HIGH-ENERGY SCRAPER SYSTEM FOR THE S-DALINAC EXTRACTION BEAM LINE - COMMISSIONING RUN*

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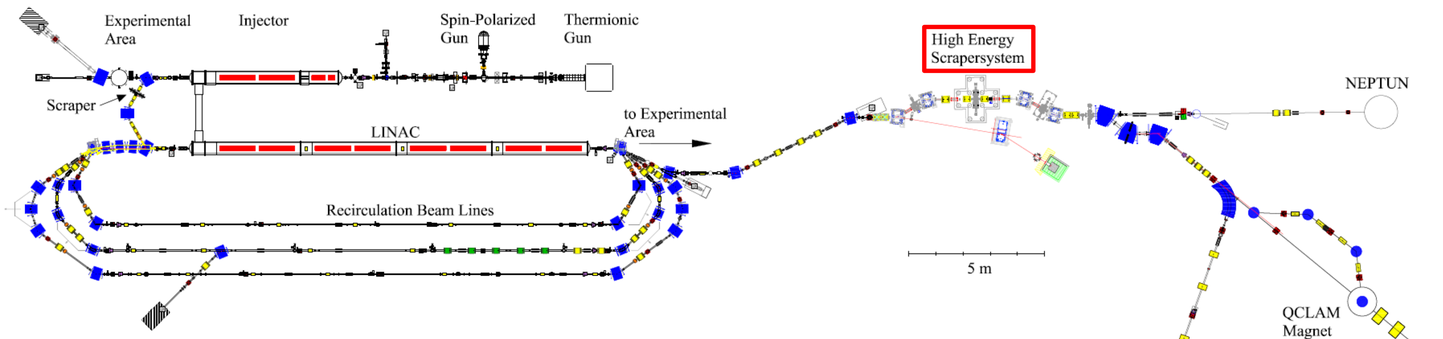
S-DALINAC



Temperature:	2 K	Design energy:	130 MeV
Frequency:	2.997 GHz	Design energy (injector):	10 MeV
Duty cycle:	cw	Beam current:	1 nA - 60 µA

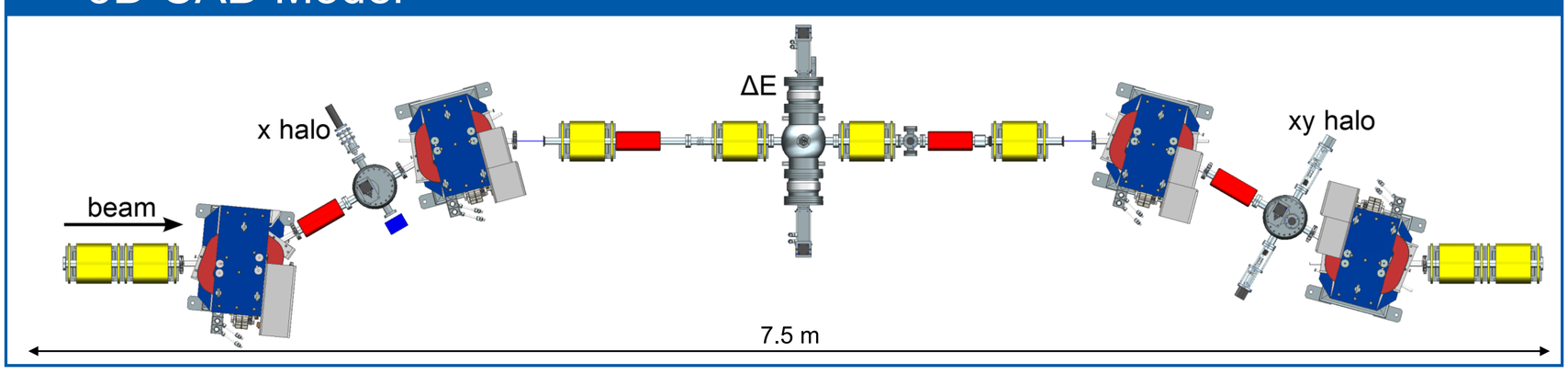
Scraper System

location:	extraction beam line
purpose:	remove x and y halo and reduce energy spread by three scraper chambers
magnets:	4 dipoles, 30°
	8 quadrupoles, 4 vertical steerers
chambers:	standard 9“ spherical vacuum chambers
scraper brackets:	copper, water cooled
drive:	stepping motor, positioning accuracy 0.01 mm

