

Top-up radiation study at ALBA Synchrotron

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Radiation Protection Service




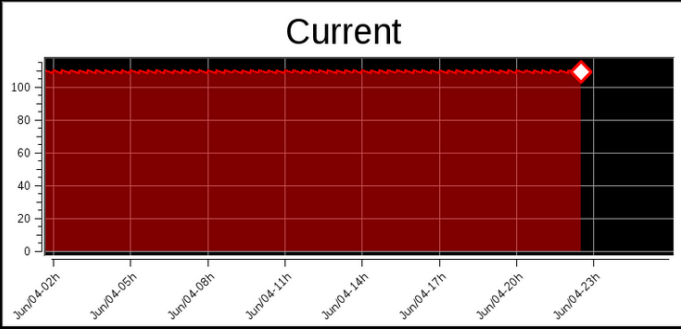
Top-up in ALBA

Radiation measured
since TOP-UP

Adopted solution

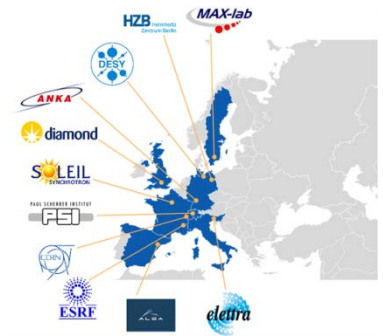
Conclusions

1 Top-up in ALBA

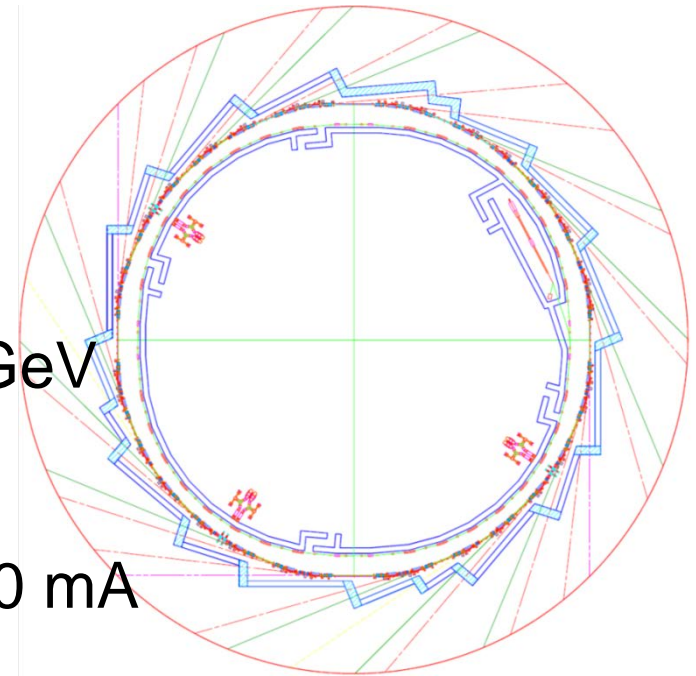
Current	109.211 mA	
Life Time	20h 21m	(2170.6)
Pressure	4.78e-10 mbar	
		
Thursday 04-Jun-2015 22:30:53		
Beam for BLs. Top-up mode.		

MSPD	FE04 Open	SCW30 B = 2.102 T
MISTRAL	FE09 Open	BEND
NCD	FE11 Open	IVU21 5.87 mm
XALOC	FE13 Open	IVU21 6.68 mm
CLAESS	FE22 Open	MPW80 12.90 mm
CIRCE	FE24 Open	EU62 36.73 mm
BOREAS	FE29 Open	EU71 44.91 mm

- 3 GeV electron accelerator generating bright beams of synchrotron radiation near Barcelona city.

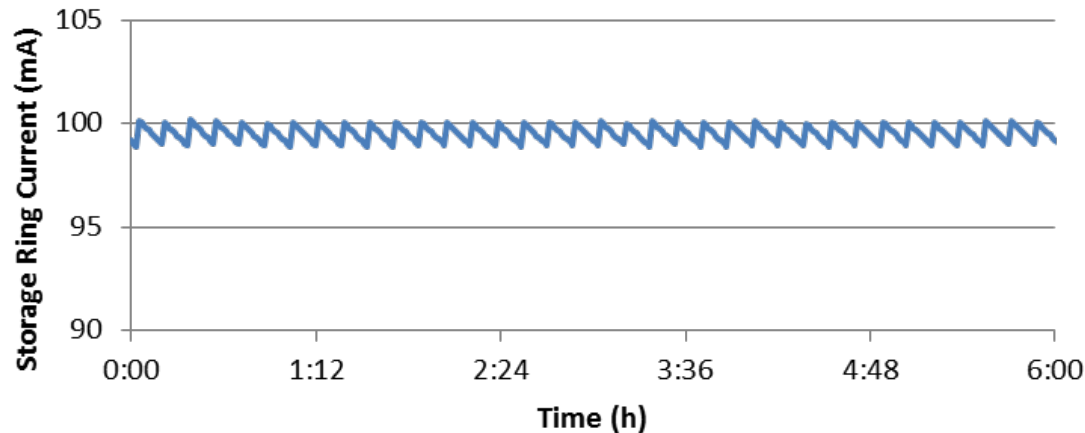


- **LINAC** up to 110 MeV
- **BOOSTER**: from 110 MeV to 3 GeV
- **STORAGE RING**:
3 GeV, currently at 120 mA, max. 400 mA



