BEAM LOSS LOCATION WITH AN OPTICAL BEAM LOSS MONITOR IN THE CLEAR FACILITY AT CERN

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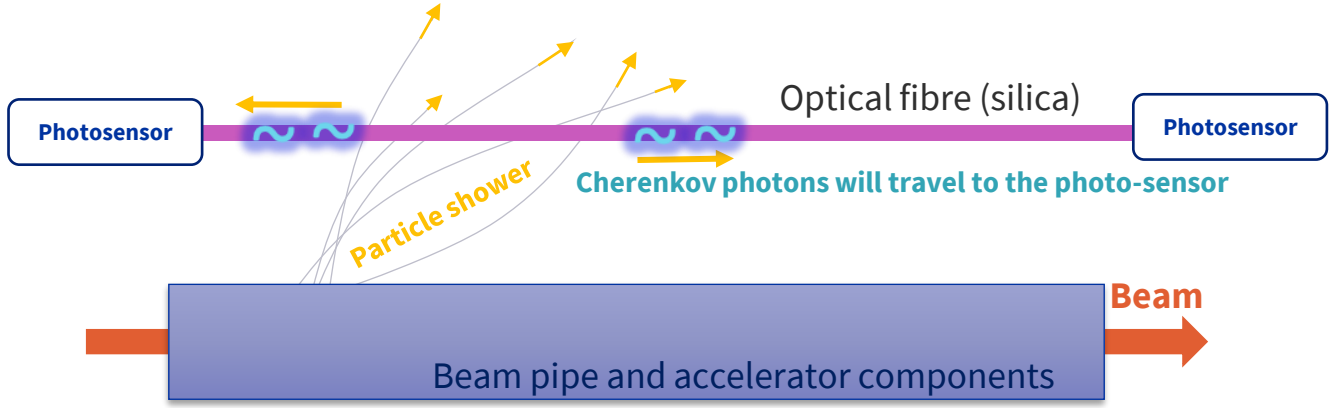
Optical Beam Loss Monitors

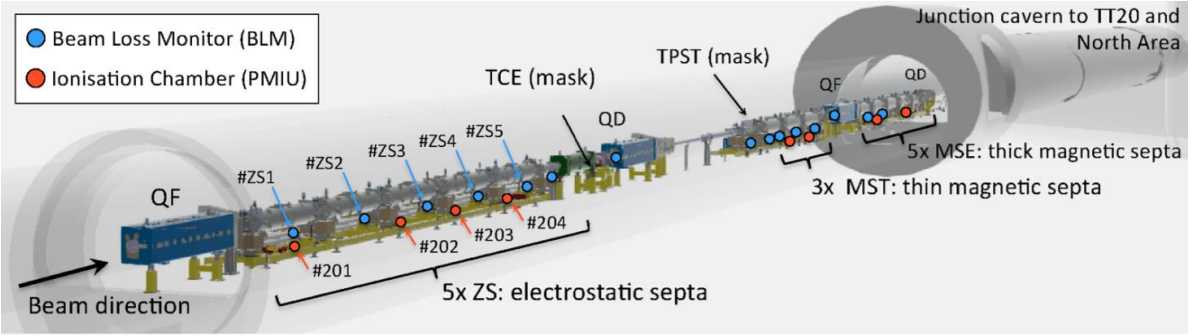
Beam loss detector capable of covering long distances continuously.

Optical fibre BLMs:
Several meters of silica optical fibres are coupled to photosensors to detect the Cherenkov light produced by secondary charged particles parallel to the beamline.



Installed in the SPS Slow extraction to the North Area.

