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Proton Irradiation Facility Summary 2014

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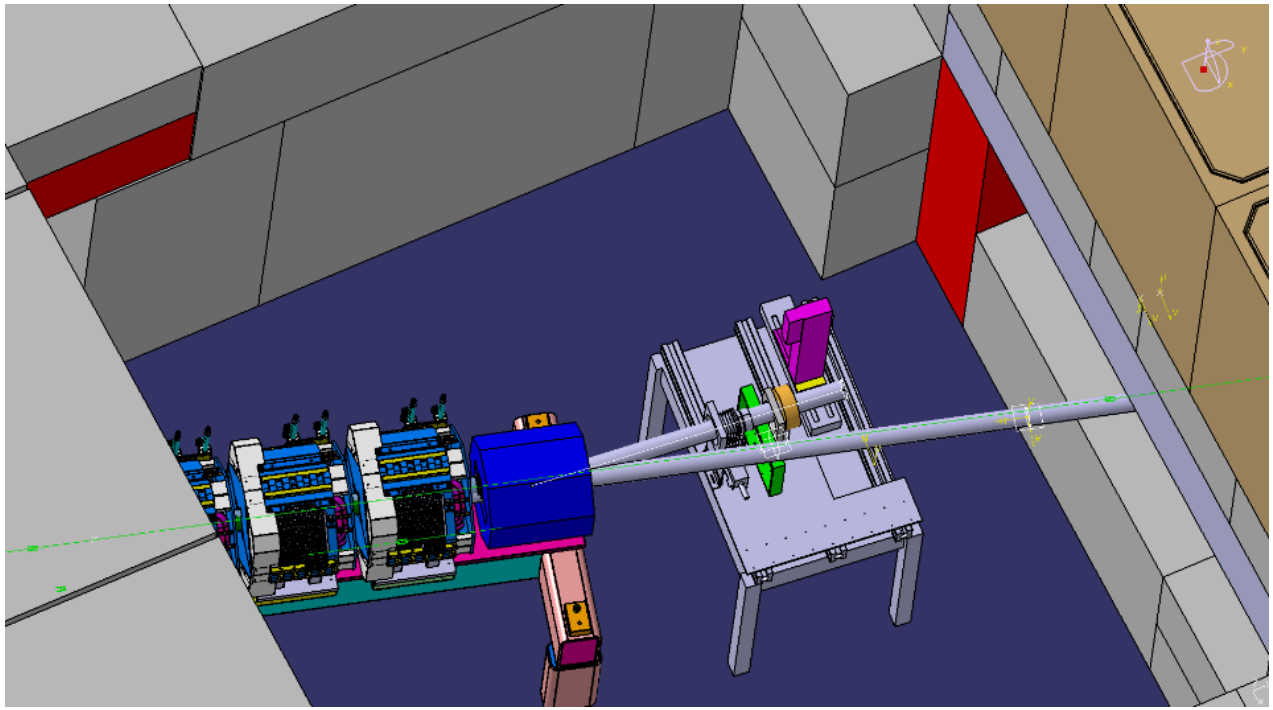
Operation highlights

1. Operation flow in 2014 during GANTRY3 project
2. Full re-construction of PIF and restoring of exposure tests
3. Adapting piM1 area for electron and proton tests
4. New dosimetry for monochromator and low intensity proton beams
5. Statistical data for PIF operation

PIF Area reconstruction I.

