

PAUL SCHERRER INSTITUT



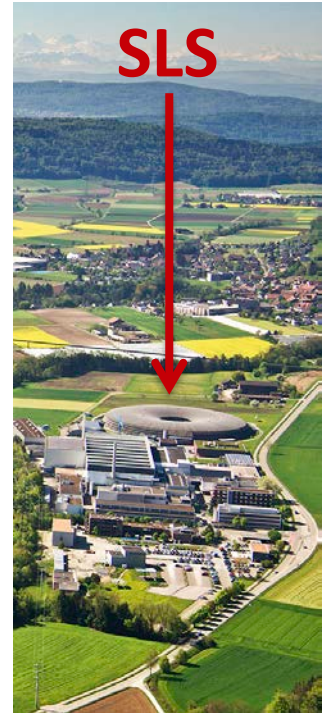
C. Zoller, C. Calzolaio, A. Gabard, P. La Marca :: Paul Scherrer Institut

Test stand for the characterization of superconducting magnets cooled with cryocoolers

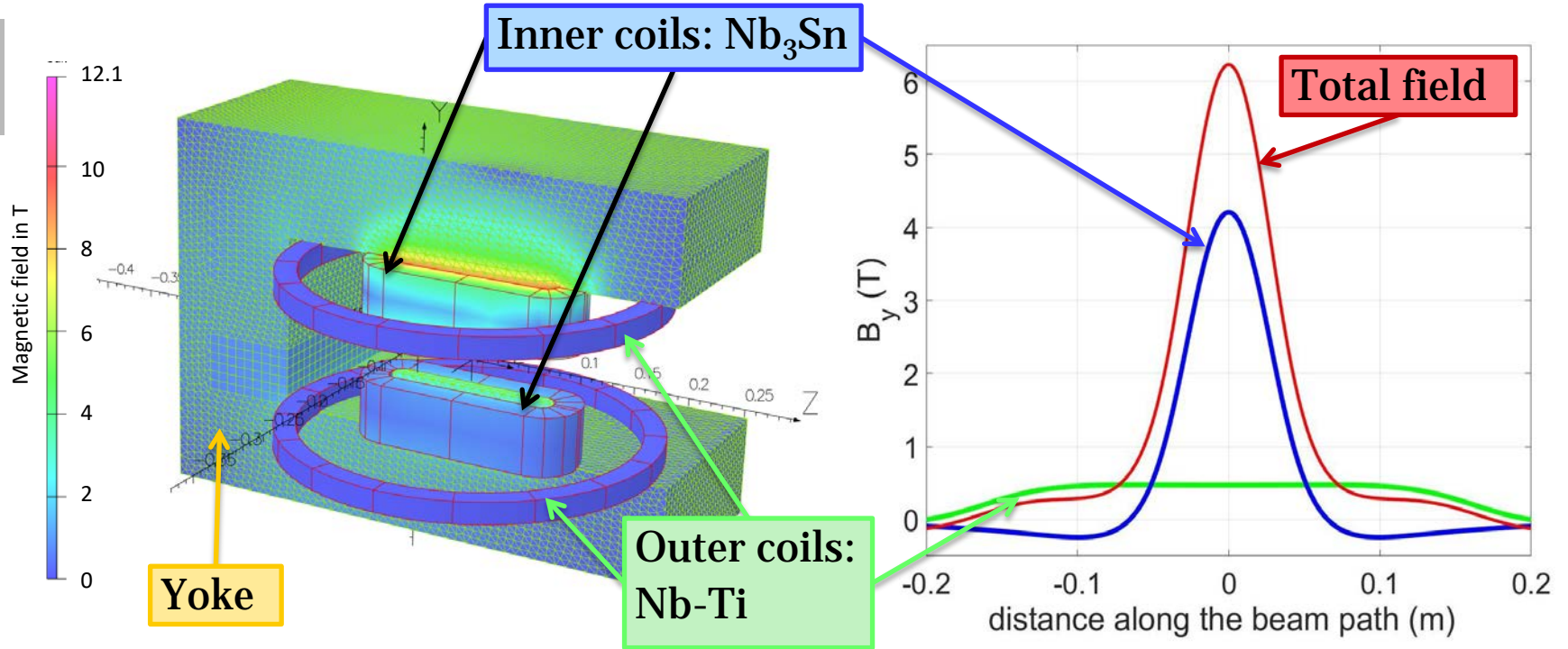
ICEC – ICMC 2018, Oxford

- Motivation
- Superconducting magnet test stand
 - Instrumentation
 - Magnetic measurement system
- Conclusion and Outlook

