WP 15.5 - IRRAD and GIF++ Facilities Infrastructure Upgrade

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- New CERN Irradiation Facilities
  - IRRAD
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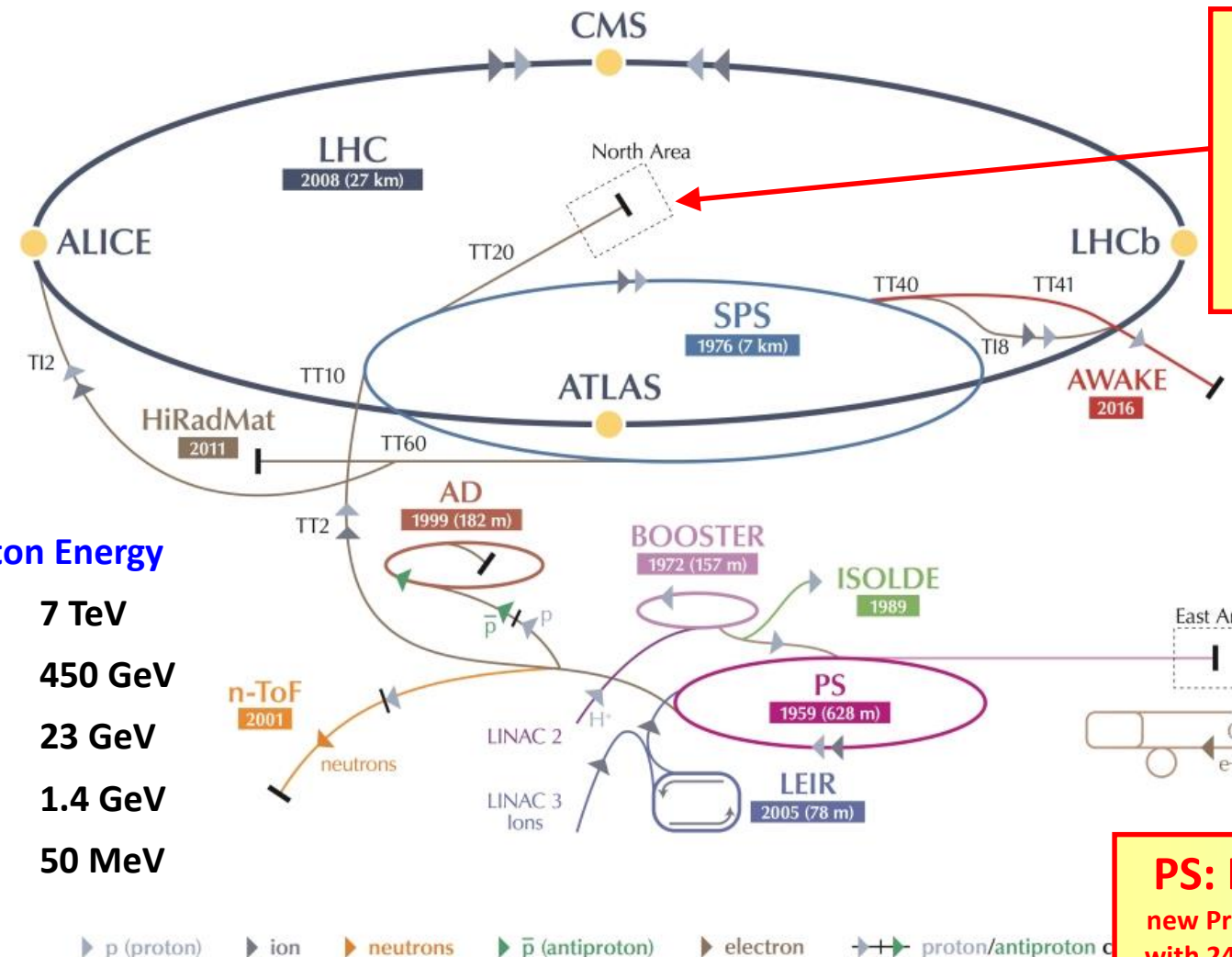
- Description of sub-tasks under CERN responsibility