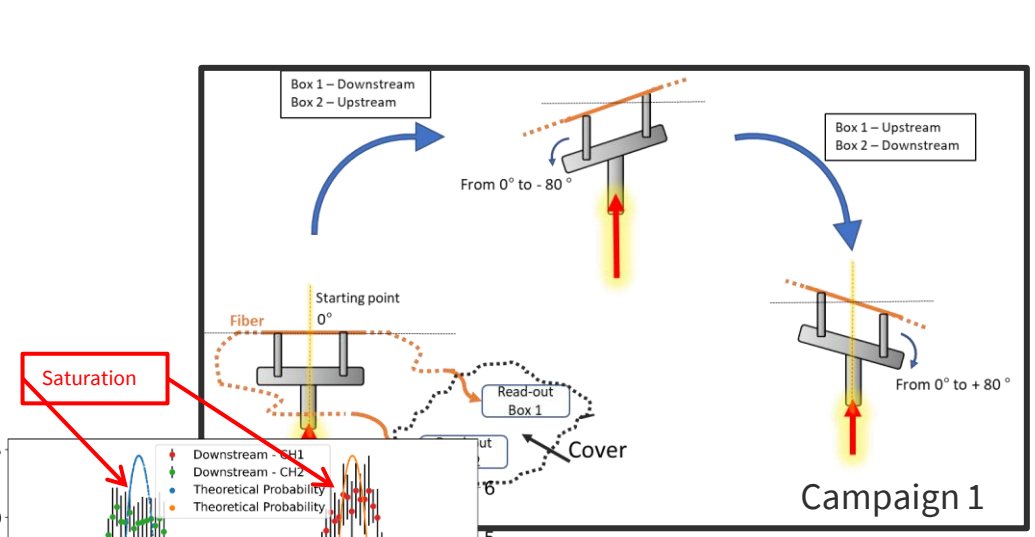
There is a need to minimize the radiation levels and optimize the machine settings.

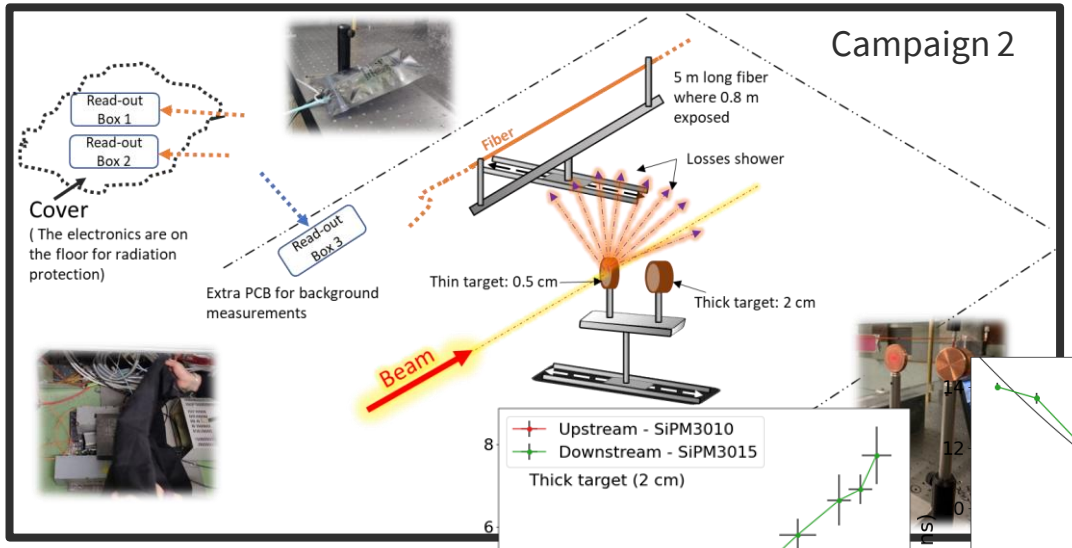


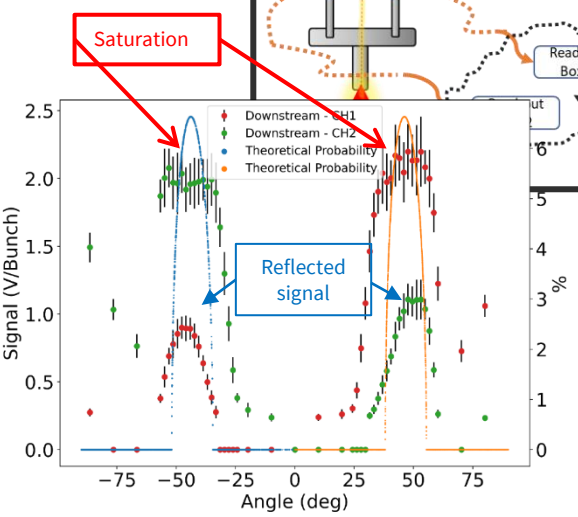
First Optical BLM experiments in CLEAR facility

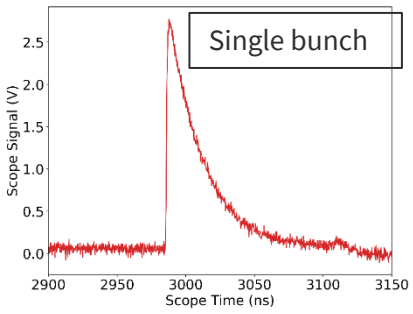
Tests in CLEAR have been very useful to benchmark the simulation results and test the sensor electronics.

