# Overview of CC60 facility activity in 2021 and outlook for 2022

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R2E Annual Meeting – 1-2 March, 2022
https://indico.cern.ch/event/1116677/

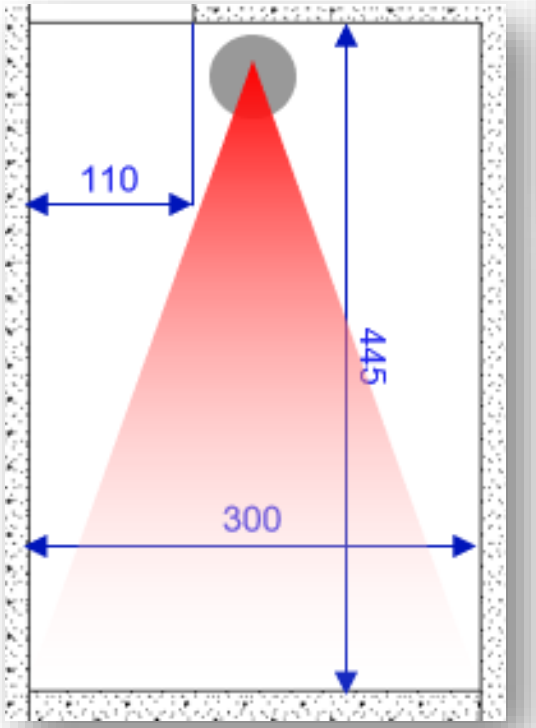
# Agenda

1. The CERN Co-60 Facility
2. Upgrade: a new 110 TBq Co60 source
3. Operation and Statistics

# The CC60 Facility

# The CERN Cobalt-60 (CC60) facility

- Located in Prévessin (bld 772), operational since 2015
- Equipped with two sources: 110 TBq $^{60}$Co (in 2019) and 10 TBq $^{60}$Co (in 2015)
- Multiple users running in parallel are allowed in the facility
- The room is 3x4.5 m$^2$
- Dose rate from 0.1 to 450 Gy/h





**The facility is used to:**

- Qualify electronic components and systems
  - Can be used for screening before CHARM or PSI tests
- Material testing
- calibration of dosimeters and R&D (Floating Gate, RadFET, Optical Fiber, NMOS)

# Service for the Users

**EPR section runs the facility as USER facility**

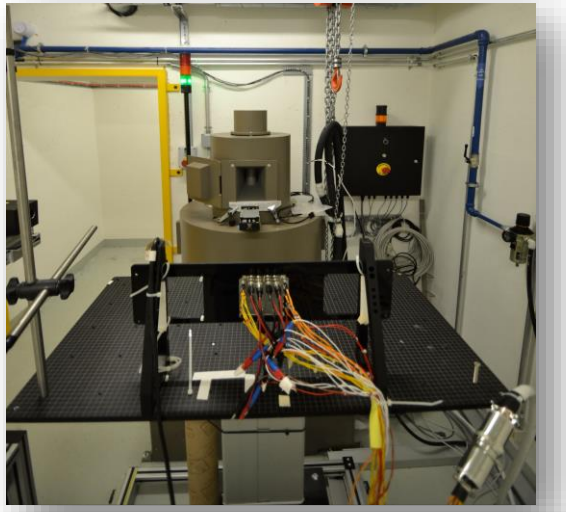
**Services**

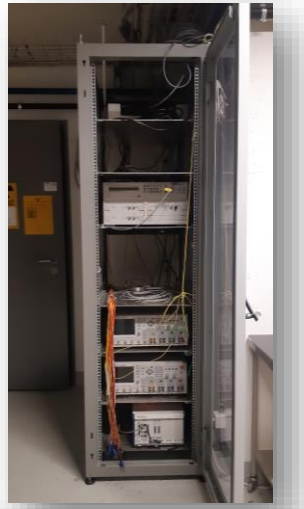
- Planning and coordination
- Support for cables and instruments
- Dosimetry and calibration for each DUT
- Radiation field homogeneity evaluation for bulky DUT