New CERN Irradiation Facilities



SPS: GIF++
new Gamma Irradiation Facility with 100 GeV μ beam

^{137}Cs source ~×30 more intense

Operational since April 2015

Proton Energy

LHC	7 TeV
SPS	450 GeV
PS	23 GeV
PSB	1.4 GeV
Linac	50 MeV

Operational since November 2014

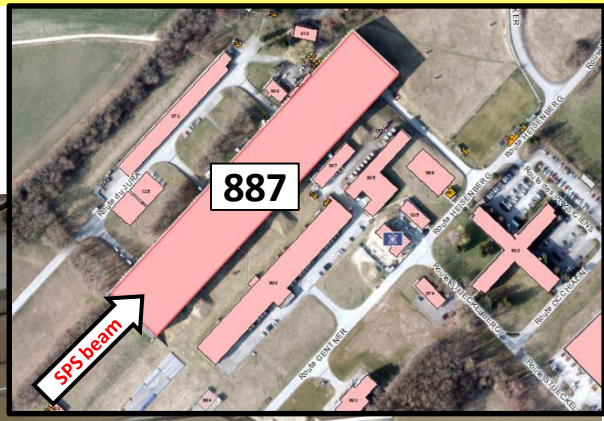
PS: IRRAD & CHARM
new Proton & Mixed-field Facilities with 24 GeV/c slow extracted beam

~×4 more intense proton beam

Upgrade projects carried out during LS1 (2012-2014)

GIF^{++} Facility Layout

- E_γ = 0.66 MeV; max. dose-rate ~0.5 Gy/h @ 1m (±37º angle)
- Several attenuation factors available (up to ~50'000)
- μ-beam from T2 on H4 beam-line (100 GeV; ~10^4 /spill)



^{137}Cs Irradiator (14 TBq)

Radiation attenuator

μ-beam

Upstream Area

Downstream Area

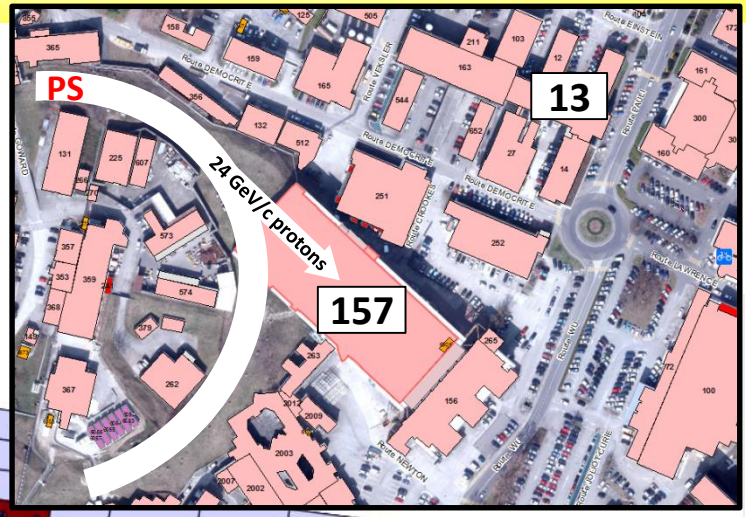
User Infrastructure from AIDA: cosmic & beam tracker, etc.

GIF++ Aerial View

www.cern.ch/gif-irrad

GIF++ is part of AIDA-2020 TA

EA-IRRAD Facility Layout



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IRRAD (proton)
CERN-PH & AIDA

T8 beam-line (~4×10^{11} pps of 400ms)

24 GeV/c p^{+}

Beam dump

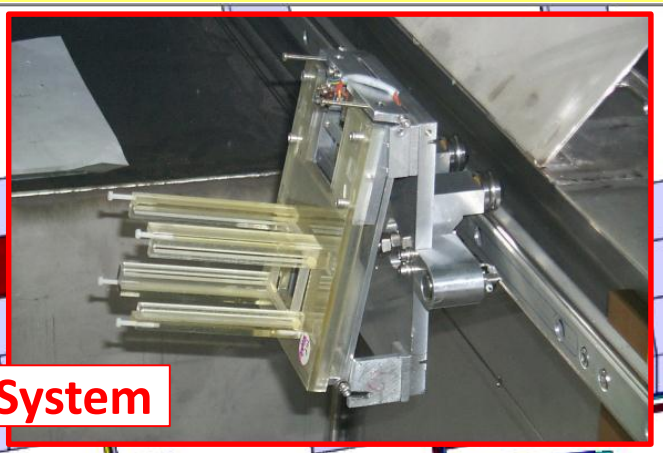
~1×10^{16} p cm^{-2} 5days^{-1}
(12x12 mm^{2} FWHM)

~10^{7}-10^{11} HEH/cm^{-2}/h
(0.01-100 Gy/h)