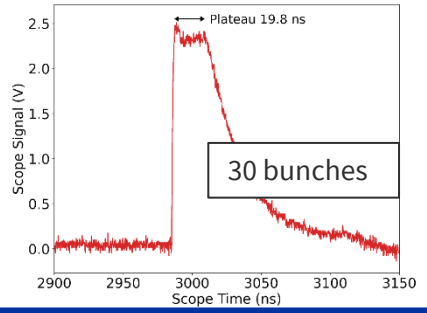
- Observation of the Cherenkov effect and system characterisation.
- Selection of the instrumentation and their parameters: fibres (type, length, core size, etc.), photosensors, read-out electronics.
- Several studies: angle of capture, shower of losses detection, photosensors saturation, single bunch Vs. train of bunches, distance, dependency, etc

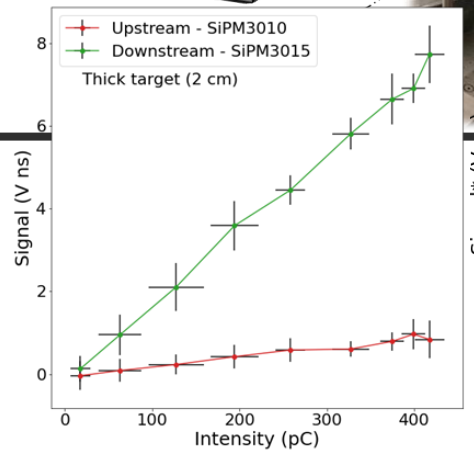


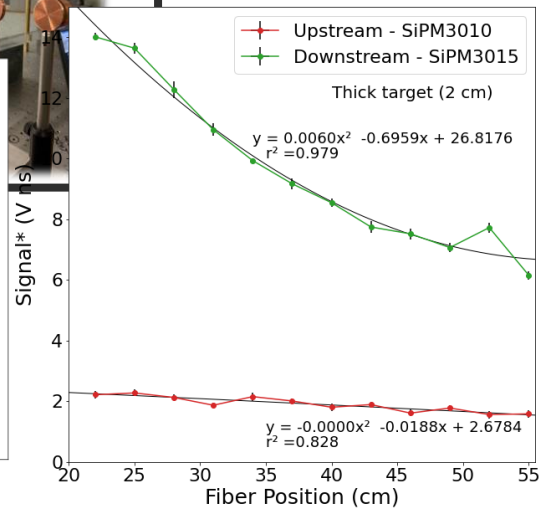






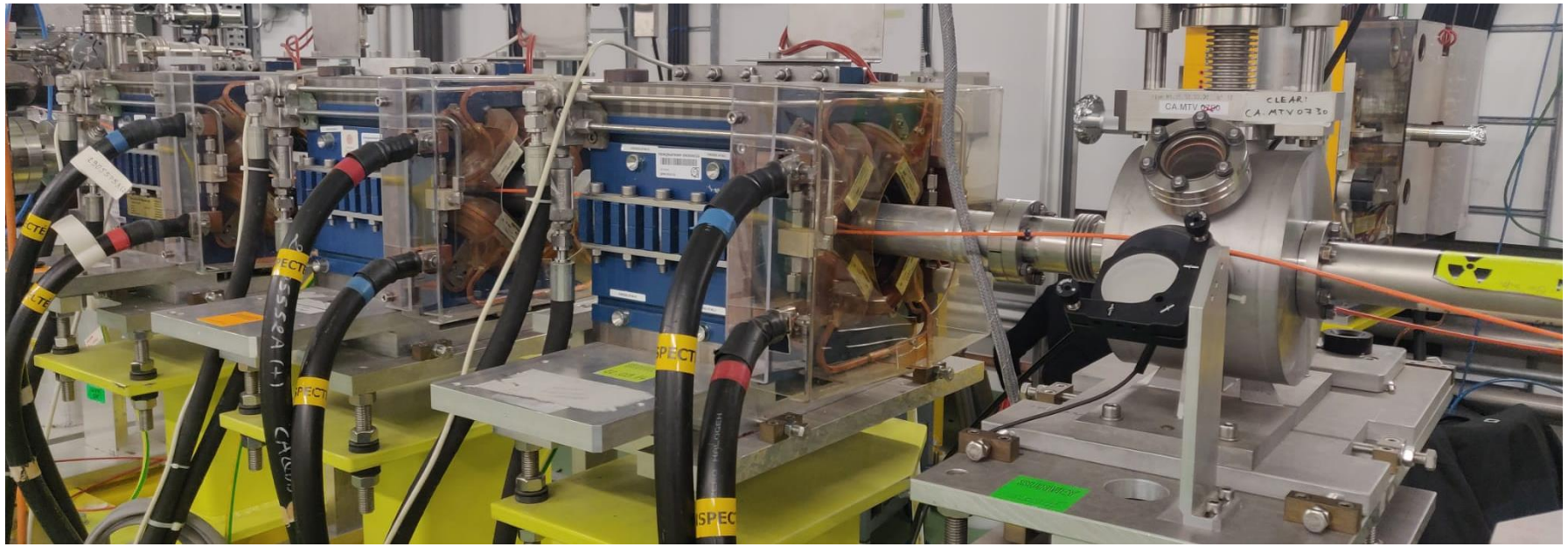


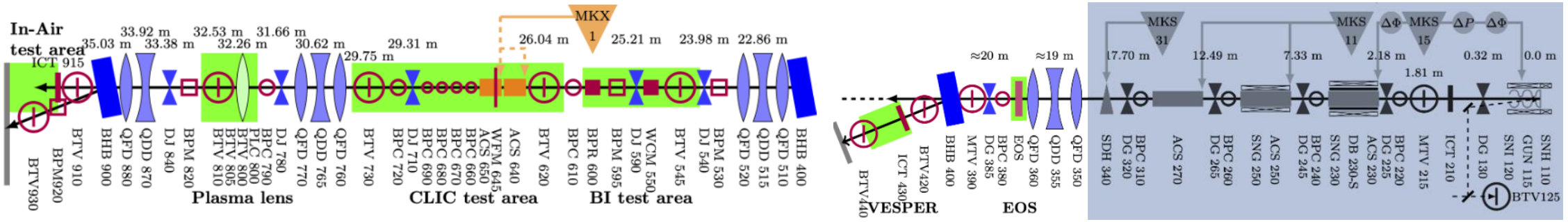




New experiments in CLEAR facility

The set-up

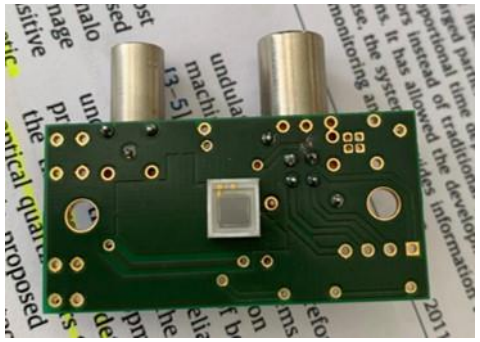




It covered the last 1/2 of the beam line ≈22 m. (In the first part there are not screens.)