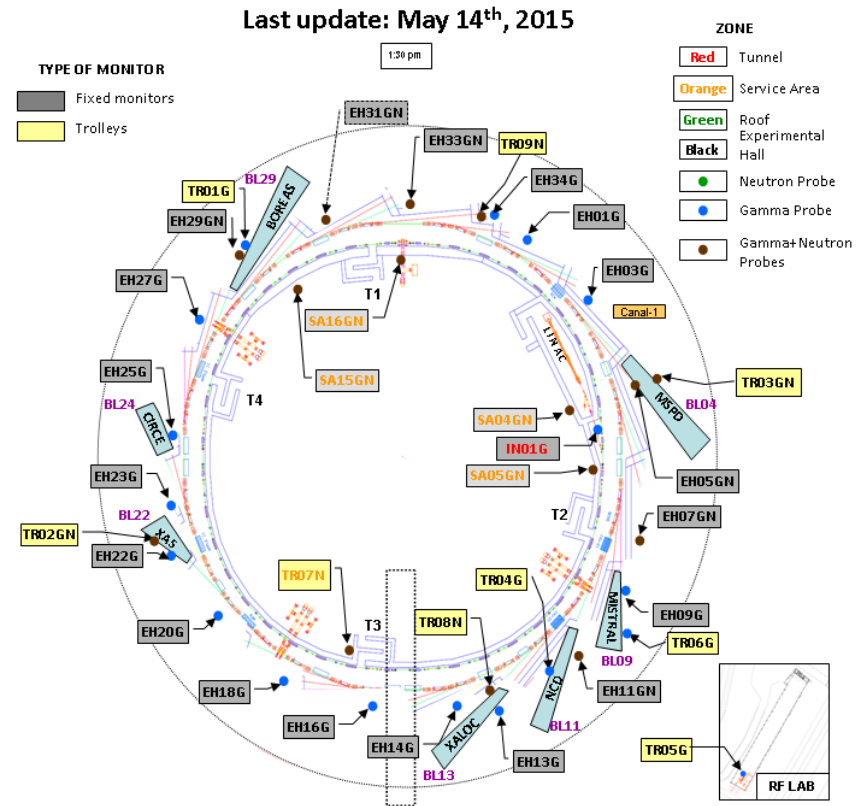
- 1. Power supply of BM-1 from Booster-to-Storage Transfer line must be in range**
 - 2. All radiation monitors must be below pre-alarm level (currently 1.5 μ Sv/4h)**
- ☐ If any criteria is violated →**

TOP-UP permits are retrieved by PSS



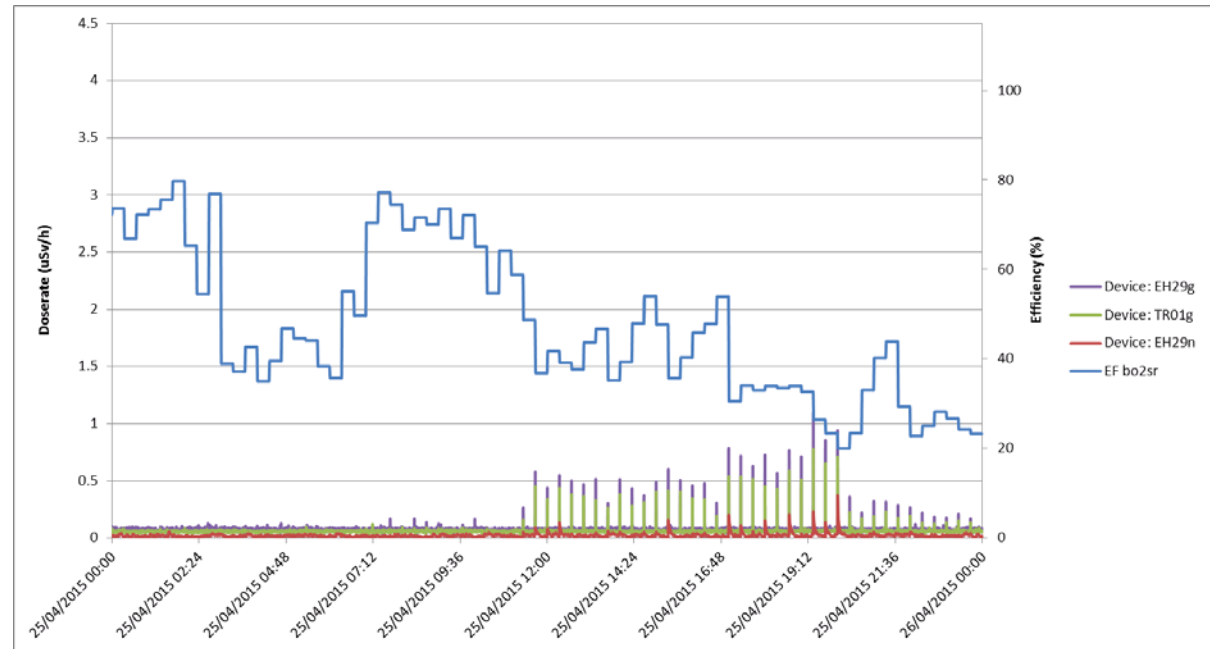
- 25th June 2014: Start of operation in Top-Up mode
- e- beam stored at 100 mA in SR
- Around 1mA injections every 20 mins with Front Ends opened

