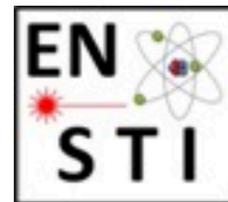




## Radiation levels in the LHC injection lines (TI2-TI8)

**WP10**  
Energy Deposition & R2E



Giuseppe Lerner, Rubén García Alía

*Review of HL-LHC radiation level specification document*

12<sup>th</sup> December 2019

# Introduction

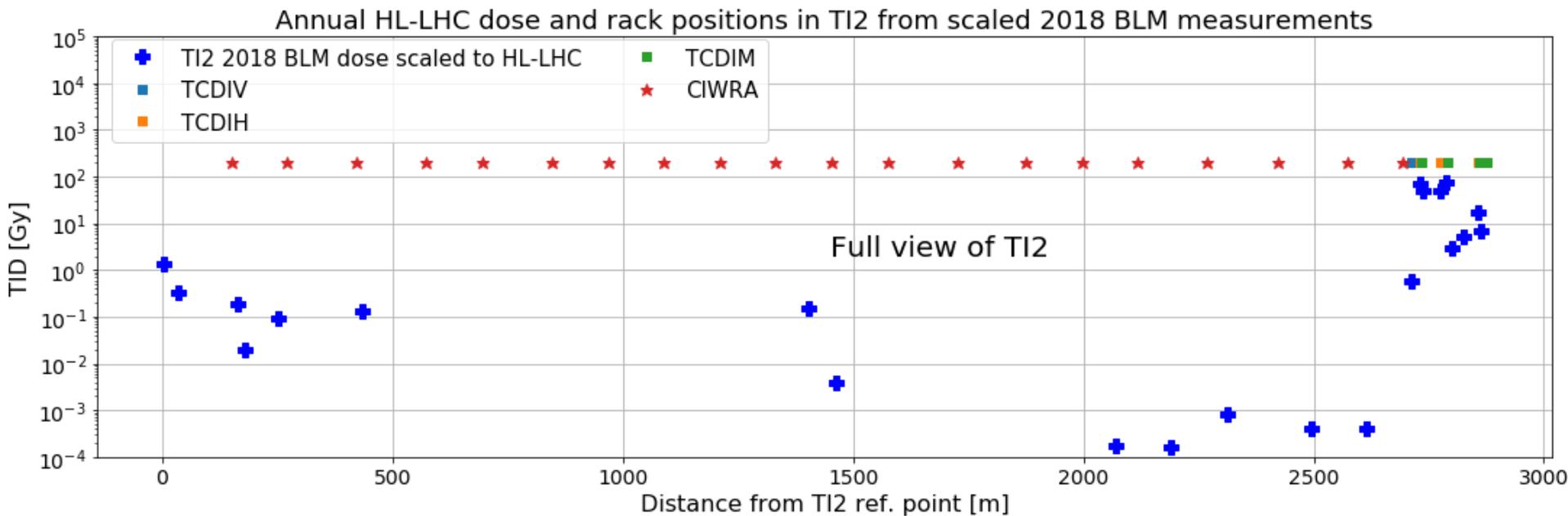
- In addition to the main IRs, the HL-LHC specification content should include the radiation level specifications in the injection lines of the LHC, TI2 and TI8.
- TI2 is ~3km long and merges into the LHC tunnel on the left side of IR2.
- TI8 is ~2.5km long and merges into the LHC tunnel on the right side of IR8.
- The analysis of the BLM levels during Run 2 (for both 2017 and 2018) has been [presented at the 38th MCWG meeting](#).

# Approach to HL-LHC specifications in TI2 and TI8

- The LIU upgrade foresees significant changes to the positions of the TCDI collimators located at the end of the TI2 and TI8 injection lines.
- No simulation is available for the full length of the TI2-TI8 lines (there is a simulation by A.Ciccotelli and L.Esposito, which focuses on the losses in UJ88 and is used to set limits on the injection losses in the DS of IR8).
- The present approach for the definition of HL-LHC specifications is to scale the 2018 BLM levels with the number of injected protons:
  - 2018:  $1.5 \cdot 10^{17}$  protons for B1+B2 (input from F.Velotti)
  - HL-LHC:  $3 \cdot 10^{17}$  (a factor 2 more).

