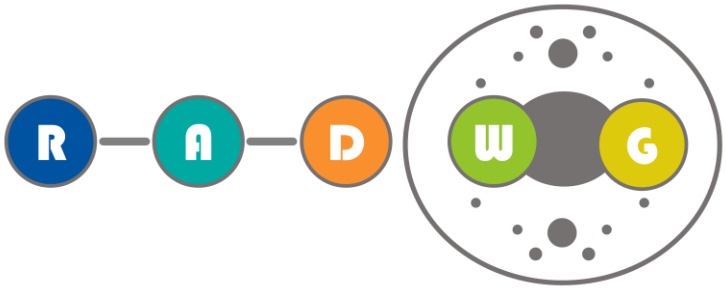
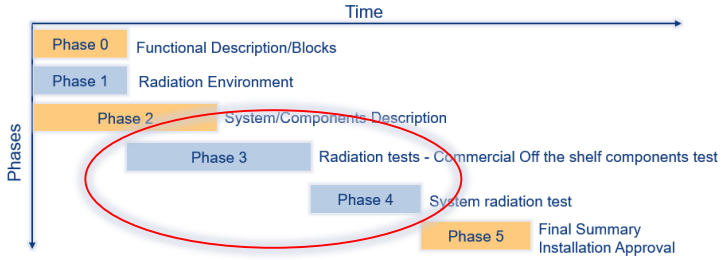
CERN facilities

Salvatore Danzeca (EN/SMM)



Up to now..



- We have the RHA guidelines
- Phase 3 and Phase 4 depends on the availability of **suitable** and **relevant** radiation test **facilities**
- Suitable for :
  - Component testing (Phase 3)
  - System level testing (Phase 4)
- Relevant
  - Adapted to test up to the expected radiation design margins (RHA)
  - Meaningful results for the expected radiation environment

Radiation test facilities for the electronics

- RHA procedure:
  - TID
  - Displacement Damage
  - SEE

- Not only at component level but also at system level
- We need facilities for assessing these quantities

Radiation test Facilities

Coordination

The user requests are collected and processed reserving the most suitable slots in the facilities. Multiple requests are accommodated in the same slot to be more effective

Operation

The facility operation includes the preparation the installation and the removal of the setup. Big part of the operation is also the beam steering, verification and follow-up.

Dosimetry

Continuous monitoring is essential to provide the users with reliable measurements. The users receive the dosimetry document for their tests

Maintenance, Upgrade

During all the course of the facilities lifetime they are maintained and improved to fulfill the increasing amount of requests

Radiation test facilities used for the electronics

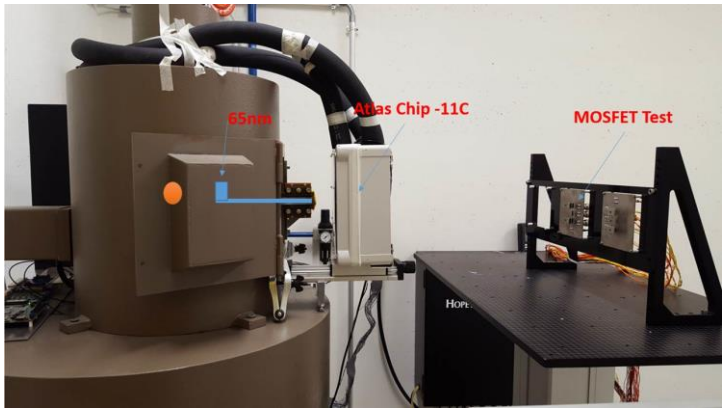
- Internal at CERN
  - CC60
  - CHARM
- PSI Proton Irradiation Facility
- Other external facilities

CC60 at CERN

- 10 TBq Co60 Facility for TID effects located in Prevessin
- Operational from the 2015
- dose rates from 20Gy/h up to 0.36Gy/h
- 300-200 Gy/h spot inside the irradiator used for EP testing (8cm from the source).
- Adapted to test for Enhancement Low Dose Rate Effects (ELDRS)
- Multiple users running in parallel are allowed in the facility
- Facility calibration at each irradiation
- Facility used also for the sensor calibration

