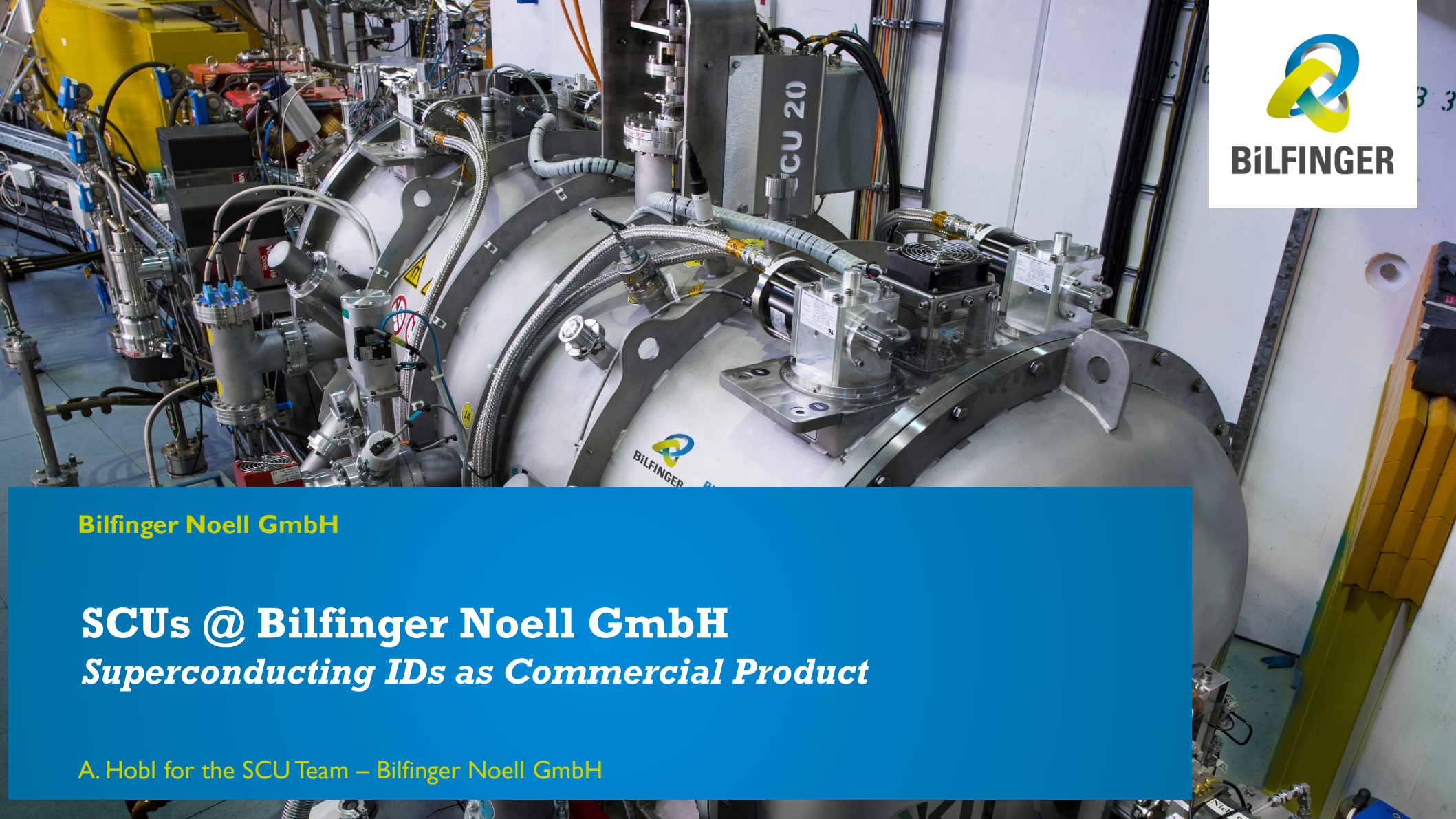


Bilfinger Noell GmbH

SCUs @ Bilfinger Noell GmbH

Superconducting IDs as Commercial Product

A. Hobl for the SCU Team – Bilfinger Noell GmbH

Statements

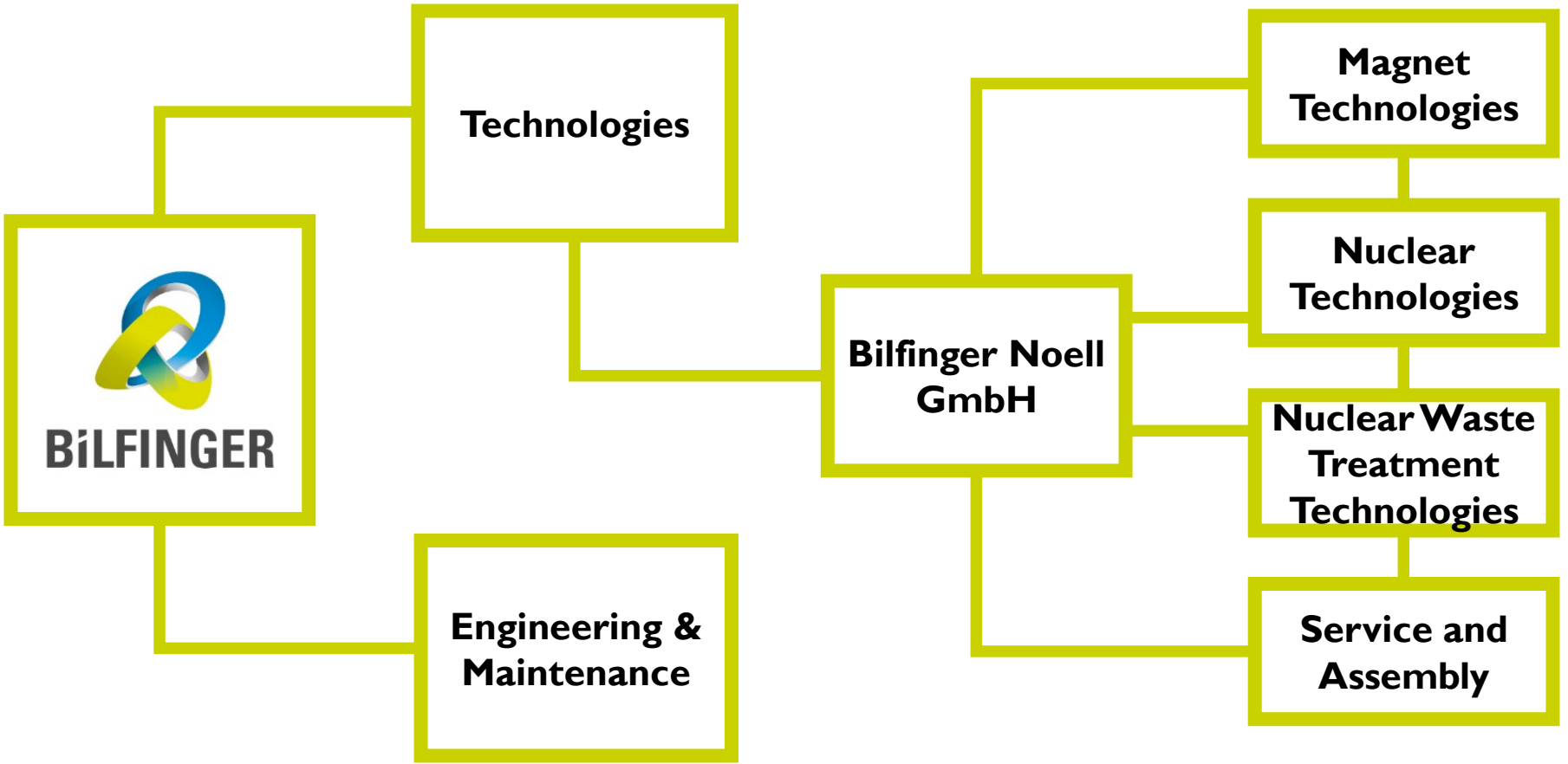
SC IDs are an industrial product

"Dry" cooling is state-of-the-art

You specify – we build

NOELL within Bilfinger

Synergy and stability



Statements

SC IDs are an industrial product

"Dry" cooling is state-of-the-art

You specify – we build

Development cooperation with KIT

Est. 2007

BILFINGER

Detailed magnetic design

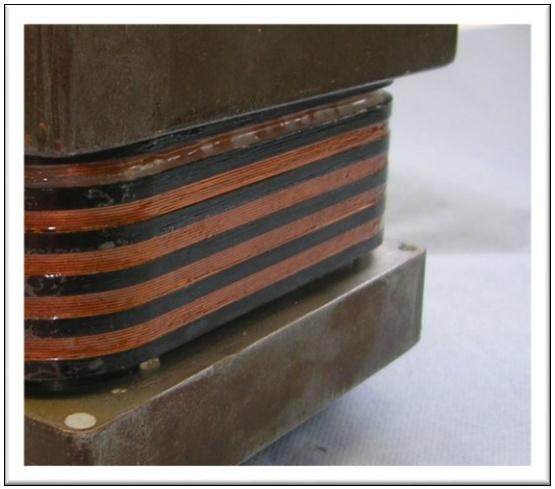
Cryogenic design

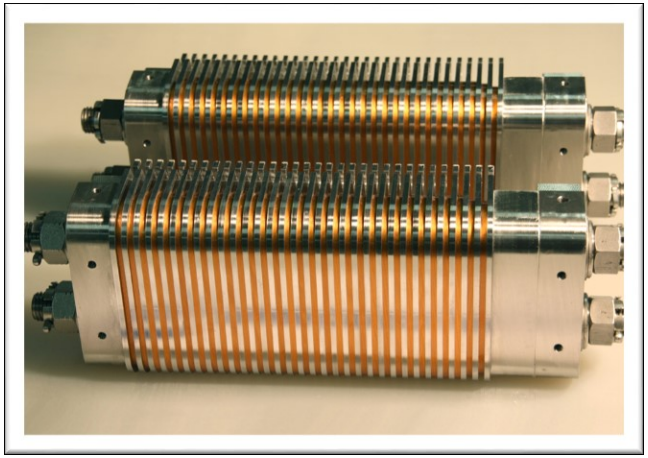
Coil manufacturing