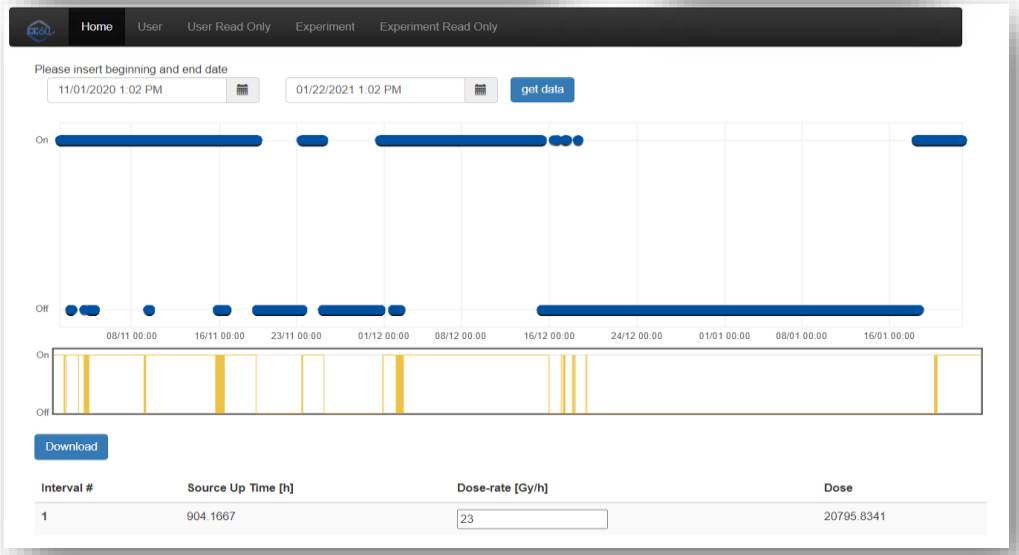
**Utilities**

- Website* *cc60facility.web.cern.ch*
- Test Request webform *cc60facility.web.cern.ch/Test_Request*
- Web Radiation Monitoring tool *cc60monit.web.cern.ch*

*[thanks to *V. Baldassarre*]







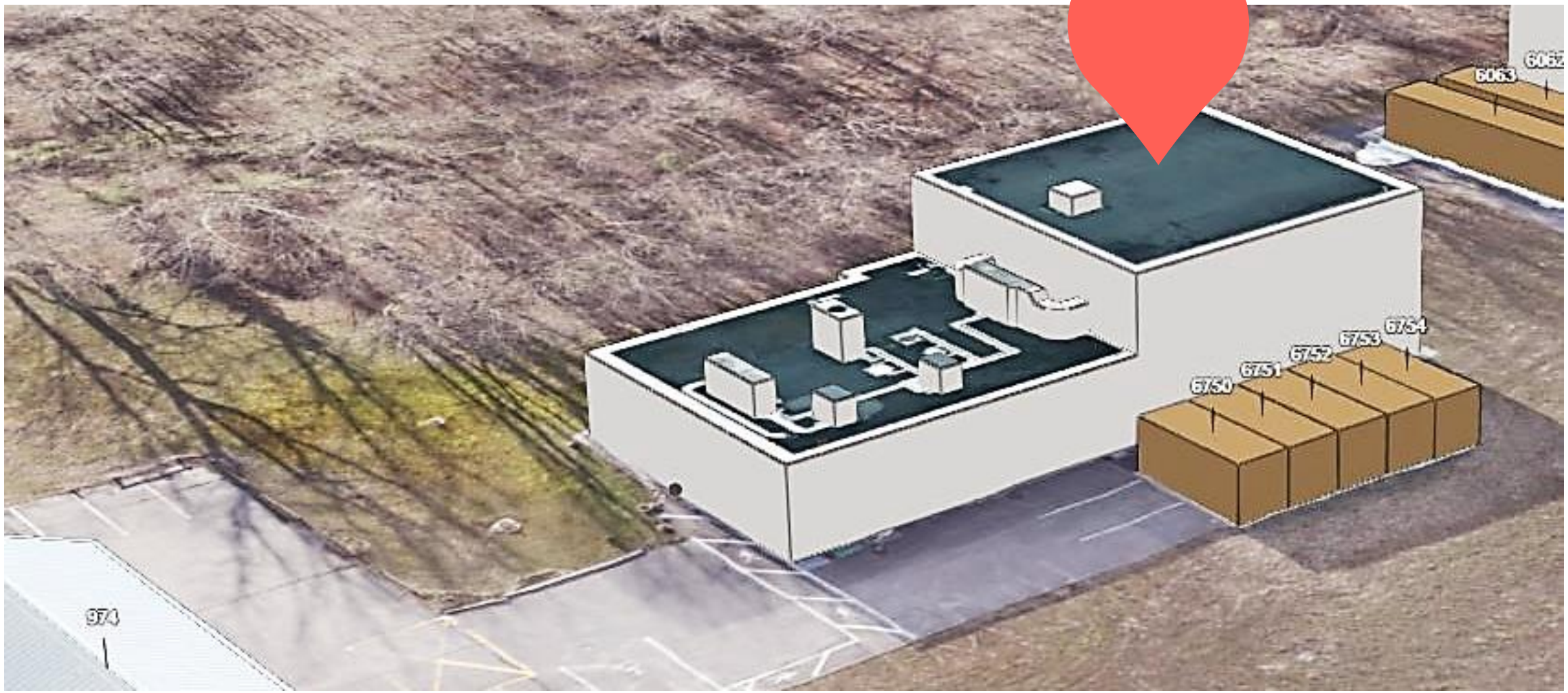
# Challenges and Users' requirements

- Satisfying the users' requests implies **parallel testing** and **24/7 availability**
  - Measurement of the exact Total Exposure Time for each user
  - Each user has to deal with the needs of one another:
    - Planned or unforeseen accesses and irradiation interruptions
    - Radiation field inhomogeneities
    - Change in the dose rate for one or more of the users' DUT