CC60 Facility utilities

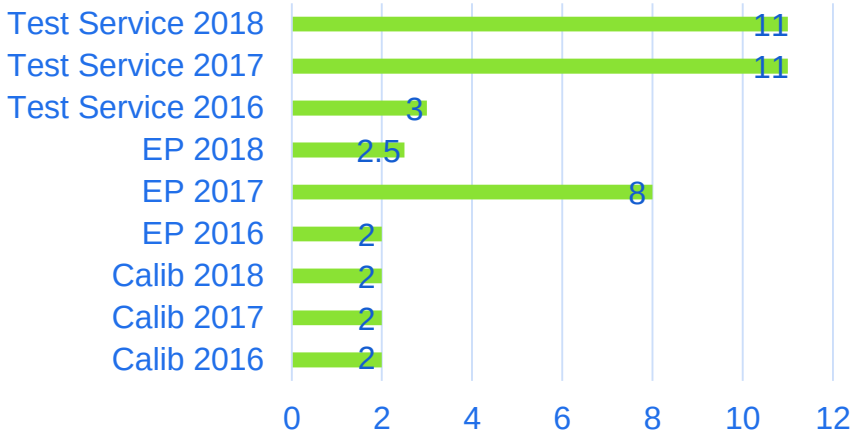
- Facility provides:
  - Running continuously 24/7
  - Internally developed website to monitor the status of the irradiation: https://cc60monit.web.cern.ch/
  - Radiation test service support a fix test setup with which the users can monitor analogue signals and supply power to their DUT
  - Possibility to carry out test up to -20 ℃ thanks to a chiller and a cold box installed in the facility (in collaboration with EP)
  - Calibration at each run with ionization chamber



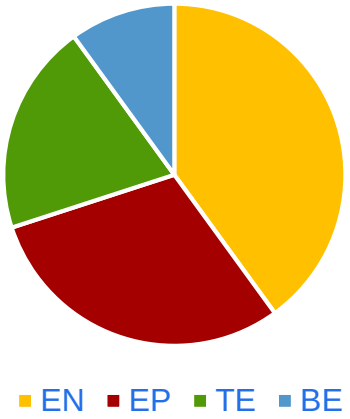
Facility usage

- The facility allows to have several users in parallel
- Around 30 % of the total irradiation time was used also by EP
- Several test campaigns usually last for months keeping the facility occupied for long time.
- The requests are more and more on high dose levels (>1KGy)
- There is the need for a new source which will be able to perform the tests quicker and at higher doses on larger volumes
- Planning to install for the 2018 a new Co60 source of x10 the activity of the one installed
- The proposal has been accepted by RP and in the three parties meeting.
- Improvements of the shielding will be required on the room walls and on the roof
- CC60 will run during LS2 and up to when HL-LHC