CHARM (mixed-field)
CERN-EN & R2E

IRRAD Proton Facility

Counting Room



Shuttle System

24GeV/c p+

detectors

electronics

Zone 1

Zone 2

Zone 3

calorimeter samples

Cryogenic System

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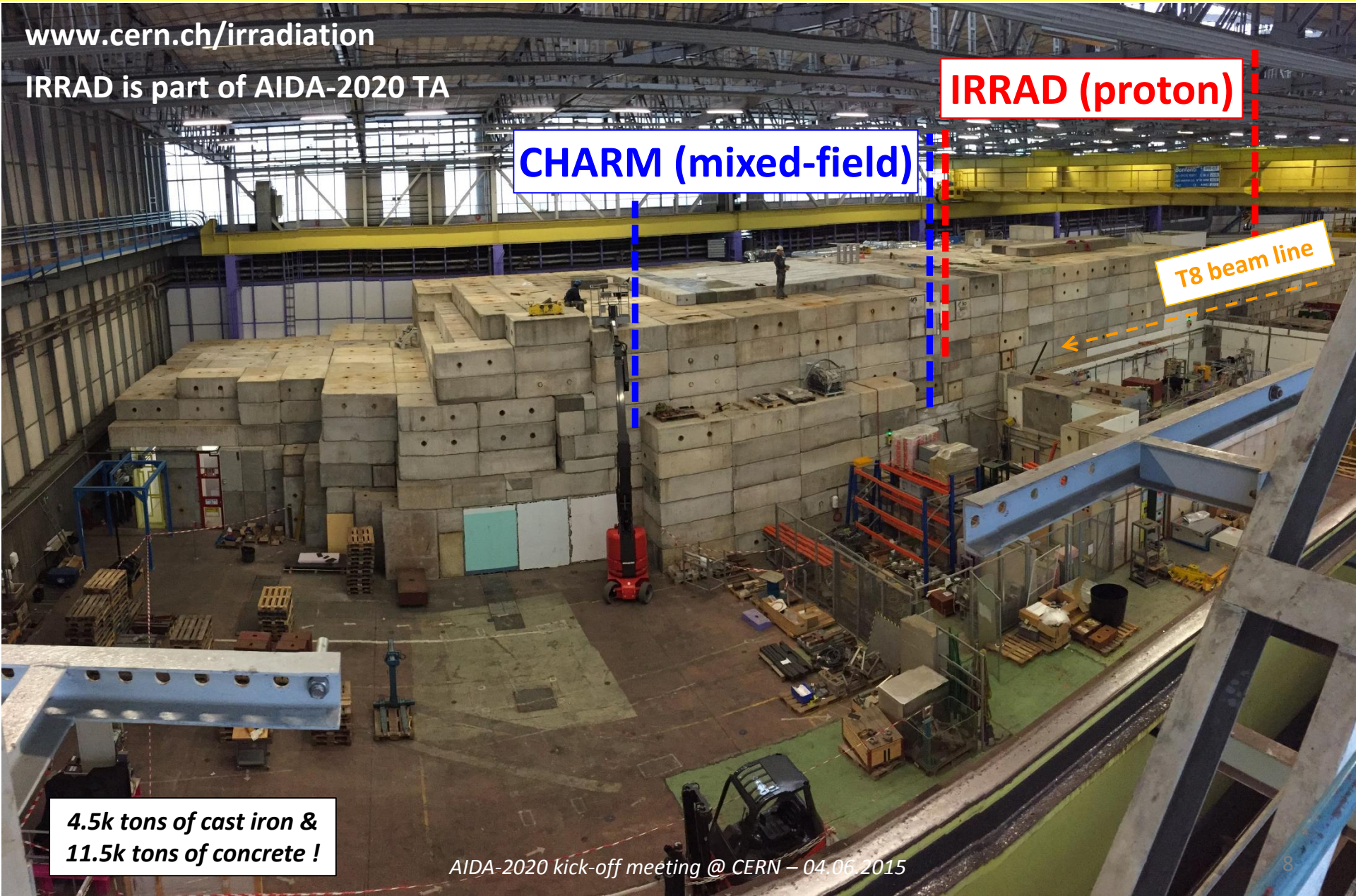
New IRRAD Facility

EA-IRRAD Aerial View



Task 15.5 in AIDA-2020

*The main aim of this task is the **upgrade of four key irradiation facilities** that provide very different types of radiation fields and are **part of the TA programme** (see WP11). **New requirements arising mainly from the HL-LHC project need to be fulfilled.** These include a rising number of irradiation tests, unprecedented radiation levels and the use of newly developed detector types and components with special requirements, (…)*

❑ CERN Gamma Irradiation Facility (GIF^{++})

- **Extension of the gas system: more parallel users, further distribution panels, mixers and IR analysis systems (D15.10)**

CERN

- **New online dose-rate monitor and studies on scintillator detectors (D15.11)**

