

PROTON IRRADIATION FACILITY



- **Main PIF task - radiation effects in electronics**
- **Realistic simulation of proton space environment**
- **Source of mono-energetic proton beams**
- **Calibration station for dose and particle detectors**
- **User friendly and commonly available**
- **Operates since 1992 - ESA Center of Excellence**

Energy range:

6 to 300 MeV

Maximum beam flux:

$\approx 10^9$ protons/sec/cm²)

Beam profiles:

Gaussian FWHM $\cong$ 6 cm (NA2),

Flat ϕ = 3.5 cm (OPTIS)

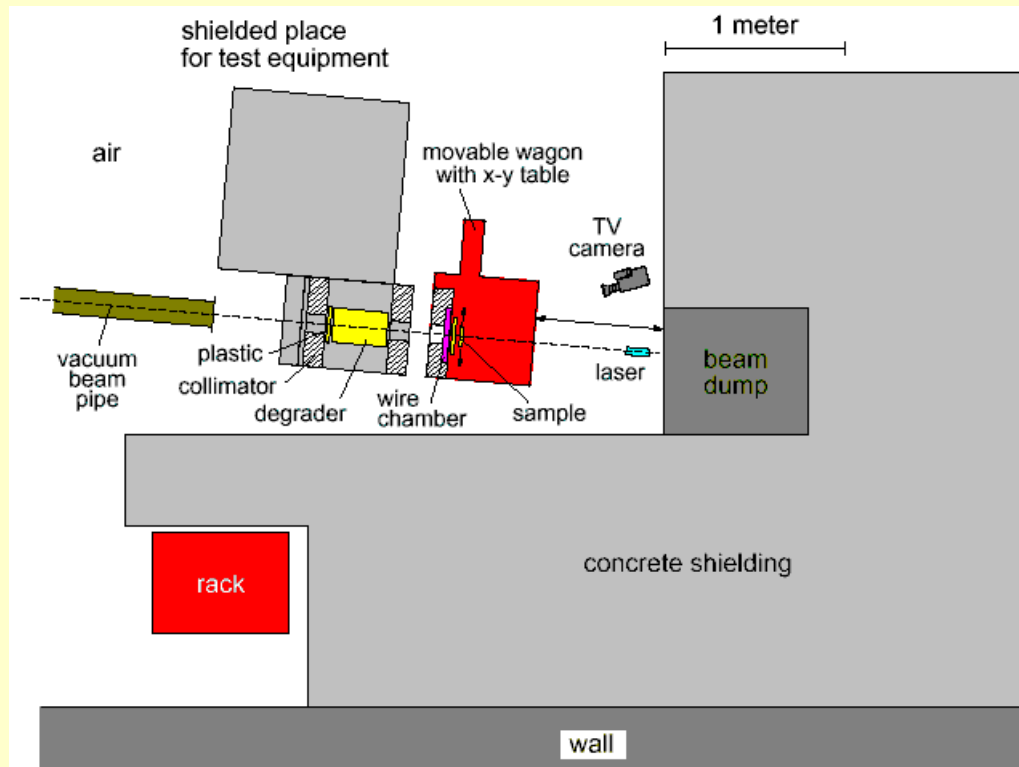
Irradiation takes place in air

Sample mounting frame attached on XY table (can be rotated)

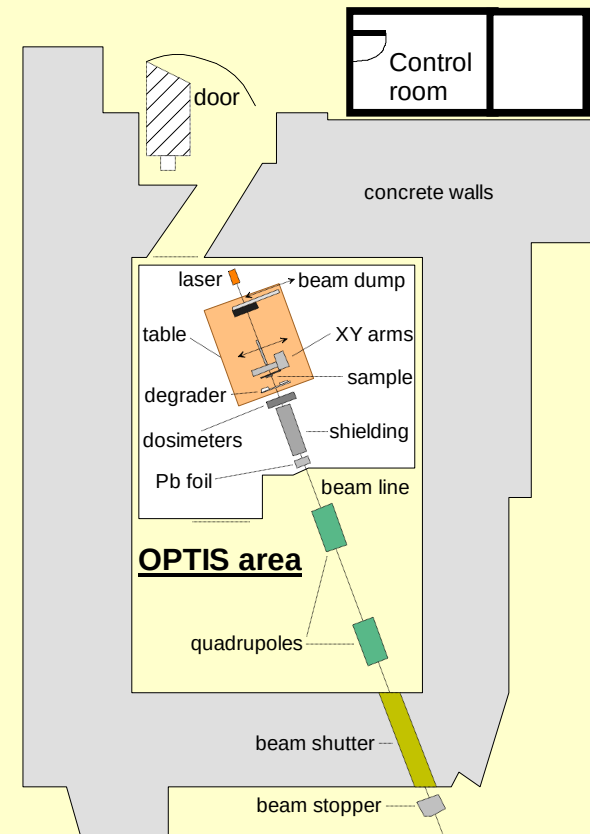
Sample test board as in SEU-Brookhaven and HIF-Brussel