2 Radiation measured during TOP-UP



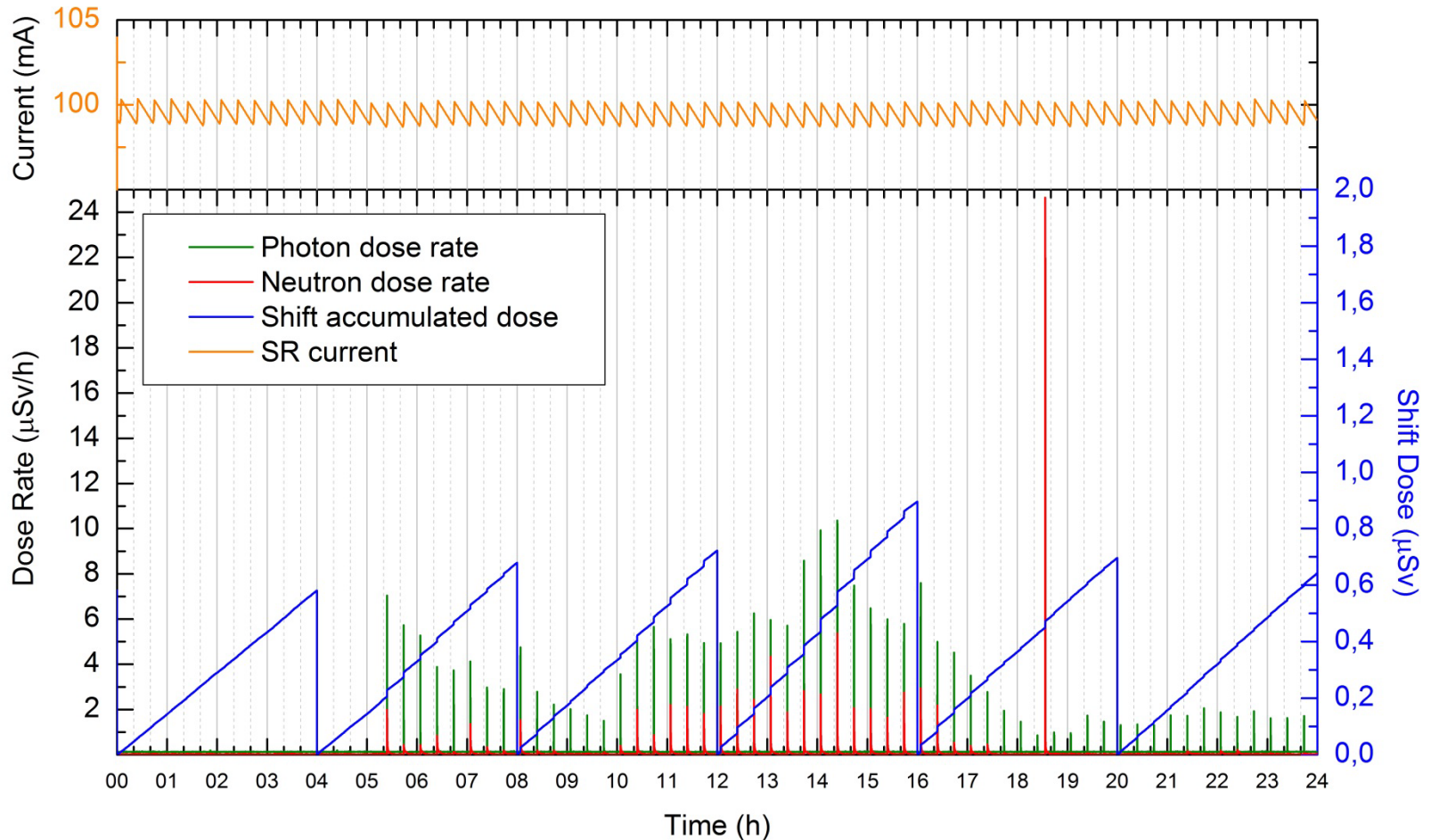
Where?	Photons	Neutrons
Outside BOREAS OH	Up to 10 $\mu\text{Sv/h}$	Up to 8 $\mu\text{Sv/h}$
FW20 – No BL	0.45 $\mu\text{Sv/h}$	--
FW27 – No BL	0.2 $\mu\text{Sv/h}$	--