  → *see talk from Institute for Nuclear Research and Nuclear Energy (INRNE)*

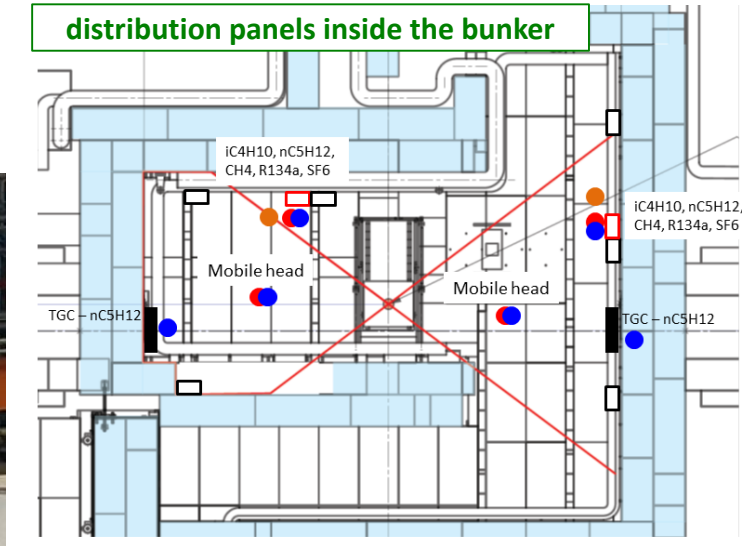
- **Extension of the cosmic ray tracker on the side walls (D15.11)**
- **Demonstrator for an augmented reality event display system (D15.11)**

  → *see talk from Istituto Nazionale Fisica Nucleare (INFN)*

GIF++ Gas System Upgrade

❑ Upgrade Plan:

- Additional 11 panels for mixture distribution
- Upgrade of control rack to handle more units: mixers, analysis, re-circulation systems, etc.
- Additional IR analysis rack for second mixer using flammable gas
- 3 new mixers for users
- 3 new gas recirculation systems for users



Task 15.5 in AIDA-2020

❑ CERN IRRAD Proton Facility

- **Improve the infrastructure and user friendliness of this facility**
  - **Dedicated area to store/handle activated materials (D15.6)**
  - **Sample and user management software system (D15.6)**
  - **High-granularity & fast Beam Profile Monitor (D15.7)**
  - **Development/test of sample holders for extremely-high proton fluence (D15.7)**

CERN

- **Online database on EU irradiation facilities of interest for the HEP (D15.6)**

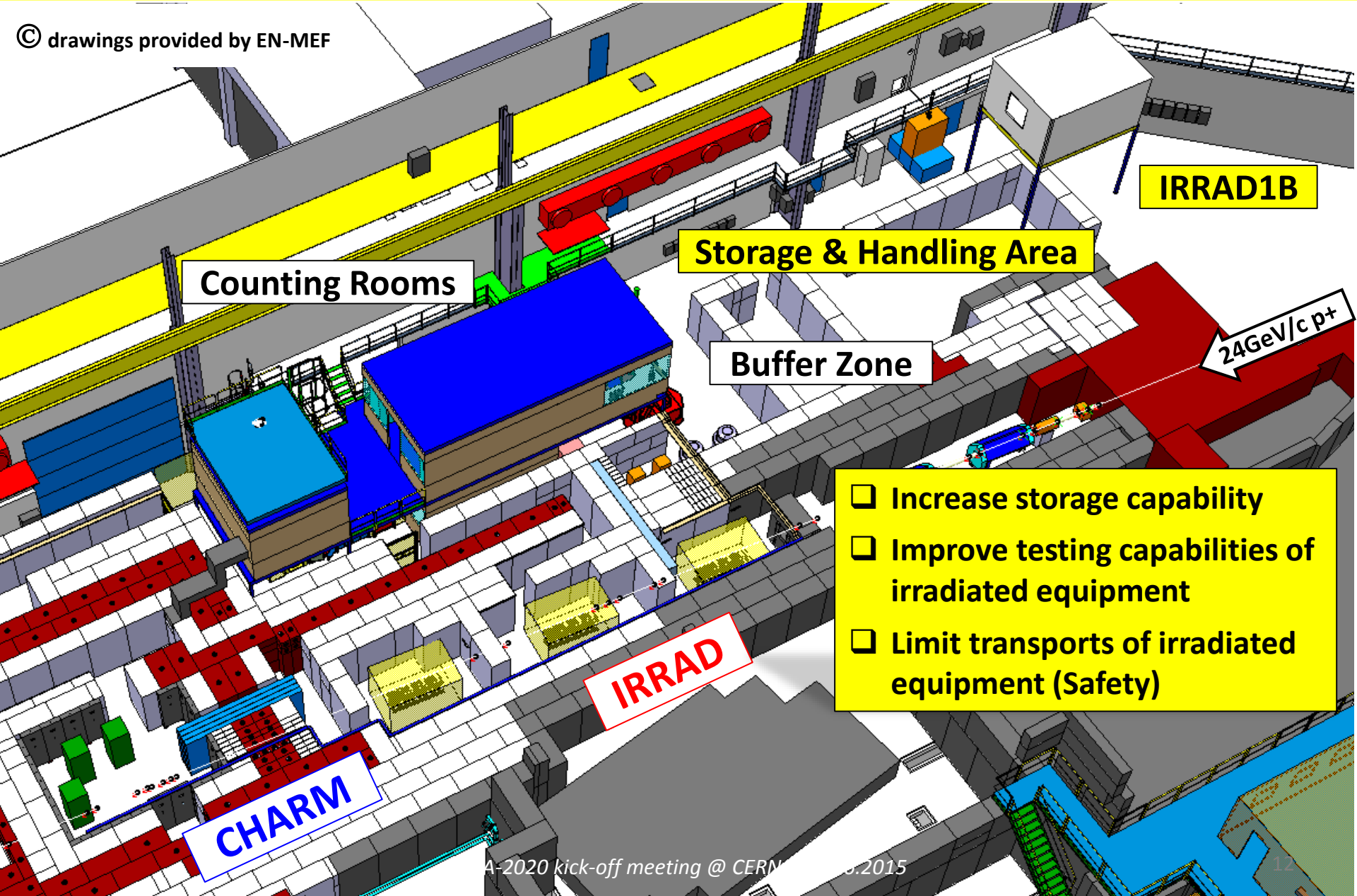
- **Position resolved fluence measurement system for proton beam (D15.6)**