Sum of test months by activities



Users by departement in 2018

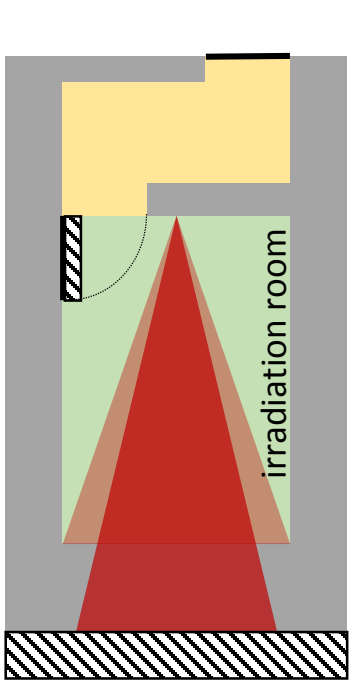


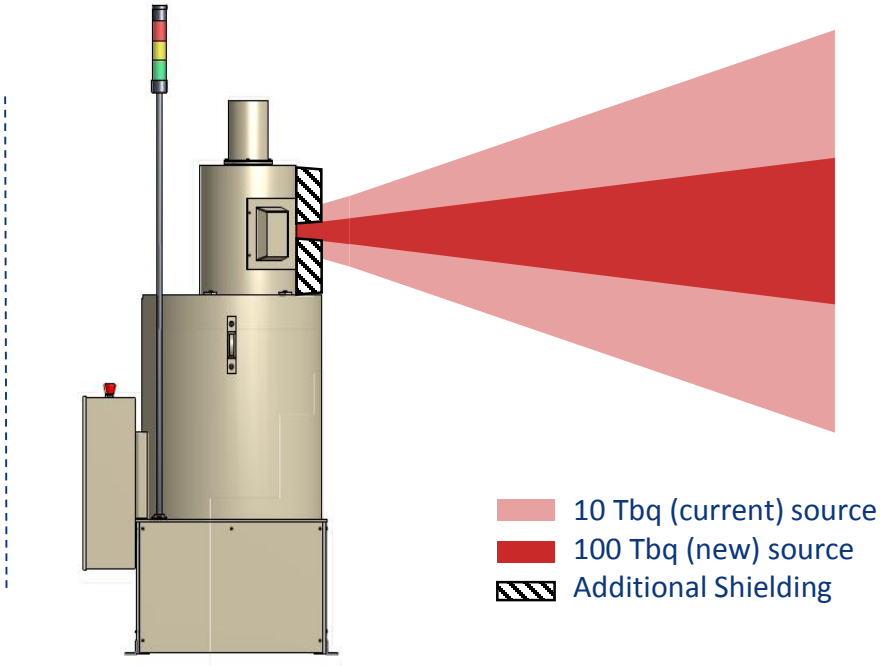
CC60 facility upgrade

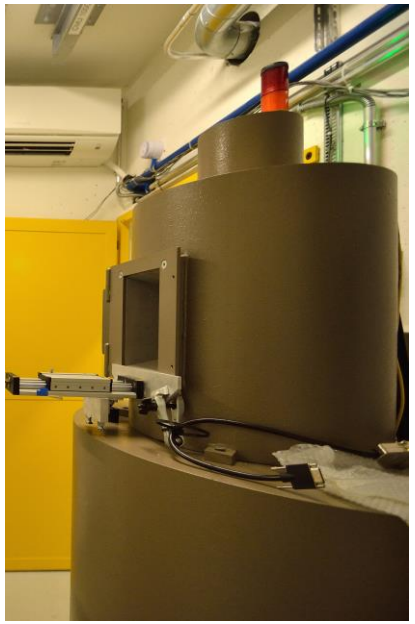
- 100TBq source
- dose rates from 200Gy/h up to 3Gy/h (end room)
- 3-2 KGy/h inside the irradiator
- Call for tender ended in October
- Q2-Q3 of 2019 source installed and ready
- New website for the user requests and information on the facility

CC60 facility - infrastructure upgrade

- Modification for RP constraints being discussed
  - wall shielding
  - collimator shape
  - irradiator shielding
  - second lead door
- Water cooling upgrade to allow large power supplies testing
- Linear axis stage to allow precise positioning inside the irradiator collimator