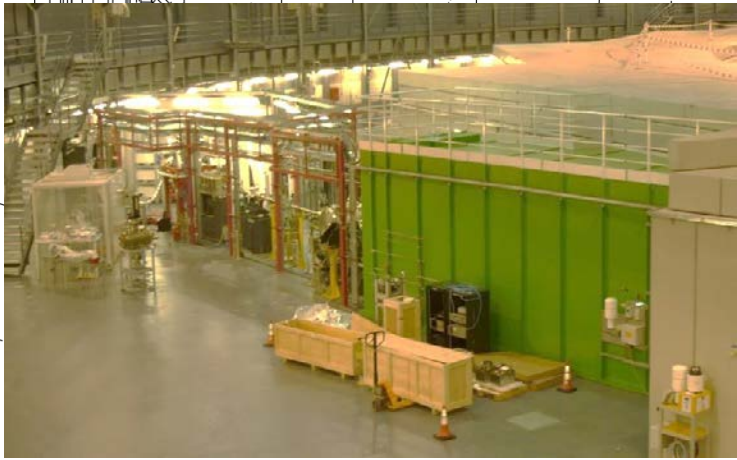
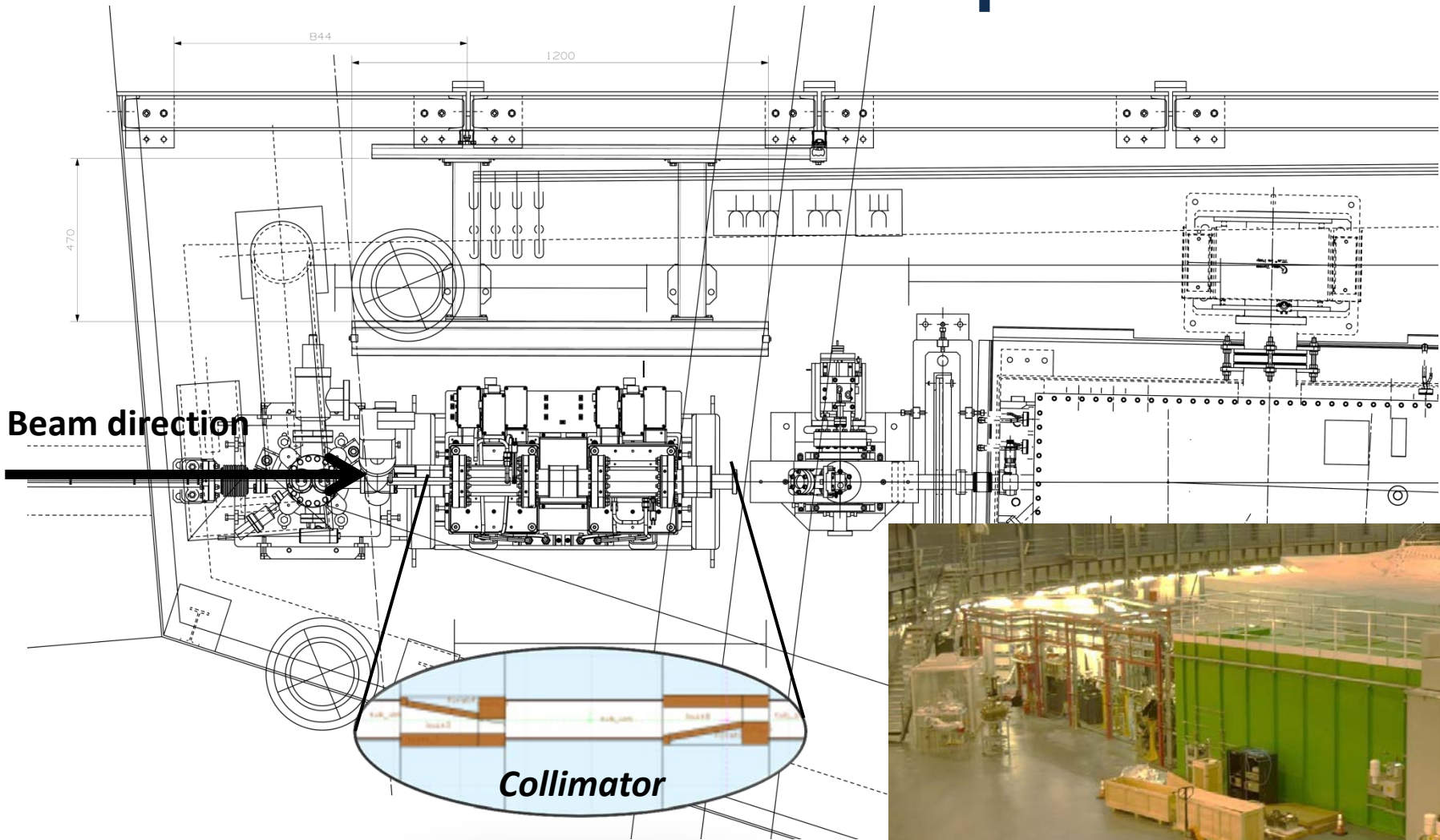
Correlation with BO to SR injection efficiency



