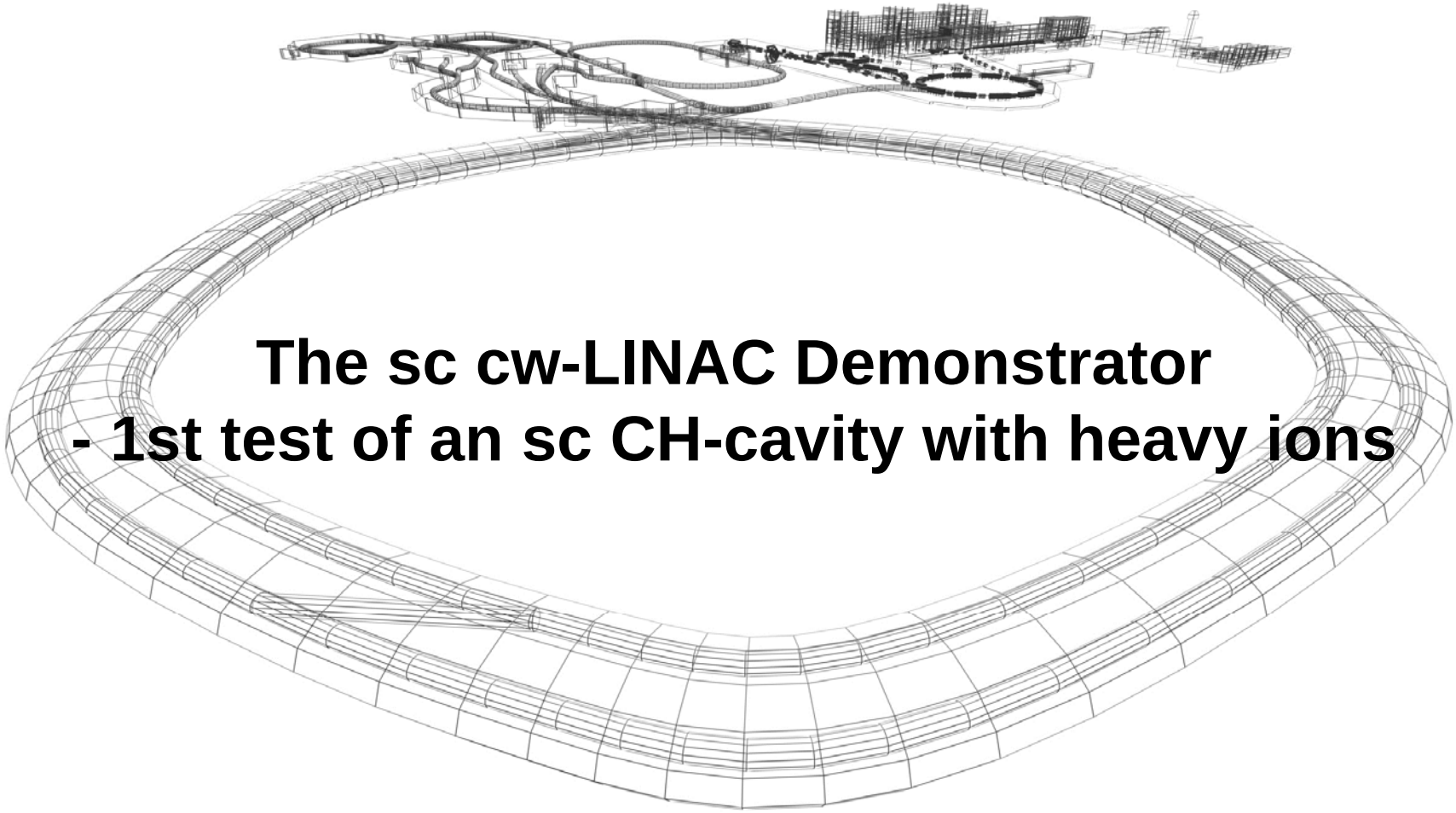


The sc cw-LINAC Demonstrator
- 1st test of an sc CH-cavity with heavy ions

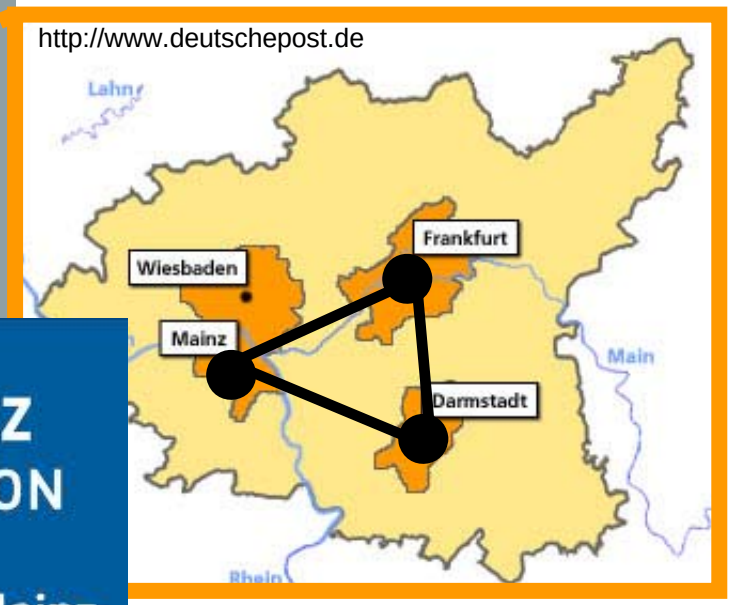
What is the sc cw LINAC Demonstrator?