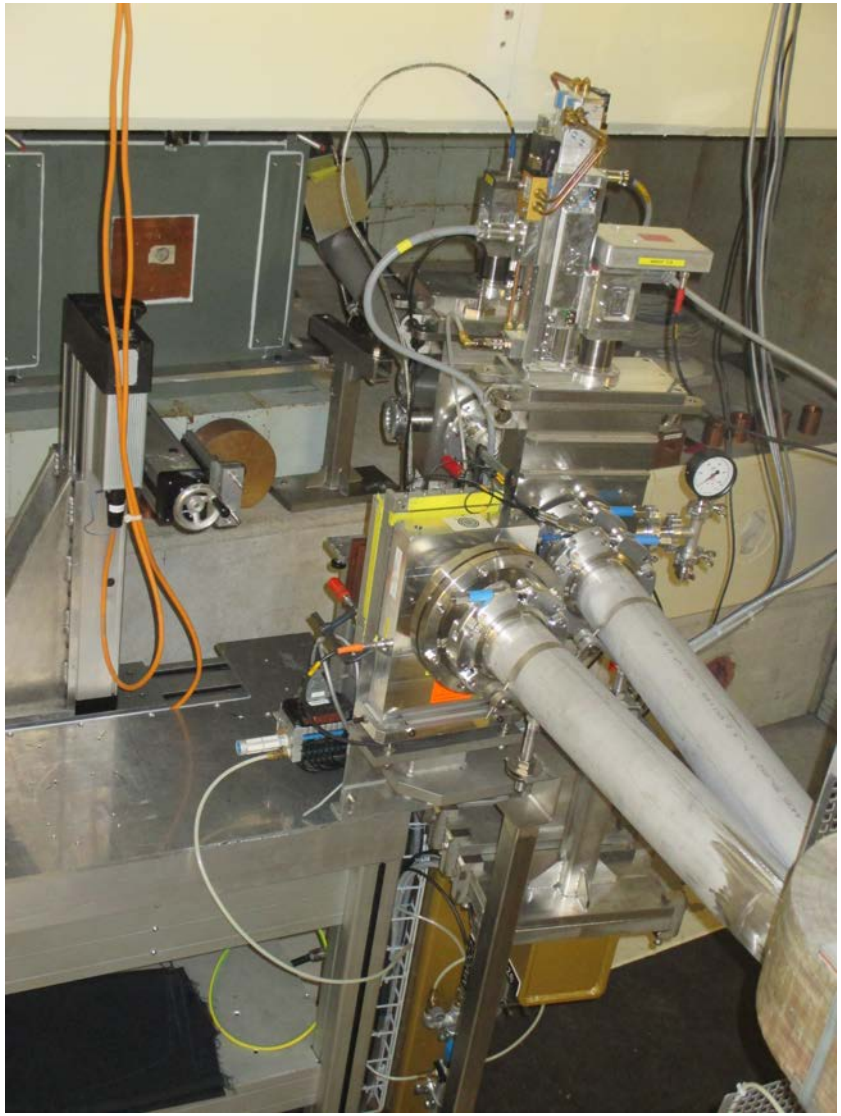
- Induced by building of GANTRY3 – new cancer treatment area behind PIF
- PIF fully re-constructed within 4½ months: Jul to Nov 2014
- Exposures during above period partly moved to piM1 area
- PiM1 covers all tests with proton beams up to 70 MeV



CAD model of the new PIF area layout

PIF Area reconstruction II.