- **Sc. undulators** using HTS bulks (prototype phase)
- Compact and light sc. magnets for a new generation of **proton therapy gantries** (conceptual phase)
- Upgrade of the Swiss Light Source **SLS-2** (pre-study ongoing)
 - New lattice type to reduce emittance 5 nm → 137 pm
 - Three sc. **super-bend magnets** to produce hard X-rays

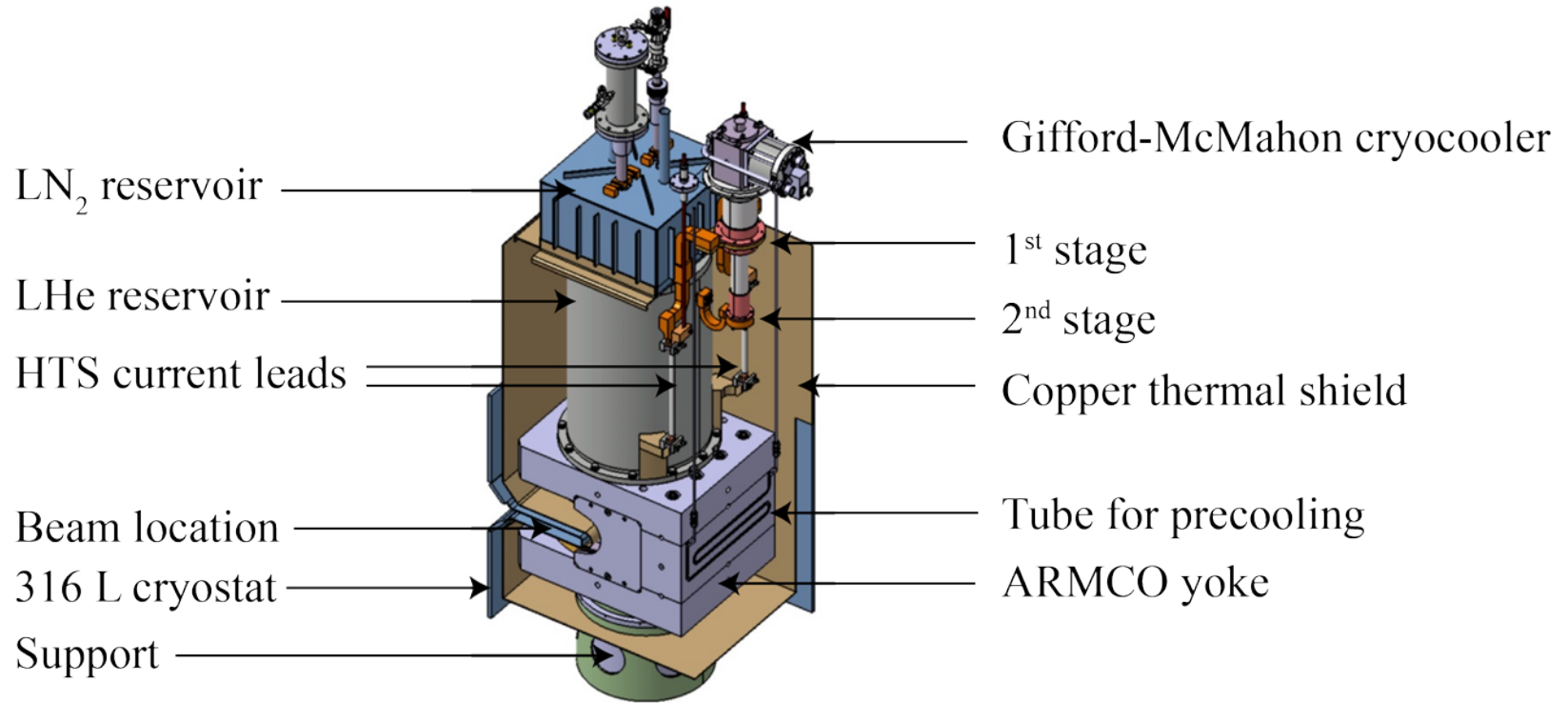


Design of the 6 T super-bend magnet for SLS-2



C. Calzolaio, S. Sanfilippo, S. Sidorov, A. Anghel and A. Streun, "Design of a Superconducting Longitudinal Gradient Bend Magnet for the SLS Upgrade", in *IEEE Trans. Appl. Supercond.*, vol. 27, no. 4, pp. 1-5, June 2017, Art no. 4000305.