1. The sc CH-Cavity
2. The Demonstrator Project
3. The sc cw LINAC
4. Summary

Collaboration-Project

IAP

test



HELMHOLTZ ASSOCIATION

Helmholtz Institute Mainz

GSI

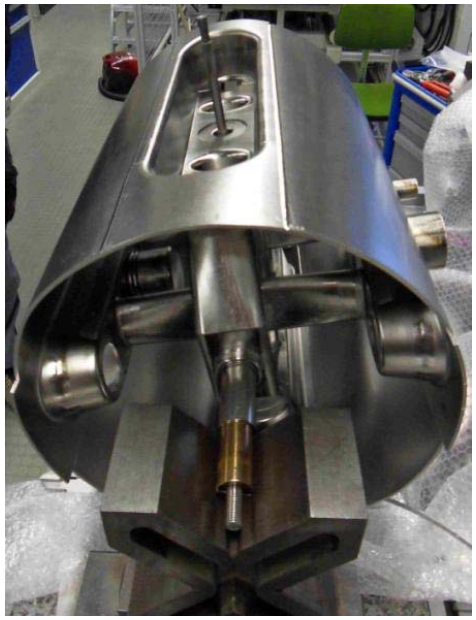
ARD-Program of the Helmholtz-Gemeinschaft

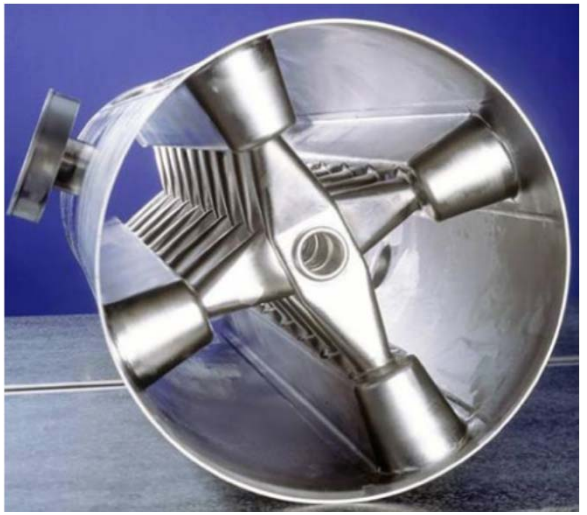
GSI	1x Postdoc
IAP	1x PhD
HIM	1x Postdoc 1x PhD 1x Engineer

What is the aim?

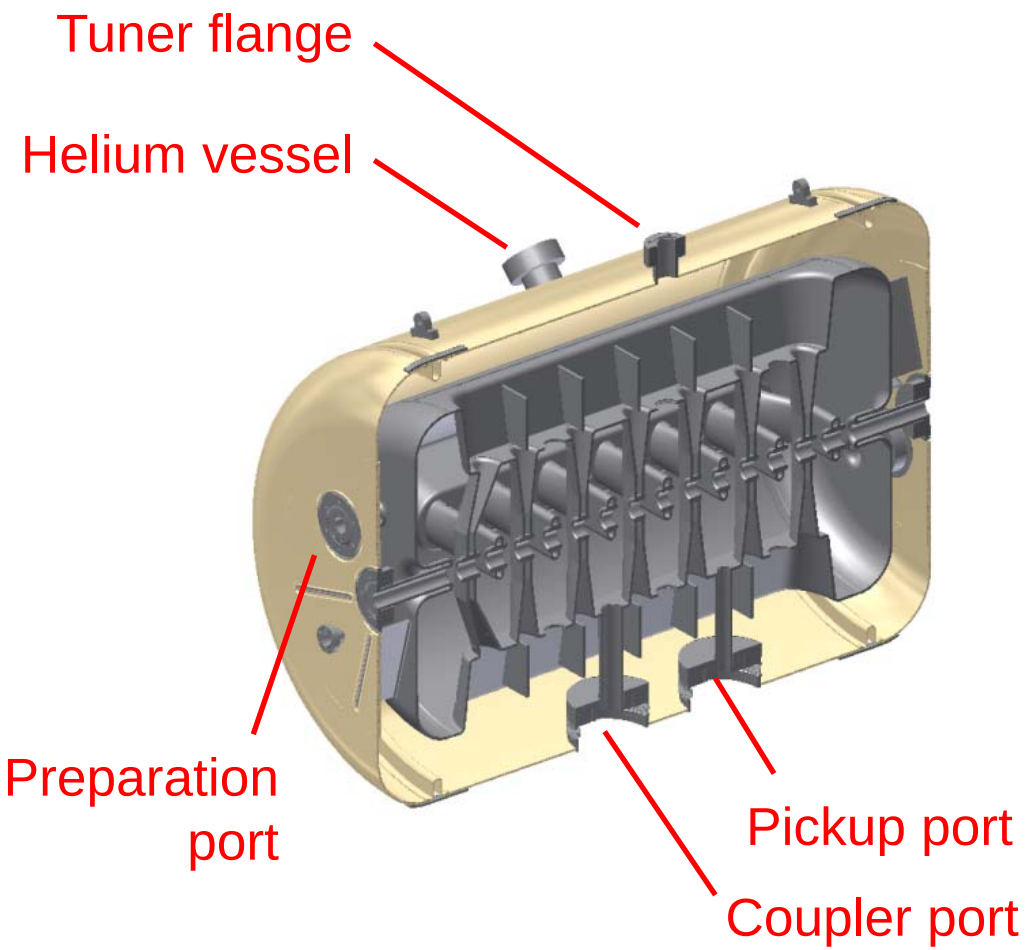
Full performance test of an sc CH-Cavity with Heavy Ion Beam.