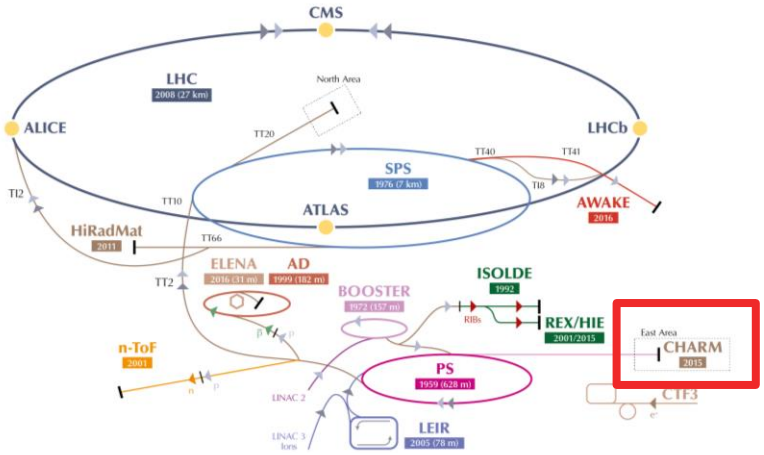






CHARM

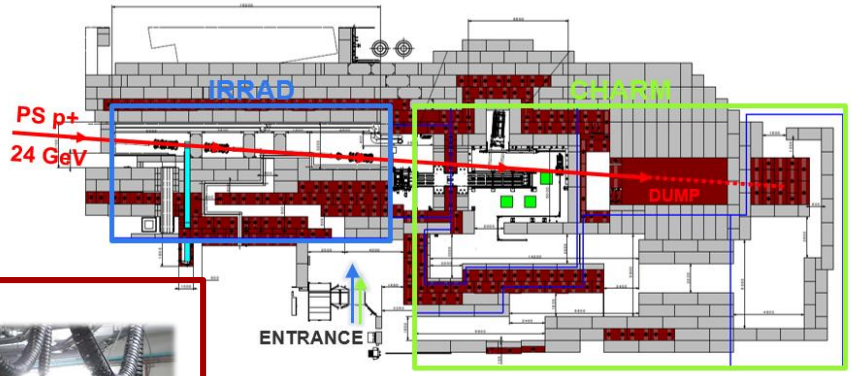
Cern High Energy AcceleRator Mixed-Field

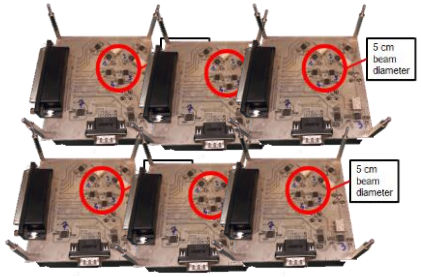


Main purpose

Radiation tests of electronic equipment and components in a radiation environment similar to some representative radiation fields.

- Large volumes electronic equipment
- High number of single components
- Mixed-Particle-Energy
  - Tunnel and Shielded areas





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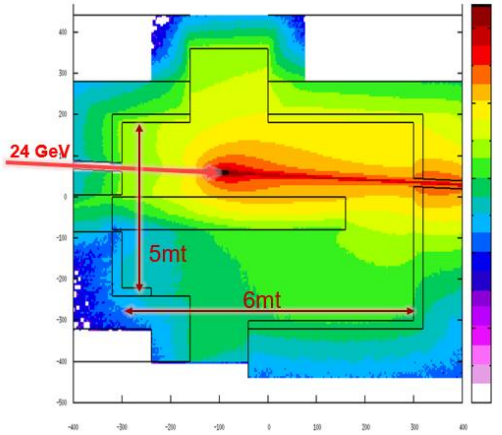
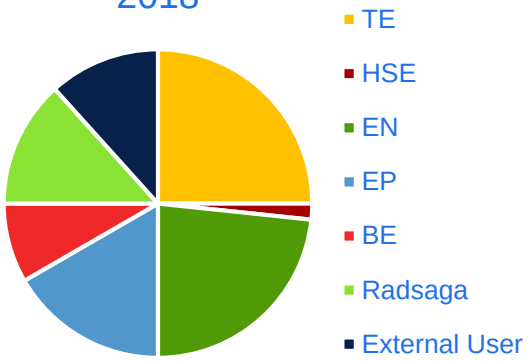
CHARM!