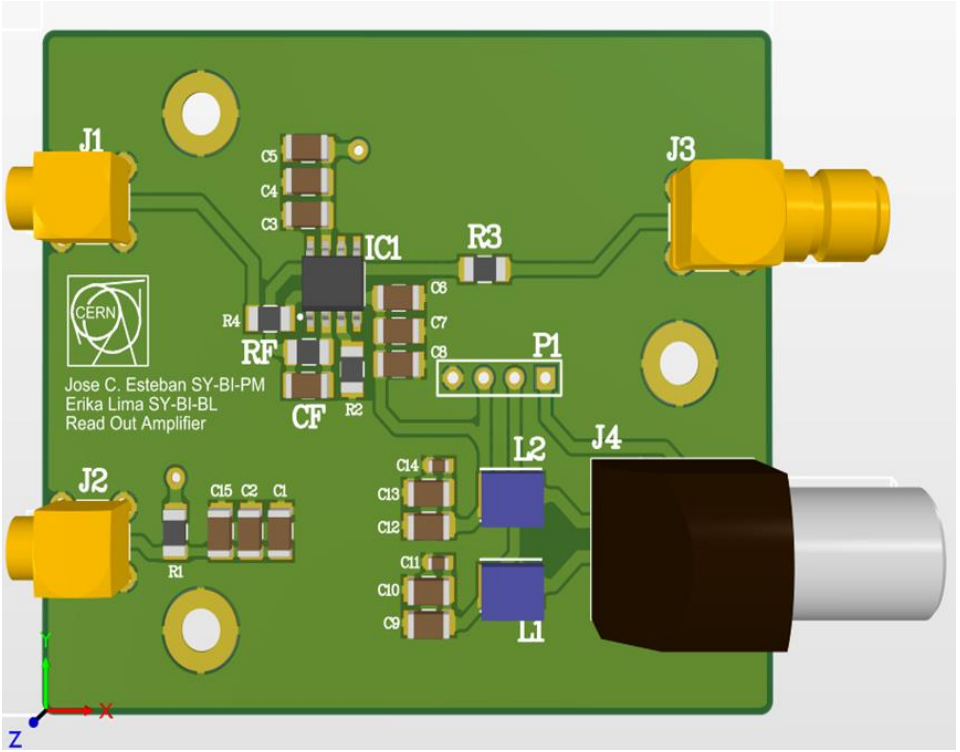
The Read Out

The system electronics, such as Downstream and Upstream photosensors, power supplies and oscilloscope, were installed in a safe technical gallery, situated on the first floor of the building above the accelerator.



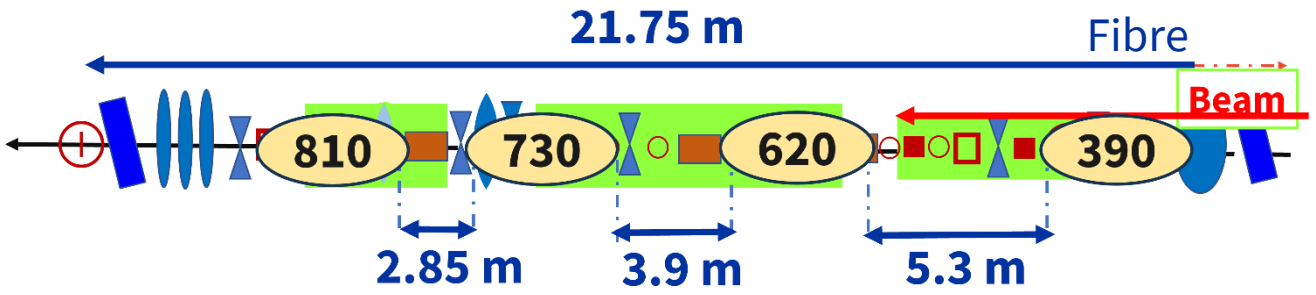
Code	Pixels	Op. Voltage	Average PDE(λ)
S14160-3015PS	40000	42 V	20%

Amplified boards.