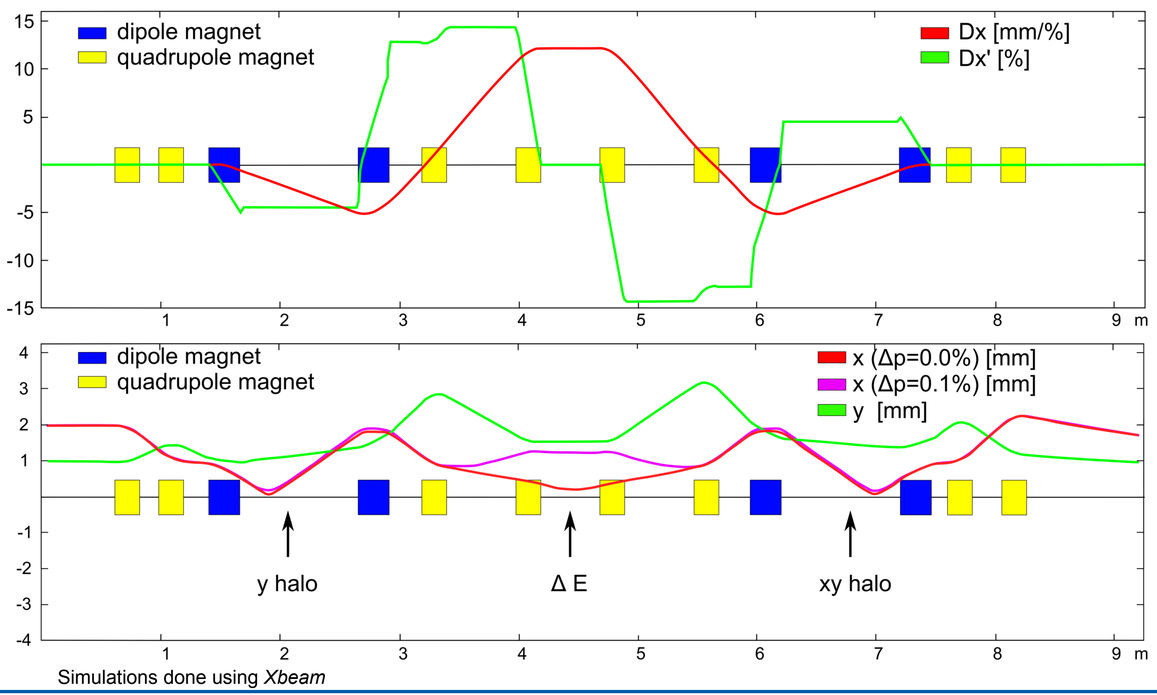
Important Parameters

Halo scrapers	- narrow beam, i.e. below 1 mm - parallel beam within the interaction length
Energy scraper:	- narrow beam, e.g. far below 1 mm - high and constant dispersion within the interaction length
Final layout:	- use 2 quadrupoles before and after the system for general beam tuning - use 4 dipoles with chamfer angles of 20° and 4 quadrupoles to increase dispersion in x direction - sustain symmetry for zero dispersion exit of chicane

