UPGRADE OF GSI HADES BEAM LINE IN PREPARATION FOR HIGH INTENSITY RUNs

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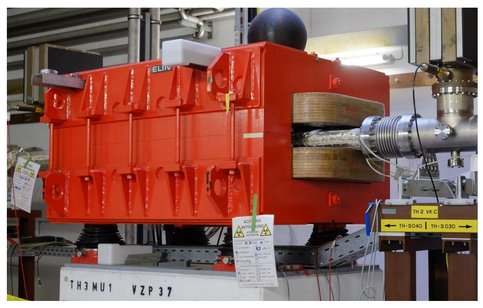
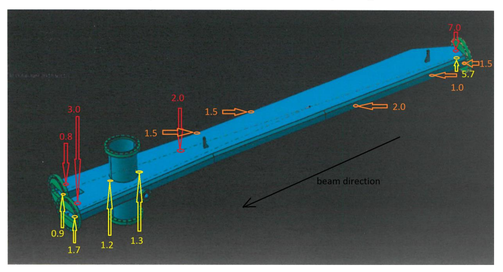
Abstract

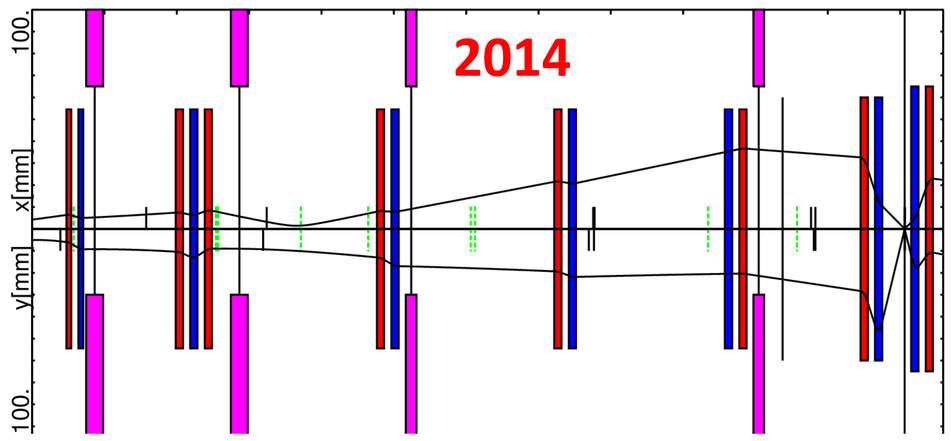
HADES is a fixed target experiment using SIS18 heavy ion beams. It investigates the microscopic properties of matter formed in heavy-ion, proton and pion - induced reactions in the 1-3.5 GeV/u energy regime. In 2014 HADES used a secondary pion beam produced by interaction between high-intensity nitrogen primary beam and a beryllium target. In these conditions beam losses, generated by slow extraction and beam transport to the experimental area, led to activation of the beam line elements and triggered radiation alarms. The primary beam intensity had to be reduced and the beam optics modified in order to keep radiation levels within the allowed limits. Similar beam conditions are requested by HADES experiment for upcoming run in 2018 and in the following years. Therefore, a number of measures have been proposed to improve beam transmission and quality. These measures are: additional shielding, **additional beam instrumentation**, **modification of beam optics** and **increase of vacuum chambers' apertures** in critical locations. The optics study and preliminary results of FLUKA simulations for optimization of location of loss detectors are presented.



GTH3MU1 dipole , activated by high losses during 2014.



Optics change



calculations performed with approximate emittances assuming centered extraction

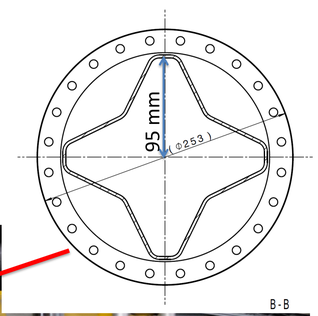
- 2 times larger margin to the vertical aperture in the most activated dipole
- beam larger (15% vertical) in final focusing quadrupoles
- gradient 10.3 T/m in the final focusing quads required (specification 10 T/m)