Assembly of the 6 T super-bend magnet for SLS-2



C. Calzolaio, S. Sanfilippo, S. Sidorov, A. Anghel and A. Streun, "Design of a Superconducting Longitudinal Gradient Bend Magnet for the SLS Upgrade", in *IEEE Trans. Appl. Supercond.*, vol. 27, no. 4, pp. 1-5, June 2017, Art no. 4000305.

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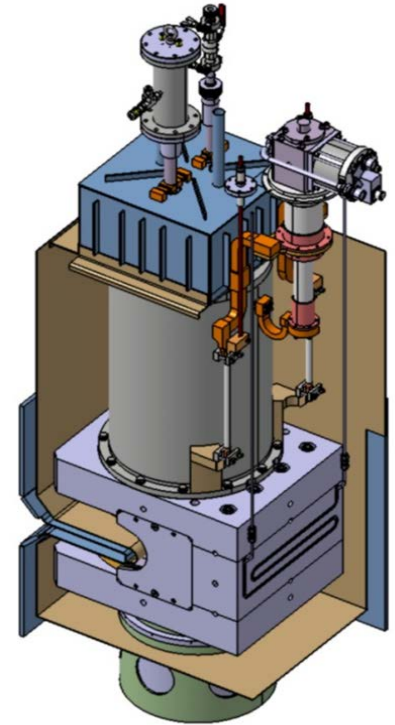
Cooling with cryocoolers required!



- Increasing demand for superconducting magnets cooled with cryocoolers
 - Cryocooler costs ↓ and performance ↑
 - Attractive for systems with space limitations and rotating systems
- Thermal, mechanical and magnetic characterization in LHe not representative