CH: Crossbar H-Mode





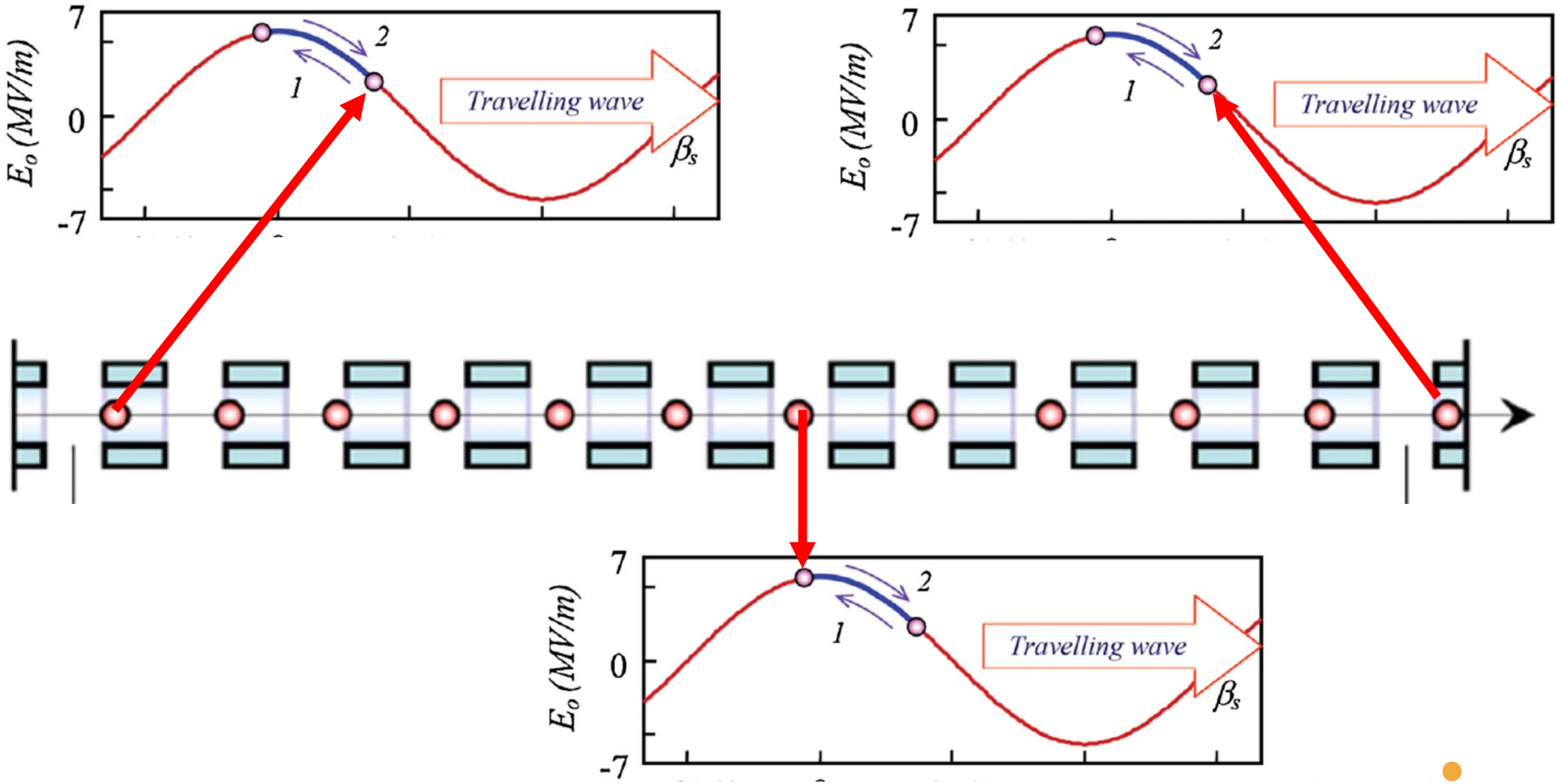
What a cavity is used?



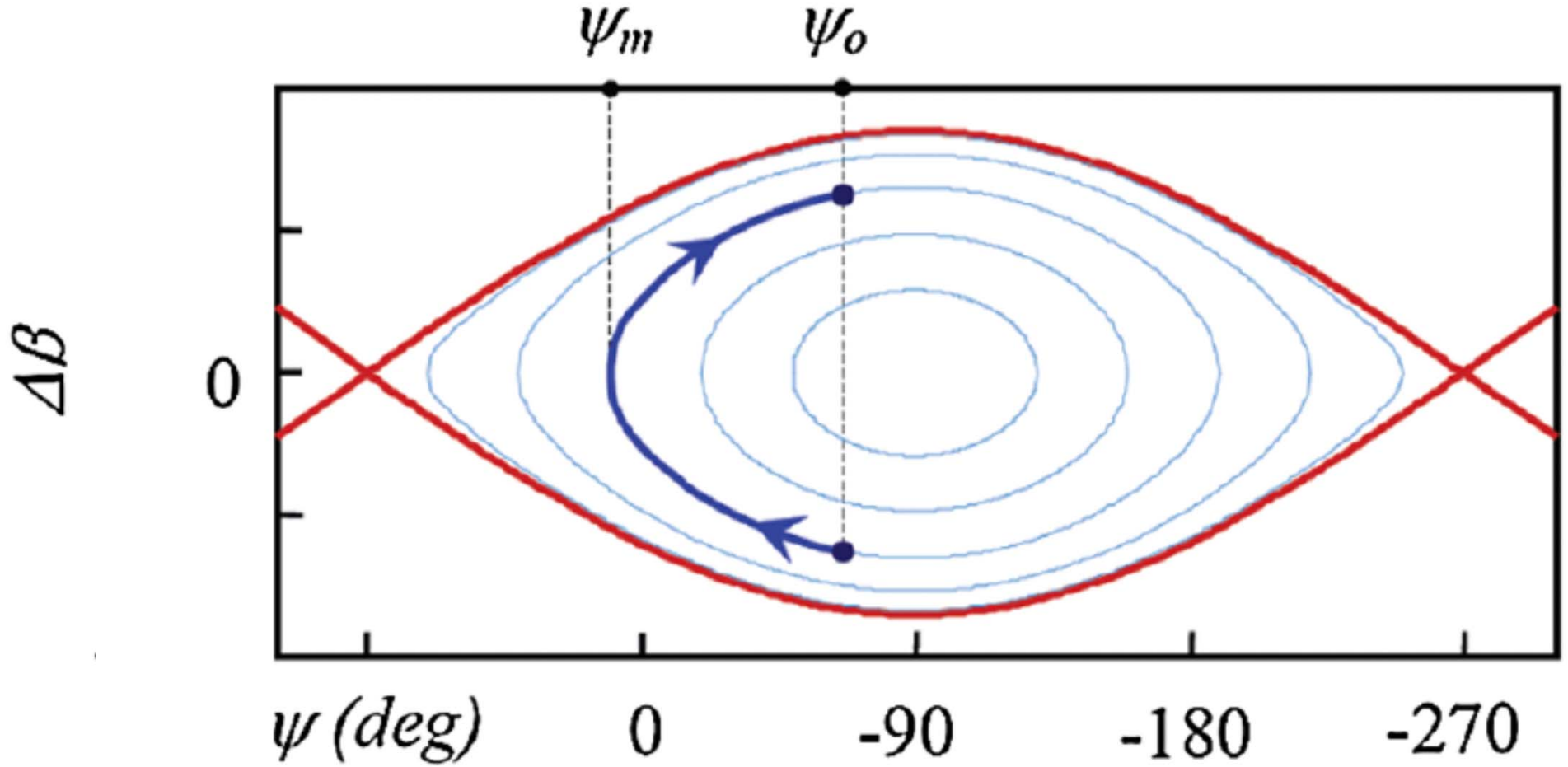
Parameter	Unit	
Beta		0.059
Frequency	MHz	216.816
Gap number		15
Total length	mm	687
Cavity diameter	mm	409
Cell length	mm	40.82
Aperture	mm	20
Energy gain	MeV	2.97
Accelerating gradient	MV/ m	5.1
Static tuner		9
Dynamic bellow tuner		3

What is EQUUS concept?