Data Acquisition System allows fully automated irradiation

Experimental sites



NA Hall with PIF



NE-A Area (OPTIS)

Portable !

OPERATION in 1999 - SUMMARY

• Irradiation period extend	20 Jan - 14 Dec
• Number of experiments	35
• Participating research groups	16
• Days with beam	51
• Beam blocks total (PIF-NA - 13, OPTIS - 8, γ -source - 2)	23
• Beam shifts	79
• Setup shifts	32



MAIN USERS

- 1 ESA / ESTEC,
- 2 PSI / GSFC / UCB,
- 3 LABEN, Alenia Spazio
- 4 Bosch-Telecom GmbH,
- 5 Carl Zeiss GmbH,
- 6 Contraves Space,
- 7 CNES,
- 8 DIFESA Officine Galileo
- 9 SIRA Electro-Optics,
- 10 ONERA-CERT,
- 11 ABB Semiconductors,
- 12 Copenhagen University,
- 13 NMRC,
- 14 SCK / CEN,
- 15 SOREQ NRC,
- 16 SODERN

SELECTED EXPERIMENTS

- RADFET dosimeter radiation response study
- Drop Voltage Regulators TD testing
- ICARE particle monitor exposures
- Proton production of neutrons in Pb-Bi targets
- Radiation damage of various CCDs
- Proton dose effects in photodiodes
- SRAM/DRAMs proton SEU characterization
- Damages in encoders and mirror coatings
- Optical fibers rad-hardness determination
- Activation measurement of Ta and Mo plates
- Radiation damage in infrared bolometers
- Radiation effects in power MOSFETs
- Performance studies of BGO veto detectors
- Full characterization of PROBA Star-tracker.

SENSITIVITY OF RADFET DOSIMETERS FOR PROTONS AND GAMMAS (PSI - NMRC - ESTEC)

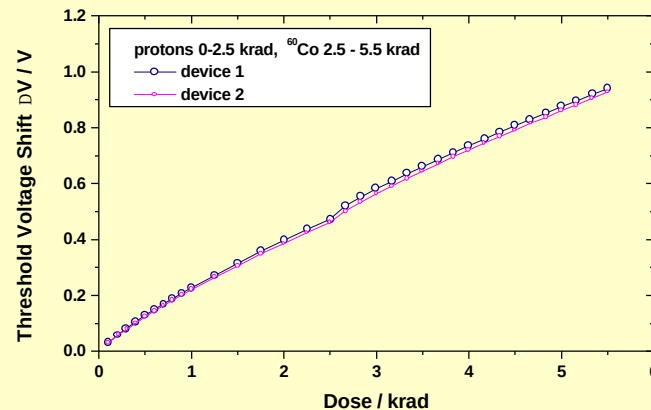
RADFET - Radiation Field Effect Transistors
from NMRC (Kork), P-MOS, 4000Å gate oxide

Purpose - Full characterization for various
energies, dose rates and exposure geometry

Utilization - All ESA missions equipped with SREM:
STRV-1c, INTREGRAL, Proba, ISS etc.