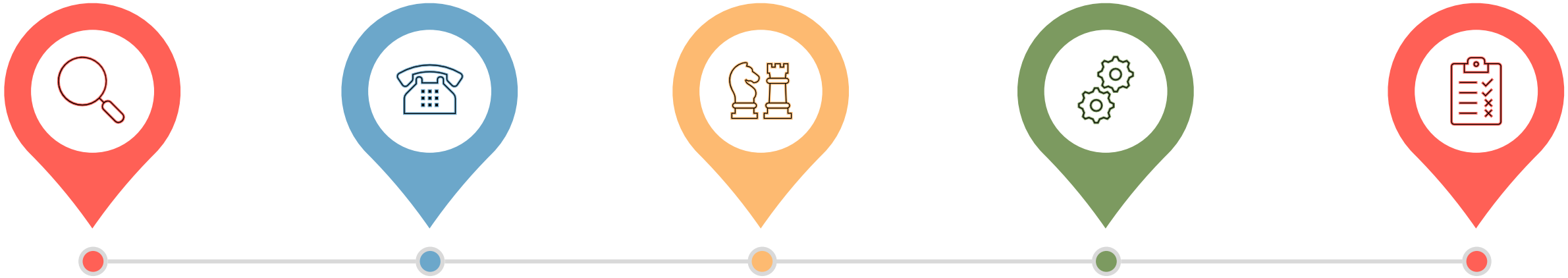
- Very High Doses (tens of kGy)
- Larger DUTs get lower dose rates

In order to deal with the many requests, the facility has been upgraded with a new high-activity $^{60}$Co source

# The CC60 facility upgrade



# $^{60}$Co source installation - project overview



## Phase 0

**PRELIMINARY STUDY (2018)**

(1) Dose Rate Levels Assessment
(2) Design of Infrastructure Upgrades

## Phase 1

**CALLS FOR TENDERS**

(1) Source Provider
(2) Installation Support

## Phase 2

**INSTALLATION STRATEGY**

(1) Procedure Design
(2) Risk Analysis
(3) DIMR & WDP
(4) Simulations
(5) Testing

## Phase 3

**WORK PREPARATION**

(1) Source production
(2) Infrastructure Upgrade
(3) ALARA Level assessment

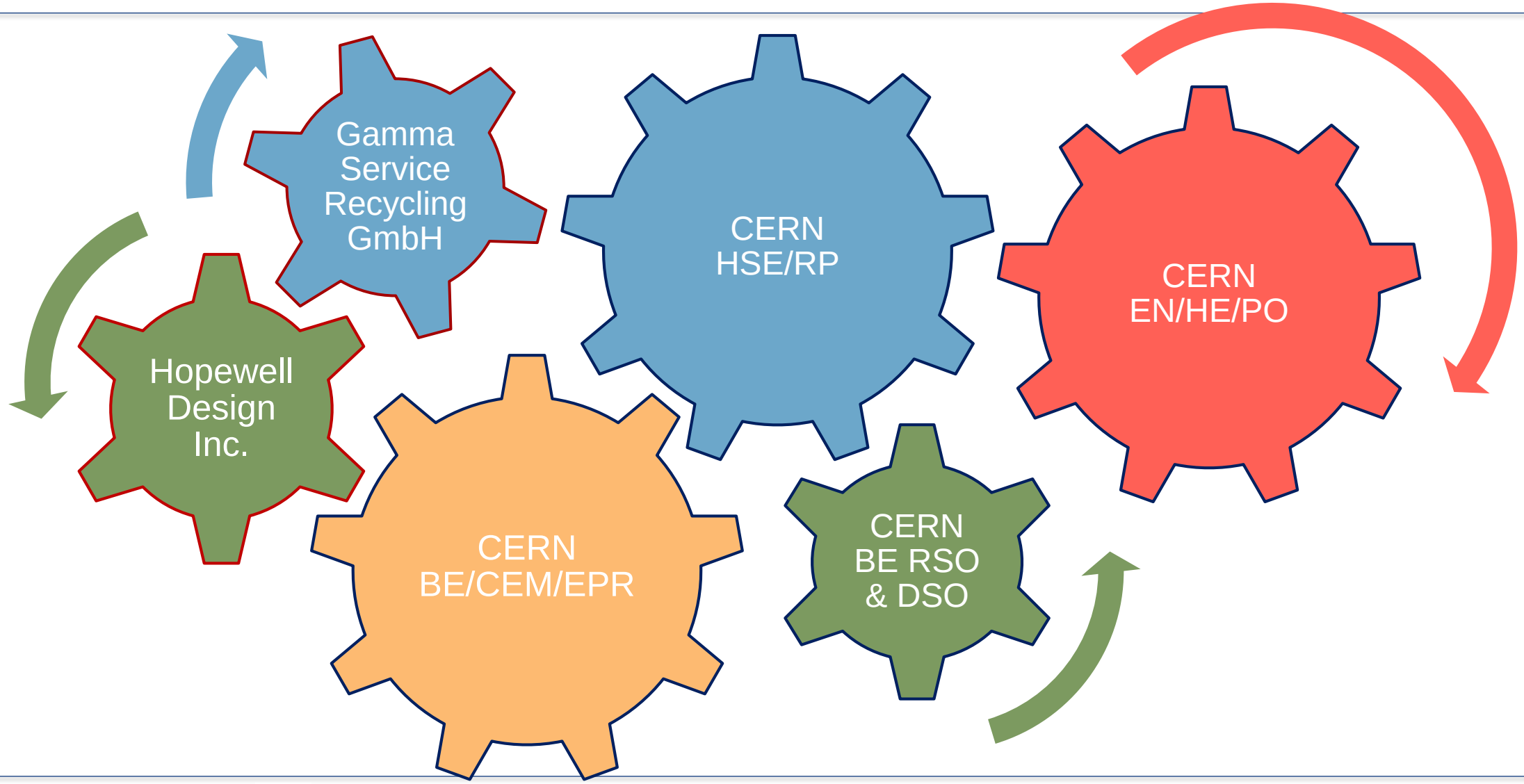
## Phase 4

**SOURCE INSTALLATION**

(1) Delivery
(2) Installation

MISSION ACCOMPLISHED IN SEPT 2021!