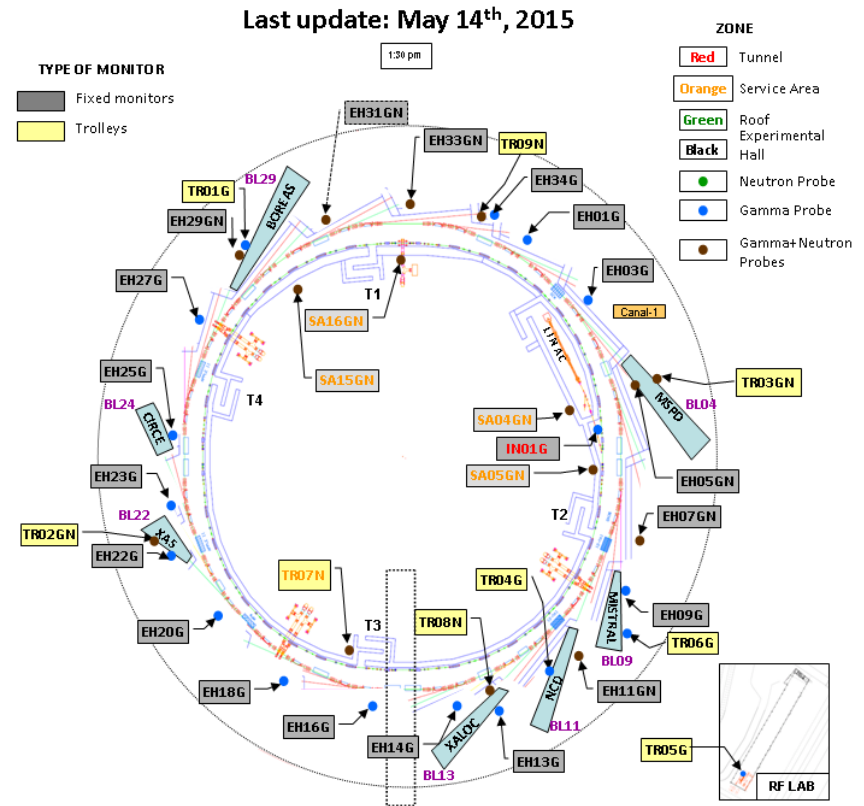
- **TOP UP Mode:** Injections every 20 mins (approx.) with **Front Ends opened**

Outside BL29 - BOREAS

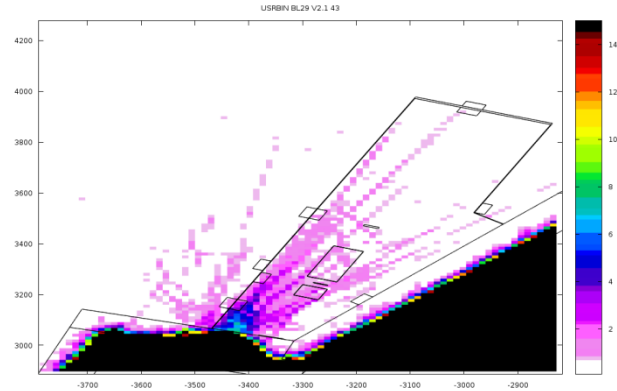
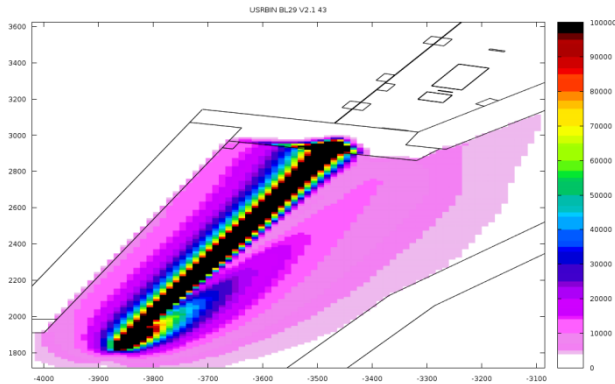




3 Adopted Solution



MC Simulations to understand radiation origin



- **Maximum gamma Dose rate at detectors for 1 nA lost in the Vacuum Chamber:**

	PENELOPE	FLUKA
Inside Hutch	14 $\mu Sv/h$	$\sim 7.0 \mu Sv/h$
Outside Hutch	1.2 $\mu Sv/h$	$\sim 1.0 \mu Sv/h$

- **Relative values:** high dependence on the current lost, the point of collision and the angle, and the material. In that case, the experimental values gives the **possibility to quantify the losses**. A solution is required to shield those losses.