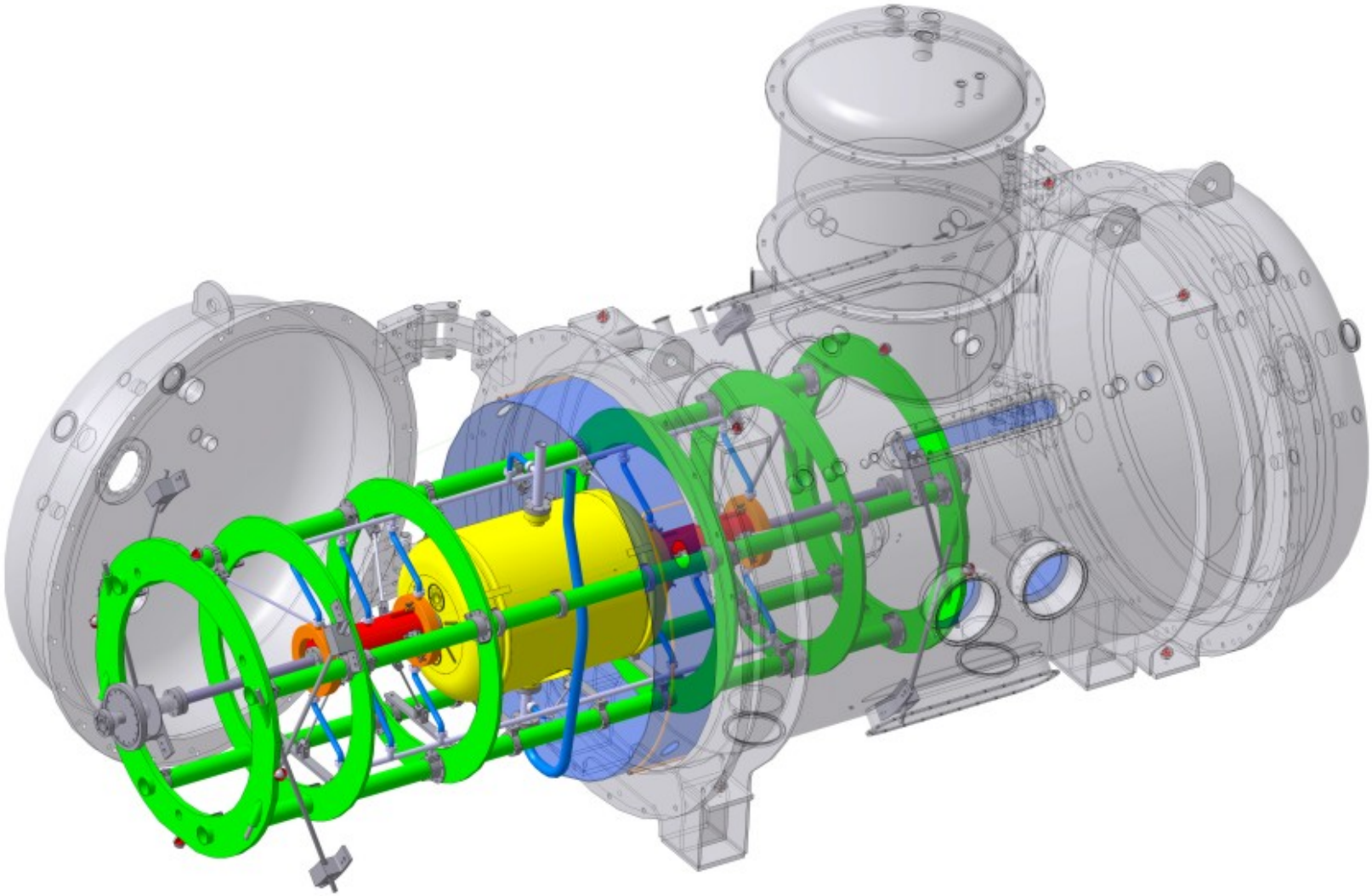
EQUidistant mUltigap Structure



Longitudinal Motion

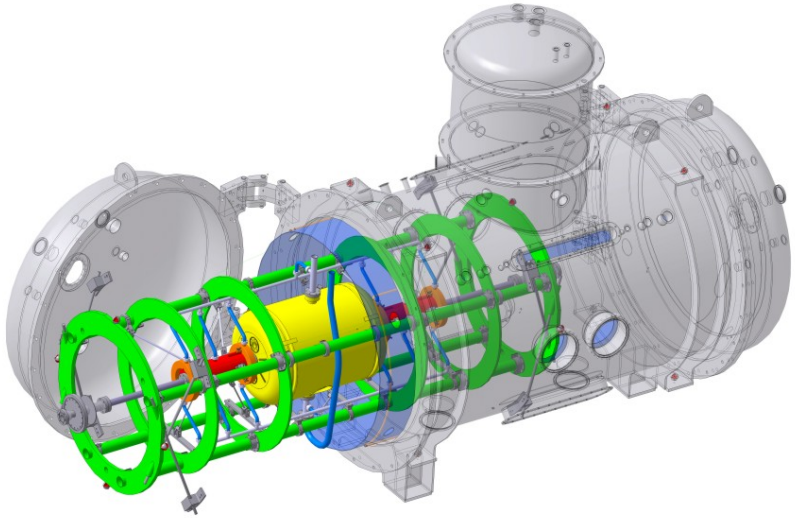


What is the sc cw-LINAC Demonstrator?