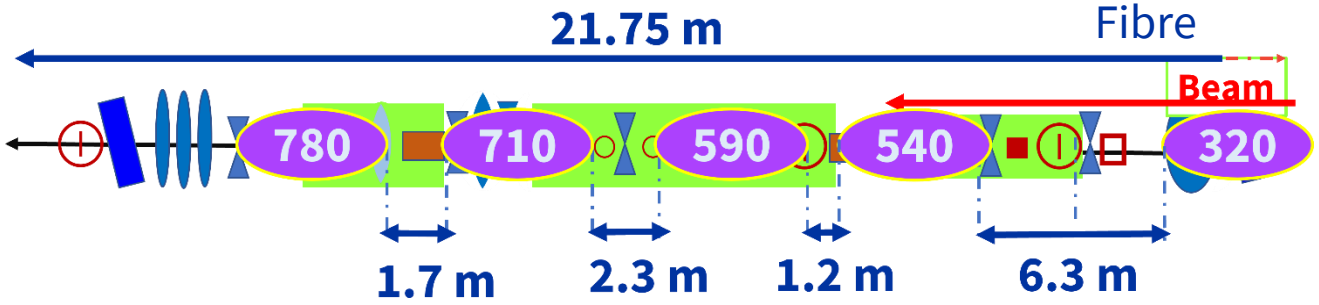


Test description

Screen locations



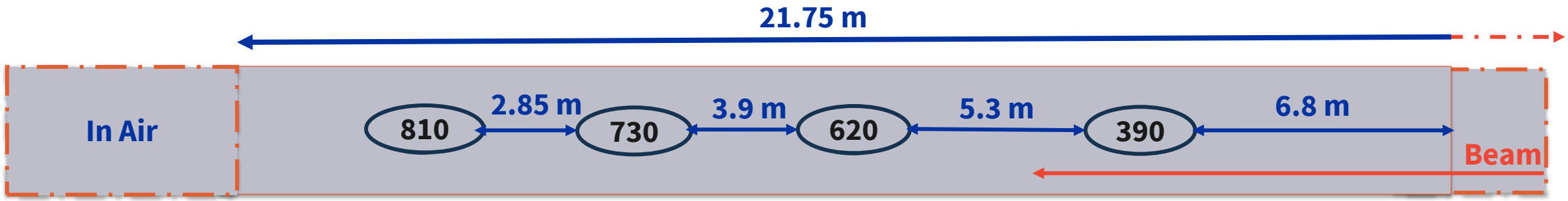
Kicker locations

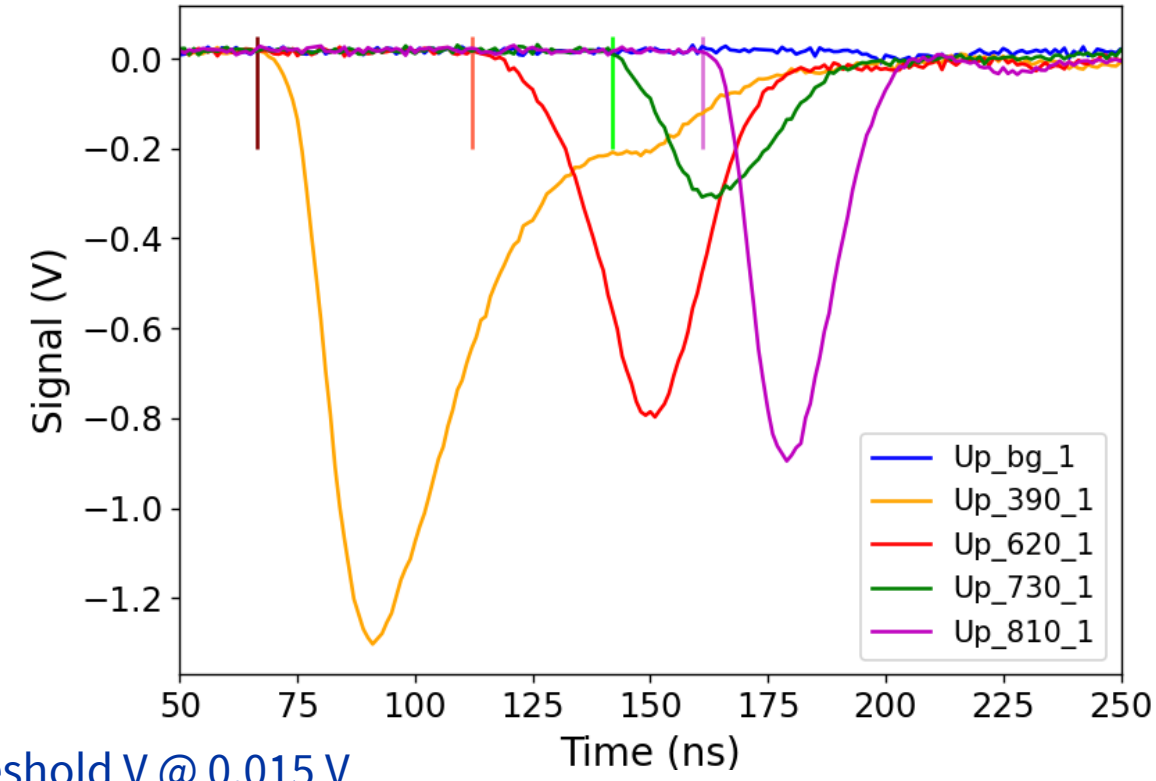


Beam parameter	Value range
Type	Electron
Energy	60 – 220 MeV
Bunch charge	0,01 – 5 nC
Bunch spacing	0,666 ns

Loss location - UPSTREAM

Distance between fibre and line 10 cm.