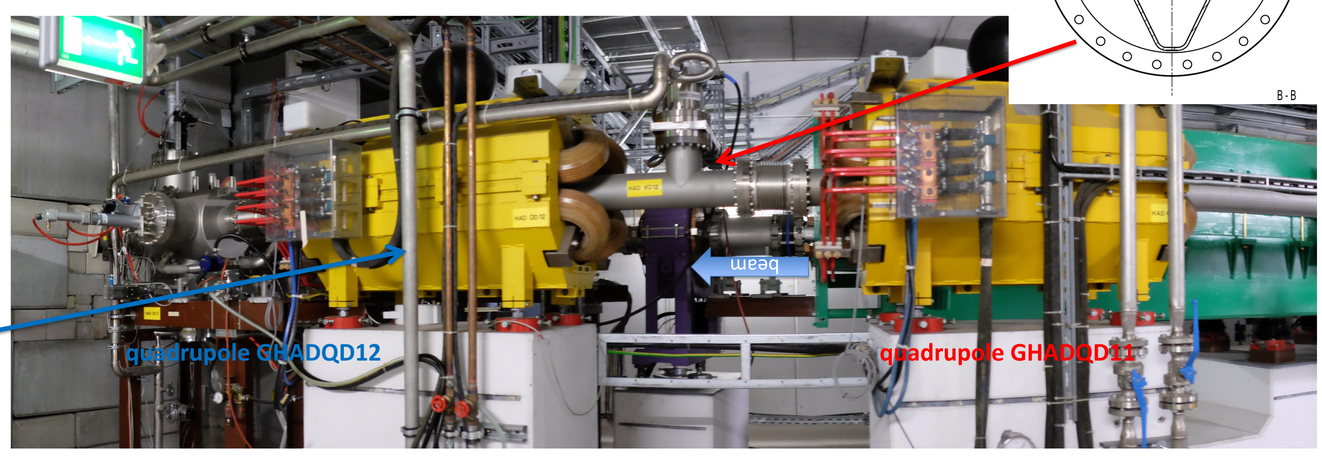
Powering test

- Enhance cooling by removal of throttles
- Stable operation with gradient 10.8 T/m achieved

Aperture increase

- Star-shaped chambers in construction
- Aperture 60->98 mm





30% reduction of beam spot size , beam line acceptance increase by 15% (H) and 45% (V)

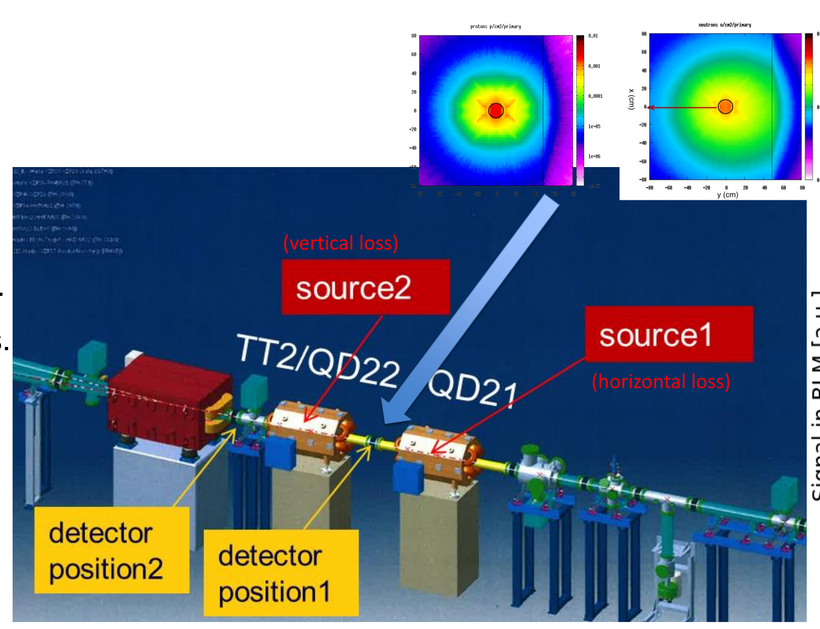
dipole GTH3MU1

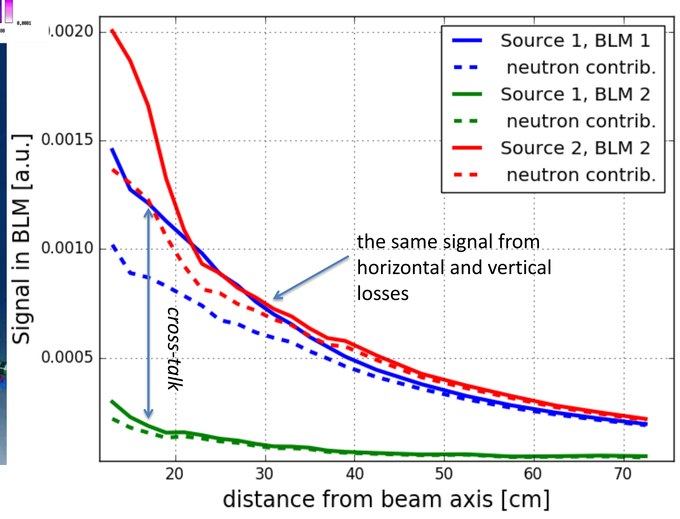
Beam Loss Monitoring system

- Fast identification of loss location and its nature is needed.
- BLM system based on scintillators + PMTs + counting electronics.
- Detectors located downstream of dipole and quadrupole magnets.