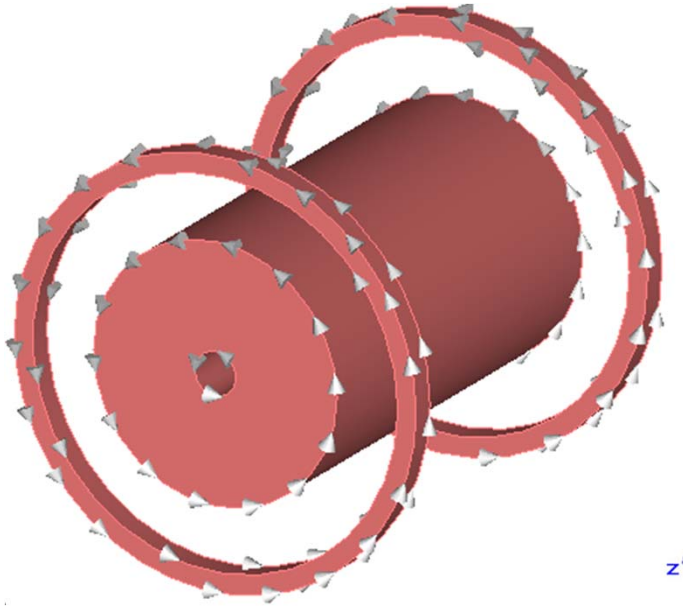
What are the parameters of the cryostat?

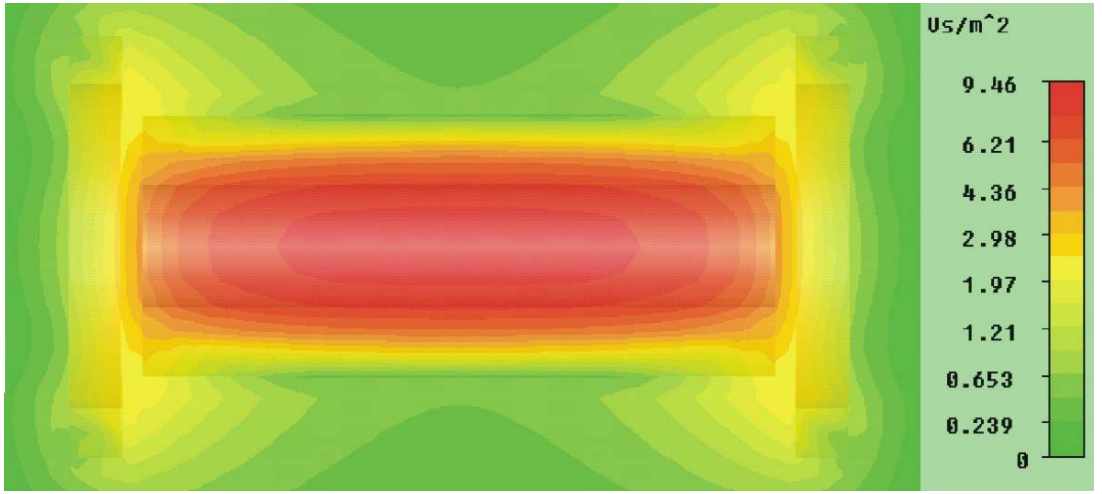
Inner length (mm)	2200
Inner diameter (mm)	1120
Material tank	Al
Isolation vacuum (mbar)	<1*10^-5
Total leak rate (mbar*l/s)	10^-9
Max. operation pressure (bar)	<0,5
Operation temperature (K)	4,4
Temperature nydrogen shield (K)	77
Material magnetic shielding	µ-Metall (2 mm)
Max. static losses in stand-by operation (W)	<10
Cold-warm-transition (beam-pipe) - gradient (K/cm)	10



IAP/GSI - Design of the solenoids

R.E. Laxdal et al: *Magnetic field studies in the ISAC-II cryomodule*,
Physica C 441 (2006) 225–228