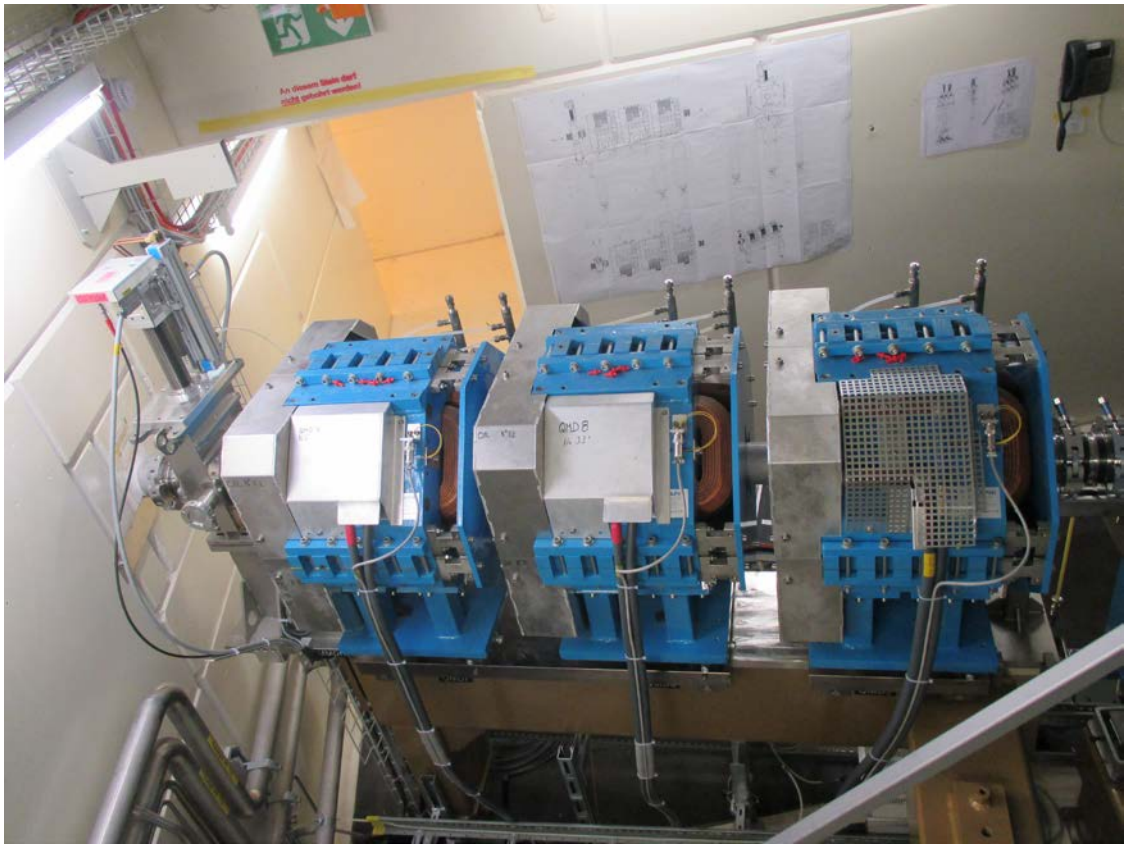
- Total de-commissioning of old PIF
- Back-wall and beamdump removal
- New construction of:
  - Test station
  - XY-table
  - Dosimetry system
  - Laser pointing
  - Beamdump
- First beams in November 2014
- Optimization of beam-tunes
- PIF functionality fully restored
- Open for users since Dec 2015



PIF after reconstruction: beamdump, XY-table, dosimetry

New magnet arrangements I.

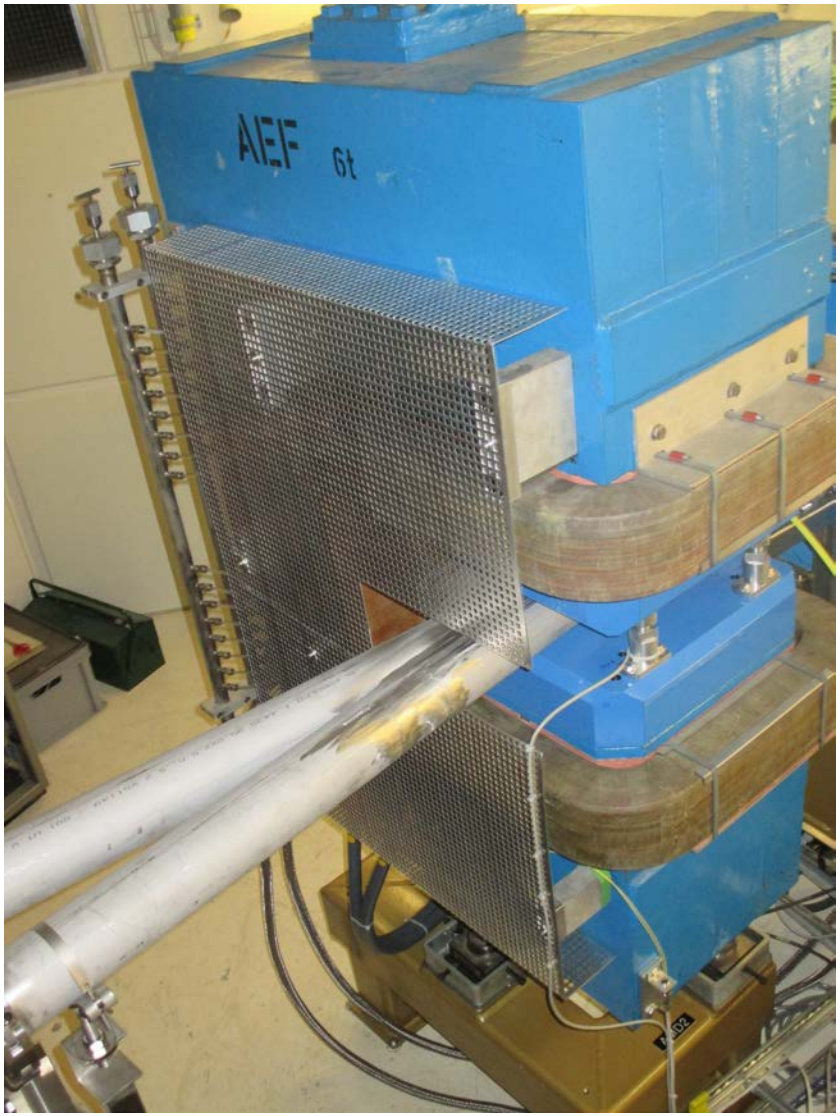
- Old doublet quadrupole replaced by triplet
- Better focusing and defocusing
- Both narrow and flat beams possible