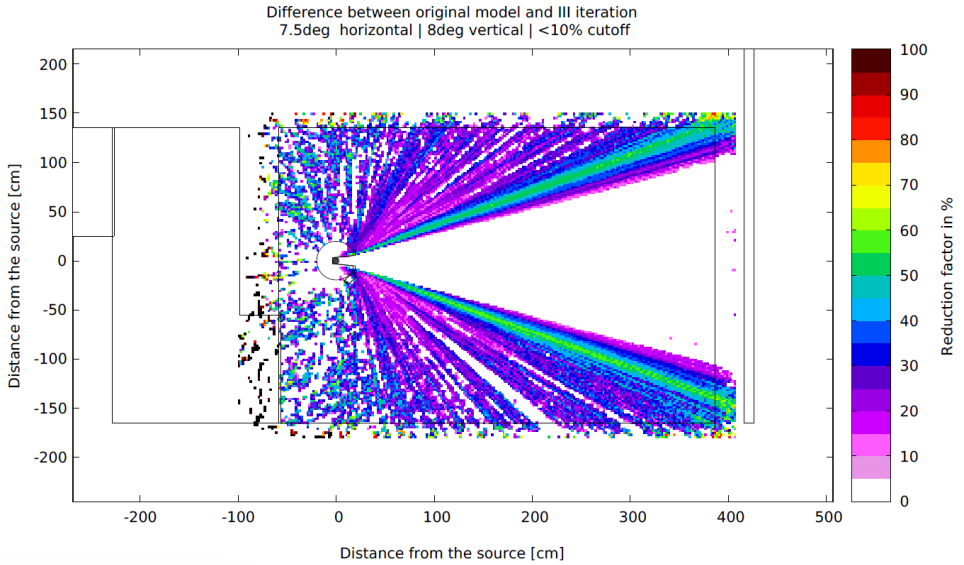
# It requires the collaboration of several entities…



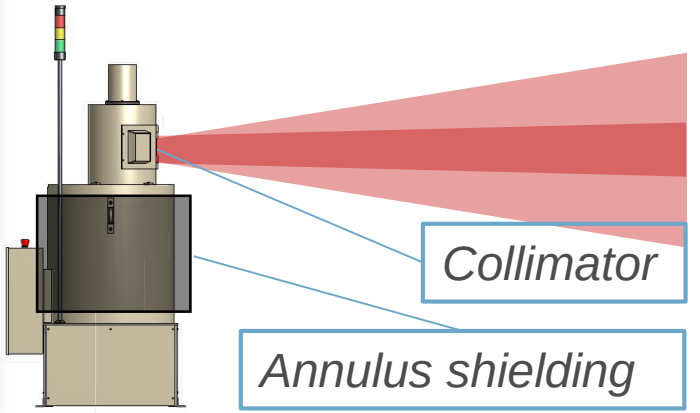
# Challenges in infrastructure upgrade

The installation of a high-activity source requires radiation levels assessment

- Simulations* were performed to design the necessary infrastructures upgrade:
  - Minimizing the residual dose around the irradiator when the source is stored → *Annulus shielding*
  - Constraining the beam size → *Collimator*
  - Minimizing the dose outside the irradiation room during irradiation → *Additional Lead door*
  - To fulfil the Swiss and French authorities' regulations → *Anti-intrusion alarm system and electronic lock*



