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IRRADIATION FACILITIES FOR THE CMS CALORIMETER PHASE II : A REVIEW

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Introduction

Here below is a short Review about the Irradiation Facilities available in order to make R&D for the CMS FCal (HCal and ECal) Phase I and Phase II. Radiation hardness issues have to be investigated, for all components [Xtals, photosensors, fibers, readout electronics etc.] of the HCal and ECal detectors, and mainly for EH and EE: HCal End Cap and ECal End Cap are in effect the part of the calorimeters specifically challenged by Luminosity and Pile Up issues for the LHC Phase I and Phase II, requiring so a special R&D effort for development of new technologies and detectors, to the extent that a total revision of the concept itself of calorimetry is to be required.

Radiation Facilities that have been used in the past (Cal R&D for Run1) will still be used. Some have been or are undergoing upgrades, and will be temporarily unavailable. Also, during these last months, more facilities have been "discovered" and added up to the list of possibilities; each R&D group is having its own preference, driven by requirements of fluence and flux rates , by location reachability, by logisitics, by financial constraints etc , so each group will at the end make its own best choice; the intent of this review is to make all groups aware of the Facilities available all over and of their characteristics, so that their choice will be optimized.

As you will notice, several paragraphs have still incomplete information; some topics/facilities may be even totally missing ... Please step in and contribute to complete this site, if you feel called to the task ! ..... 🙂

Test Beam Facilities will also be listed for completeness, wherever possible.

IRRADIATION FACILITY at CERN PS

location: CERN Meyrin

Beam : 24 GeV protons

max fluences expected: 1 e16 neq/ 4 cm2

status : under Upgrade

expctd availability : by end 2014 (neutrons), by summer 2014 (protons)

TEST BEAM FACILITY at CERN SPS

location: North Area CERN Prevessin (H2 area (CMS HCal), H4 area (CMS ECal), H6 and H8 (ATLAS)

Beam: 24 GeV protons

max fluences: 1 e11 protons per bunch (0.4 s ; per beam Xsection)

status: beam off -- LHC Long Shot Down LS1

expected availability : second half of 2014.

NUCLEAR REACTOR at UCL LOUVAIN, Belgium (AIDA)

source: REACTOR

produced radiation: protons, neutrons, photons

characteristics: Power = 100MW

Neutron Energy up to 70MeV;

High Flux (HF) and Low Flux (LF) protons(P) neutrons(N) or photons(G) Irradiation Facility (IF)

average fluences :

HF-PIF 1 e17 p/cm2 in few hours

HF-NIF 1 e14 neq/cm2 in 2 hours at R=10cm

--- or : 7e10 neq/cm2 s (R=7cm)

--- or: 7e11 neq/cm2 s at R=0 (distance from source)

HF-GIF Co60

status : active

3 -- **NUCLEAR REACTOR at LJUBLIANA**

power max:

source: REACTOR

produced radiation: protons neutrons

avg fluences: 7 e11 neq/cm2 s

status: active

REM -- already used precedently, typical irradiation tests for the EB's APDs, Run1 (~ 1 e14 fluences needed) et similar

1. -- **NUCLEAR REACTOR at ROME, CASACCIA (ENEA)**

source : REACTOR

power max: 1MW (TRIGA) and 5kW (TAPIRO)

produced radiation: thermal neutrons (TRIGA) , fast neutrons (TAPIRO)

fluences mx : 2.7 e13 neq/cm2 s @1MW (TRIGA)

4 e12/cm2 s @5kW (TAPIRO)

status : not available -- upgrade works undergoing

expected active: ~ 2015

1. -- **NUCLEAR REACTOR at ROME, FRASCATI (ENEA)**

used for ECal EB tests, much lower fluences

max fluence: 7 e10 neq/cm2 (s?)

status
not available -- upgrade works undergoing

expected active: ~ 2015

6 -- **LAUSANNE REACTOR (CROCUS)**

location: Lausanne (40 mi from CERN)