New quadrupole triple magnet in front of PIF

New magnet arrangements II.

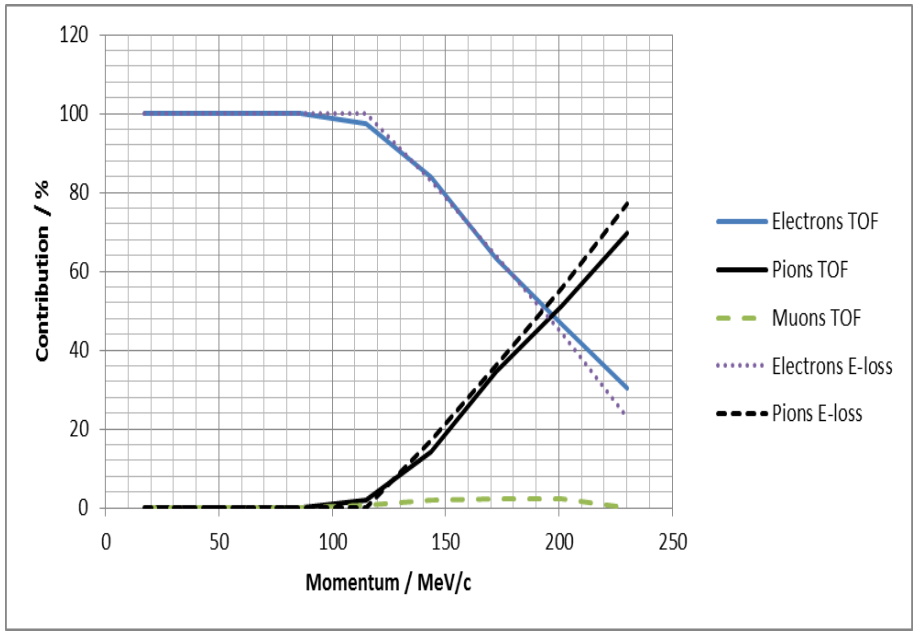
- Dedicated small dipole magnet
- Beam bending direction PIF
- Allows for slow horizontal swaps
- Coverage of energies up 230 MeV



Small bending magnet in PIF area

PiM1 Area for electron tests

- Adapting of secondary beam area of PSI ring for exposure tests
- Positive and negative particles possible
- Clean electrons beams from about 15 MeV up to 100 MeV
- Protons available up to 70 MeV
- Pions and muons from 100 MeV/c to 350 MeV/c