  → *see talk from Vilnius University (VU)*

- **Thermal box (LN_2 cooled) for high-flux irradiations from RT to -40°C for CERN (D15.7) and Birmingham (D15.8)**

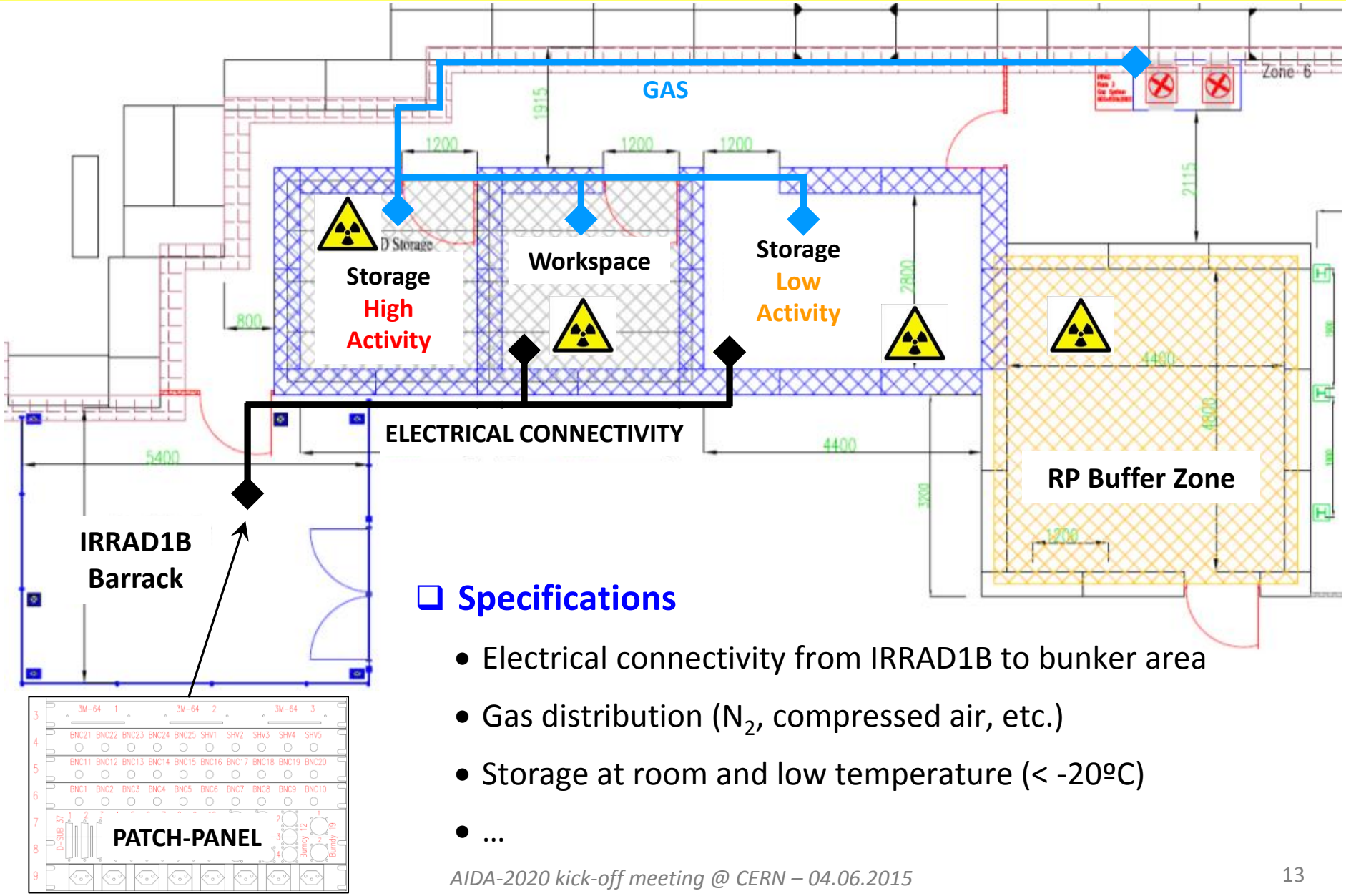
  → *see talk from the University of Sheffield (USFD)*