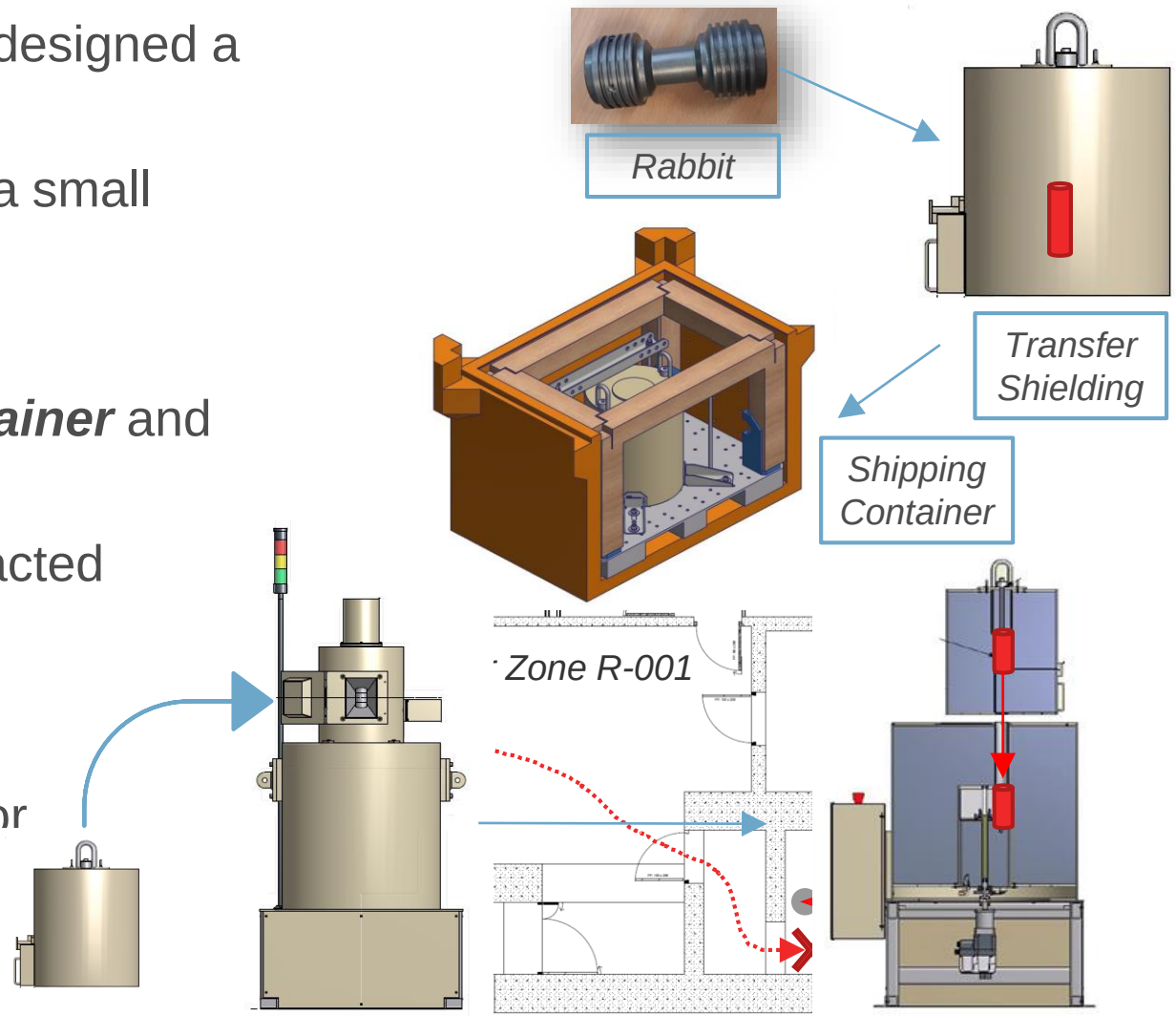

*[performed by *A. Infantino*]



# Installation Strategy

Following the investigation of different procedures, we designed a strategy to minimize the risks and the dose exposure:

- Gamma Service produces the source and loads it in a small container called ***rabbit***, provided by Hopewell
- The rabbit is stored in the ***transfer shielding***
- The transfer shielding is stored in the ***shipping container*** and transported to CERN by Gamma service
- The container is open, and the transfer shield is extracted
- The transfer shield is brought next to the irradiator
- The transfer shield is lifted on top if the irradiator
- The drawer is open and the rabbit fells in the irradiator
- Once the rabbit is loaded, the irradiator can be closed and tested



# Summing-up the upgrade project

- During the installation everything went smoothly
  - None of unexpected events described in the safety procedure occurred
- The dose absorbed by the operators was within the predicted limits
  - The operations were faster than expected leading to lower doses

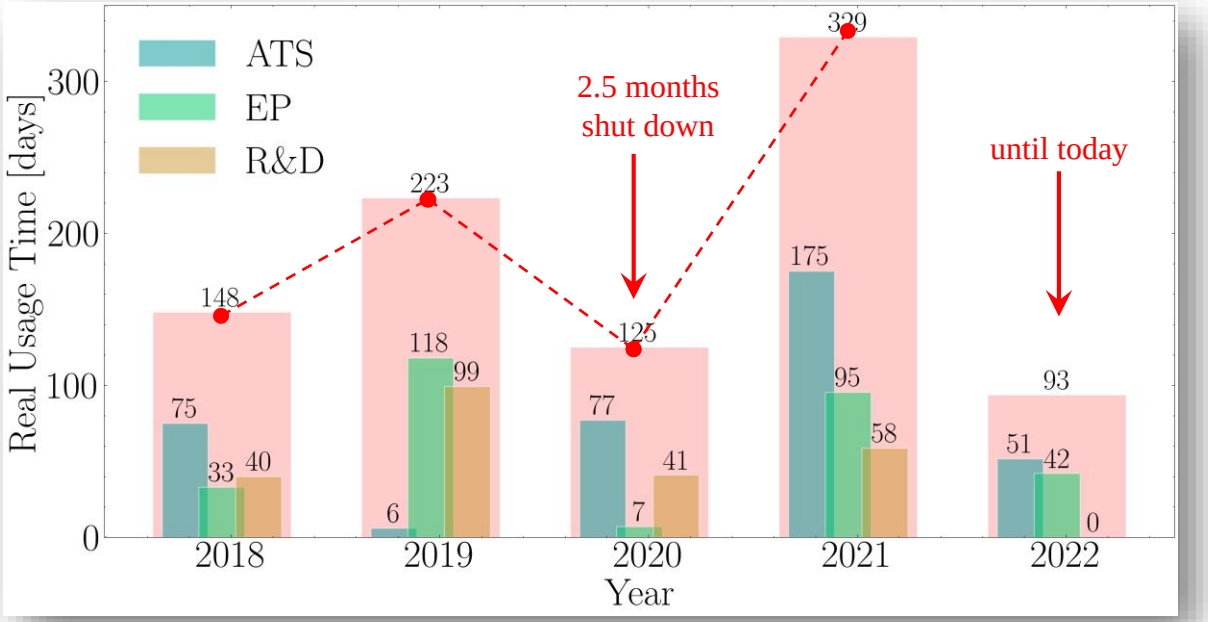
| Group/Company | Estimated Dose (µSv) | Dose (µSv) |
|---|---|---|
| HOPEWELL | 107 | 22 |
| HSE-RP | 10 | 23 |
| EN-HE | 117 | 14 |
| BE-CEM-EPR | 0 | 1 |
| GAMMA SERVICE | 12 | 0 |