Beam contamination level as function of momentum

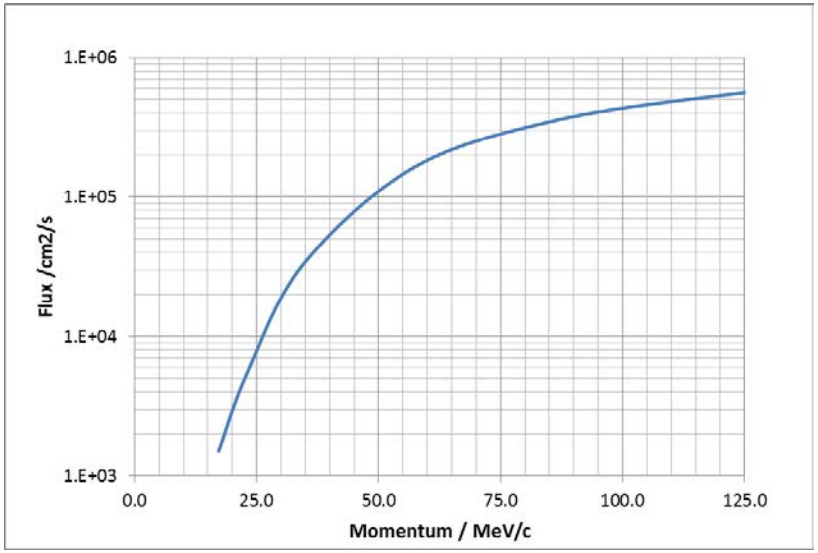
piM1 Test area: beam exit and PIP-JUICE setup

Electron beam features

- All tests done in air at 2nd focal point
- Longest distance from production target
- Pure electron beams up to 100 MeV/c
- Typical intensities: $2 \cdot 10^5$ – $1 \cdot 10^7$ /s and fluxes: $2 \cdot 10^3$ – $5 \cdot 10^5$ /cm^2/s
- FWHM between 4 cm and 10 cm
- Well suited for studies of instrument shielding and calibration
- Too low fluxes for TID tests; fast power law decay for flux/intensity

Electron beam parameters in piM1 area.

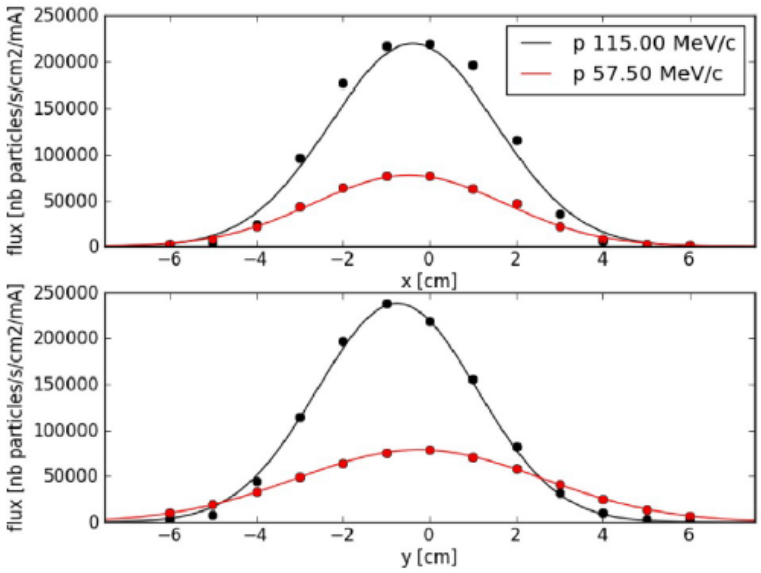
Momentum MeV/c	Intensity s/mA	Flux cm2/s/mA	FWHMx cm	FWHMy cm
17.3	1.16E+05	7.21E+02	10.4	13.2
23.0	3.28E+05	2.57E+03	9.0	12.9
34.5	1.16E+06	1.56E+04	6.6	9.6
57.5	3.08E+06	7.88E+04	5.2	6.6
86.3	5.13E+06	1.69E+05	4.2	5.1
115.0	5.18E+06	2.42E+05	4.4	4.3