Threshold V @ 0,015 V

67 ± 4 ns
112 ± 4 ns
142 ± 3 ns
161 ± 2 ns

$$\Delta t = \frac{\Delta x}{c}(n+1)$$

$n = 1.46$

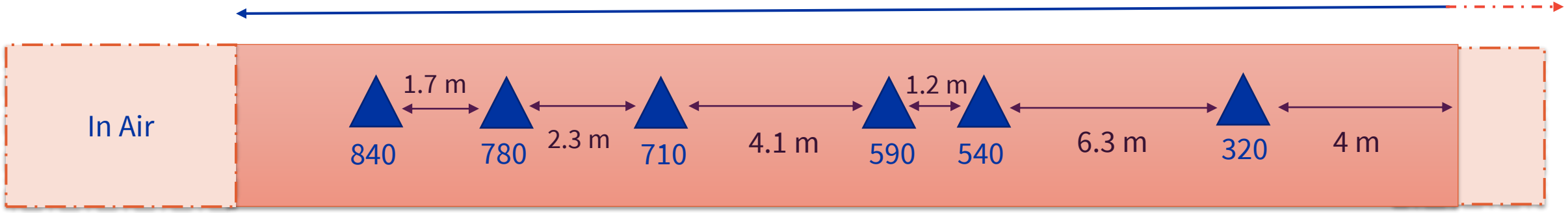
Screens	Up time (ns)	d (m)
620 - 390	45 ± 8	**5.5** ± 0.9
730 – 620	30 ± 7	**3.7** ± 0.8
810 – 730	19 ± 5	**2.3** ± 0.6

Kickers

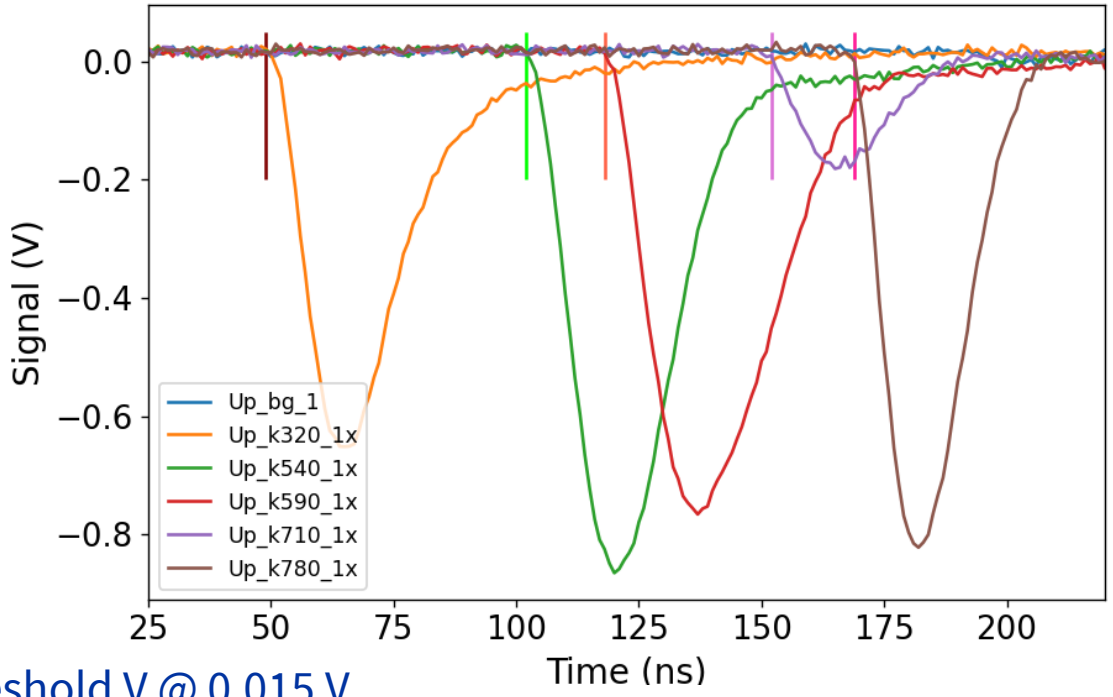
xxx Screens

Kickers

Distance between fibre and line 10 cm.