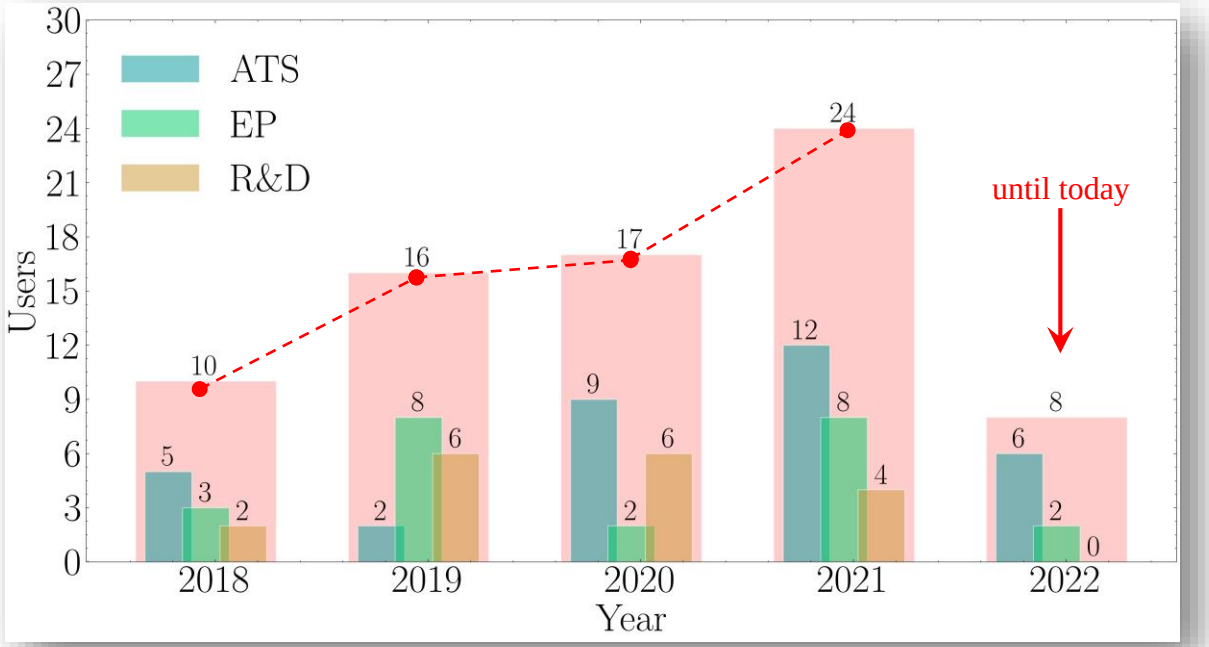
# CC60 Operation Statistics

# The CC60 in numbers

**Operation in the last four years**

- 75 tests have been performed
- ~220 effective days of irradiation per year on average
- More than 20 publications in journals