Cryostat manufacturing

Assembly

FAT & SAT





KIT Karlsruher Institut für Technologie

Beam related topics - spectra

Definition of beam heat loads

Basic magnetic design

Magnetic measurements

Cold mass testing

Operation experience

Prototype Fabrication - HTS

Back in 2010

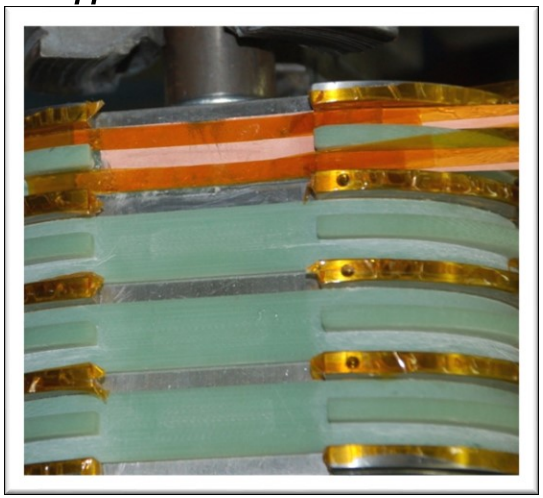
Yoke made of a single block (68 mm long):

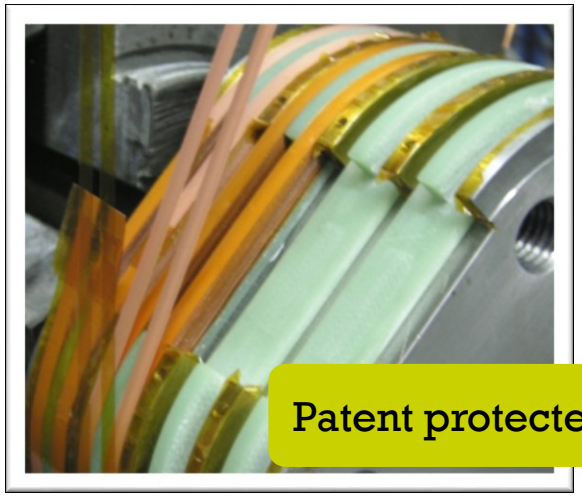
- Flatness 4 μm
- Pole positioning 1 μm
- Overall winding groove flatness 5 μm

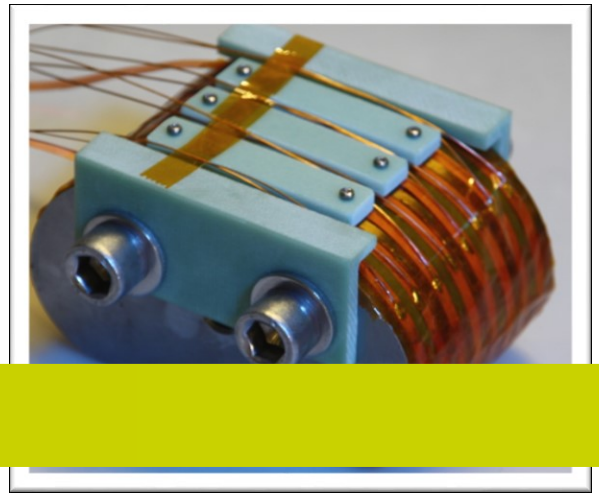
Winding process:

- Co-winding 50 μm Kapton tape
- GRP layer as non magnetic material
- Side ground insulation 50 μm Kapton

Boffo et al. SRI2010.