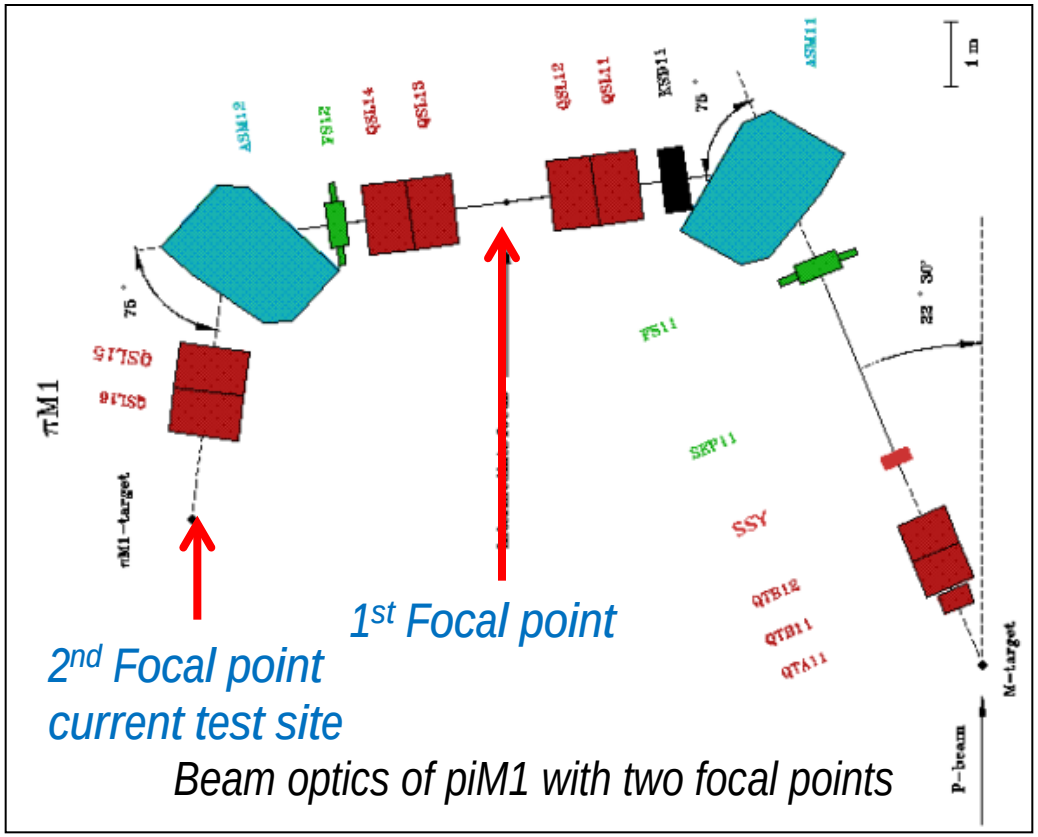
Electron flux vs. momentum

Flux increase plan

- Much higher beam intensities available in first focal point
- Distance from the target shorter by a factor of about two
- Qualification tests planned for May 2015
- Determination of electron TID feasibility between 20 MeV and 100 MeV