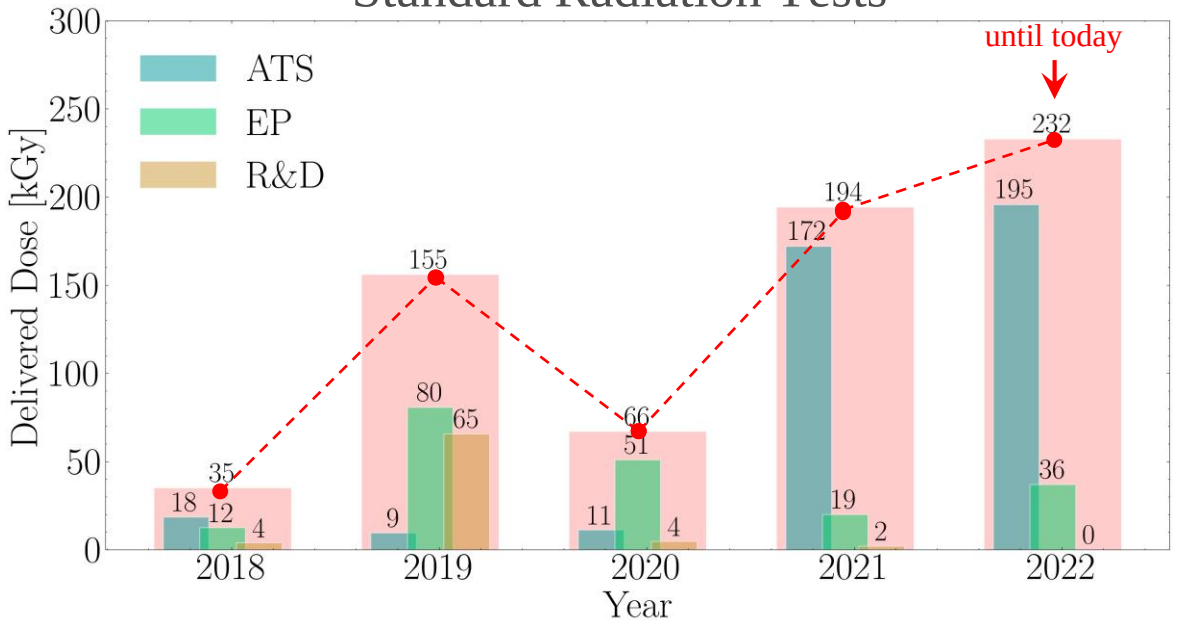



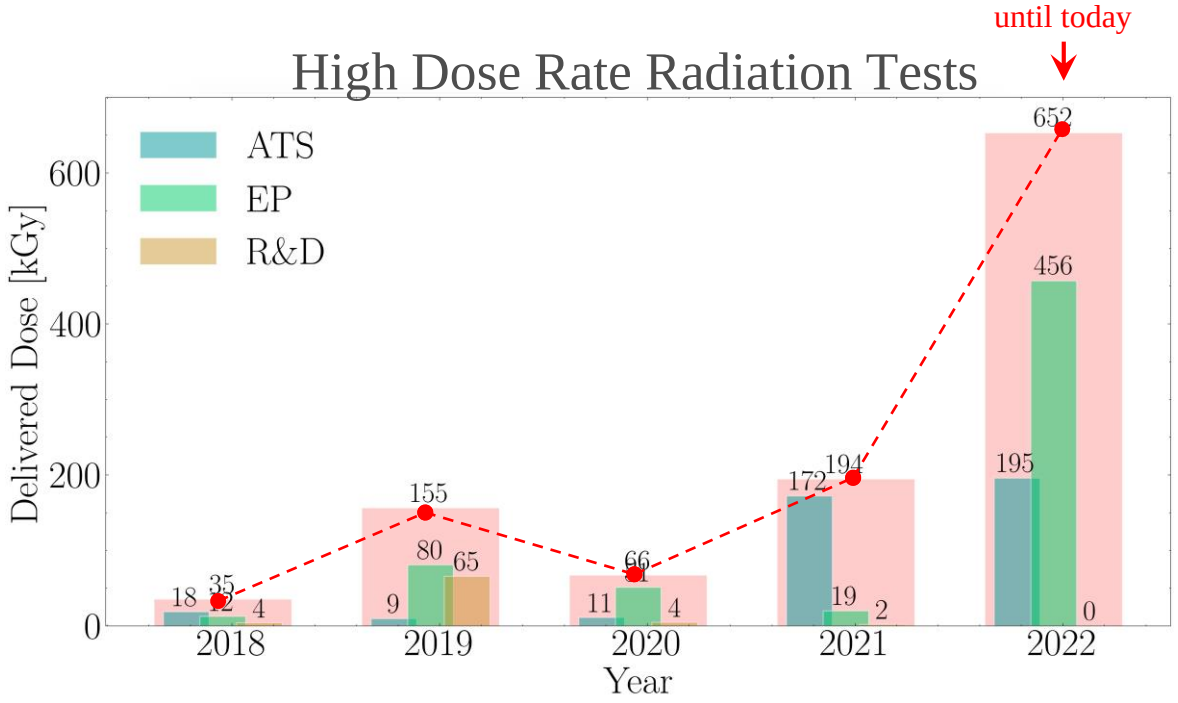

- The number of tests and users increased over time thanks to the optimization of parallel testing
- These KPIs do not reflect the performance improved yet of the facility

# The CC60 in numbers

**In terms of delivered dose, the impact of the new source is already**

- The achievable dose rate in standard position reaches 450 Gy/h (x17 higher)
- However, small samples can be installed in the irradiator aperture, where the dose rate reaches 1 kGy/h