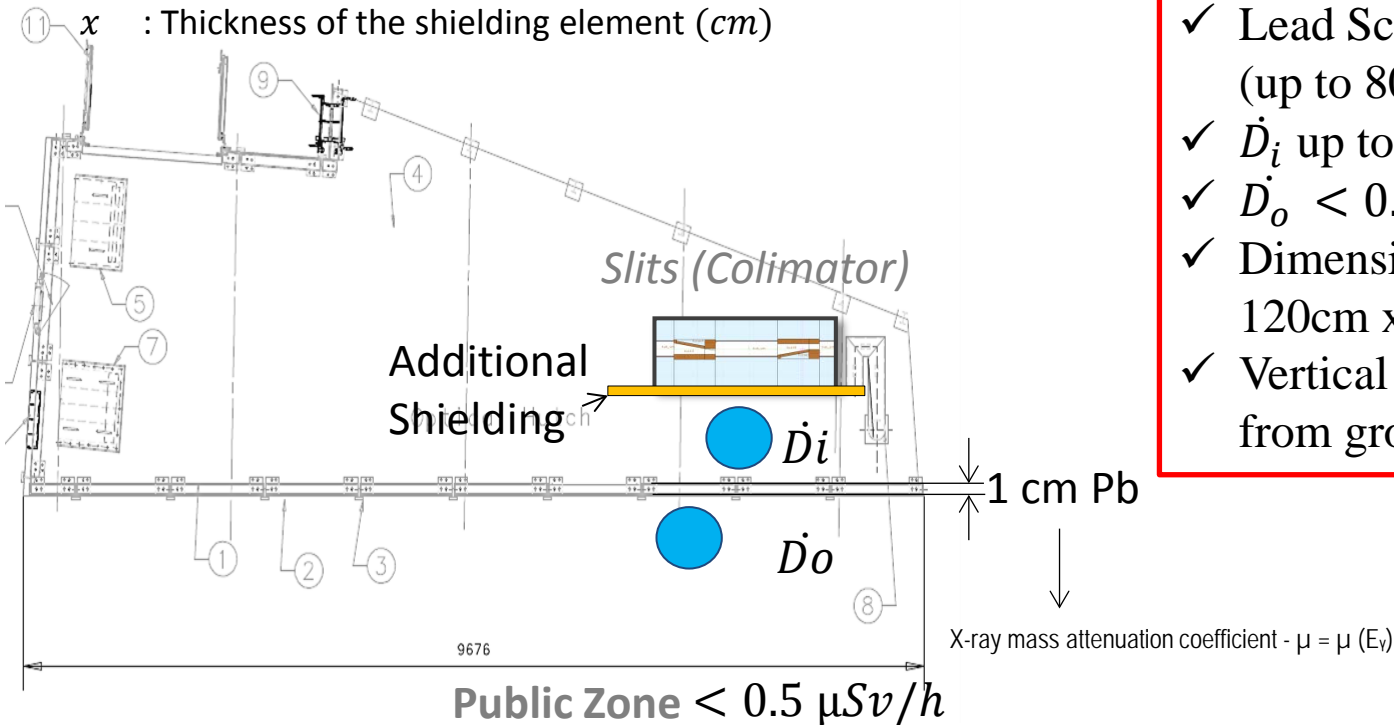
Design of additional Shielding for BL29- BOREAS

$$\dot{D}_o = \dot{D}_i * e^{(-\mu/\rho * \rho_{Pb} * x)}$$

μ/ρ : Mass attenuation coefficients (cm^2/g)

ρ_{Pb} : Density of the shielding element (g/cm^3)

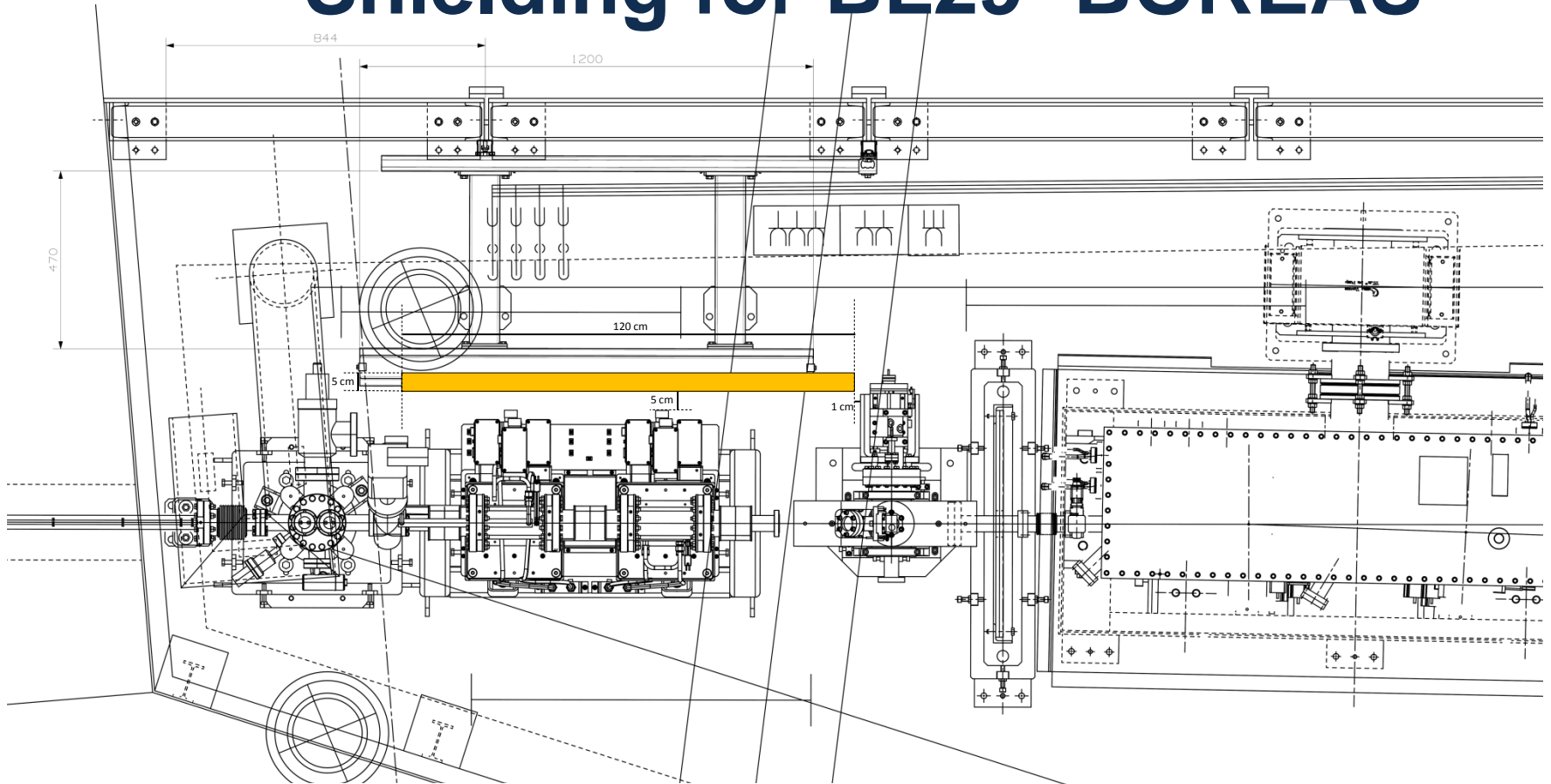
x : Thickness of the shielding element (cm)