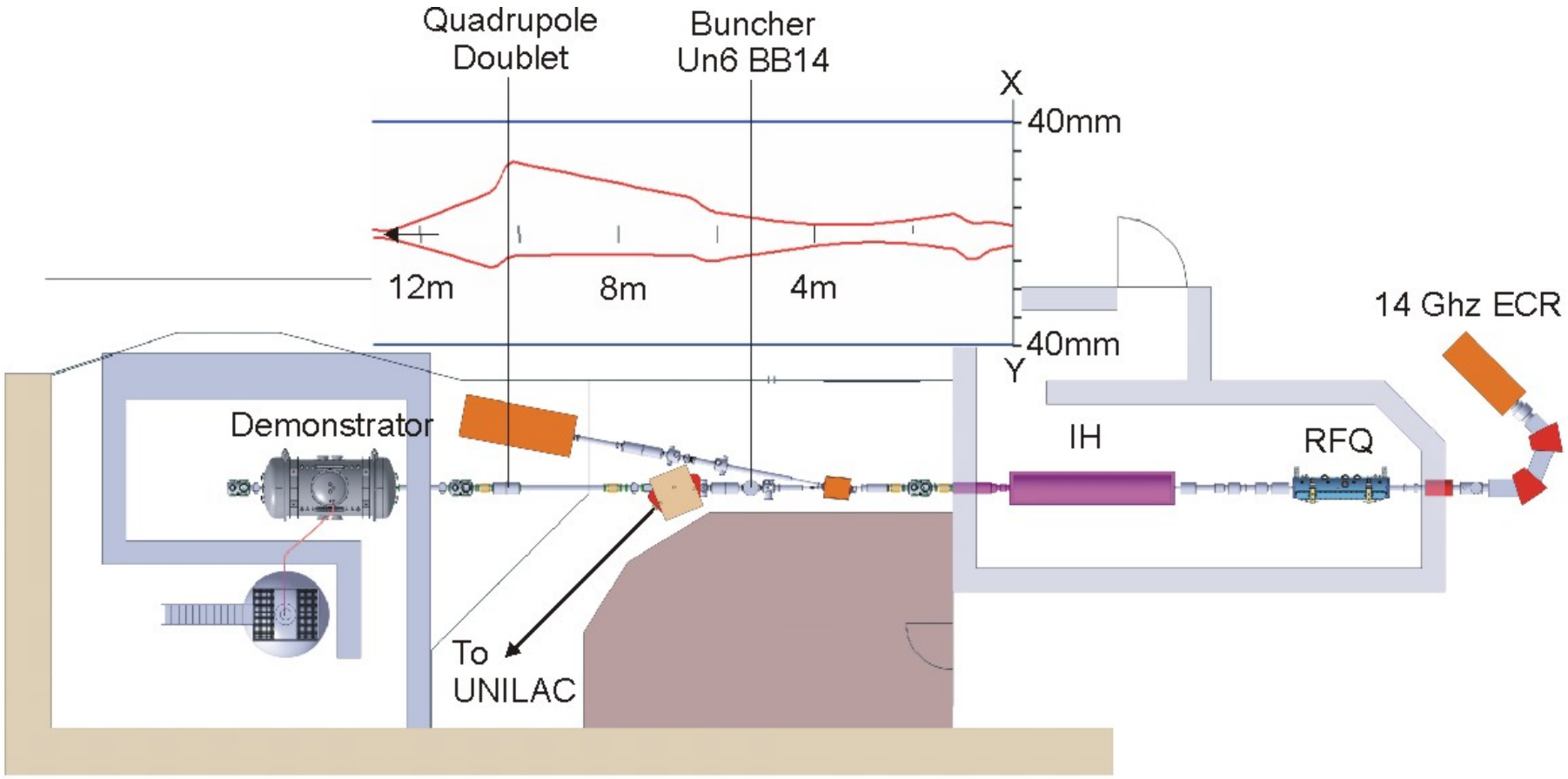




Bmax	**9,323T**
B^2*L	**24 T^2m**
L	**0,28 m**
Aperture	**30 mm**

Where is the Demonstrator mounted @ GSI?

High Charge Injector (HLI), 1.4 AMeV, 108 MHz



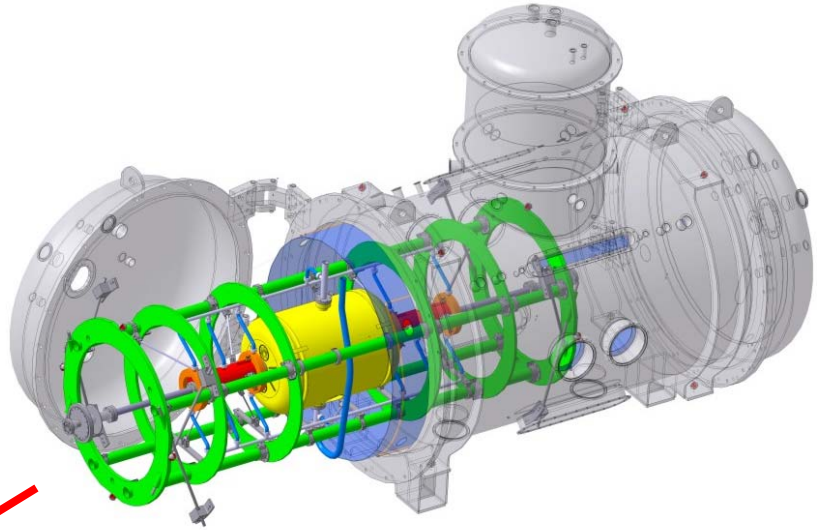
What is the timetable?

2010-12	**Tendering & Ordering**
	order of CH-cavity is placed to RI, Germany order of cryostat & solenoids is placed to Cryogenic, UK
2011	**Delivery**
	5kW-Amplifier (DB Elettronica, Italy), 3000 ltr LHe-Tank (Cryoanlagenbau, Germany) 25m^3 He-Recovery Balloon (Bieri-Zeltaplan, Germany)
2013	**Test environment at GSI HLI is assembled** **Delivery of the cavity** **1st tests (warm & cold) @IAP**
2014	**Delivery of the cryostat and the solenoid** **Starting full performance tests @GSI-HLI**

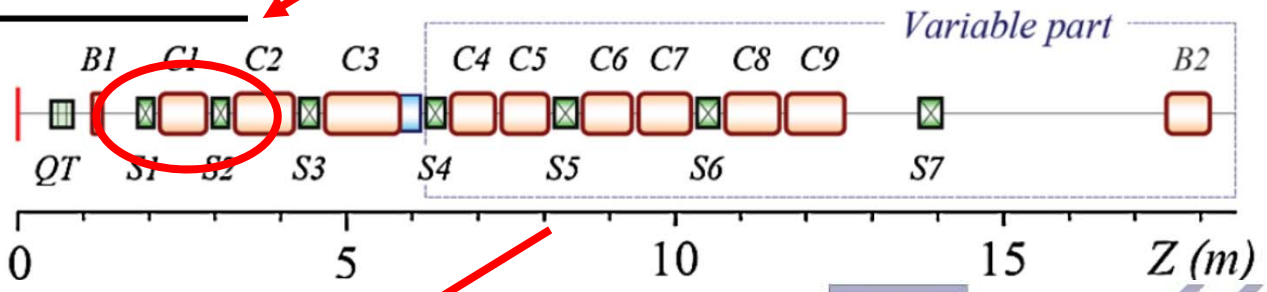
What are the applications?

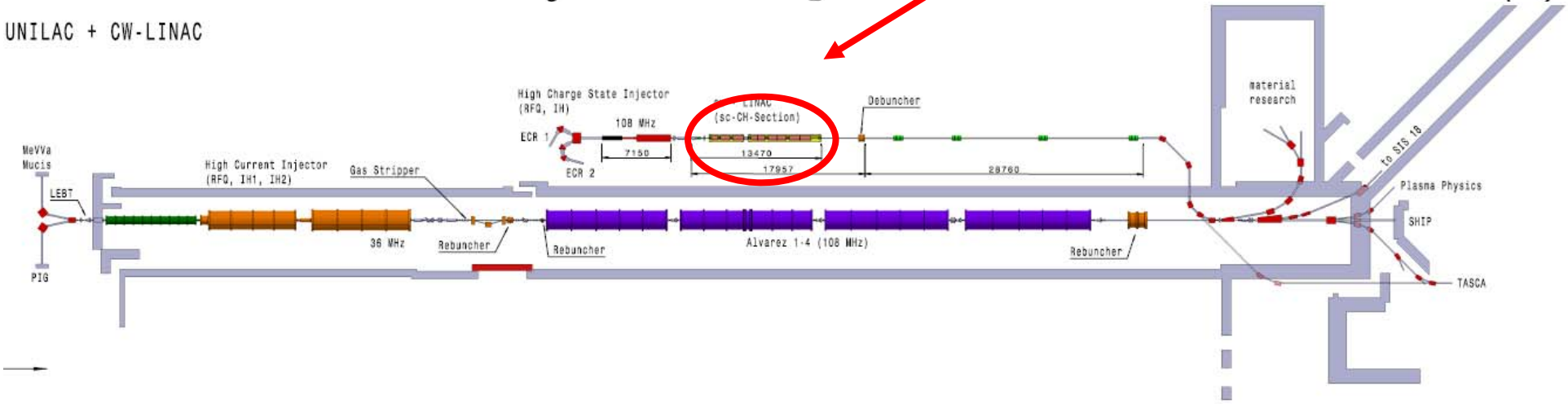
No	Frequency [MHz]	Beta	Status	Application
1	360	0.1	1st prototype Successful rf-tests (warm + cold) @IAP in 2007	Accelerator Driven System (ADS) „EUROTRANS“
2	325	0.16	1st SAT was successful in 2012	Energy Booster LINAC 2nd stage upgrade option for GSI-UNILAC
3	217	0.06	In fabrication Delivery in 2013	Sc cw LINAC @GSI
4	176	0.12-0.18	Under development	MYRRHA , Mol/Belgium