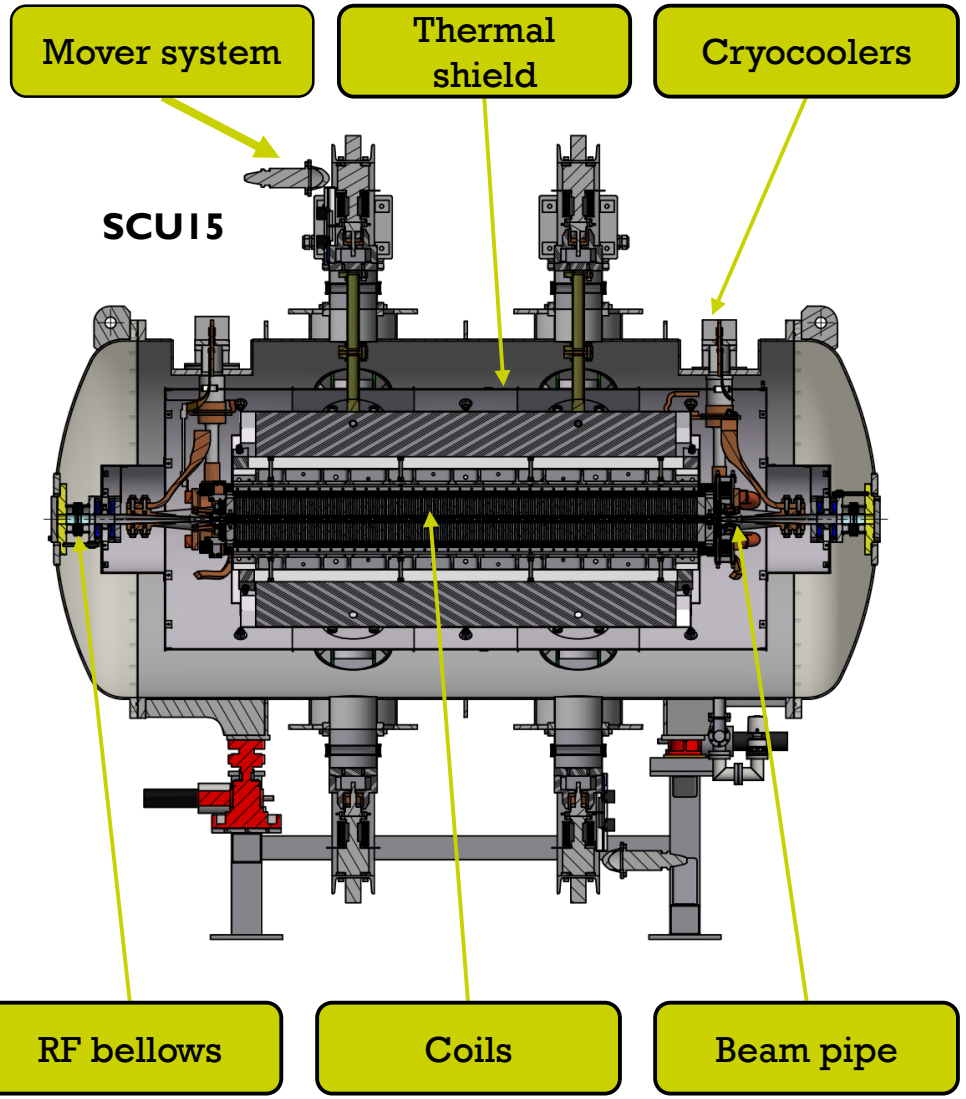


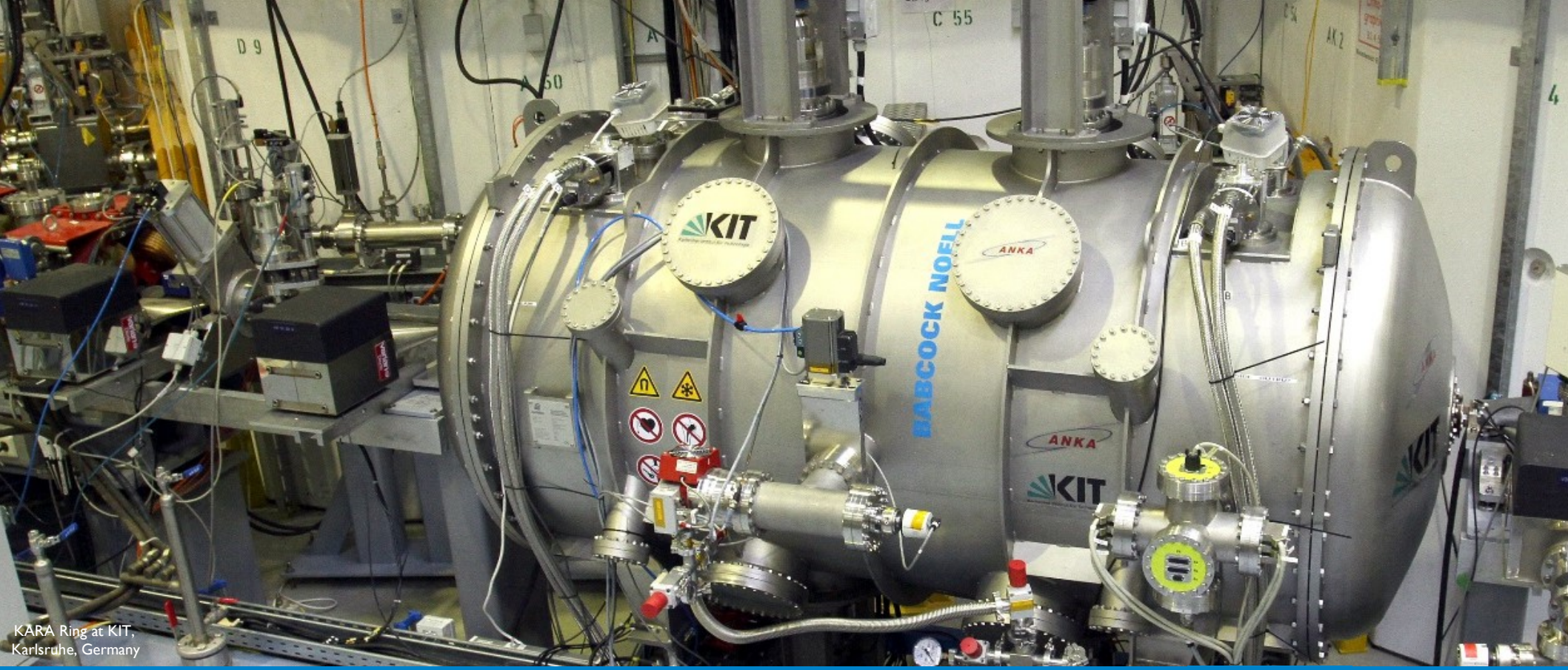
Patent protected

Main steps: SCU15 and SCU20

Parameters

	SCU15	SCU20	Units
Period length	15	20	mm
Full periods	100.5	74.5	#
Max field on axis 7 mm gap	0.73	1.19	T
Nominal current	150	395	A
Ramp to nominal current	450	300	s
Operating vacuum gap	7	7	mm
Injection vacuum gap	15	15	mm
Beam heat load	4	4	W
Design temperature	4.2	4.2	K