Analytic estimation from experimental data and Monte Carlo simulation:

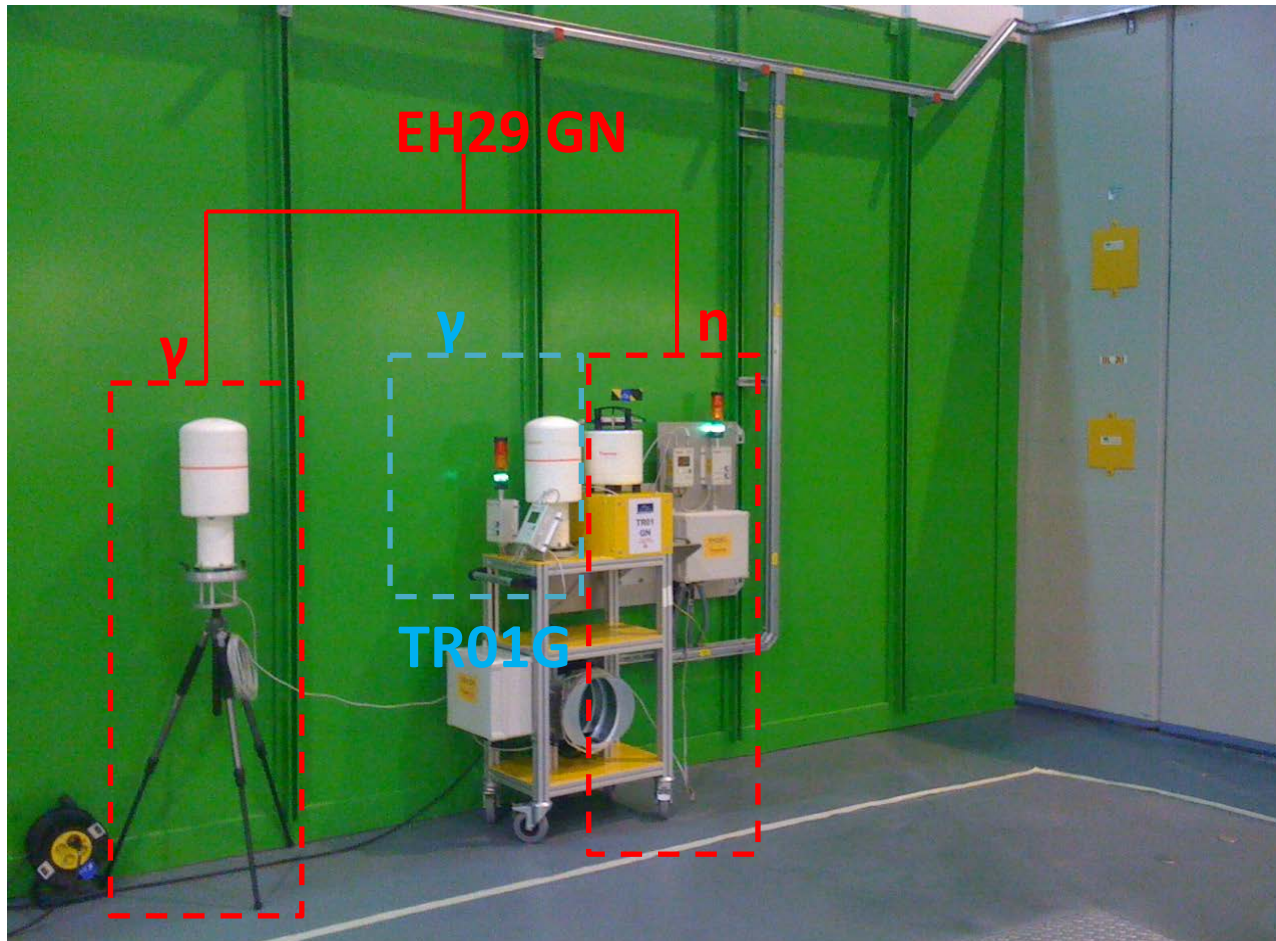
- ✓ Lead Screen to shield photon (up to 800 keV)
- ✓ \dot{D}_i up to 1,2 mSv/h
- ✓ $\dot{D}_o < 0.5 \mu Sv/h$
- ✓ Dimensions: 5cm (thickness) 120cm x 80cm
- ✓ Vertical position: at 140 cm from ground level