IRRAD Storage & Handling Area



- Increase storage capability
- Improve testing capabilities of irradiated equipment
- Limit transports of irradiated equipment (Safety)

IRRAD Storage & Handling Area



❑ Specifications

- Electrical connectivity from IRRAD1B to bunker area
- Gas distribution (N_2, compressed air, etc.)
- Storage at room and low temperature (< -20ºC)
- …

Sample & User Management System

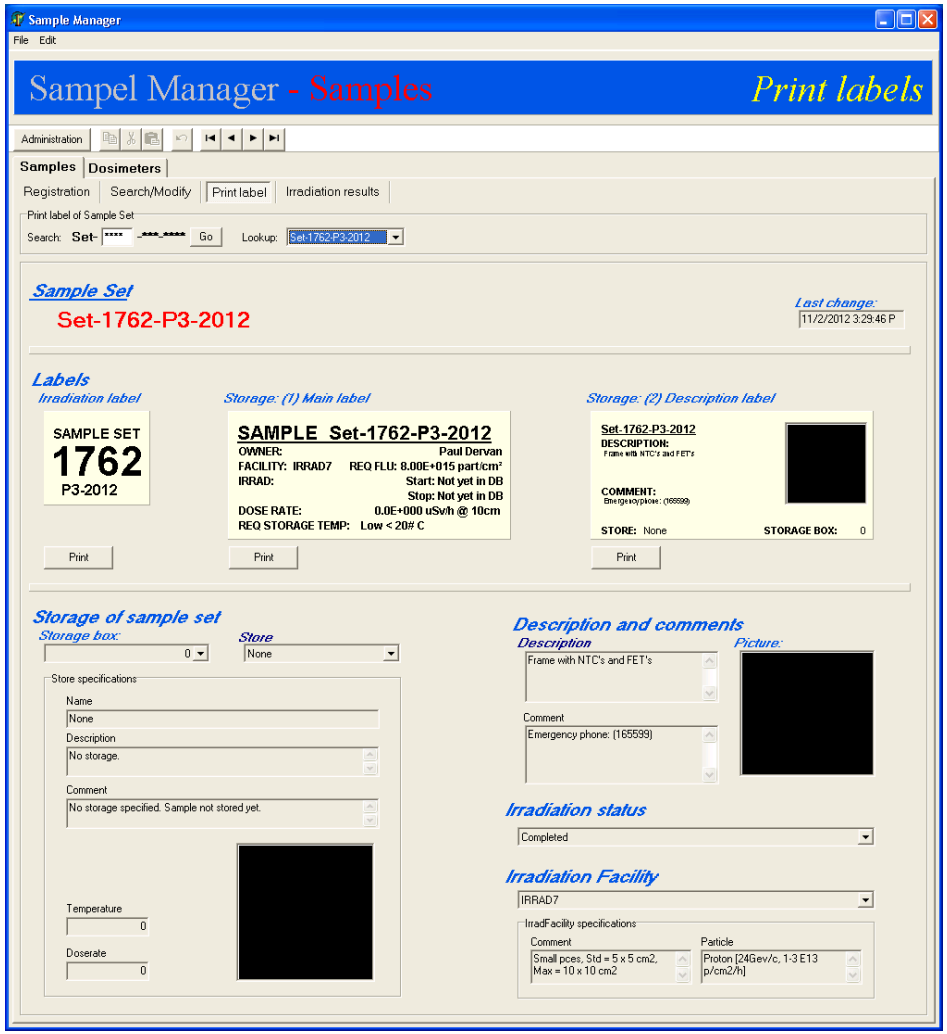
PH-DT

Motivation

- Increased number of irradiation systems
- Renewing the existing tool (15y old)
  - up-to-date IT platform
  - increased data capacity
  - new RP standards/procedures at CERN (TREC)