KARA Ring at KIT,
Karlsruhe, Germany

SCU15

Prototype to Product

Design and Manufacturing Optimization

OPTIMIZATION & COST REDUCTION

Standard low-carbon steel for the former

Fixtures to improve alignment

Reduced weight of cold mass

Reduced diameter and length of cryostat

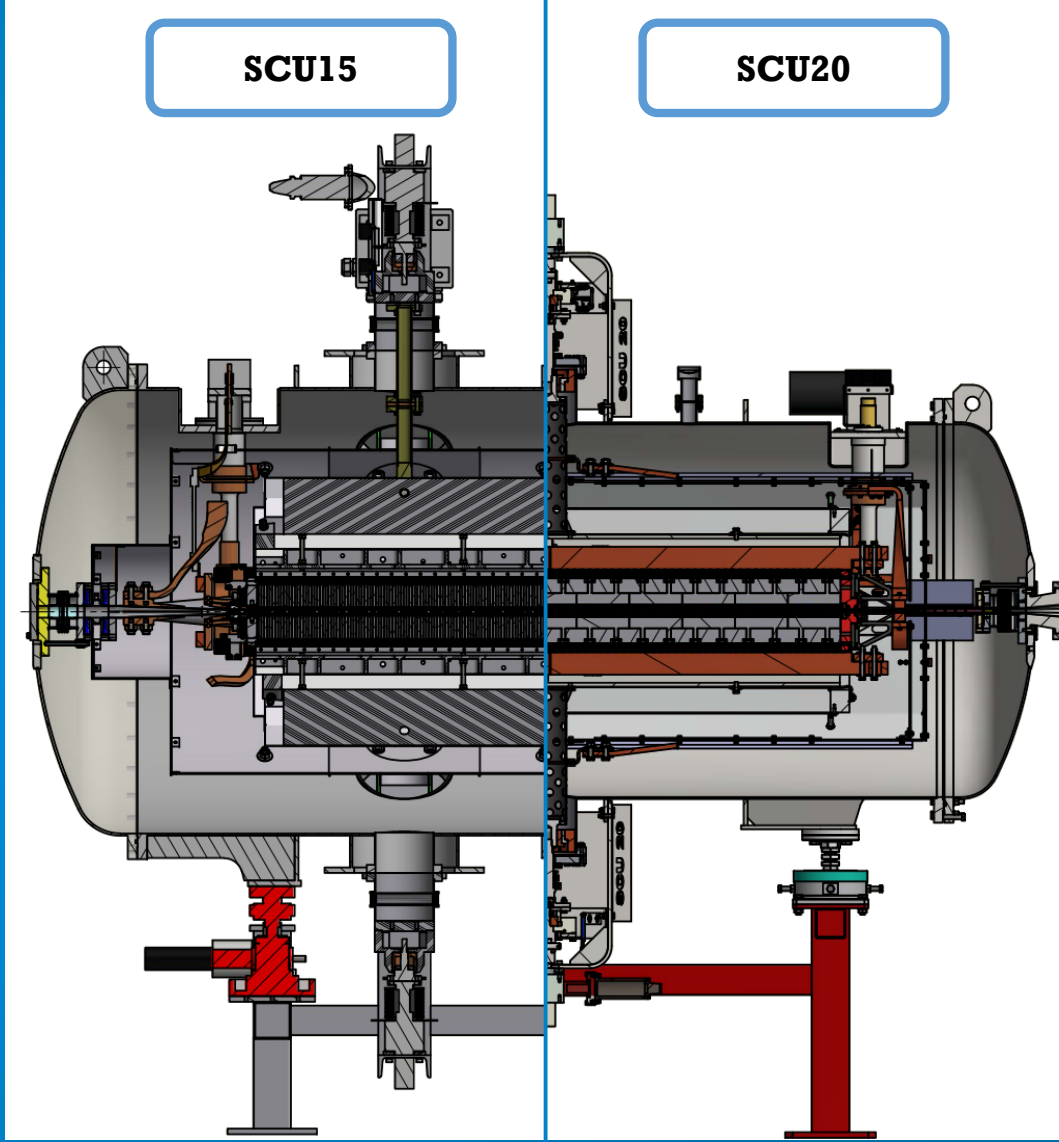
Use one single penetration for movers

Reduced number of ports on cryostat

4 identical cryocoolers

Simplified support system

Manual adjusting feet



KARA Ring at KIT,
Karlsruhe, Germany

SCU20

Prototype to Product

Design and Manufacturing Optimization

IMPROVED PERFORMANCE

Block design for the former

Simplified and improved mover structure

Increased number of corrector coils

Using the flexible beam pipe as magnet spacer

INCREASED RELIABILITY

Improved former insulation

Optimized winding scheme without joints

Finger bellows at room temperature

HTS leads for corrector coils

Improved thermal diagnostics

Statements

SC IDs are an industrial product

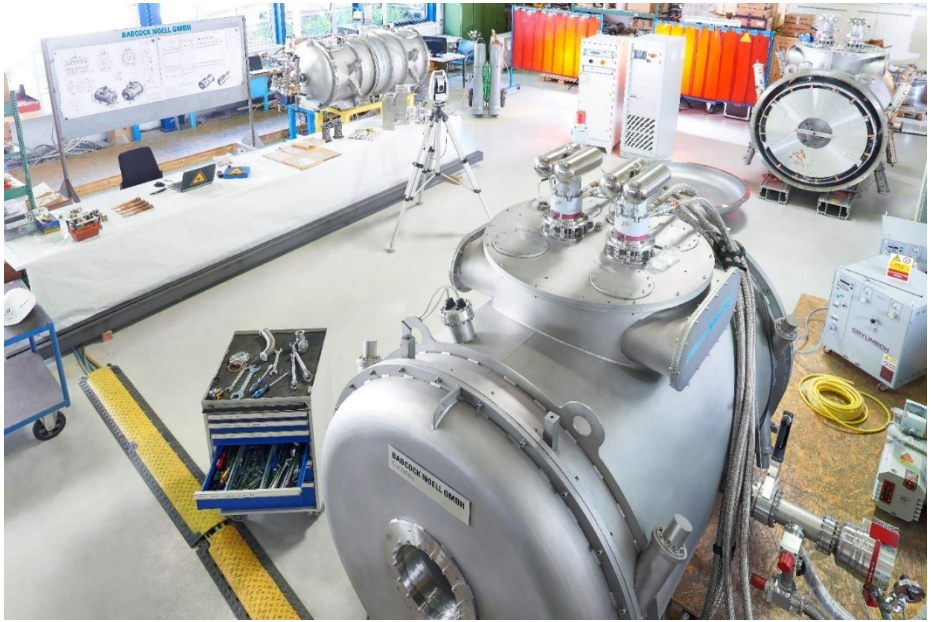
“Dry” cooling is state-of-the-art

You specify – we build

Large Cryogen-Free Magnets

Large magnets cooled by 2 cryocoolers

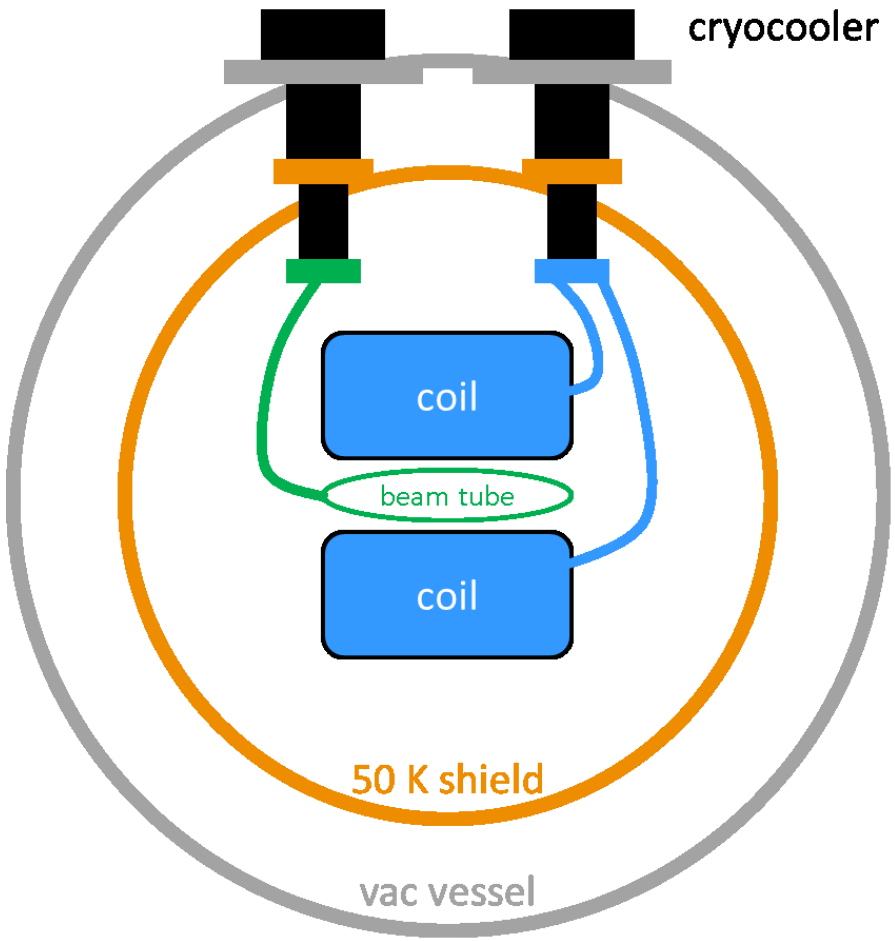
- Diameter up to 1.6 m
- Length up to 2.5 m
- Typical RT bore ~300 mm
- Field up to 4 T



