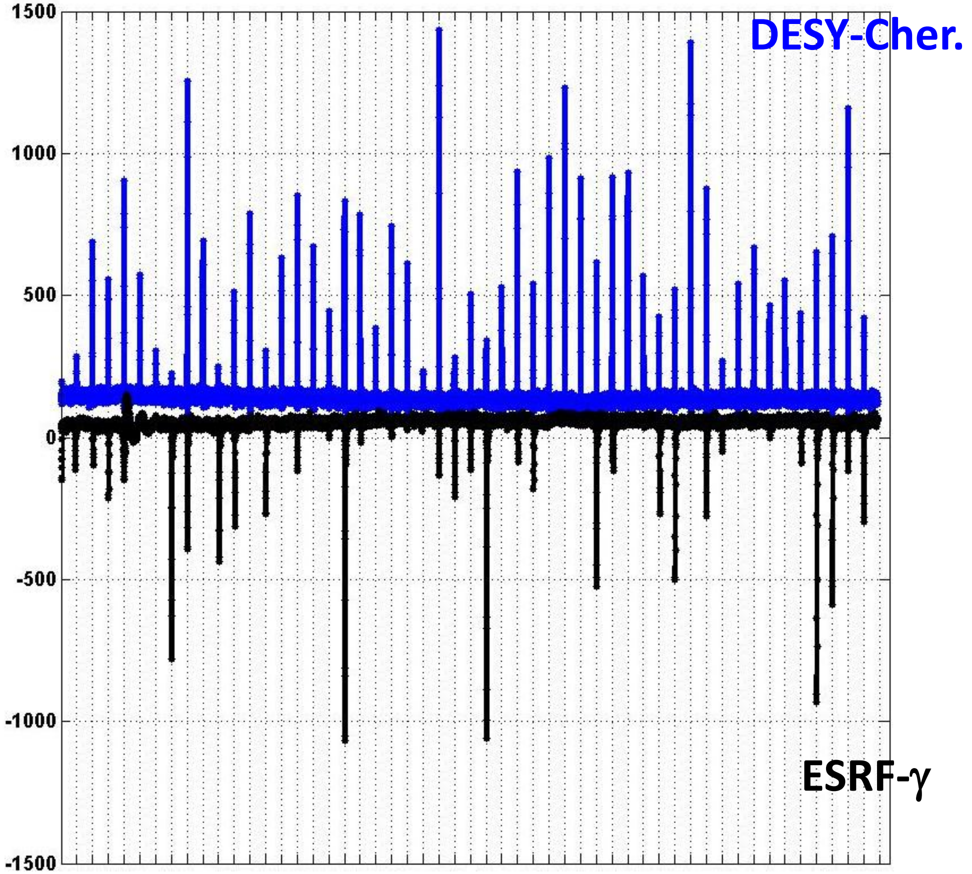
thank you for your attention !