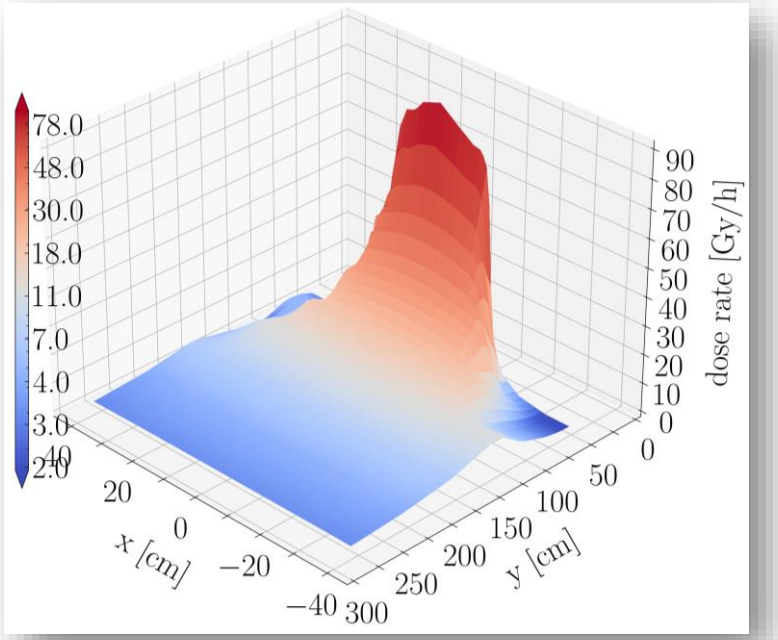



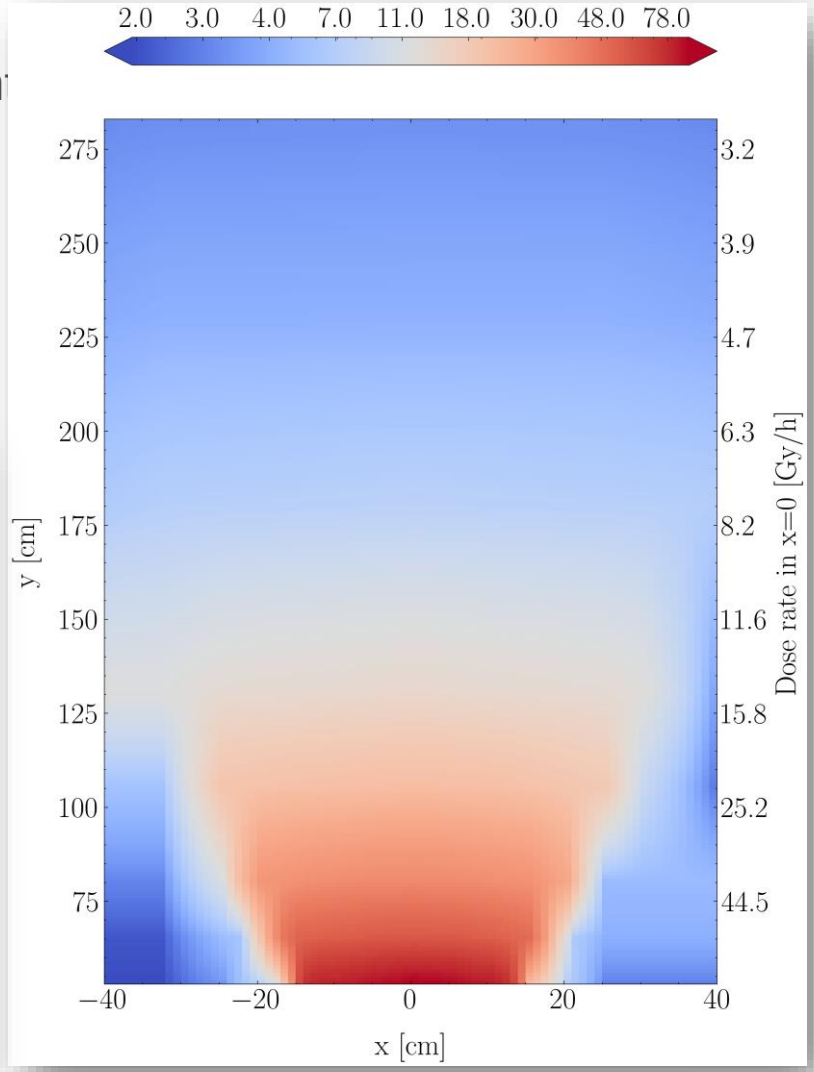
# CC60 2D Dose Field Mapping (ongoing)

- A dose map of the radiation field has been performed by means of an Ionization Chamber: data interpolation allowed to get a 2d map at beam-height

**ISmpact on scheduling and coordination**

- Dose rate can be evaluated as a function of the (x,y) position
- Field homogeneity as a function of the distance can be evaluated according with the area of the user setup

# Conclusions

- The CC60 serves many users CERN-wide (ATS and EP)
  - EPR runs the facility as USER facility
    - Support to the users in test setups
    - Coordination and planning to maximize the efficiency → parallel testing, 24/7 availability
    - Constant work on the dosimetry: DUT position calibration

- CC60 Upgrade project
  - Long planning and risk analysis lead to successful installation in Sept 2021
  - The impact on the delivered dose is already remarkable after few months of operation

Thank you for
your attention!

CERN BEAMS Controls Electronics & Mechatronics R2E

# Phase 3 and 4 – Work Preparation and Source Delivery

- Installation procedure and Risk Analysis has been approved (EDMS link) ✅
  - Partial test performed with the empty transfer shield
  - Simulations performed to assess the radiation levels during the installation
- DIMR and Work Dose Plan ✅
- ALARA Levels Assessment ✅

- Delivery of the source and installation date
  - Foreseen for Q1-2021 (dealing with Covid19 travel restrictions) ⚠️