1.5 T, 10 coil Neutron Spin-Echo Spectrometer

4 T, high homogeneity, transportable magnet

Insertion Device Cooling Scheme



4 K

10 K

50 K

300 K

Typical cooling arrangement

2 GM cryocoolers 2-stage,
for coils

2 GM cryocoolers 2-stage,
for beam tube

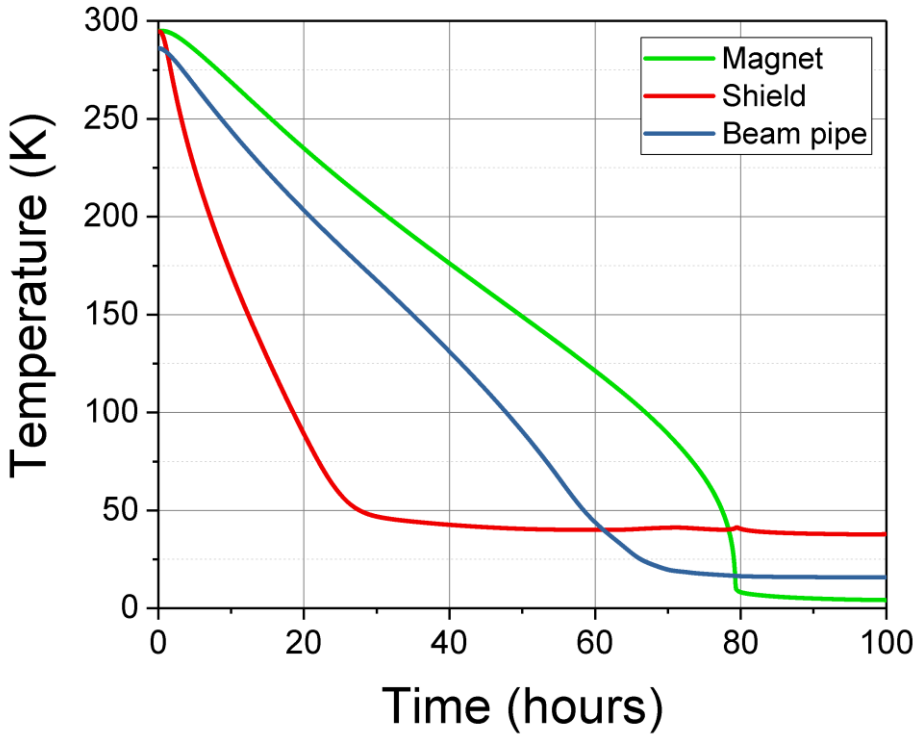
→ in total 4 identical coolers

Mover not needed in top-up synchrotrons or linacs

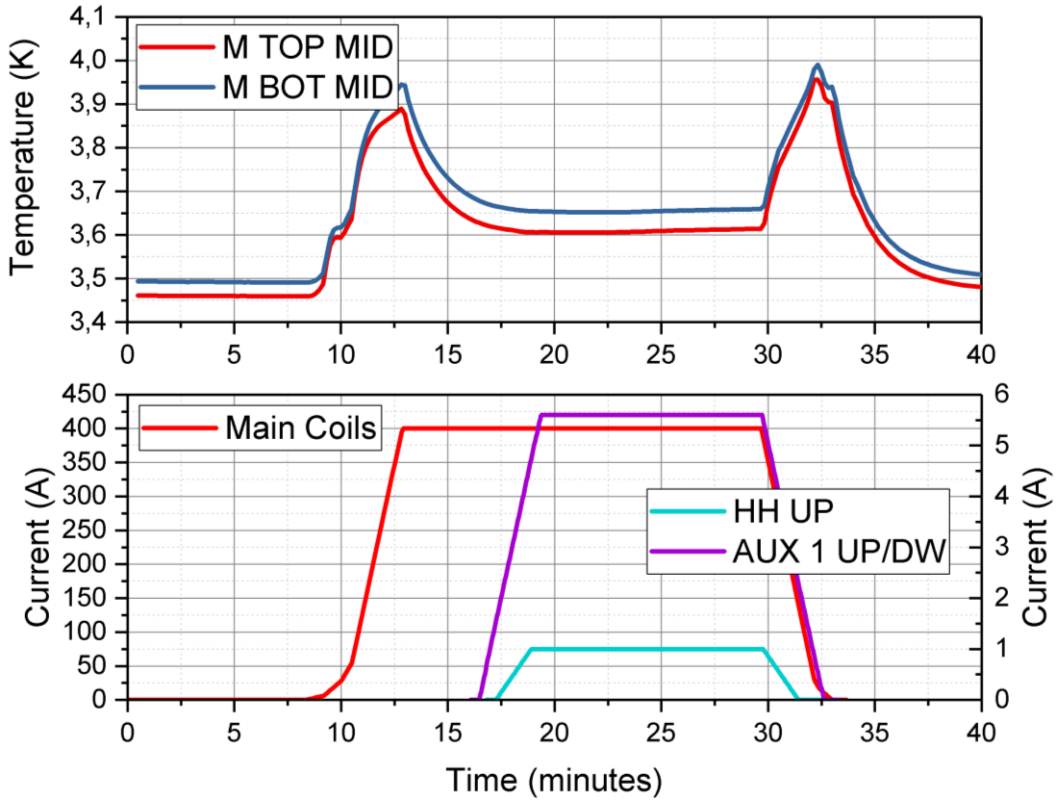
Performance of SCU 20

Results of the Factory and Site Acceptance Tests

Fast cooldown



Minimal temperature drift during ramping



Cryocoolers for SC Applications

Pros

- Arbitrary temperature
- Safety: no pressure vessels
- Safety: no helium relief
- Simple handling
- OPEX (TCO)
- @4 K: avoid shortage of helium

&

Cons

- Regular maintenance (dependent on type)
- Potential vibrations
- High quality thermal connections
- Cool-down time
- CAPEX

Cryocoolers for SC Applications

Really Cons?	Solutions
▪ Regular maintenance (dependent on type)	→ Can be well scheduled (no warm-up at PT coolers)
▪ Potential vibrations	→ No issue for devices built by Bilfinger Noell
▪ High quality thermal connections	→ State of the art @ Bilfinger Noell
▪ Cool-down time	→ Few days, scheduled, push button, remote
▪ CAPEX	→ No He infrastructure, low TCO