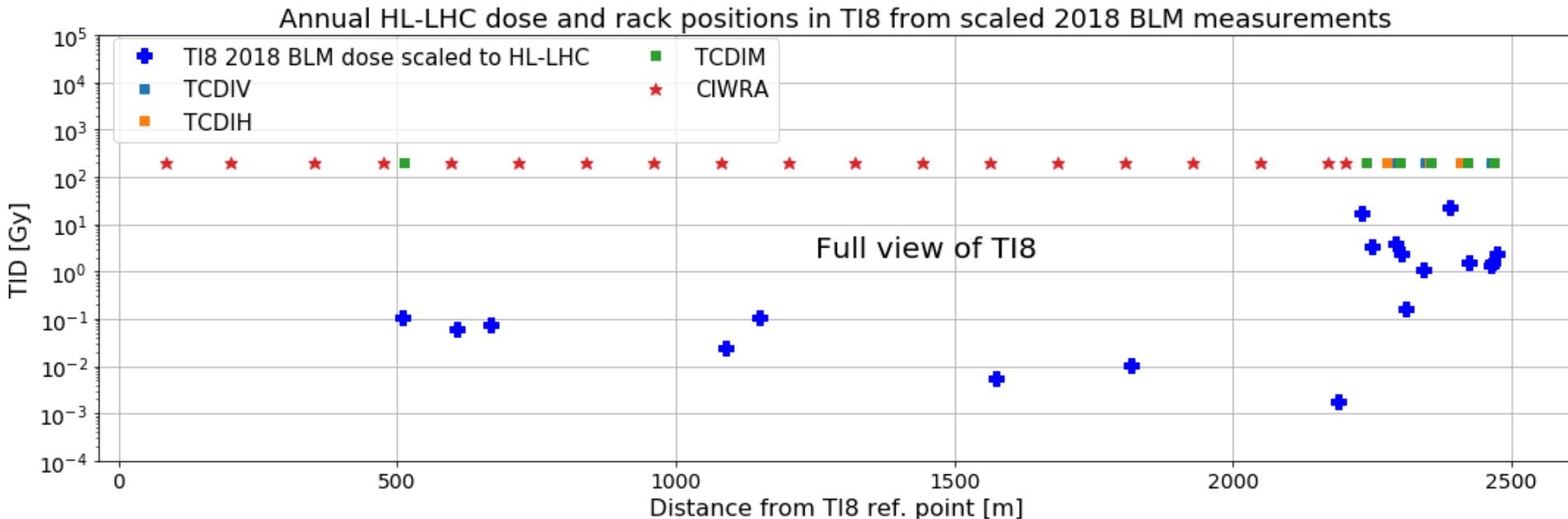
# BLM TID profile in TI2 rescaled to HL-LHC

- Annual HL-LHC BLM levels in TI2 from 2018 BLM measurements scaled with the number of injected protons (i.e. by a factor 2).
- High TID at the end of TI2 near the TCDI collimators, <1 Gy/y elsewhere (except for one outlier in the first part of the line).



# BLM TID profile in TI8 rescaled to HL-LHC

- Annual HL-LHC BLM levels in TI8 from 2018 BLM measurements scaled with the number of injected protons (i.e. by a factor 2).
- High TID at the end of TI8 near the TCDI collimators,  $<1$  Gy/y elsewhere.



# HL-LHC specifications in TI2-TI8

- The TI2-TI8 BLM profiles identify two separate regions:
  - Before the first TCDI collimator the levels are stable and quite low. Since there is no particular element on the beamline that could cause radiation showers (e.g. collimators or absorbers) we can assume that the levels are constant over this whole region.
  - Higher gradients are observed in the vicinity of the TCDI collimators. Since the exact locations of the collimators will change after LIU we prefer to give a common specification for this area, with significantly higher levels compared to the bulk of the injection lines.

# Summary of the T12-T18 specifications

- In summary, we specify the following levels:
  - **T12:** 1 Gy/yr from 0 to 2.7 km of distance from the reference point of T12, 100 Gy/yr in the final section (i.e. beyond 2.7km) near the TCDI collimators.
  - **T18:** <1 Gy/yr from 0 to 2.2 km of distance from the reference point of T18, 50 Gy/yr in the final section (i.e. beyond 2.2km) near the TCDI collimators.
- The specifications may be further refined in the future if we are able to refine the post-LIU predictions (e.g. with FLUKA) but the above results should provide a realistic (and conservative) benchmark.

# BACKUP