



Management
System
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Juelich Neutron Choppers – Capabilities and Opportunities

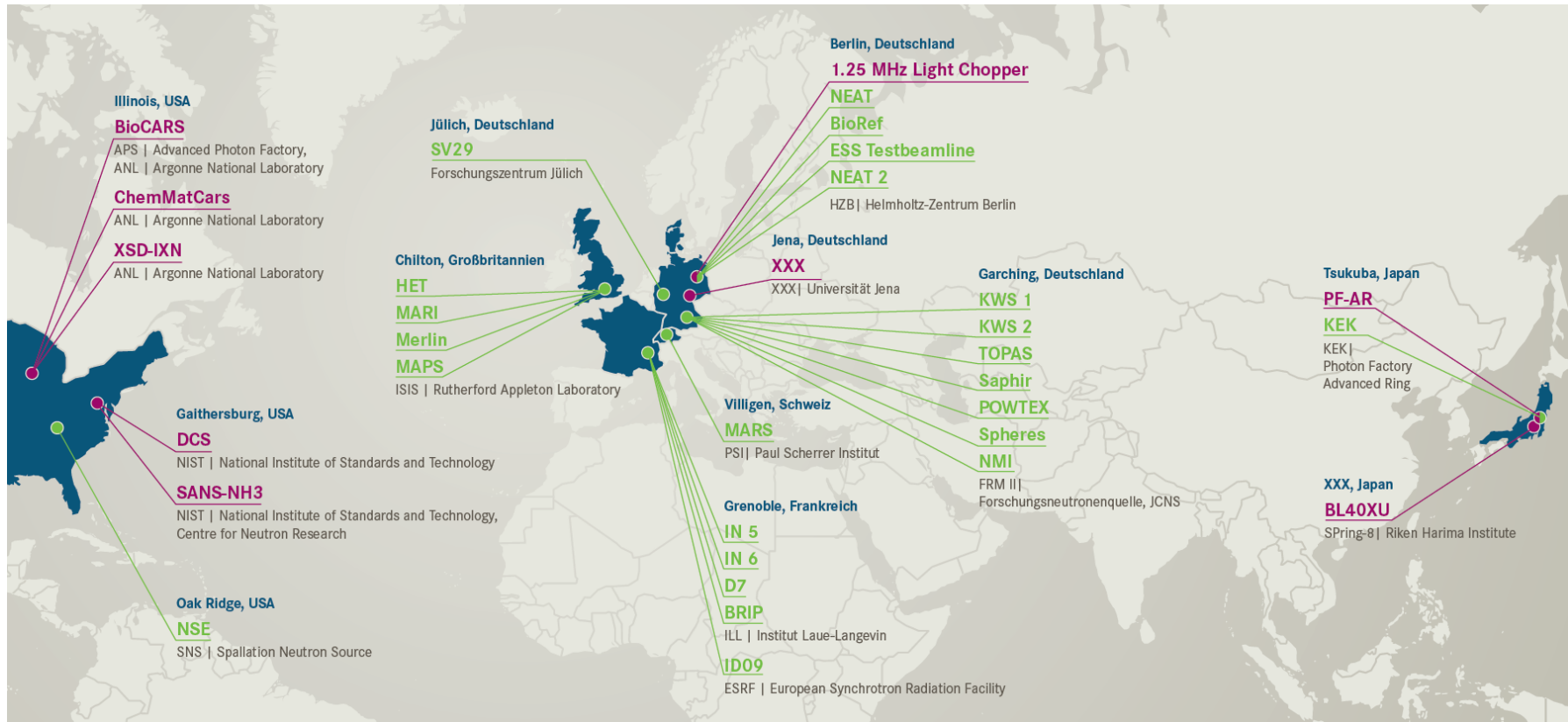
DENIM 2014

19. September 2014 | Michael Butzek (on behalf of the Juelich chopper team)

Outline