Preliminary Specifications

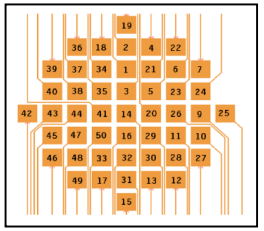
- Trace each sample/dosimeter
- Store relevant samples material data
- Record irradiation “history” data
- Serve as tool for planning the access to the irradiation area (beam OFF)
- Handle radioactive storage inventory
- …



High-Granularity & Fast BPM

❑ Beam Profile Monitors

- Metal-foil detectors
- Specifically developed for high-intensity beams (> 10^{11} /burst)
- Current version is optimized for “slow-extracted” beam

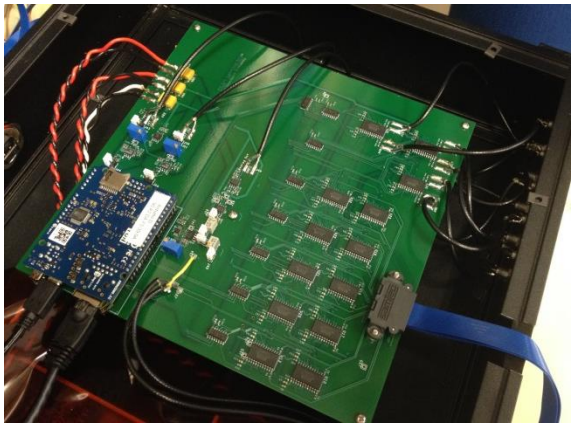


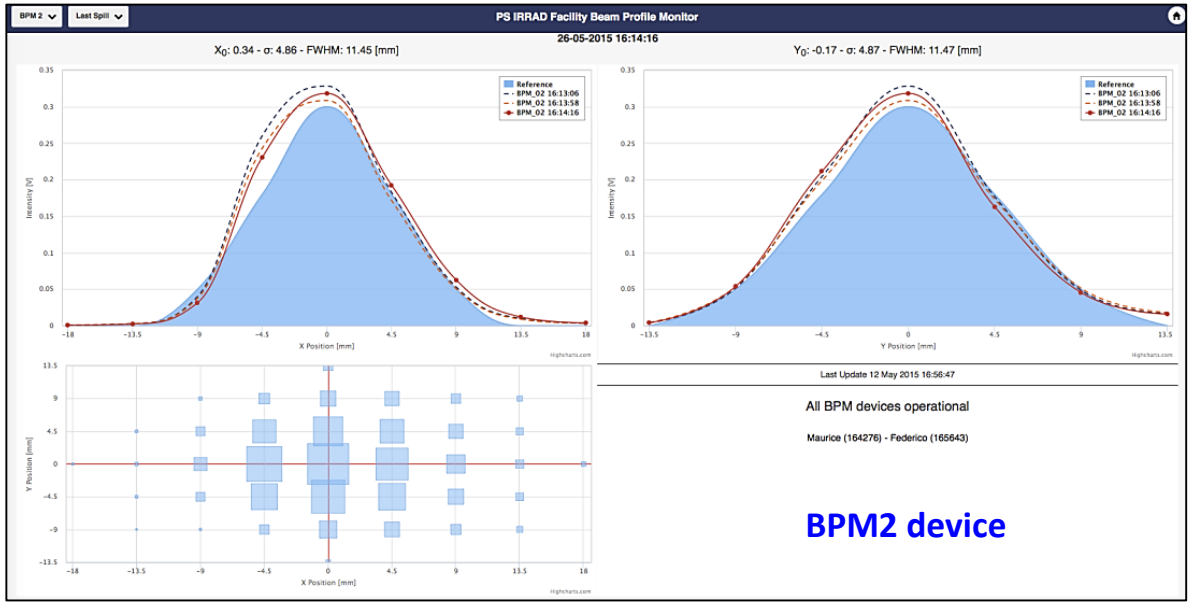
Standard pixelated pattern

❑ New requirements

- Development of new patterns for special beam conditions
- Qualification as a “small-area” particle counter
- Qualification with “fast-extracted “ beam

  → improve readout chain ?