Dry cooling is reliable, comfortable, and safe

Statements

SC IDs are an industrial product

"Dry" cooling is state-of-the-art

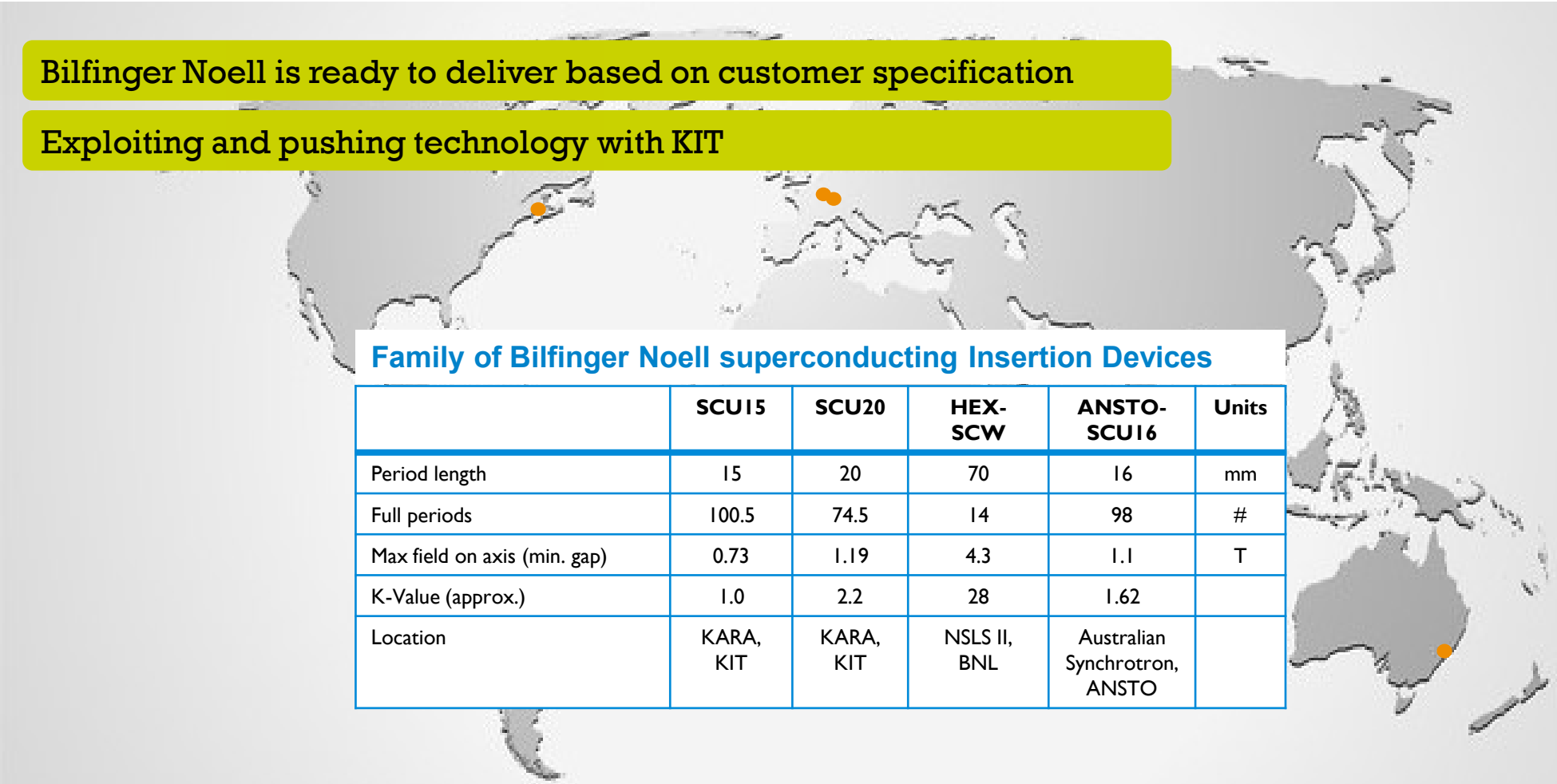
You specify – we build

New Devices

Worldwide activity of Bilfinger Noell on ScIDs

Bilfinger Noell is ready to deliver based on customer specification

Exploiting and pushing technology with KIT