Beam profiles at the 2nd focal point

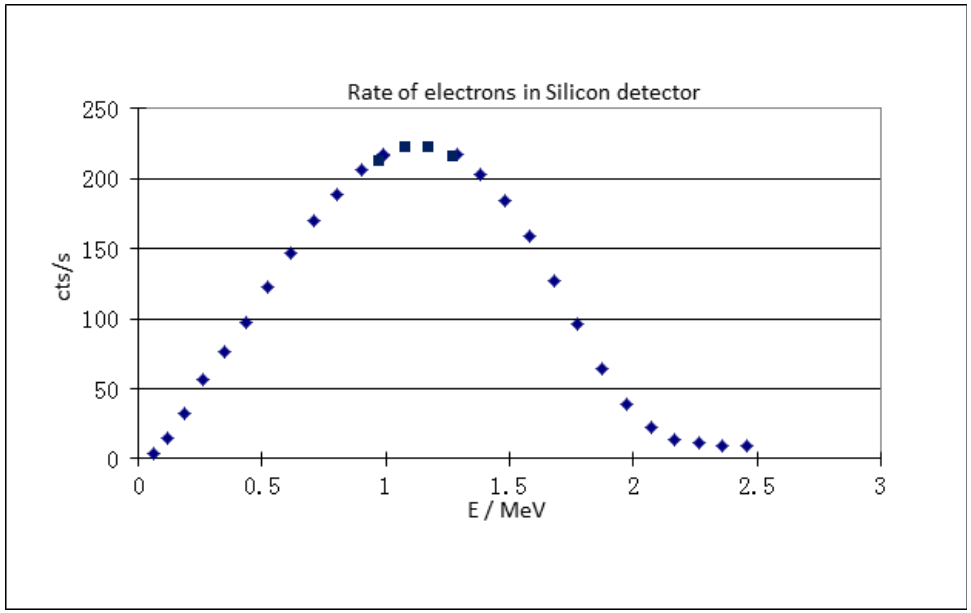


Beam optics of piM1 with two focal points

New dosimetry for Electron Monochromator

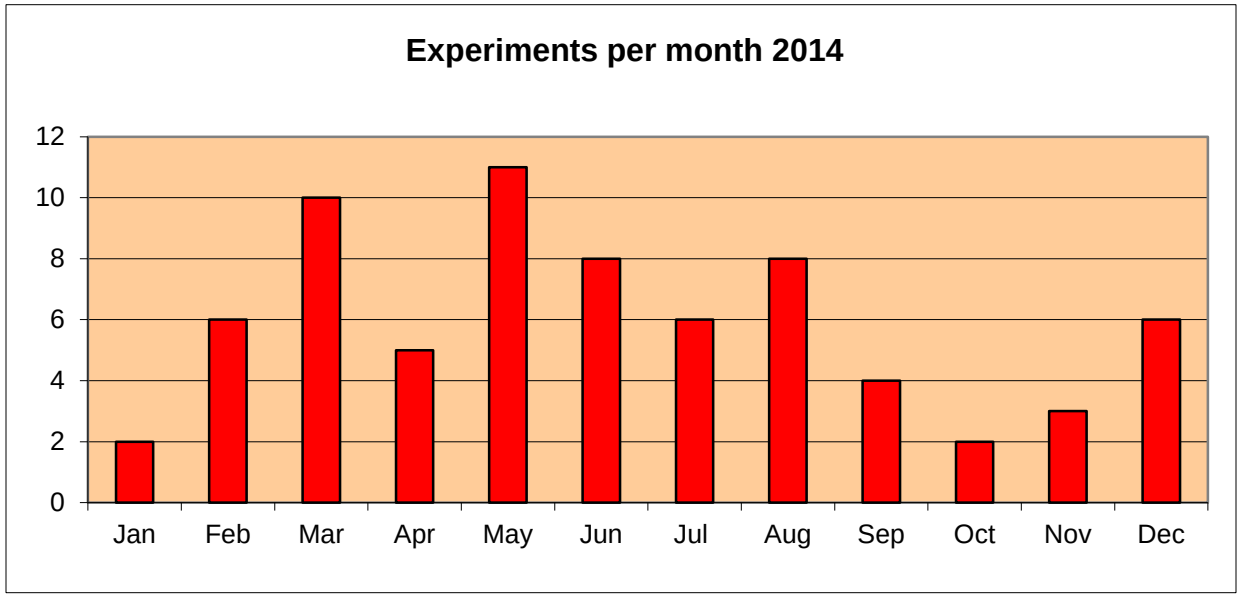
- Simple Flux control system constructed
- Si-detector with dedicated DAQ (analogue and digital)
- Repeatable calibration of monochromator performance
- Two units: PSI and ESTEC
- Further improvements: intensity increase by 90º bending (instead of 180º)