scraping the single bunch
mildly



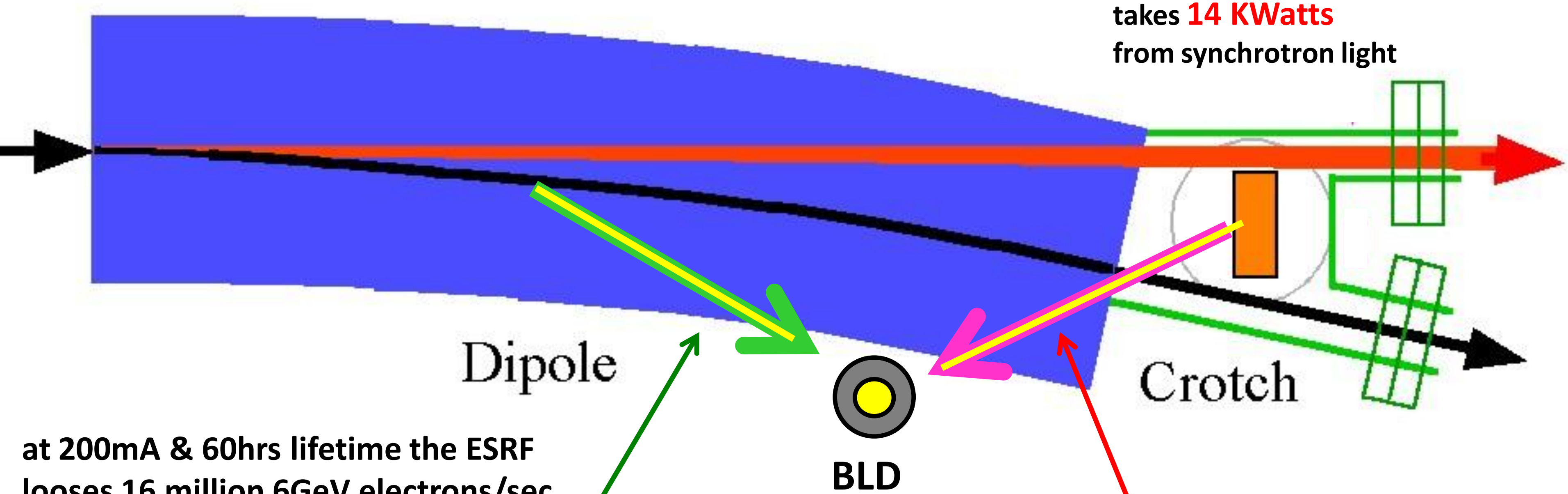
scraping the single bunch
STRONGLY



best place for the BLD :

inside the dipole,
somewhere in the 2nd half,
but NOT too close to the crotch-absorber

at 200mA the Crotch Absorber
takes 14 KWatts
from synchrotron light



at 200mA & 60hrs lifetime the ESRF
looses 16 million 6GeV electrons/sec
in its 844m circumference
→ 2 10^{-11} Watt/meter

shower of energetic particles,
resulting from an electron crashing on
the inside of Dipole chamber
the "good" signal for a BLD

back-scattered particles,
resulting from synchrotron light
hitting the absorber
to be avoided

Upgrades on the BeamLoss Detectors

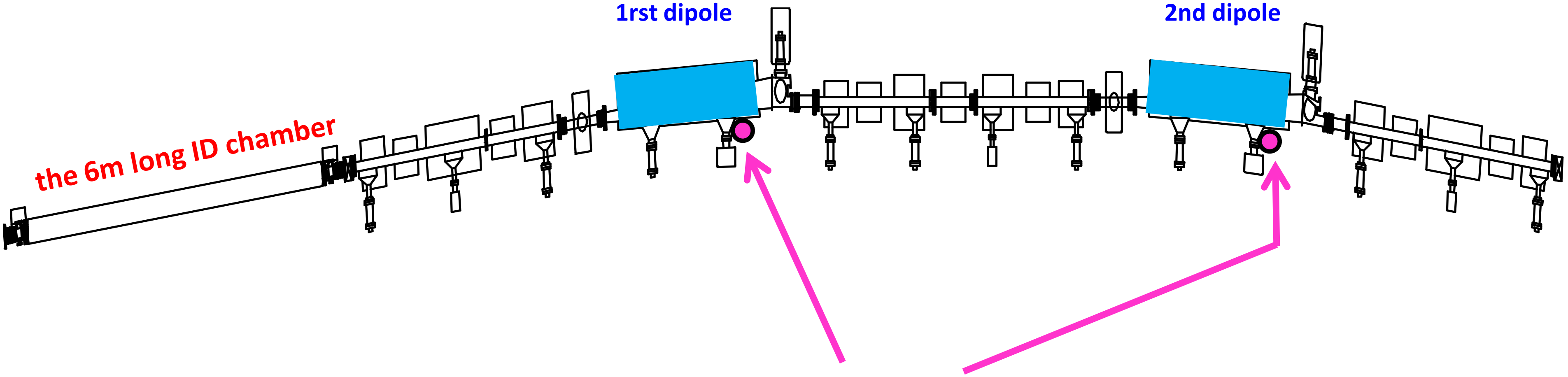
The vacuum lay-out of 1 cell (1 / 32 of the Ring) with :

the 6m long ID chamber

the 2 dipoles

the 2 BeamLoss Detectors

Top View



BeamLoss Detectors

on IN-side of the dipole

So : in total 64 BLDs in the Ring