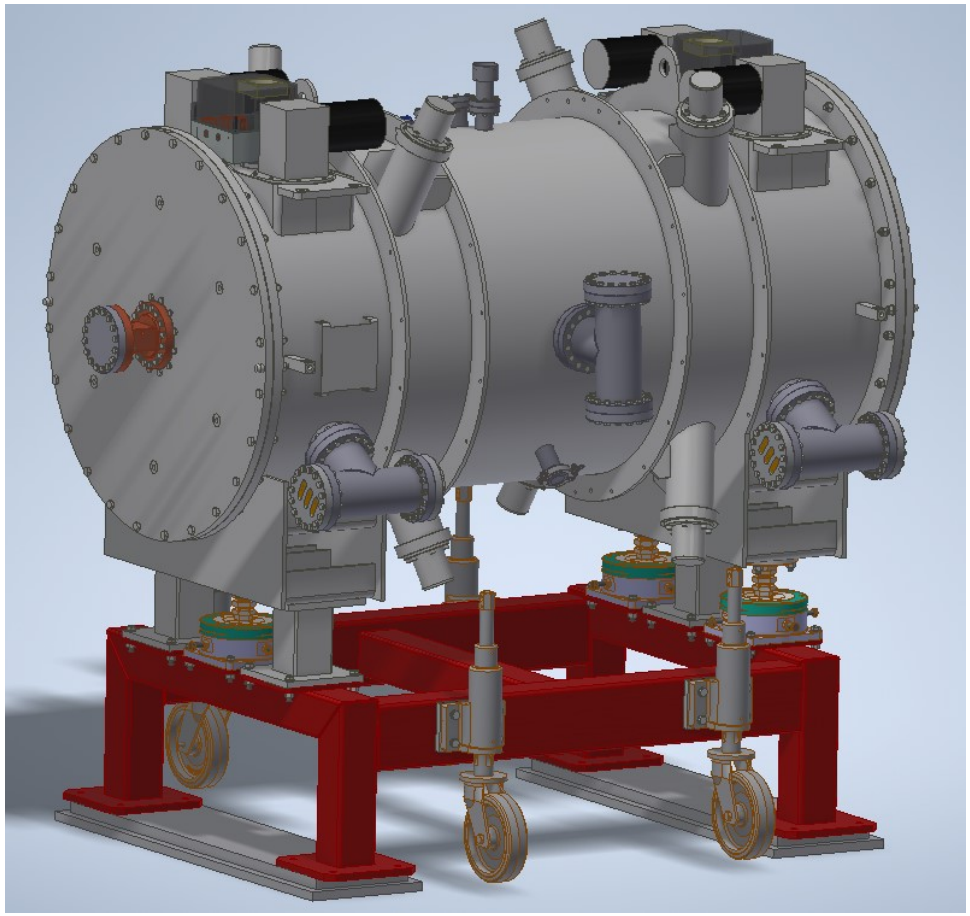
Family of Bilfinger Noell superconducting Insertion Devices

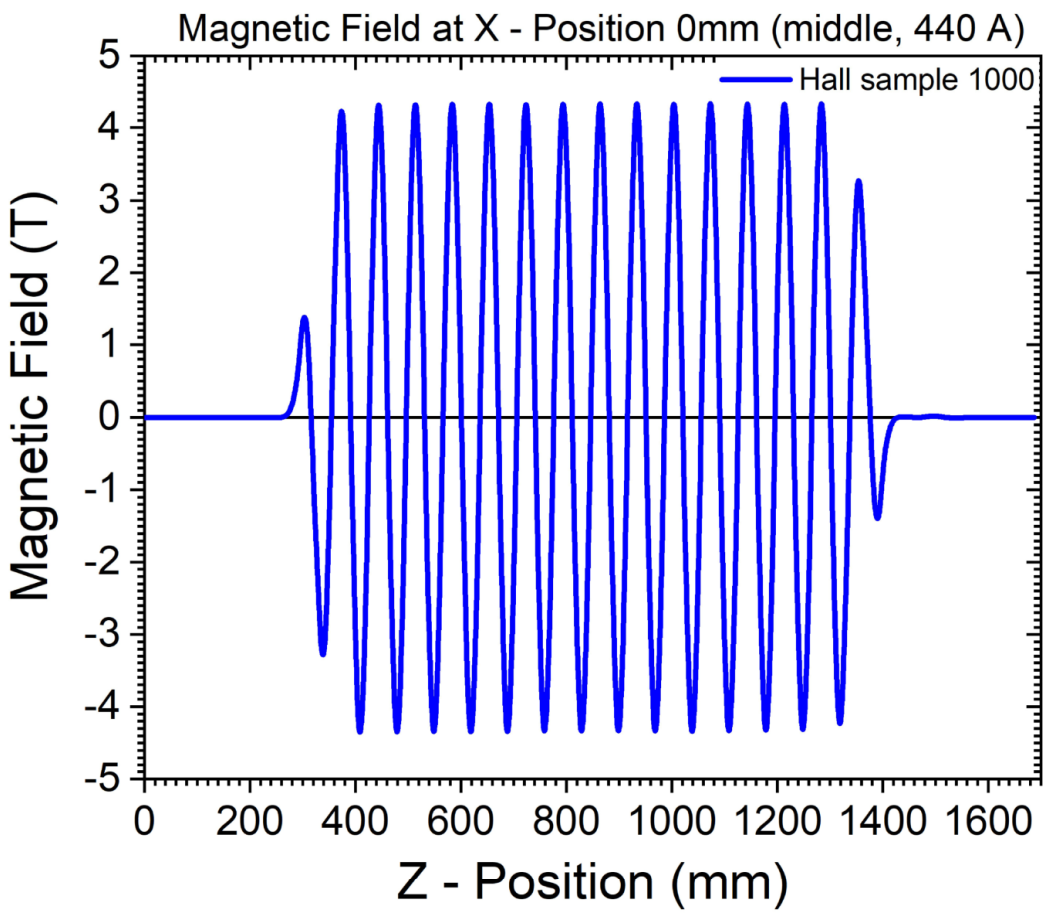
	SCU15	SCU20	HEX-SCW	ANSTO-SCU16	Units
Period length	15	20	70	16	mm
Full periods	100.5	74.5	14	98	#
Max field on axis (min. gap)	0.73	1.19	4.3	1.1	T
K-Value (approx.)	1.0	2.2	28	1.62	
Location	KARA, KIT	KARA, KIT	NSLS II, BNL	Australian Synchrotron, ANSTO	