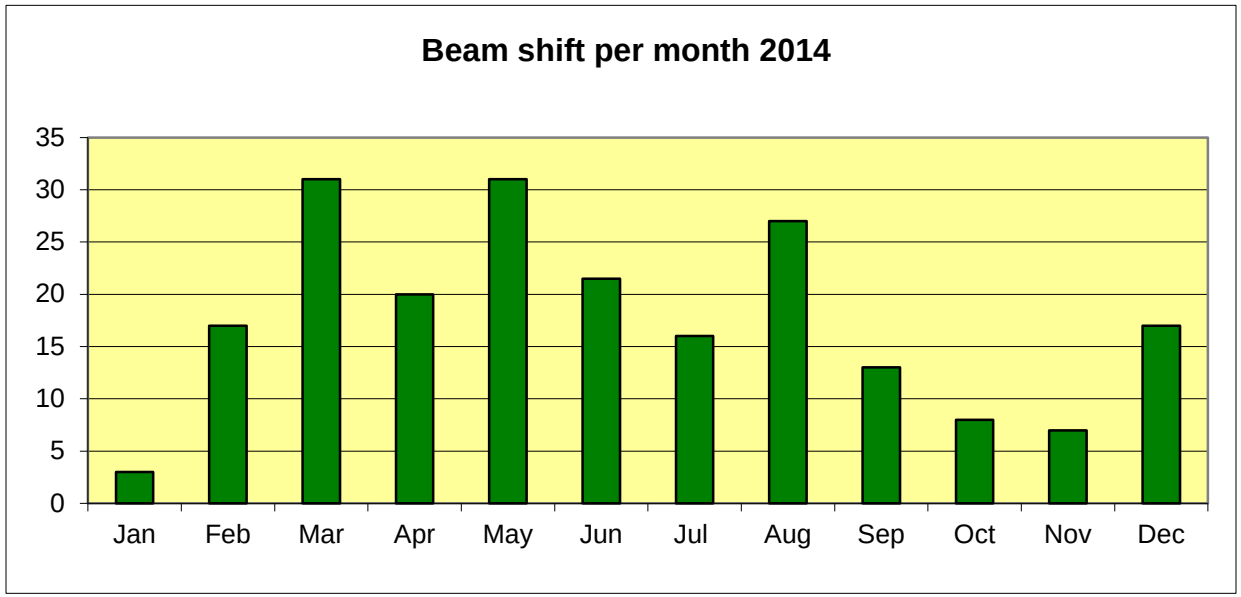
Si-detector and DAQ system (left); Monochromator chamber (right)



Intensity curve for ^{90}Sr electron source; Si-detector placed 2 cm from beam exit

Operation Calendar





Statistics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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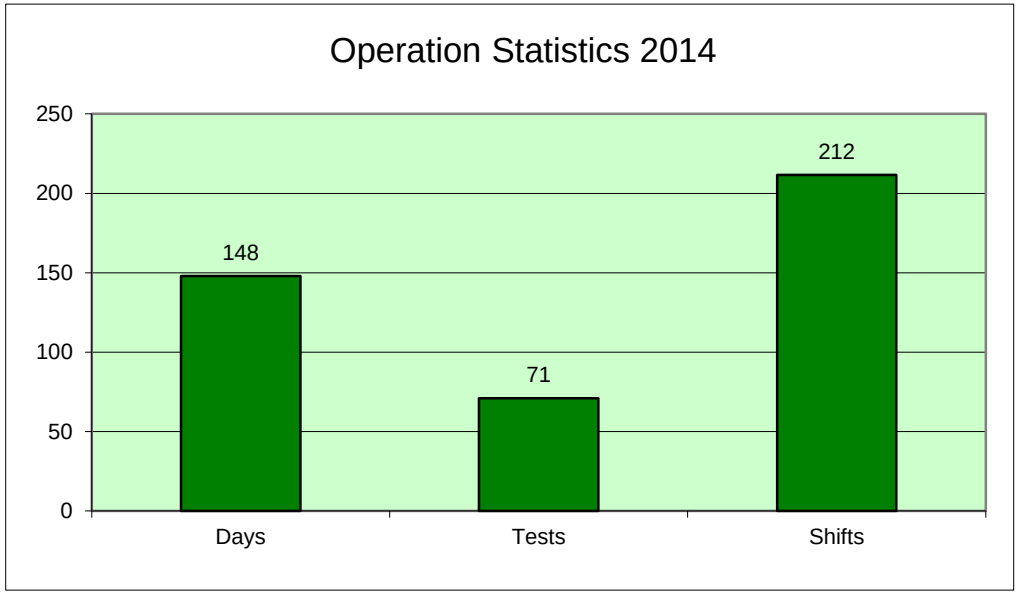

Summary

1. Semi-continuous PIF operation in 2014 despite large re-construction
2. Operational break of main PIF from Jul to Nov
3. Parallel use of piM1 area for proton tests up to 70 MeV
4. Full operational capability restored at the end of November
5. Better focusing functionality due to new quadrupole triplet
6. Slow horizontal swaps with new bending magnets if needed
7. Fully characterized new electron test-side available in piM1 area
8. Improvements planned for high intensity usability possible
9. New DAQ for both electron monochromator and low flux proton tests
10. In total all PIF facilities gave more than 70 tests and 140 beam-days

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Thank You

PiM1 Area for electron tests

The Gamma-Ray

GRIPS

GRIPS