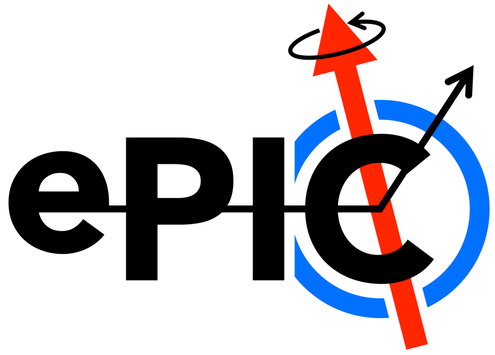
# Radiation-hardness Studies

Prakhar Garg

TIC meeting
January 22, 2024




# Introduction:

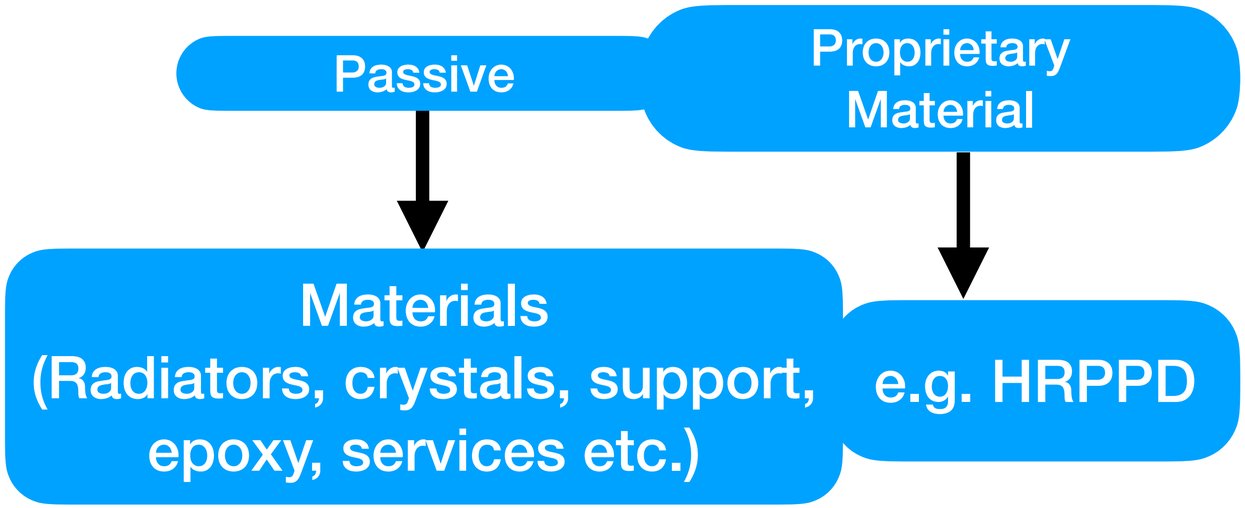
## Useful Links:

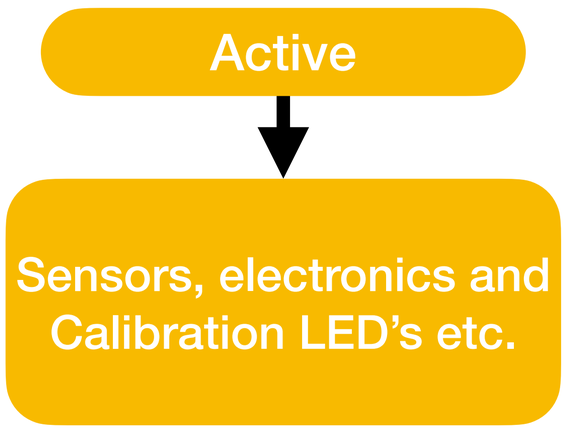
- Needs of rad-hard studies for various subsystems: **Link** to Indico
- ePIC Radiation Doses and Particle Fluence can be found: **Link to wiki**

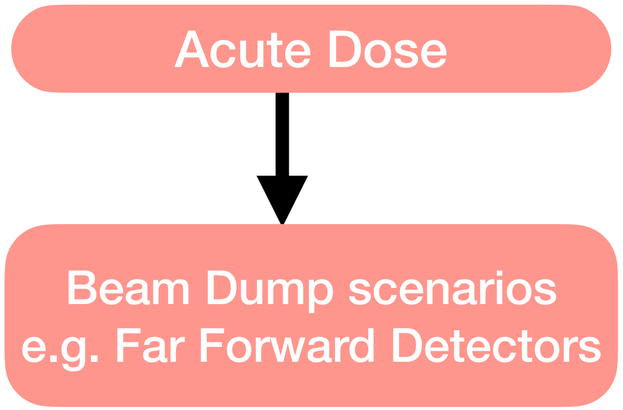
- It's an attempt to collect all the available Information and try to come-up with a coherent unified picture