FLUKA simulations

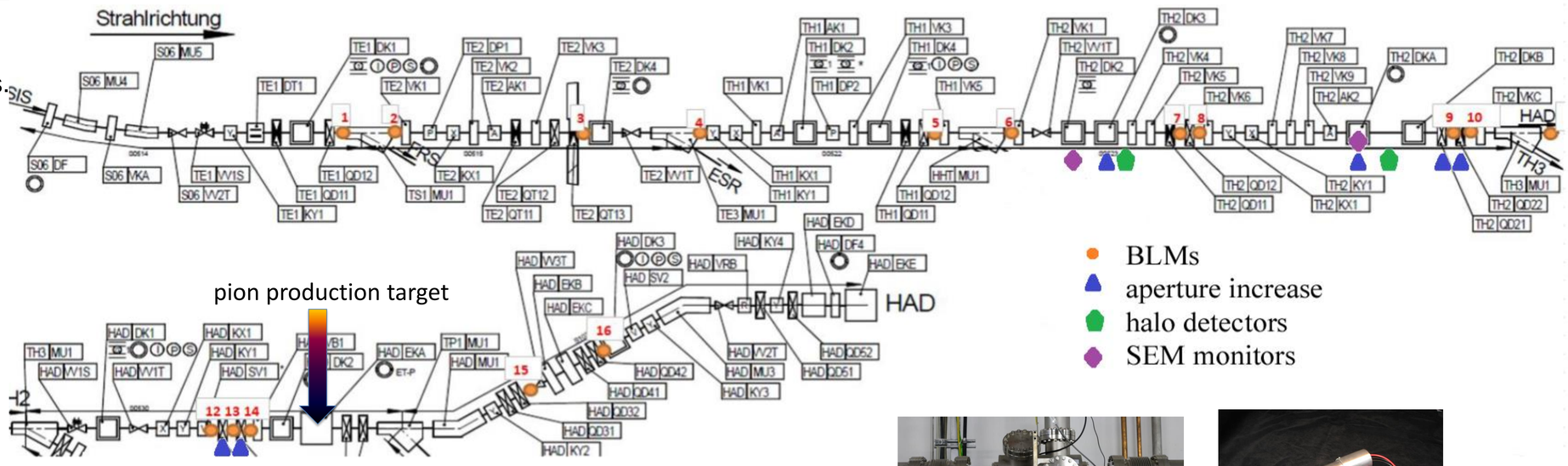
- first estimation of detector location in transverse plane
- signal dominated by fast neutrons, but up to 25% of protons close to the vacuum chamber
- **local losses give 7x higher signal than upstream losses – good position resolution – small cross-talk**

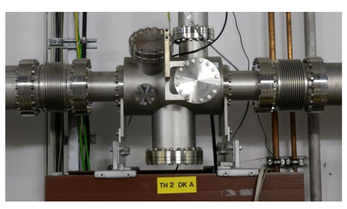




Other improvements

- Vacuum chamber aperture upgrades.
- Halo detectors - 4 retractable scintillators to observe beam shape on the target – good spatial and temporal resolutions.
- SEM detectors for relative beam intensity measurements.
- Control system upgrade (LSA).
- **Data archiving system.**





Summary and Outlook

- Beam line adaptations to high-intensity run based on optics change and aperture upgrade.
- Beam loss monitoring system allowing much better location of the losses.
- Lots of smaller improvements , data acquisition system to properly log the beam data.
- Future FLUKA simulation will include large part of beam line, shielding, roof, etc.

Literature

- T. Radon *et al.*, "Dose Measurement at SIS18 and connected experimental halls TR, EX, TH", GSI-Report-2014-1.
- T. Hoffman *et al.*, "LASSIE: The large analogue signal and scaling information environment for FAIR", in *Proc. ICALEPCS2011*, Grenoble, France, MOPMN008.
- P. Boutachkov *et al.*, "In-beam Test of the new Secondary Electron Detector for FAIR", GSI-Report-2016.