BNL Wiggler Performance

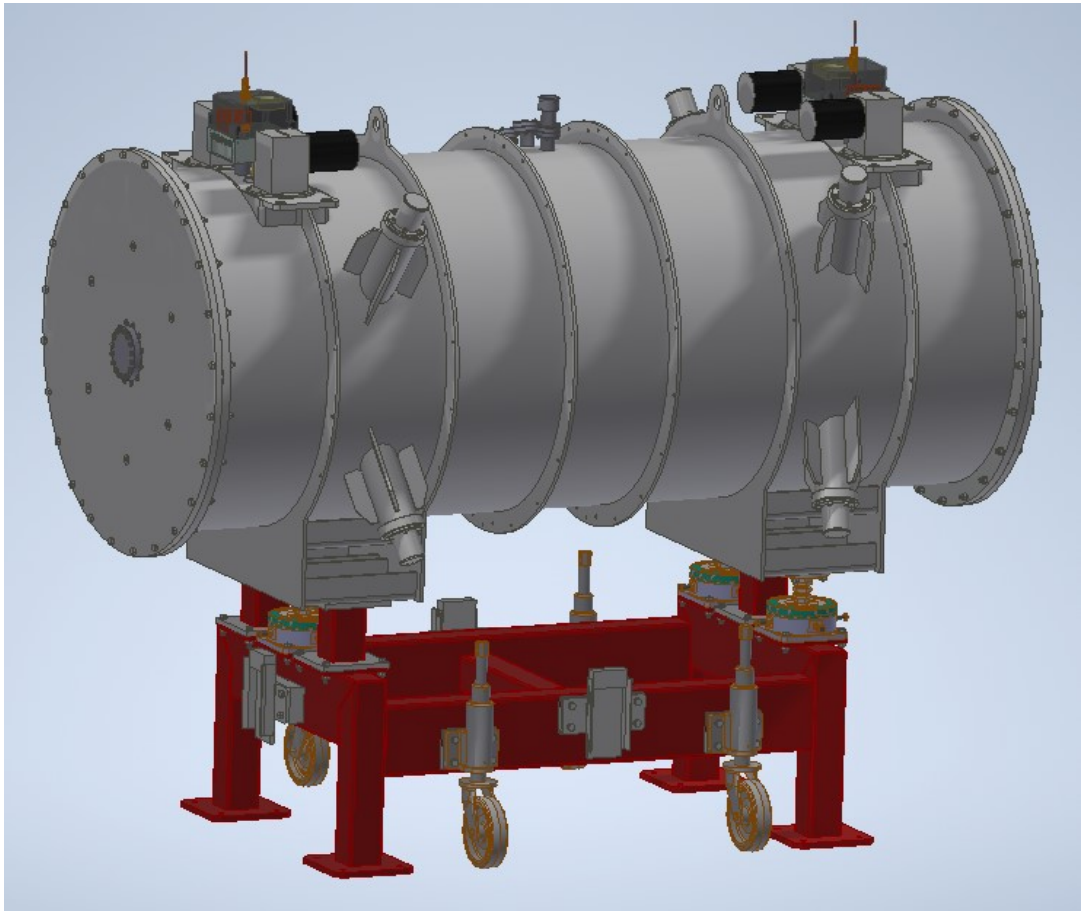
Results of the BNL Wiggler Magnetic Tests

4.3 T central field reached





ANSTO SCU Status



Design

1.1 T on axis, 16 mm period length

Design T margin > 1.25 K

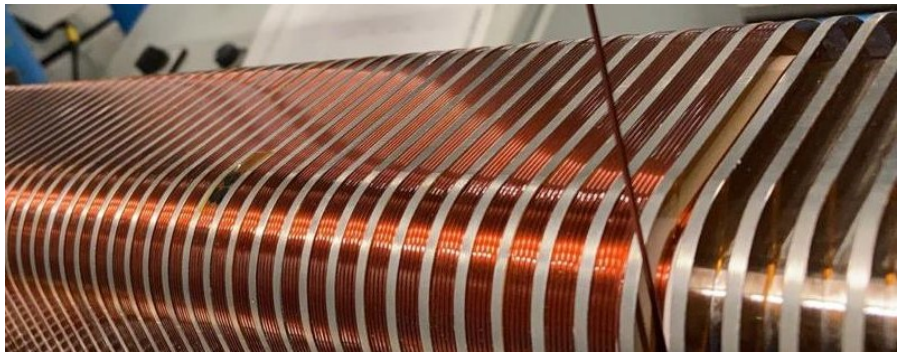
Cool down time expected 5 days

Status

Design is completed

Coil manufacturing almost finished

Planned 21 months from contract to delivery



www.noell.bilfinger.com/scu/

Thanks to:

KIT: Sara Casalbuoni (now XFEL), Andreas Grau and all colleagues at KIT

Bilfinger Noell: Thomas Gerhard, Marcel Breitenbach, Philipp Revilak, and many others

RELIABLE

SCU15 and SCU20 demonstrated long term operation in the KIT ring. SCU20 serves as source for user beamline

SAFE

No liquid cryogens needed

PLUG´n PLAY

Only requires power and cooling water

COMMERCIALLY AVAILABLE

Send your specification and ask for a quote

Contact

Bilfinger Noell GmbH
Alfred-Nobel-Str. 20
97080 Würzburg
Germany

Phone +49 931 903-6042
Fax +49 931 903-6010
noell.info@bilfinger.com
www.noell.bilfinger.com

Registered at Local Court Würzburg, HRB 7156
VAT-Id. No.: DE211420259

Executive Management:
Roland Pechtl