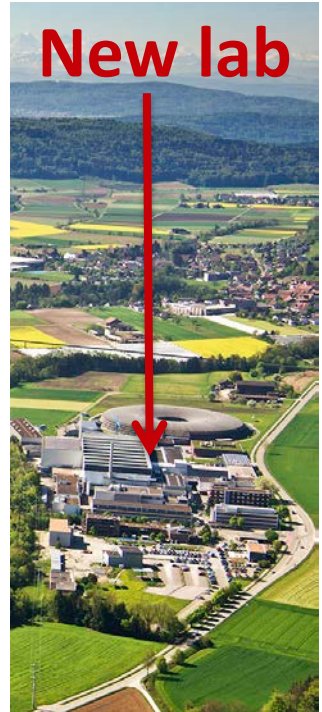


Tests under operating conditions needed

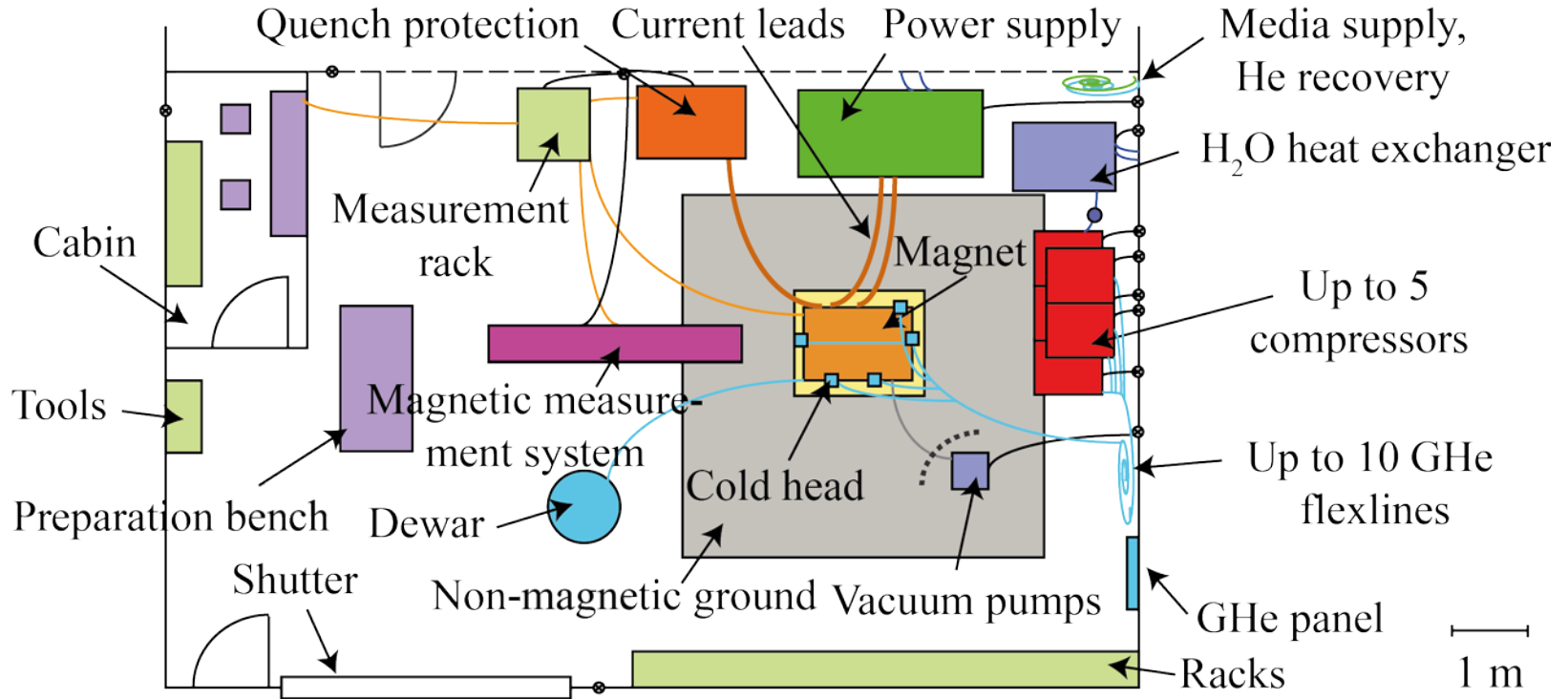


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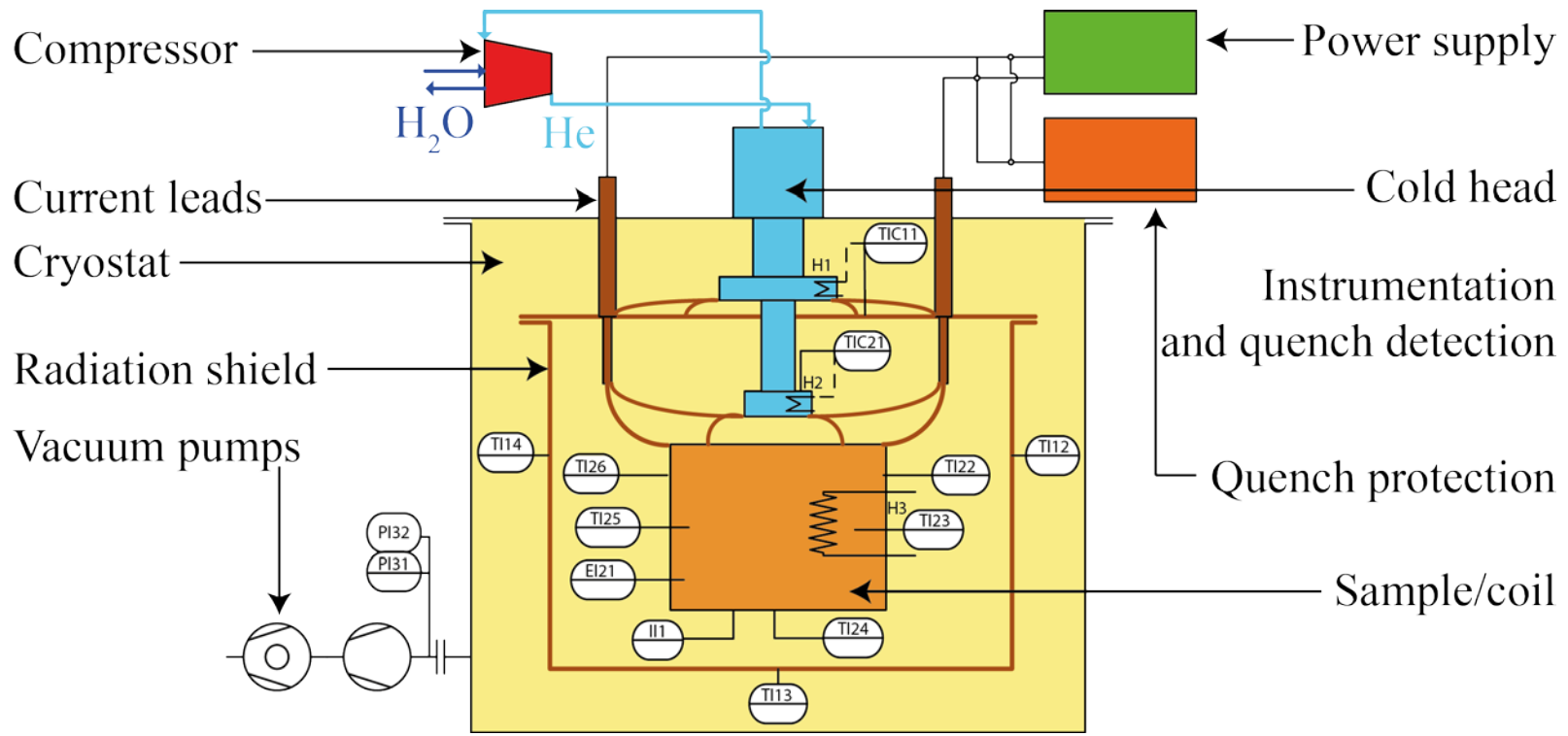
- Adjustable test stand for systems cooled with cryocoolers under operating conditions
- Verification of effectiveness and reliability of
 - Cooling method
 - Electrical performance at cold temperatures
 - Instrumentation
 - Operation at nominal current
 - Quench detection and protection
 - Field integral
 - Magnetic profile