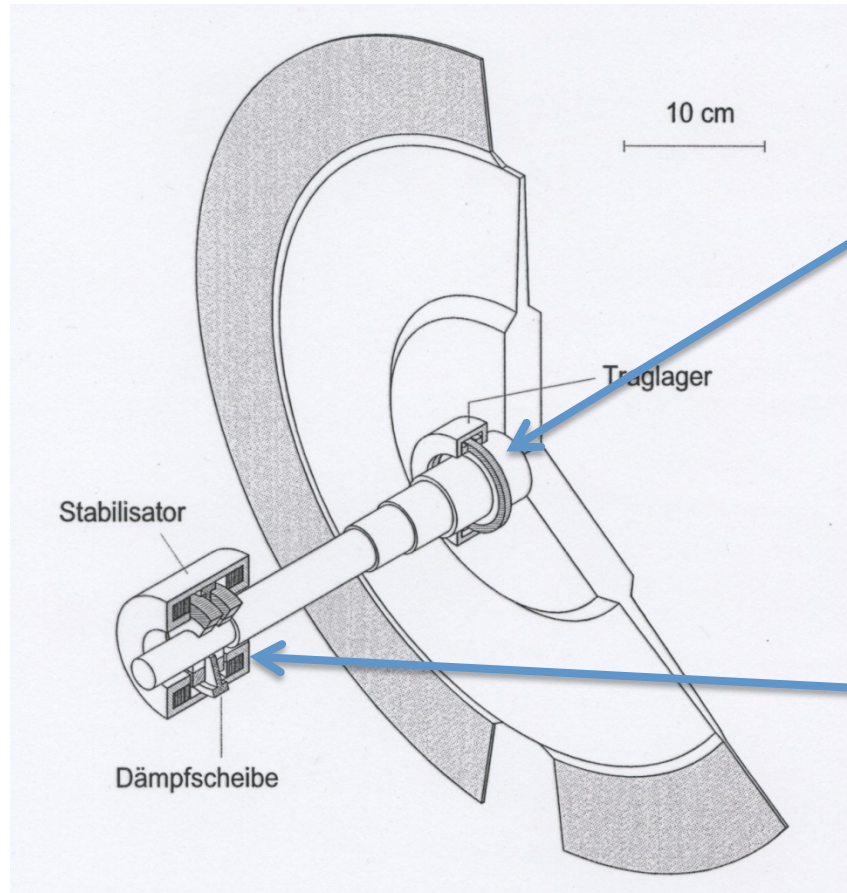
- Magnetic bearing choppers “System Juelich” worldwide
- The passive magnetic bearing
- In-house manufacturing
- Limitations of the rotor speed
- Modular digital control electronic
- Operation experience
- Electronic upgrade program