Table 1: General Parameters of the cw-LINAC		
Mass/Charge		6
Frequency	MHz	217
max. beam current	mA	1
Injection Energy	MeV/u	1.4
Output energy	MeV/u	3.5 – 7.3
Output energy spread	keV/u	+- 3
Length of acceleration	m	12.7
Sc CH-cavities		9
Sc solenoids		7



Minaev et al (IAP, 2009)

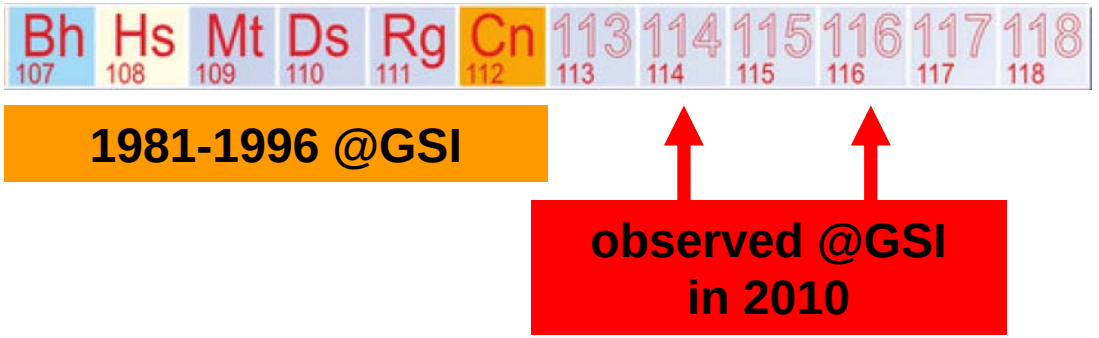




What is the benefit?

e.g. SHE@GSI:

@JNRL (Dubna, RUS)



Element 120, <0.1 pb (1pb <-> 1 event/week)

	UNILAC	cw-LINAC
Intensity (Particles per sec)	3 *10^{12}	6 *10^{13}
Beam on Target	10 weeks	4 days
Investment and (Operational) costs over 10 years (Million EUR)	0 *(352)*	20 *(14)*

S. Hofmann et al, EXON 2004, Peterhof, Russia

What is the perspective of a cw-LINAC @GSI?

- 1st proposal and follow-up proposal were evaluated "excellent" by HGF
- but NO funding at the moment
- proof of principle on the CH-cavity
  -> succesful Demonstrator-project
- strong user community has to be picked up, not only SHE, requesting energies in the Coulomb barrier range
- Check the existing design with respect to the requirements of a broad community: max. energy, A/Q, …
- Is a standalone accelerator concept reasonable?

How does the cw LINAC match the future GSI?

Today: B. Schlitt - Design studies for a new heavy ion injector LINAC for FAIR
Thu: L Dahl – Development of the Intensity & Quality of the Heavy Ion Beams @GSI

What is the sc cw Demonstrator?

- The aim is a 1st test of an sc CH-cavity with beam
- The equidistant multigap-structure has advantage with respect to manufacturing
- High acc. gradients can be reached due to high density of acc. gaps
- The Demonstrator project is a proof-of-principle on the cavity
- Successful tests open a broad field of applications:

  - ADS for transmutation of nuclear waste

  - energy booster LINAC

  - sc cw-LINAC

Acknowledgement

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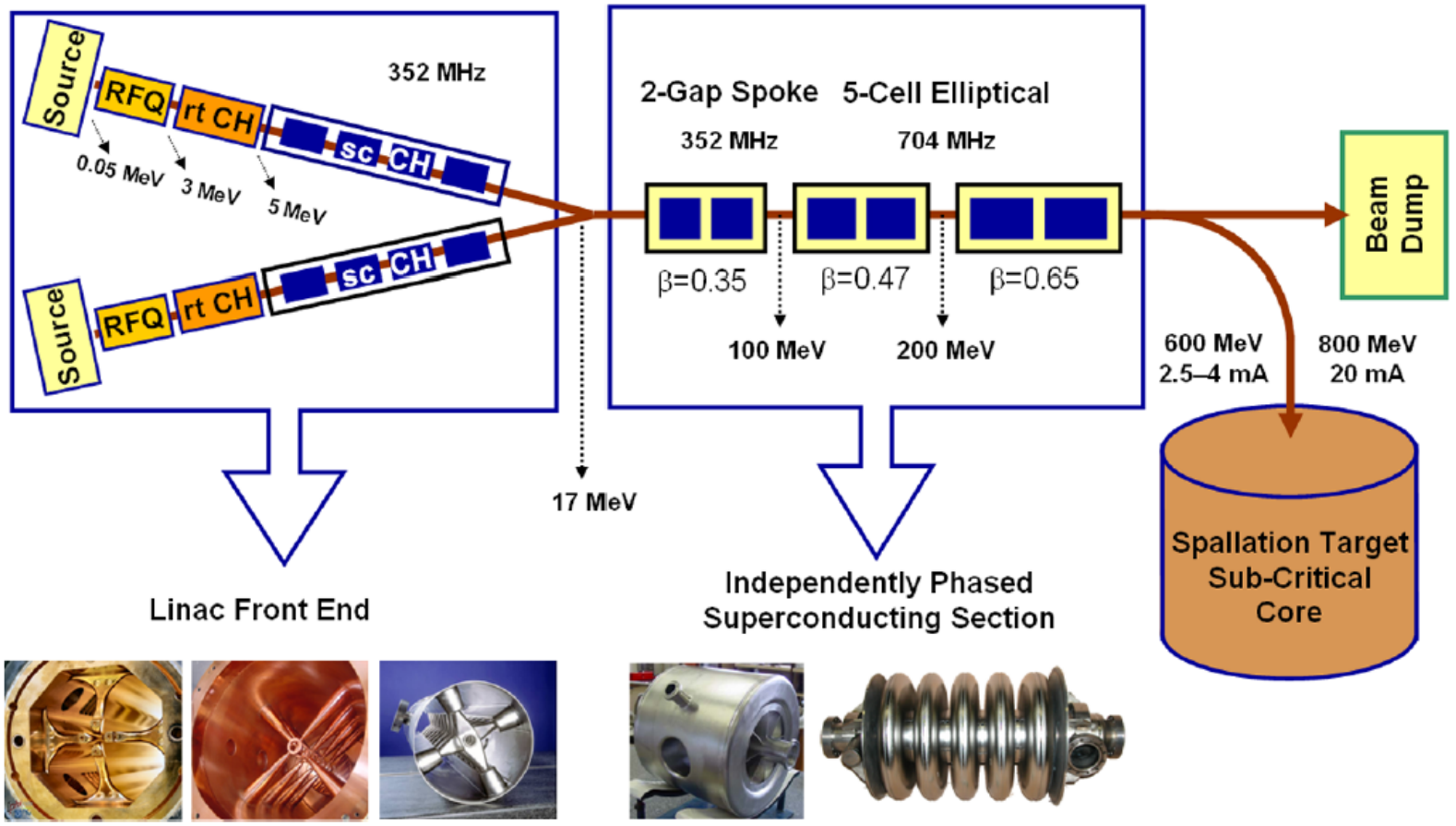
Claus Schröder
Hans Müller
Carsten Mühle

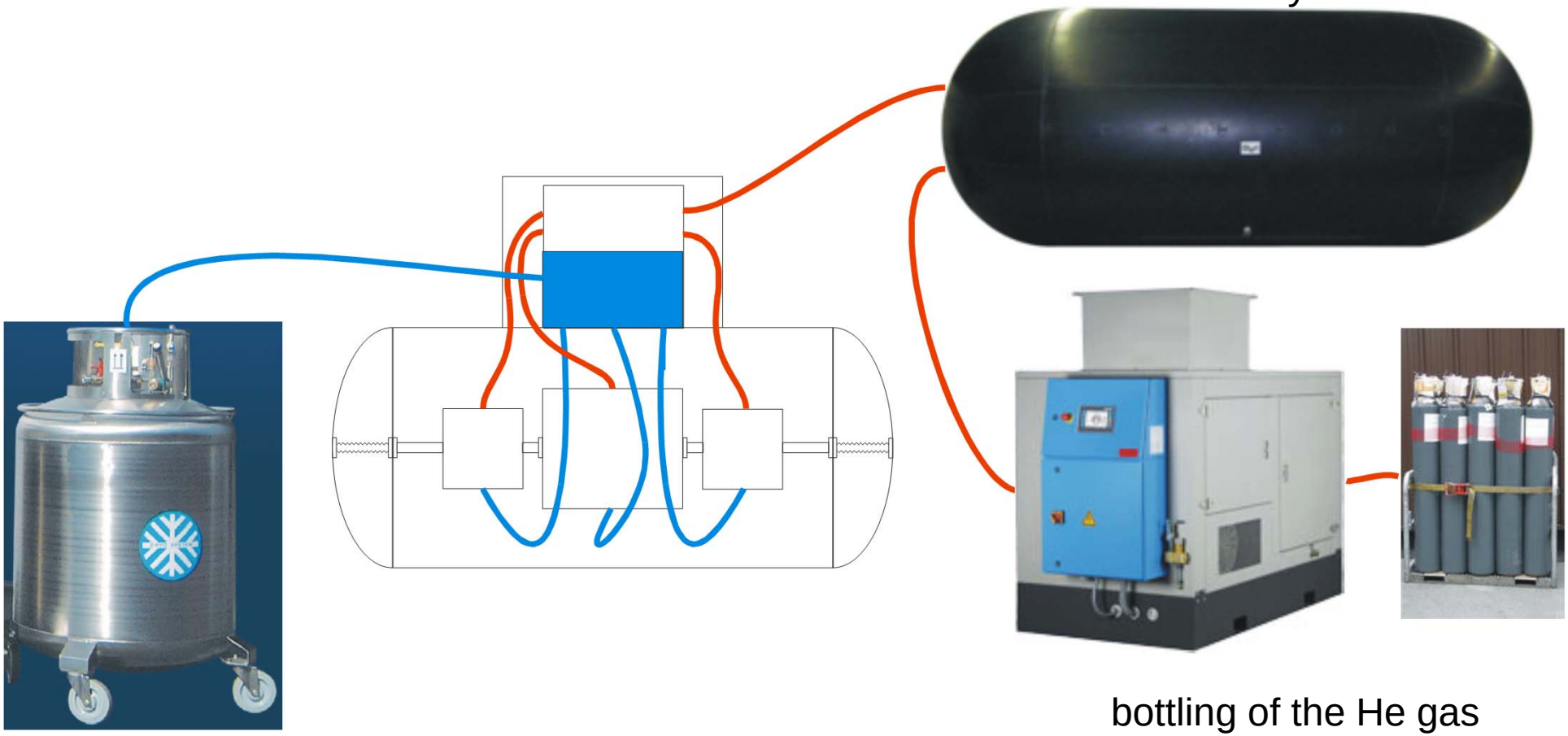
ZT:
(Dietrich Schäfer, VBE)
Wilfried Sturm

Multi-purpose hybrid research reactor for high-tech applications (MYRRHA)



How the LHe is provided?

25 m^3 recovery ballon



3000 ltr reservoir

bottling of the He gas