Test of Components for the S-DALINAC Injector Upgrade

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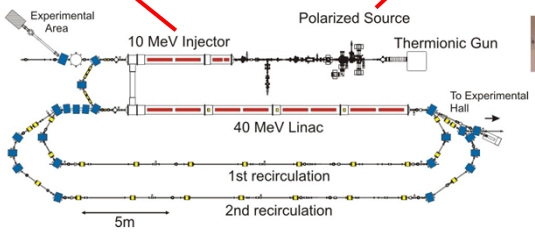
Abstract

In 2009 a vertical bath cryostat was commissioned at the S-DALINAC. Since then, components for the new cryostat module within the framework of the injector upgrade have been tested. Measurements have been performed to check the leak rate of "Quick-CF" UHV flanges. Furthermore, the performance of piezo actors in superfluid helium has been investigated.

To extend the range of possible measurements at the vertical bath cryostat, systems for measureing the quality factor via the decay-time method and for quench localisation via second sound will be implemented this year.

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 µA

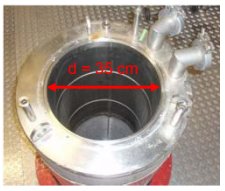
Superconducting cavity

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

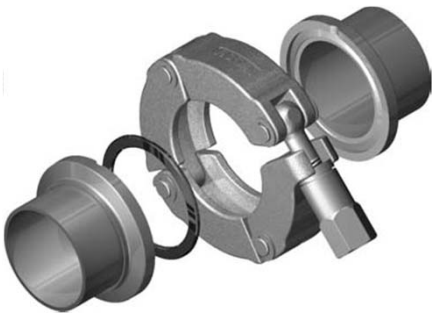
Vertical bath cryostat

- Can be connected to pumping stations
- Operation at 4 K and 2 K possible
- Independent from accelerator operation

Diameter:	35 cm
Depth:	260 cm
LHe-level:	190 cm

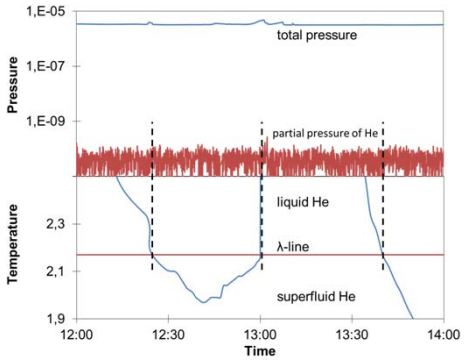


Quick-CF in superfluid He



The Quick-CF Connection* with clamp chain: Photograph and exploded drawing of assembly parts

*Quick-CF flange set for test purposes provided by VACOM [www.vacom.de]



In several cycles of cooling-down and warming-up to the temperature of liquid nitrogen (77 K), the connection did not show any signs of leakage. Even cycles at cryogenic temperatures through the lambda-point of liquid helium did not increase the leak rate. This means that we can verify that the QCF connection in principle is leak-proof for superfluid helium.

Piezoelectric actors at 2 Kelvin

Piezo measurement with cavity tuner

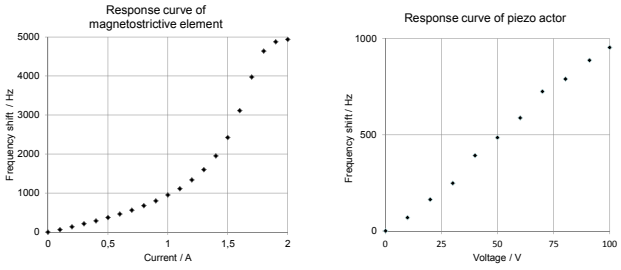
Investigation of the stroke of a piezo-actor at 2 K to replace magnetostricitive elements of fine tuning system.

- Required frequency shift: 1000 Hz
- Resulting cavity deformation: 2 µm
- Stroke of fine tuner: 5 µm

- Stroke of piezo-actor @ 300 K: 90 µm
- Measured stroke in gHe @ 4 K: 22.5 µm
- Measured frequency shift @ 4 K in lHe: ~ 1100 Hz
- Resulting stroke of piezo-actor: ~ 5.5 µm
- Measured frequency shift @ 2 K in lHe: ~ 950 Hz
- Resulting stroke of piezo-actor: ~ 4.5 µm

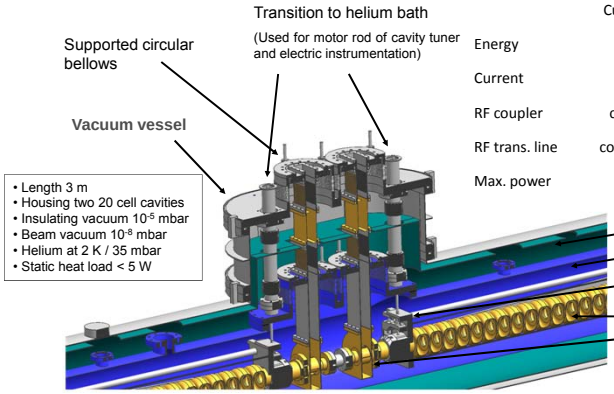
Advantage of piezo actors:

- Linear dependency of stroke to voltage (good for RF control system)
- Use of several piezos possible (increase of tuning range)
- Don't create magnetic flux near the superconducting cavities



Comparison between the response curves of the magnetostrictive element and the piezo actor. Both measured in liquid helium at 2 K

New cryostat module

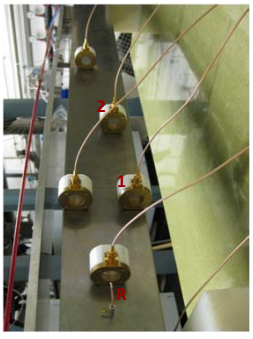


	Current design	New design
Energy	10 MeV	14 MeV
Current	60 µA	150-250 µA
RF coupler	coax-to-coax	waveguide-to-coax
RF trans. line	coaxial (21 mm)	waveguide (WR-284)
Max. power	500 W	2000 W

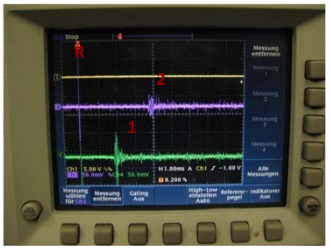
More on MOPO018

New equipment for the bath cryostat

Successful test of Oscillating Superleak Transducers



R – Moment of the heat pulse
1 – Response of the 1st OST after ~ 2 ms
2 – Response of the 2nd OST after ~ 4 ms



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