Exposures - Representative space conditions:
power and read-out circuits as in SREM

*Response function to
proton and gamma rays*



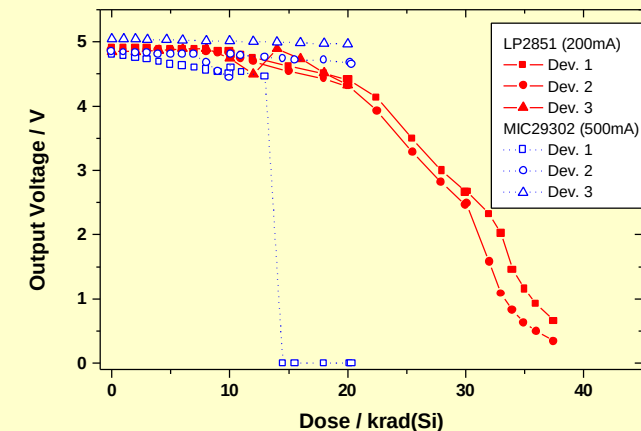
Irradiation setup in OPTIS facility

COMPONENTS TESTING FOR HESSI MISSION - VOLTAGE REGULATORS (PSI - GSFC - UCB)

<u>HESSI</u>	- High Energy Solar Spectroscopic Imager
<u>Launch</u>	- 4 July 2000
<u>Components</u>	- mostly COTS
<u>Radiation</u>	- predominantly protons in SAA
<u>Qualification</u>	- mission oriented proton exposures:
	• 10 krad total dose - no damage • Working characteristics stay within limits • SEU allowed for low upset cross section • SEL immune / or protection circuit

Response Voltage prior and post-radiation (10 krad (Si))

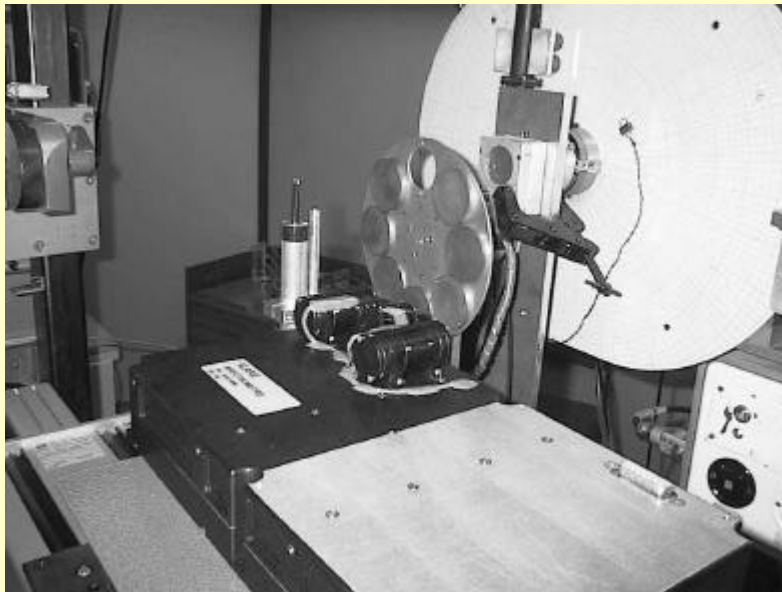
Type	V-prior	V-post
MIC29372 !	4.96	4.17
MIC29302	4.95	4.84
LP2951	11.91	11.70
LM2991	-5.09	-5.17



Output signal for LP2915 and MIC29302 voltage regulators as function of deposited dose

ICARE particle monitor proton exposures (CNES, Onera-Cert)

- ICARE - Influence of Space Radiation on Advance Components
- Missions - SAS-C, MIR
- Detectors - electrons, protons, HI