Magnetic bearing choppers “System Juelich” operating worldwide

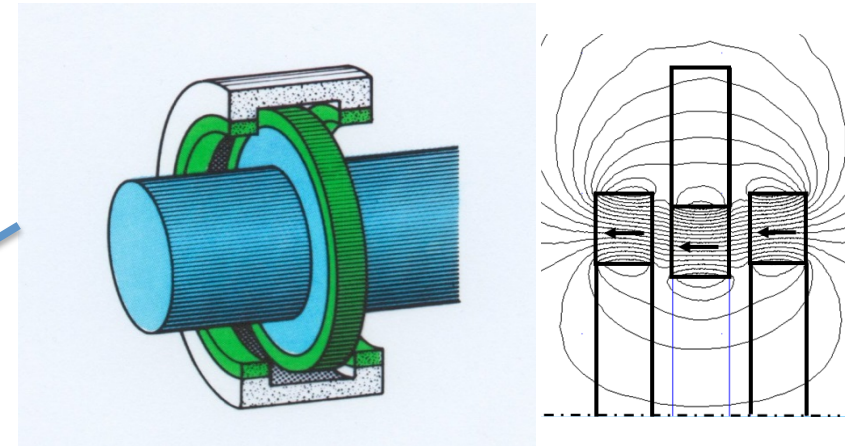


Over 20 years of operation experience

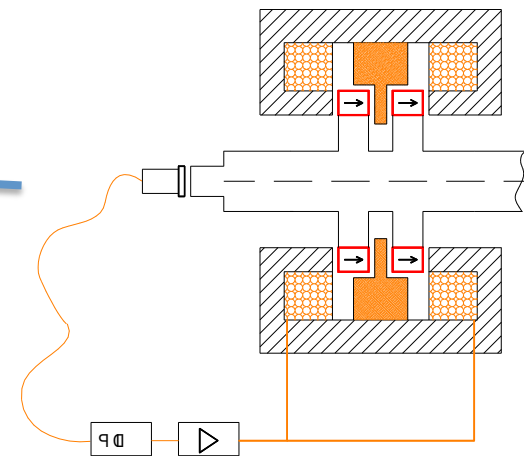
The passive magnetic bearing



Typical disk chopper bearing arrangement



Passive radial load bearing



Active axial stabilisation

Passive vs. active magnetic bearing

Pros

- Very low power consumption during routine operation (load carried by passive magnets)
- Smaller size
- Fewer controllers (radial passive -> only one axis controlled) -> less expensive
- No external cooling necessary (holds for most mag. bearings)
- Touch down bearing doesn't carry the payload



Passive vs. active magnetic bearing

Cons

- Less flexible. Bearing designed to the weight of the rotor.
- No radial electrical damping (only passive damping possible)
- Low bearing stiffness



-> We will investigate more into “actively supported” passive bearings in the future

A photograph showing a variety of custom-machined metal parts laid out on a light-colored wooden surface. The parts include two large cylindrical coils with internal windings and external wiring, several smaller cylindrical components with flanges, and numerous flat circular discs or rings. Some of the discs have green or gold-colored inner surfaces or coatings. The components are arranged in a grid-like fashion, showcasing the range of parts produced by the machine tooling.



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In-house manufacturing (electronics)



Circuit board design and manufacturing



Labview and DSP/FPGA programming



Assembling



Test and fine tuning

High in-house manufacturing rate (pros and cons)

Pros

- High flexibility to “customer” requirements
- Basically all interfaces possible
- Long term support possible
- Updates / Upgrades possible