3D CAD Model



Beam Dynamics

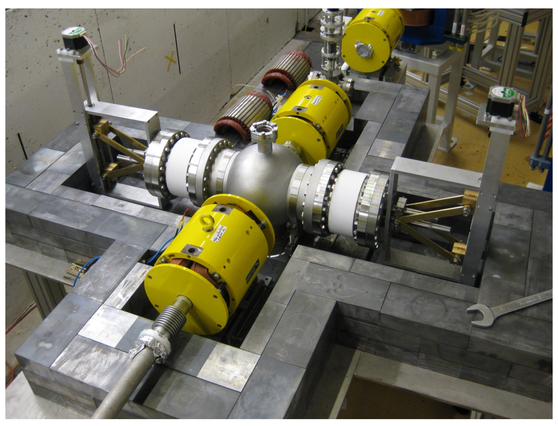


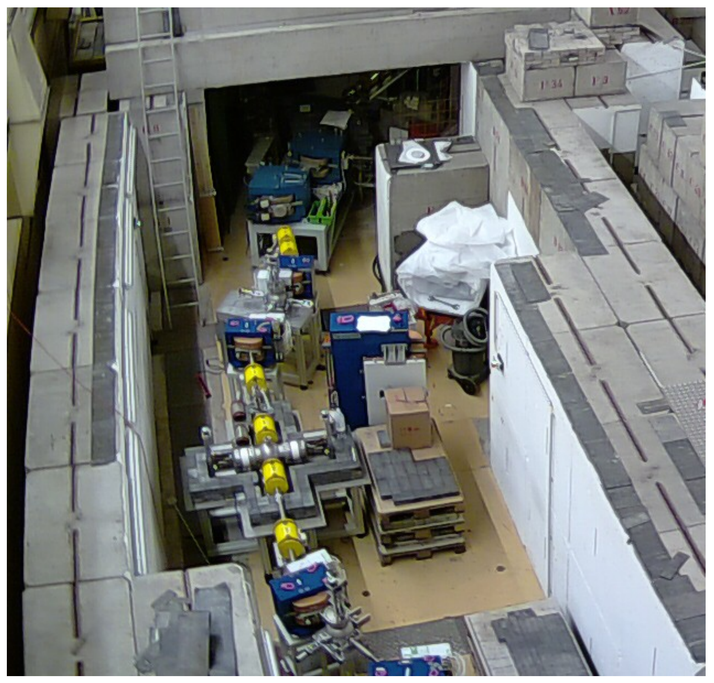
Simulations done using *Xbeam*

Installation

September 2015 – January 2016

- ✓ vacuum system closed
- ✓ magnets and chambers aligned ~ 0.1 mm
- ✓ concrete tunnel closed
- ✓ radiation shielding, cooling water and electrics





Commissioning Run

Experimental beam time in Oct. 2017 with 22.5 MeV:

- variation of gap width
- measurement of energy spread

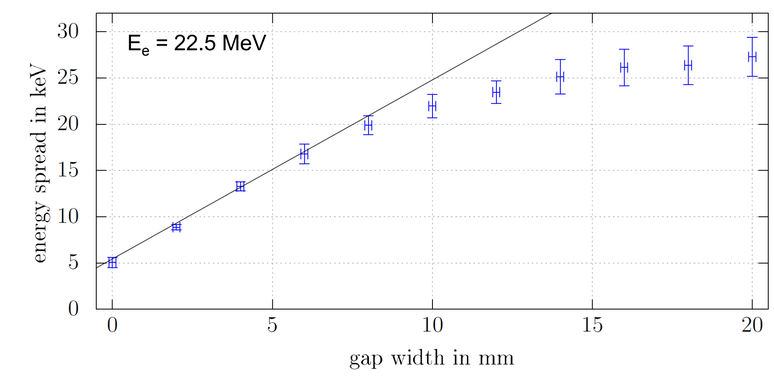
➢ energy spread reduced from 25 keV to 5 keV

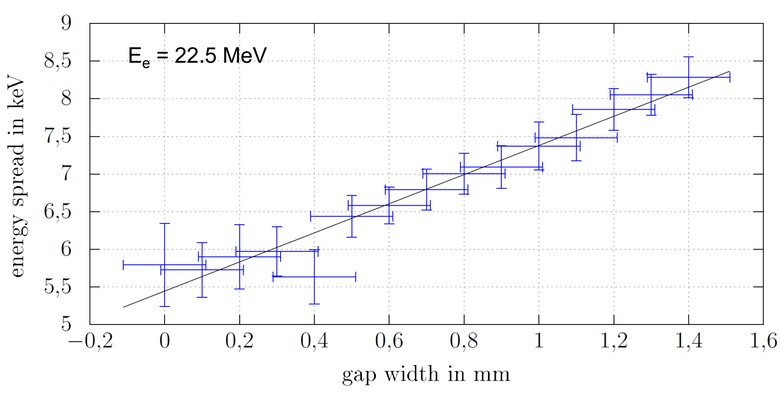
➢ further tests with 42.5 MeV showed reduction to energy spread below 8 keV (0.2 ‰)

Further improvements:

➢ reduction of background count rates next to the experimental area

➢ energy spread, energy fluctuations and drifts were observed by measuring the deposited beam current on each side of the energy scraper





Conclusion and Outlook

The new high-energy scraper system at the S-DALINAC and its first commissioning run have been presented in this contribution. The system will help to improve beam quality by halo and energy scraping of the beam after acceleration. The energy defining scraper performed well and therefore has already been used for experimental beam times. Using this new feature, future experiments with demand for high resolution and low noise can be approached.

Further tests and developments:

The commissioning of the built-in halo scrapers has to be done next and is scheduled for the upcoming beam time.

By measuring the deposited beam current on each of the energy scraper brackets we gained information on both, fast and slow energy fluctuations. Future plans could include energy monitoring by this set-up and might allow for an automatic stabilization of the beam energy by slightly adjusting the rf-amplitude of our accelerating structures.

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