University and EPFL, Dept of Nuclear Reactor ENgineering

source : REACTOR Pu, U

max power : "ZERO POWER" (100W)

radiation produced: neutrons photons

typical fluence: 1 e8 neq/cm2 per 4 hrs

use: exclusive education

Note --- could provide ONE PuBe source for use of LOTUS (see below)

6a ---- **LAUSANNE NEUTRON SOURCES (LOTUS)**

location
Lausanne University and EPFL, Dept of Nuclear Reactor Engineering

source : 3 (possibly 5) Pu-Be nuclear sources

characteristics: Activity Pu = 2 e11 Bq (0.2 TBq or 5.2 Ci)

neutron Flux (per source) = 9 e 6 n/s

neutron Energy max = 10.6 MeV

neutron Energy avg = 3.5 MeV

photon Energy = 4-5 MeV

fluences : 1.4 e11 neq/cm2 per week (3 sources geom)

2.3 e11 neq/cm2 per week (4 sources geom)

--- ie gain x2 or x3 with 4 or 5 sources geometry --

C: ~ 1 e12 in ~ 4 (/ 6) wks

more gen. characteristics:

nuclear sources geometry can be varied

online monitoring -- possible

space for big(ger) dimensions objects -- possible

especially apt for SLOW neutron irradiations

objects characterization in situ -- possible

LOTUS is a facility for neutron irradiation at slow fluxes -- ideal for HCal (HB, HO,HF) irradiation measurements (HCal Xtals, scintillator tile materials, fibers, SiPM, QIE10, other electronics read out elements, etc, typically SiPM sensors. Also OK for ECal EE (Shashlick remote SiPM readout option) QIE11, capillary fibers, LYSO Xtals, and new photosensors GaInP.....).

Lotus Facility is being used so far for R&D and irradiations of semiconductors, pin-diodes and photosensors, and for development of special materials for research and for industry.

status : could be available for long periods and continuously (if booked in advance)

6b --- **LAUSANNE - PRAHA RESEARCH REACTOR (LVR-15)**

location : Nuclear Research Institute, REZ PLC, Praha University --

direct link to Lausanne, Universisy and EPFL, Dept of Nuclear Reactor Engineering

source: 5kg U235

Light-water moderated and cooled tank , nuclear reactor with forced cooling

thermal power max: 10MW

fluences max : thermal neutrons in the core 1.5e14 neq/cm2 s

fast neutrons in the core 3e14 neq/cm2 s

fluences <: thermal neutrons at end beam tube 1e9 neq/cm2 s

thermal neutrons in irrad channel in fuel 1.2e14 neq/cm2 s

thermal neutrons in irrad channel in reflector 9e13 neq/cm2 s

applications: material testing expts -- activation analysis -- Nuclear and Applied Physics with beam tubes --- iridium irradiation for medical and radio-pharmaceutical -- irradiation of Silicon monocrystals --- neutron capture therapy

status: active --- available (needs booking)

7 --- **GRENOBLE REACTOR**

location : Institut Laue Langevin -- Grenoble University (ILL)

status : shut down at present

expected active after June 2014 at least

1. 1. -- **IRRADIATION FACILITIES IN USA**

FERMILAB HOSPITAL (PROCURE) ---

source: BEAM , protons

characteristics : protons Energy 225 MeV

fluence : 7e9 p/cm2 s

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* LANL -- Los Alamos* ---

produced : neutron, proton, photon

University of VIRGINIA -- (LIGHT SPIN) ---

source: BEAM 12 MeV electrons

fluence: 1e12 neq/cm2 s

University of MARYLAND ---

radiation produced : protons, neutrons

University of MINNESOTA ---

produced
neutron, proton

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9 --- **TEST BEAM FACILITY at FERMILAB** ---

T1041 experiment

location: Meson Test Facility , Fermilab

source : BEAM , muon, pion etc

Beam Energy : up to 70 GeV pions, muons etc

Instant Luminosity : .....

-- SilviaTentindo - 22 Jan 2014

This topic: Sandbox > SilviaTentindoCMSFCalPhase2Irradiations
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