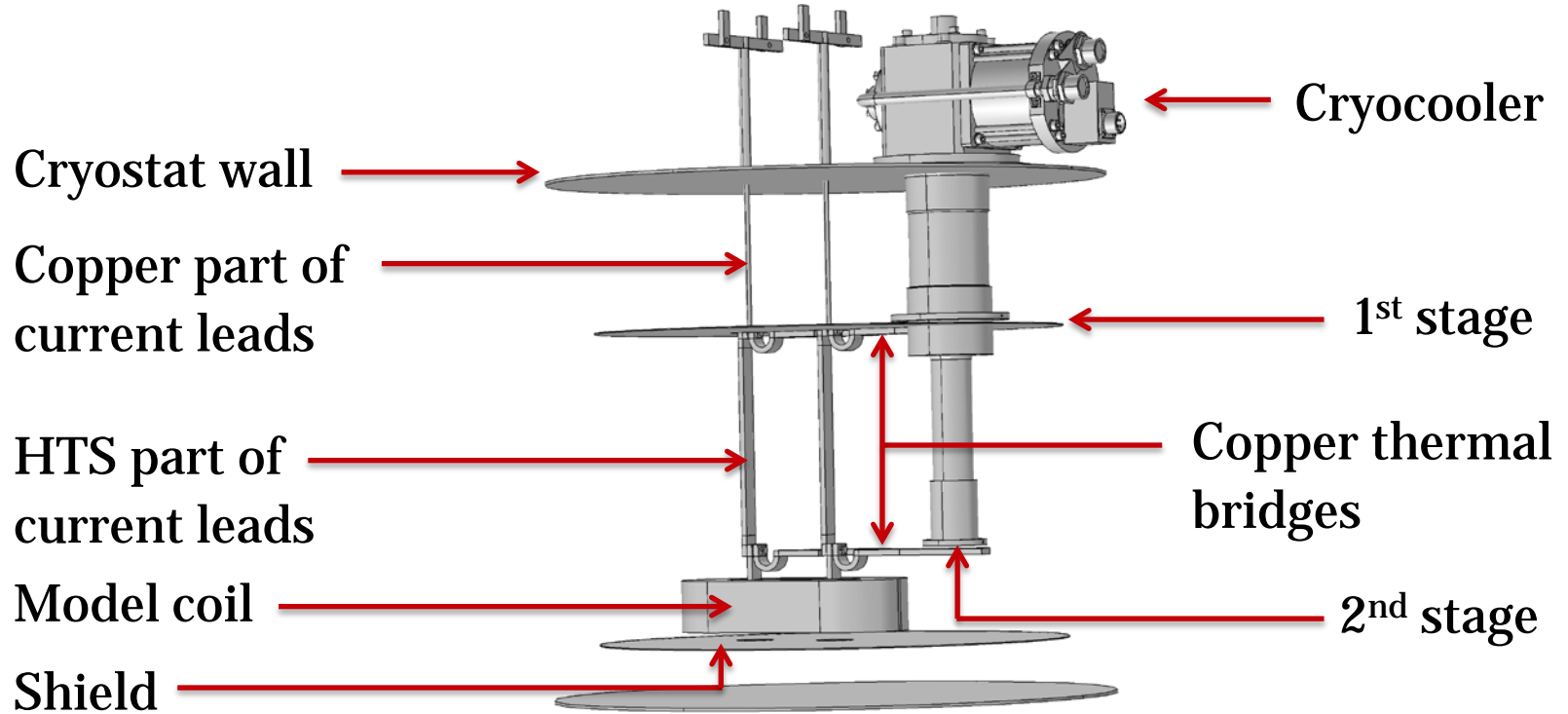
Schematic overview of the new PSI lab



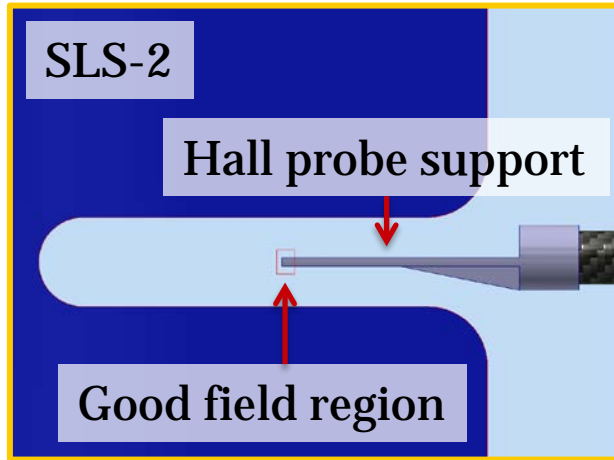
PID of SLS-2 model coil pre-tests



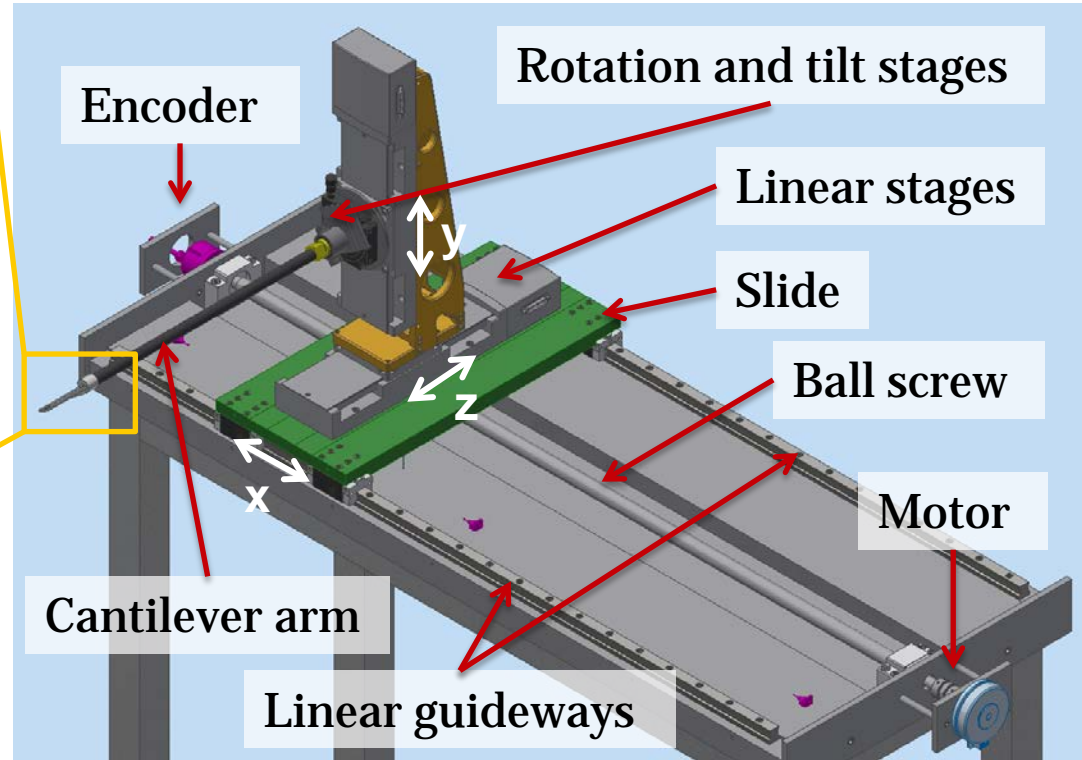
Cryogenic test of the SLS-2 model coils



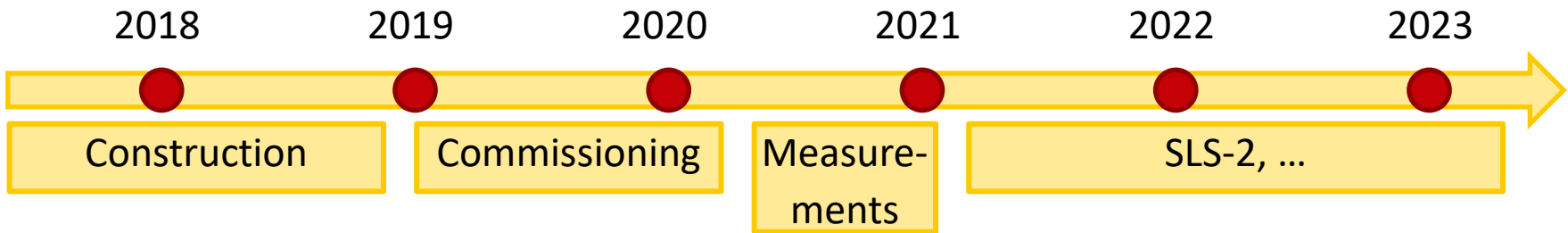
Magnetic measurement system for SLS-2



Later upgrade to curved magnets and magnets of complicated geometry



- Increasing demand for thermal, mechanical and magnetic characterization of sc. magnets cooled with cryocoolers under **operating conditions**
- New dedicated **test stand** under construction at PSI
- Commissioning with Nb₃Sn model coils in 2019
- Magnetic measurement system operational in 2020



Wir schaffen Wissen – heute für morgen

We create knowledge – today for tomorrow

**Thank you for
your attention**