CHARM Status

- No free slots in the 2018 planning. All the operational weeks booked
  - 32 users in the 2016
  - 25 users in the 2017
  - 61 users in the 2018
  - 3 User running during the overall CHARM Irradiation sessions: TE/VSC, TE/MPE, HSE/RP.
- Coordination of the access carried out between RP, EN/SMM and EN/HE.
- Installation/Removal of test equipment: every Wednesday
- Full support during the dry run and test preparation in terms of cabling and organization
- Online dosimetry with the RadMon system
  - Complex radiation spectra
  - Several dose rates
  - Self shielding

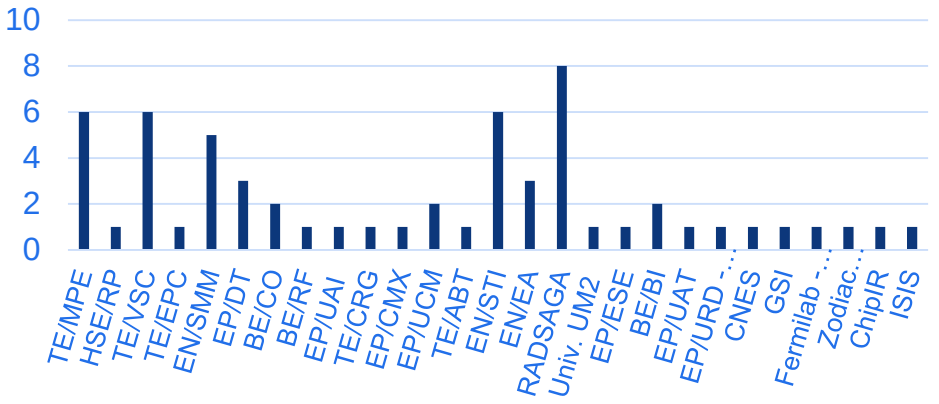
Users by department/institute in 2018



Proton On Target

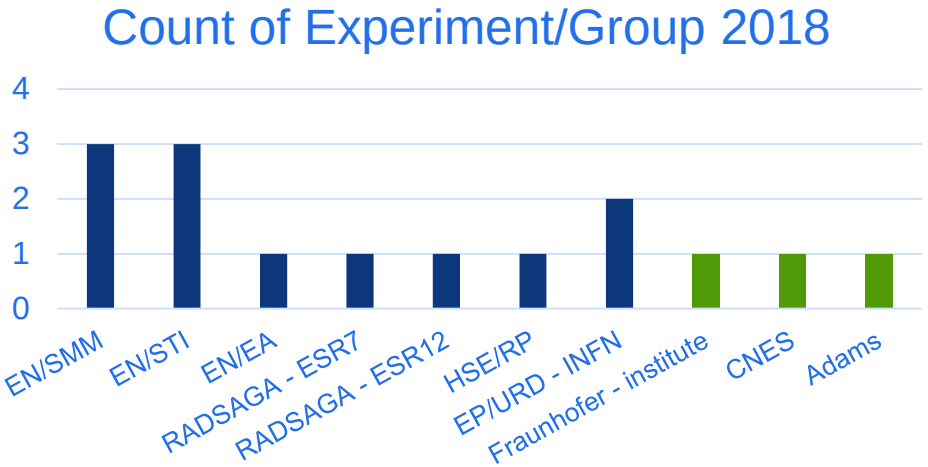
	2017		2018	
Cu	2.85E+17	80.05%	3.49E+17	74.92%
Al	4.71E+15	1.32%	1.68E+15	0.50%
AlH	1.36E+16	3.82%	1.63E+15	0.04%

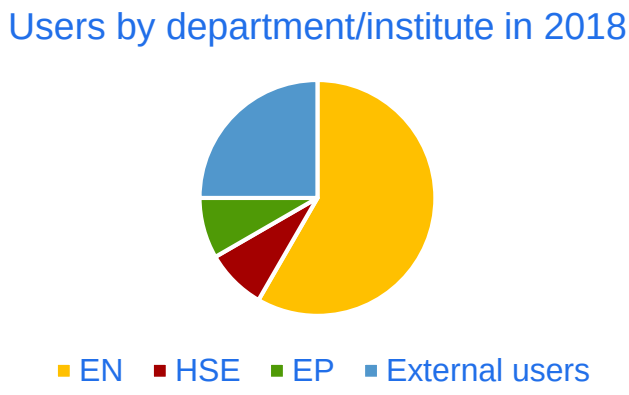
Count of Experiment/Group 2018



CHARM Status – Heavy Ion session

- Three weeks of irradiation:
- No free slots in the 2018 planning. All the operational weeks booked:
  - 15 users in the 2018
  - the access carried out between RP, EN/SMM and EN/HE
- Installation/Removal of test equipment every Day: 25 access in total (two or three accesses/days)
- Full support for the organization (in terms of cabling and planning), during tests installation, during the irradiation session (continuous communication with the CCC), also during the late afternoon, night.