- With so many systems, it's most useful that they all estimate the red-hardness in a consistent way

# A broad view:




- **There needs to be a defined constant "safety factor" across all detector subsystems**
  [(10 years)*(6 month running period)*(100% machine/detector efficiency)*(Highest Lumi.)]**X Safety Factor?**

- **Synergies: SiPM's and read out electronics is one of the "most popular" and critical components among several detectors**

# If one uses the same technology as various R-Z positions

- Its better to pick the highest number as a benchmark

## Just as an Example:

| MPGD layers | | Radiation dose (10 years Phys) EM radiation |
|---|---|---|
| Barrel | mRwell @ R ~ 72 cm | ~0.054 krads – 0.3 krads |
| | MMG @ R ~ 50 cm | ~ 0.073 krads – 0.217 krads |
| Hadron end cap | mRwell @ z ~ 148 cm | ~0.85 krads -- 51.2 krads |
| | mRwell @ z ~ 163 cm | ~0.96 krads – 52.6 krads |
| Electron end cap | mRwell @ z ~ - 112.5 cm | ~0.07 krads – 3.2 krads |
| | mRwell @ z ~ -122.5 cm | ~ 0.07 krads – 4.2 krads |

# Collect Information for Consistency:

| Detectors | Comment on Missin | 1 MeV Eq. Neutron Fluence | | EM Dose | | Ionizing Charged Particle Dose | | Its been tested or known (Y/N) |
|---|---|---|---|---|---|---|---|---|
| | | DIS | e/p Beam gas | DIS | e/p Beam gas | DIS | e/p Beam gas | |
| SVT | | | | | | | | |
| MPGDs | | | | | | | | |
| Backward ECal | | | | | | | | |
| Barrel I | | | | | | | | |
| Forward | | | | | | | | |
| Backward HCal | | | | | | | | |
| Barrel | | | | | | | | |
| Forward | | | | | | | | |
| pfRICH | | | | | | | | |
| hpDIRC | | | | | | | | |
| dRICH | | | | | | | | |
| AC-LGADs | | | | | | | | |
| Far | | | | | | | | |
| Luminosit | | | | | | | | |
| Far Backwar | | | | | | | | |

(10 years)*(6 month running period)*(100% machine/detector efficiency)*(Highest Lumi.)

Of course Different Detectors can add different components if the requirements are different because of their positions

# Some Rad-Hard Test Facilities

## NSUF Partner Institutions

Link: https://nsuf.inl.gov/Home/PartnerInstitutions

**Contains a list of 19+ 54 Places within US with details**

## GIF++ at CERN

Link: https://ep-dep-dt.web.cern.ch/irradiation-facilities/gif

- 14 TBq $^{137}$Ce source (378.37 Cu)
- Muon beam with momentum up to 100 GeV/c

## Sandia National Lab, New Mexico

Gamma Irradiation Facility and Low-Dose-Rate Irradiation Facility

Link: https://www.sandia.gov/research/gamma-irradiation-facility-and-low-dose-rate-irradiation-facility/

**Sources: Cs-137, cobalt-60, and AmBe**
**Designed for Radiation Damage Studies**
**(US ATLAS groups have used it in the past)**

## NASA Space Radiation Laboratory @BNL

https://www.bnl.gov/nsrl/userguide/beam-ion-species-and-energies.php

**Gamma Radiation Source Facility**

**Tandem Van de Graaff**

**Several Beam Ion Species and Energies**

## Oak Ridge National Lab

Link: https://www.ornl.gov/facility/imetf

## Los Alamos Neutron Science Center

link:https://lansce.lanl.gov/facilities/Radiation%20Effects/index.php

## Availability at Yale, New Haven

- **AmBe (“ambee”) 1Ci total [Mix of Am-241 and Be-9]**

Average neutron energy: 4.2 MeV (11 max)

- **Sr90 100mCi**

Relatively easy access
Not positioned to use right away
Will require some minor rigging and planning if someone is interested to use

**Although, most of the Detector systems seems to have their own favorite places already**

# Summary

- Most of the detector groups know radiation doses/Fluence in their acceptance.
- Far-forward and Far-Backward detectors need Simulated maps.
- I think its better to ask DSL's to fill out a pre-formatted spread sheet (w/ help from Alex)?
- We need to define a common "safety factor" (Even if it's 1)

Once we have a common formatted data, It would be easy for everyone to cluster with similar goals.

**All suggestions are welcome !**