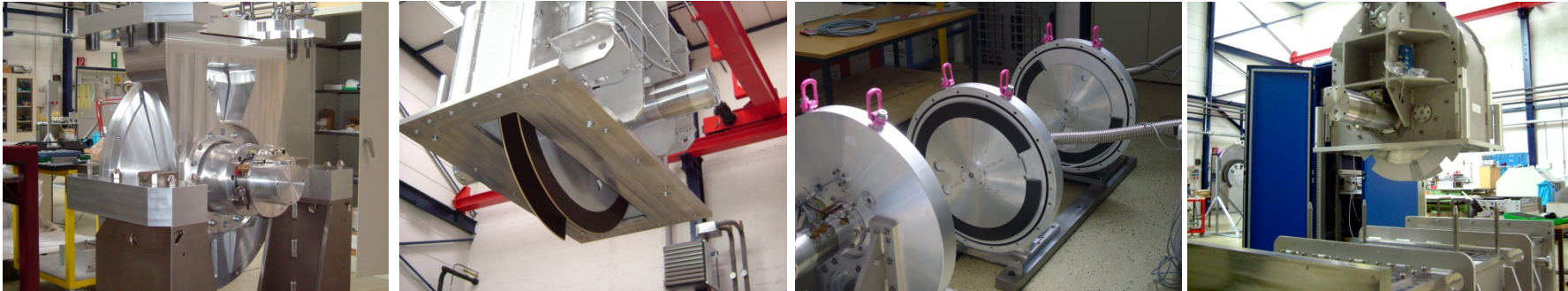


Cons

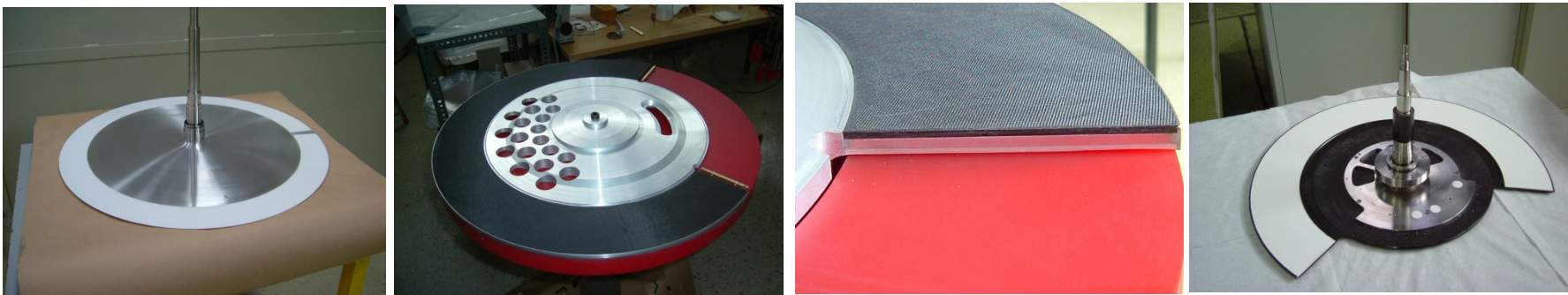
- Higher costs (no use of “mass production”)



Flexible design

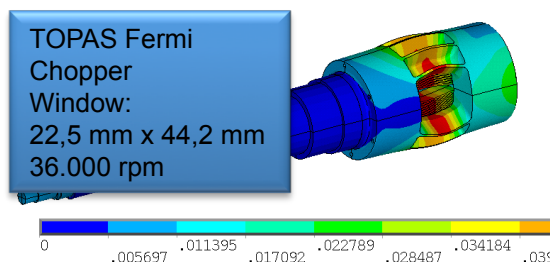
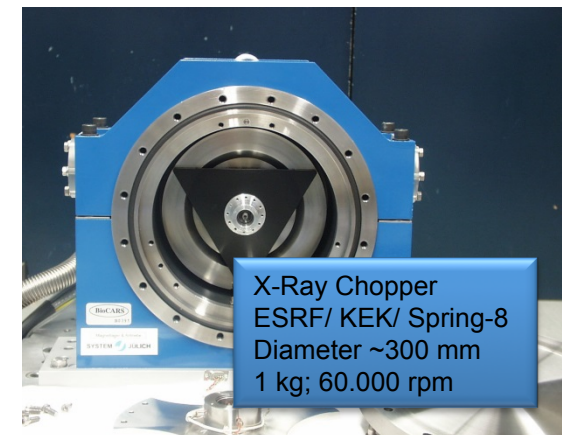
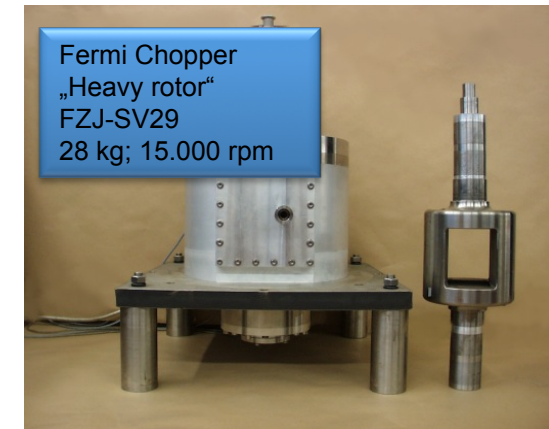


Disk choppers with beamline specific housings and disk designs



Customized absorber coatings

Systems delivered / under development and current “limits”



