

The Upgraded Injector Cryostat Module and Upcoming Improvements at the S-DALINAC



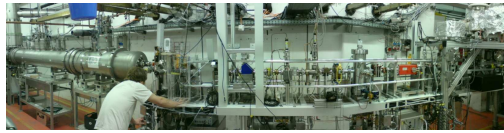
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MOPO018

S-DALINAC

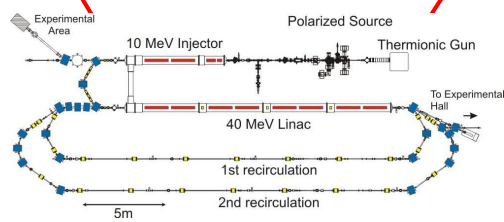


Temperature: 2 K
Frequency: 2.997 GHz
Duty cycle: cw
Design energy: 130 MeV
Design energy (injector): 10 MeV
Max. beam current: 60 μ A

Superconducting cavity



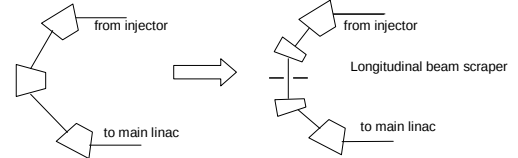
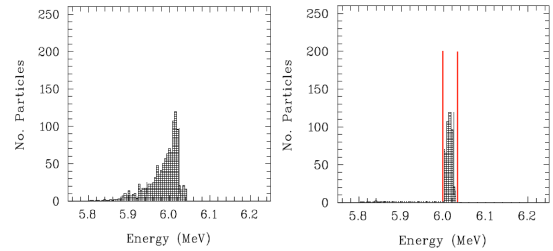
	Design	Typ.
Length:	1 m	20
Number of cells:	20	
Mode:	TM_{010}, π	
Acc. field:	5 MV/m	6.5 MV/m
Quality factor:	$3 \cdot 10^9$	$8 \cdot 10^9$
Diss. power:	4.2 W	20 W
Material:	niobium	



Installation of 2 scraper systems

Injector scraper system:

Long. phase space behind the injector



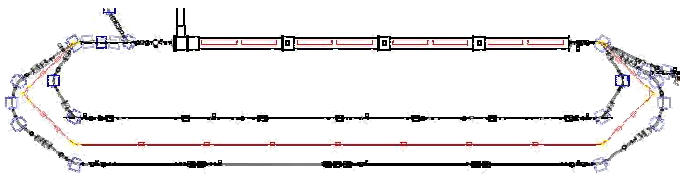
Halo-free beam required for upcoming coincidence experiments ($e, e^+ \gamma$)

Installation of a 3rd recirculation path

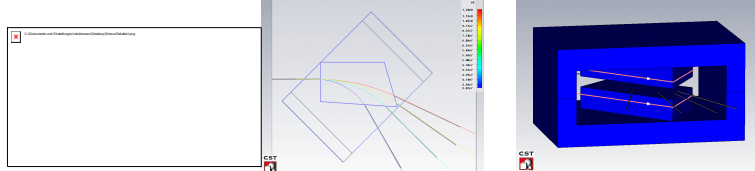
- Achievable accelerating gradients are above design
- Quality factors are below
- Cooling power (He-plant) is limited
- $\Rightarrow$ limiting fields in cw operation
- improving Q was an issue for 20 years
- Decision now: Accept Q, increase energy by installing an additional recirculation path

$$E_{\text{cav}} = \sum_{\text{inj}} \Delta E_{\text{inj}} + 3 \cdot \sum_{\text{lin}} \Delta E$$

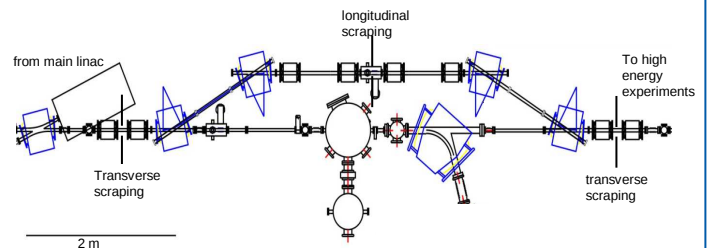
$$P_{\text{dis}} = \frac{E^2 |I|^2}{\beta_Q Q_0} \quad \sum P_{\text{dis}} < 100 \text{ W}$$



Splitter magnet design:



Final energy collimator:



- Up to 5 times higher energy collimation compared to existing energy collimator system

$$\frac{\Delta E}{E} = 2 \cdot 10^{-5}$$

Injector upgrade cryostat module

	Current design	New design
Energy	10 MeV	14 MeV
Current	60 μ A	150-250 μ A
RF coupler	coax-to-coax	waveguide-to-coax
RF trans. line	coaxial (21 mm)	waveguide (WR-284)
Max. power	500 W	2000 W

Design data

- length 3 m
- housing two 20 cell cavities
- insulating vacuum 10^{-8} mbar
- beam vacuum 10^{-8} mbar
- helium at 2 K / 35 mbar
- static heat load < 5 W

Transition to helium bath

(Used for motor rod (cavity tuner) and electric instrumentation)

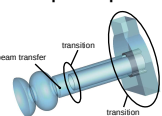
Flexible waveguide

- stainless steel below
- WR-284
- custom product
- length: 101 mm
- copper coated (to be done)

Cryo module (tower section)



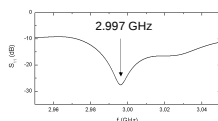
RF input coupler



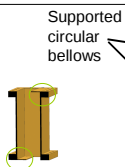
Design: TEMF



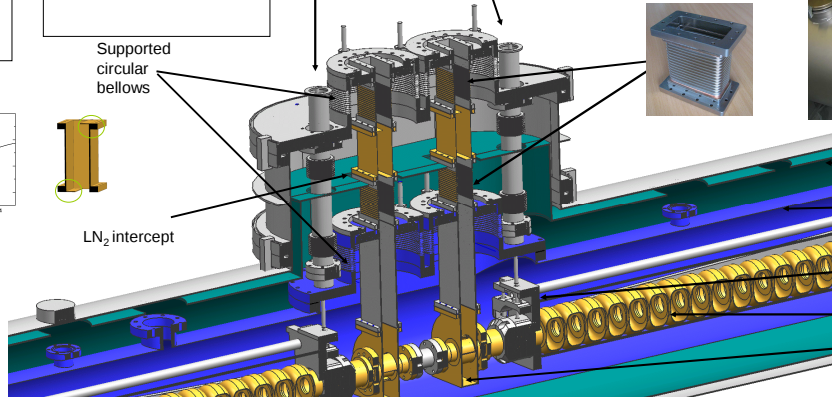
Fabrication: FZ Jülich



- small bars inside the waveguide cooled down to 77 K
- RF reflection is minimized at working frequency
- losses due to heat radiation in the transition lines < 1 W



LN₂ intercept



LN₂ shielding

Helium vessel @ 2 K

Cavity tuner

Superconducting cavities & RF couplers