Design of additional Shielding for BL29- BOREAS



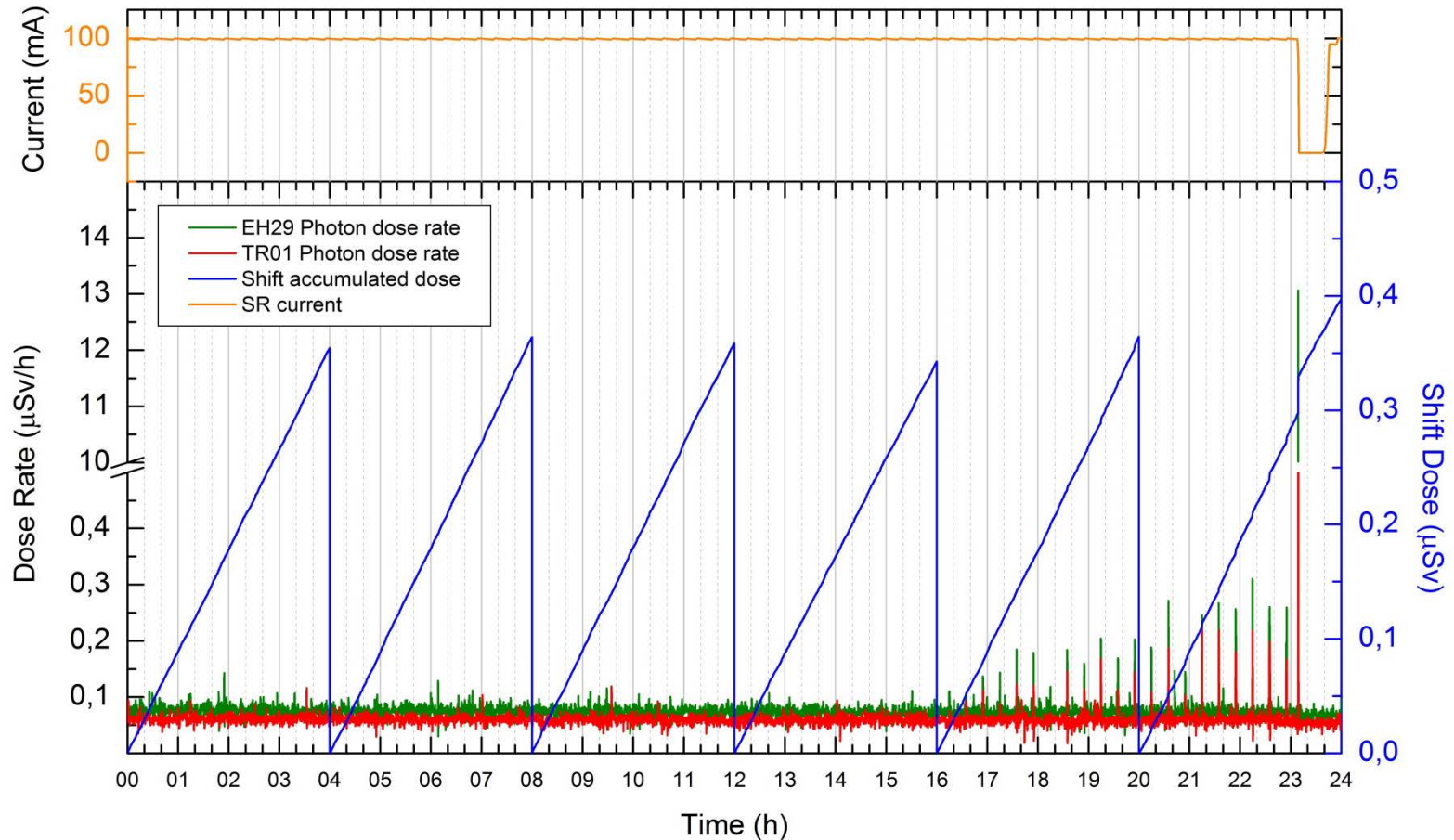
- **Type:** Lead screen
- **Dimensions:** 120 cm x 5cm x 80 cm
- **Vertical position:** centered at 140 cm from ground level

Repositioning of radiation monitors



- After shielding installation

Outside BL29 - BOREAS



4 Conclusions



1. Experimental data from Radiation Measurements gave an accurate characterization of the radiation levels produced by the new Top-Up operation mode
2. A comparative radiation study has helped to understand the origin of the map dose levels in specific conditions
3. A solution has been developed for BOREAS Beamline with an additional shielding designed to maintain Public level

Thank you all of you!!

Radiation Protection Service (SPR)

**Specially to Xavier Queralt
who is now at ISIS**
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