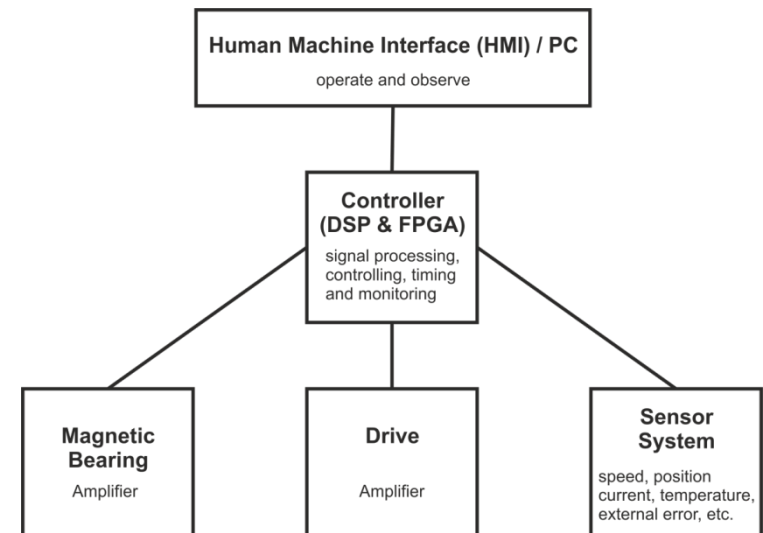
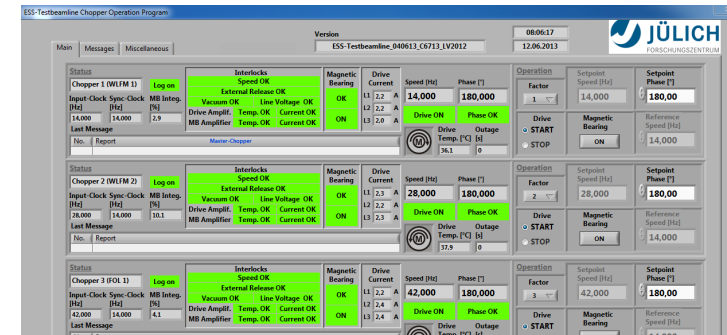
Limitations of the rotor speed

- Diameter of the rotor
- Disk material (CFK-> higher strength but no “virtual” windows possible)
- Depth of cut outs (highest stress in slot bottom)
- Width / height of opening (for Fermi rotors)
- Arrangement of windows (e.g. asymmetrical require additional balancing weights -> point loads)
- Requested non structural masses (^{10}B instead of Gd)
- Design of magnetic bearing (sheathing of magnets)



Modular digital control electronics

- State of the art (floating point DSP)
- Digital control of magnetic bearing
- Software-Controller (parameterization by software)
- Error diagnosis and equipment condition monitoring
- Remote maintenance
- Resolution of time signals 10ns
- Flexible design, e.g. one controller per disk (ESS approach)



Modular digital control electronics



- Industry PCI based modular system
- PC located remote / connected by optical fibre

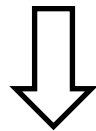


Operation experience of new digital controller

Instrument	qty	Type	Location	In Operation
SV29	2	Fermi	FZJ, Jülich, Germany	12/2004–04/2006
NSE	4	Disk	SNS, Oak Ridge, USA	since 08/2008
BioRef	3	Disk	HZB, Berlin, Germany	since 10/2009
KWS 2	2	Disk	FRM-2, Garching, Germany	since 10/2010
BRISP	1	Fermi	ILL, Grenoble, France	since 06/2011
BioRef upgrade	1	Disk	HZB, Berlin, Germany	since 12/2012
KWS 1	2	Disk	FRM-2, Garching, Germany	since 05/2013
ESS-Testbeamline	4	Disk	HZB, Berlin, Germany	since 07/2013

Electronic upgrade program

- Electronics will become obsolete: Typical life-cycle of components in the order of less than 10 years.
- Very long lifetime of the “mechanical” components.



- Upgrade of older chopper systems using our new digital controller increases system lifetime.
- Update/upgrade can also implement new / improved features



Planned upgrades:

ILL/IN5: cascade of 6 disk choppers

ISIS: 3 Fermi choppers

**Thank you
for your ...
... attention**