Upgrade

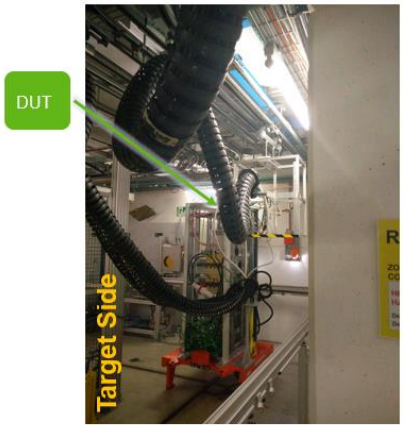
Done

- CHARMBot Robot for inspection
- Overhead conveyer test setup in the preparation room
- Software for Axis x-y Montrac
- New DC power cables

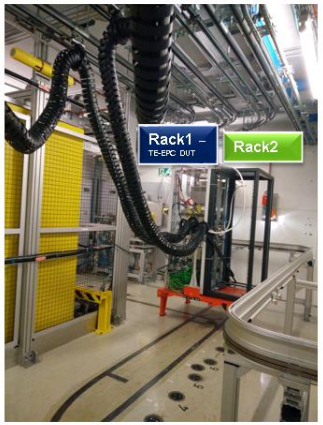
Foreseen (LS2)

- 66 Items : Link
- Automatic cable chain insertion system
- Enlarge the Control Room
- Improve Control room conditioning system

Position 16 – Overhead Convoyer – Inside the target area



Position S10 – Example of double rack configuration



PSI Proton Irradiation Facility

- Component qualification is mainly made in PSI with proton beam of 200MeV
- Motivation:
  - Possibility of testing the three radiation effects at same time : TID, DD and SEE
  - Relatively short cables allow high speed digital components to be tested
  - Collimated beam allow to irradiate only one small portion of the board where the DUTs are mounted without caring of the components around (no effects on the electronics around)
- 7-8 campaigns per year for a total of 240 hours/year
- Is available during the LS2
- Beam time during the weekend
- Possibility to test up to 10 components per campaigns
- Contract with PSI since 2011, renewed every year.
- We concluded in 2017 a 5 years contract which allow us to cover all the needs up to LS3

Other external facilities

- Other gamma facilities are used when the expected radiation levels are higher than 1KGy
- Coordination with R2M in order to profit of the same slots
- External gamma facilities
  - BGS (Wiehl in Germany) 30 MGy in 45 days for small volumes
  - Ionisos (Dagneux near Lyon) 500 kGy in 45 days
- Displacement Damage facilities
  - JSI TRIGA reactor available through the AIDA2020
  - 1 Test carried out in the 2018
- Calibrations and research
  - CHIPir (Oxford) 1 test carried out in the 2018
  - ILL Grenoble Thermal neutron
  - PTB
- Other : **irradiation-facilities.web.cern.ch**

Conclusions

- Overview of the internal facilities
  - Requires continuous follow-up:
    - Users coordination
    - Operation
    - Dosimetry
    - Upgrades
- CC60 facility is the CERN internal facility for gamma irradiation used 24/7 for most of the year
- Upgrade with the new CC60 source planned for Q2-Q3 2019
- CHARM facility is the CERN mixed field irradiation facility used for component and system testing in a radiation environment similar to the LHC
  - CHARM is in continuous upgrade to face the increasing number of user and requests that book the facility for long periods of time
  - Restart April 2021
- PSI PIF proton facility is used and it will be used for component qualification
  - 7-8 Campaigns per year: 240hours/year
- Other external facilities can be used for calibration and testing purposes

Thanks to all the CHARM Team