BPM2 device

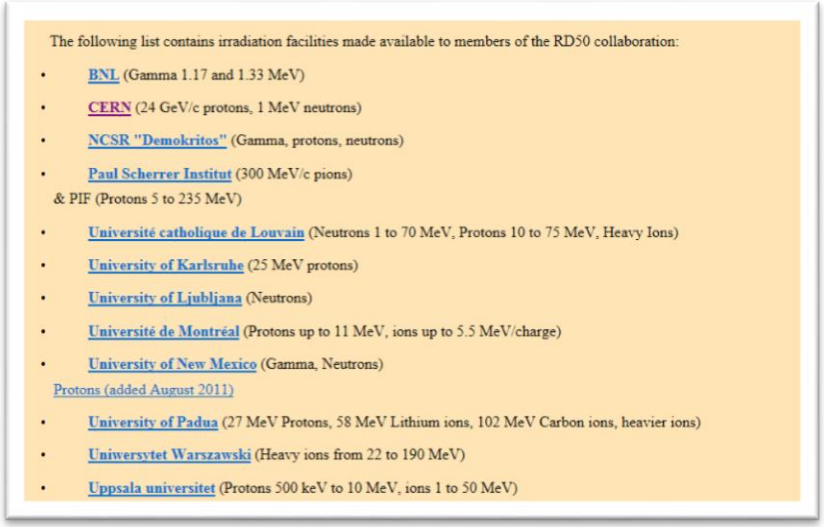
Sample Holders / Online DB

❑ Sample holders for proton irradiation

- Irradiation of small sensors (Si detectors) in IRRAD
- Replace "paperboard" holders at $\Phi > 10^{17}$ p/cm^2
- Evaluate new materials
  - Increased radiation hardness
  - Low activation (ALARA)
  - High availability, low cost, etc.

❑ Online database of irradiation facilities for HEP

- Merge existing compilations
- One unique CERN portal



The following list contains irradiation facilities made available to members of the RD50 collaboration:

- BNL (Gamma 1.17 and 1.33 MeV)
- CERN (24 GeV/c protons, 1 MeV neutrons)
- NCSR "Demokritos" (Gamma, protons, neutrons)
- Paul Scherrer Institut (300 MeV/c pions)
  & PIF (Protons 5 to 235 MeV)
- Université catholique de Louvain (Neutrons 1 to 70 MeV, Protons 10 to 75 MeV, Heavy Ions)
- University of Karlsruhe (25 MeV protons)
- University of Ljubljana (Neutrons)
- Université de Montréal (Protons up to 11 MeV, ions up to 5.5 MeV/charge)
- University of New Mexico (Gamma, Neutrons)
  Protons (added August 2011)
- University of Padua (27 MeV Protons, 58 MeV Lithium ions, 102 MeV Carbon ions, heavier ions)
- Uniwersytet Warszawski (Heavy ions from 22 to 190 MeV)
- Uppsala universitet (Protons 500 keV to 10 MeV, ions 1 to 50 MeV)

www.cern.ch/rd50

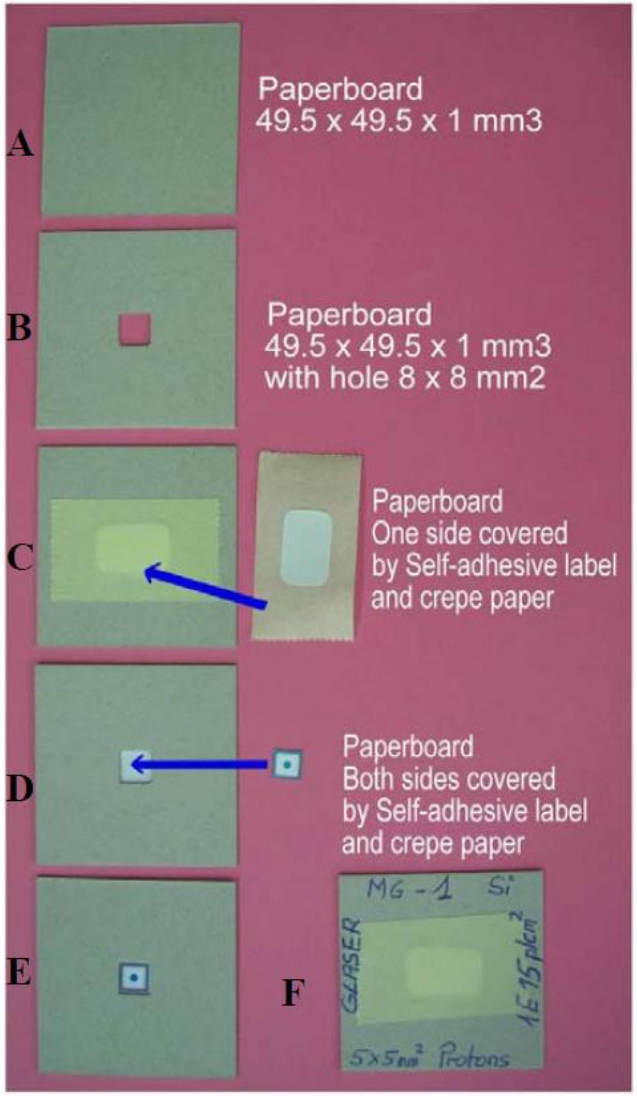


Figure 1.: Packaging of small samples for irradiation.