CLEAR BEAM LINE



49 ± 3 ns

102 ± 4 ns

118 ± 10 ns

152 ± 6 ns

169 ± 3 ns

$$\Delta t = \frac{\Delta x}{c}(n+1)$$

$n = 1.46$

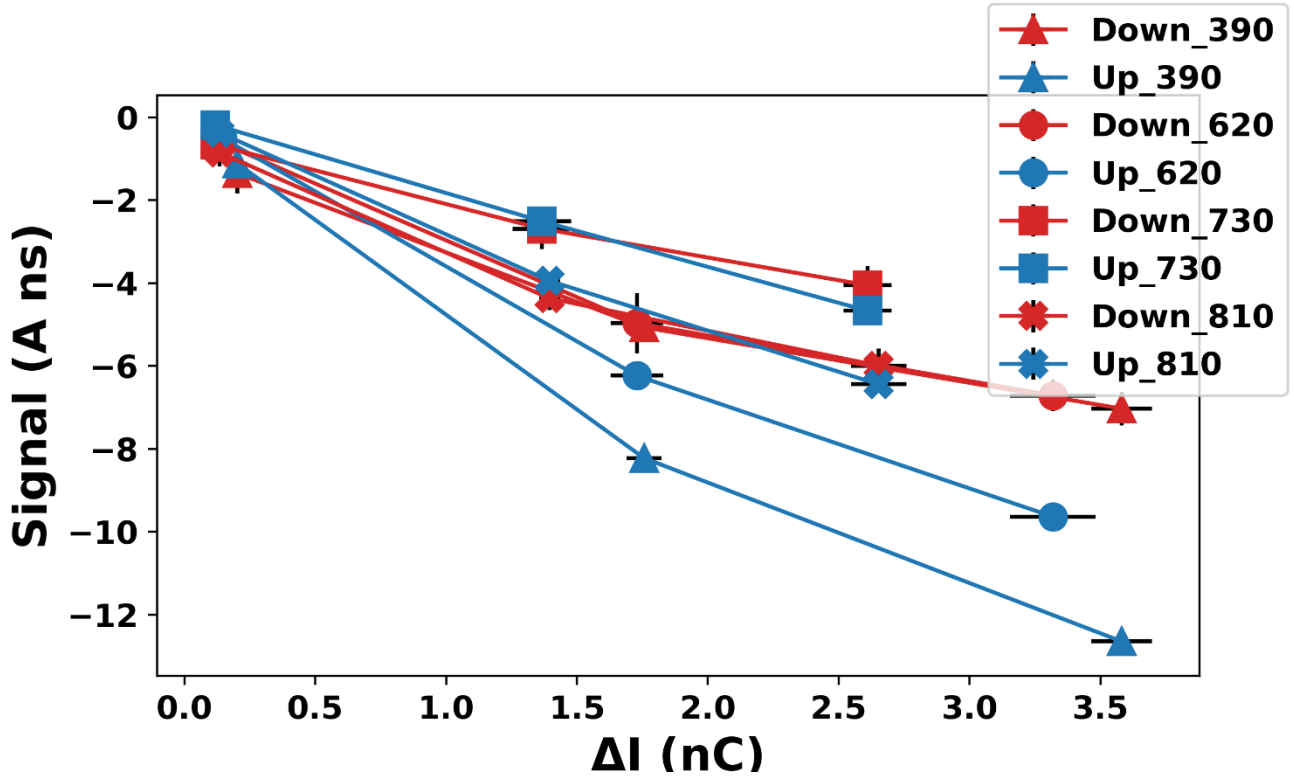
Screens	Up time (ns)	d (m)
540-320	53 ± 7	**6.7** ± 0.9
590-540	16 ± 14	**2** ± 2
710-590	34 ± 16	**4.15** ± 2
780-710	17± 9	**2.1** ± 1

Threshold V @ 0,015 V

Intensity detection linearity

Relation between the lost charge and the intensity measured by the fibre during the screen scans.

Points calculated for 1, 5 and 10 bunches.



The system detection behaviour is not guaranteed to be linear, and this can be a direct consequence of the saturation in the photosensor signals at the 5 and 10 bunches measurements.

Future work

CLEAR

- Read-out development. New measurements with no amplified boards.
  - More scans with higher number of bunches avoiding saturation. Sensor calibration and linearity.
- Impact of the distance between the fibre and the beamline.
- Localisation methodology combining the Down-Upstream signals.

SPS

- Expecting signal from the unbunched beam.

Thank you for your attention

Questions?