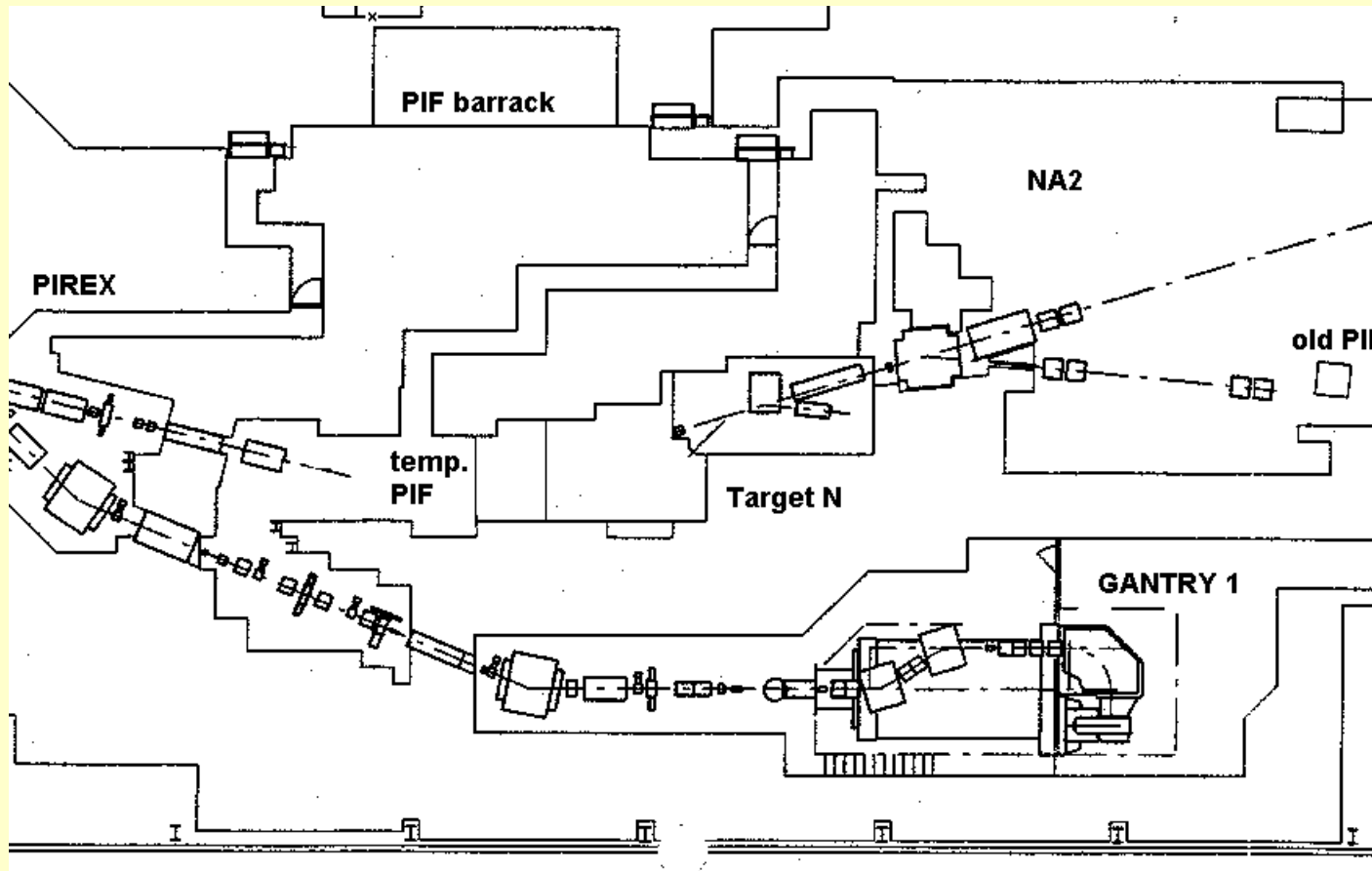
Proton induced spallation in Pb-Bi targets (PSI, SCK/CEN, Soreq NRC)

- Purpose - Studies of neutron production yield by high energy protons
- Application - Neutron production, material studies (defects, imaging etc.)
- Method 1 - Water bath and activation foil analysis
- Method 2 - Neutron time-of-flight measurement: energy spectra, angular distributions

Operation plan Jan-Jun 2000

- PIF temporary area construction - Jan to Mar
 - Beam development and tests - Mar
 - **Standard operation** - **April**
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- Low energy new area setting - Jan to Feb
 - Beam development and tests - Feb
 - **Low energy standard operation** - **Mar**
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- First irradiation tests: PSI, ESA-ESTEC, ABB, Bradford,
UCB-GSFC, UTMIC, Contraves, Dornier

Location of the PIF area in Proton channel PKC2



PROSCAN Project - new cyclotron in PSI

- New dedicated cyclotron designed for proton therapy
- Location foreseen in present NA (Nucleon Area)
- Operation demand: 12 months (very short service periods)
- **Test areas are planned for e.g. material science (PIF)**
- Time-table:
 - 2000 : dismantling NA2, temporary PIF (shutdown)
 - 2001/2 : construction / tests of new cyclotron
 - 2003 : construction / tests of GENTRY, OPTIS, Exp. Area (PIF)

Layout: cyclotron, beam lines and experimental areas

- Energy 250 MeV
- Intensity 500 nA
- PIF initial energies:
250 MeV, 70 MeV
for accurate selection in
range from 1 to 250 MeV
- Operation:
nights and weekends
much more flexible

