

"White Nights Science"

Meeting & Summer School in Tallinn
on

New Concepts in Energy Storage

June 13.-20. 2015



www.nmri.ttu.ee/upcoming-events

Program

The meeting and summer school from 13th till 20th of June – the very best time in the Baltic - is organized by Tallinn University of Technology (TUT) in cooperation with Helmholtz Institute Ulm (HIU) and Karlsruhe Institute of Technology (KIT).

It is open to everyone and we are expecting participants from Germany, other EU countries, UAE, etc.

Content

Focus is on the basics and new achievements related to advanced energy materials, such as hydrogen storage and battery compounds supported by Frontiers of HIU and KIT.

A special highlight will be a two day focus on optimal analytical method: Nuclear Magnetic Resonance – a long lasting tradition in Tallinn

Rotating Locations

- Pärnu Conference Center
- Tallinn University of Technology
- Energy Discovery Center
- Seaplane Harbor
- Tallinn TV-tower
- Glehn Castle



Saturday (13th)

Welcome, Introduction and general Concepts

Raiker Witter, Maximilian Fichtner and Ago Samoson

Sunday (14th)

Hydrogen Storage: Synthesis and Characterization

Maximilian Fichtner and Zhirong Zhao-Karger

Monday (15th)

Battery Materials: Synthesis and Characterization

Maximilian Fichtner and Anji Reddy Munnangi

Tuesday (16th)

Material Characterization with Focus on Nuclear Magnetic Resonance for Energy Research

Raiker Witter

Wednesday (17th)

Selected Presentations

Raiker Witter

Thursday (18th)

Advanced and new Concepts in NMR

Raiker Witter

Friday (19th)

Alternative Developments and Applications

Ago Samoson, Raiker Witter

Saturday (20th)

Departure after Breakfast

Saturday (13th, Pärnu Conference Center)

Welcome, Introduction and general Concepts

Raiker Witter, Maximilian Fichtner and Ago Samoson

Our first day is considered for getting know each other, the environment, topic of the meeting and summer school.

There will be given a general introduction to energy related issue with focus on energy storage, actual situation in the H₂ and the battery sector, implications for future energy storage materials and concepts.

Basic principles of conventional strategies will be presented and an overview of new concepts shall be outlaid.

Very interesting aspect is the variety of similarities of conversion materials for H-storage and batteries. History, Thermodynamics, Kinetics, Engineering and Examples will be provided:

$$U = U^0 + \frac{RT}{nF} \ln \frac{a_p}{a_r}$$

Historical aspects

Conceptual aspects

Materials aspects

Engineering aspects

$$d \ln p = -\frac{\Delta H_r}{RT} + \frac{\Delta S_r}{R}$$

Economy

Ecology

Society

How many "Energy-Slaves" do you have?

Sunday (14th, Pärnu Conference Center)

Hydrogen Storage: Synthesis and Characterization

Maximilian Fichtner and Zhirong Zhao-Karger

On the second day H₂ storage options will be presented.

At first a motivation – the proton fuel cell – will be basically introduced.

Since there is no ONE material yet, we will provide an overview of possibilities:

Fundamentals about hydrogen

Methods to produce hydrogen

Biomass and sunlight

Compressed hydrogen

Cryoliquids

Cryo-compressed

Physisorption and Chemisorption

Carbon nanotubes

Metal hydrides

Non-metal hydrides

Complex Hydrides

Crystalline Nanoporous Materials

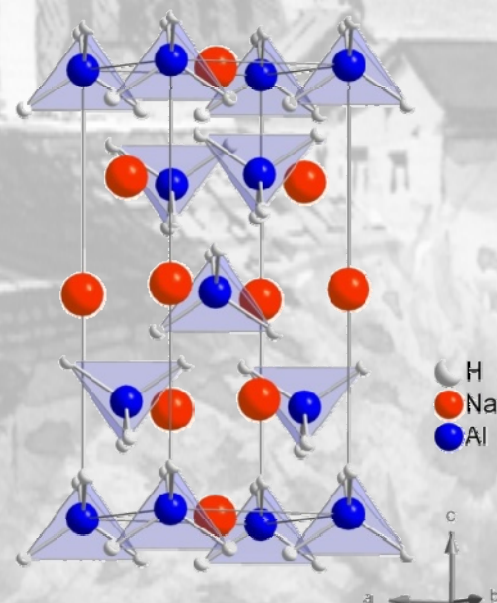
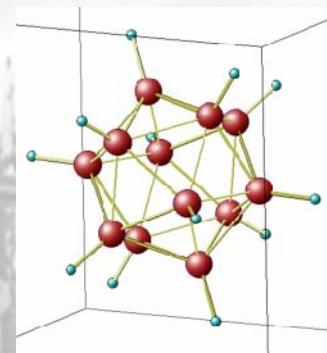
Self-Assembled materials

Advanced Hydrides

Inorganic – Organic Compounds

Micro- and Mesoporous Materials

Nanosize Powders



Examples for synthesis, characterization and performance will be given.

Monday (15th, Energy Discovery Center)

Battery Materials: Synthesis and Characterization

Maximilian Fichtner and Anji Reddy Munnangi

The third day will focus on concepts of energy storage in batteries.

A general introduction to commercial electrochemical cells will be provided.

New cutting edge concepts will be introduced:

Storage principles in batteries

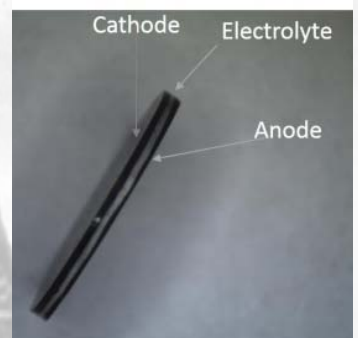
Concept and examples of

Lithium-Ion Batteries

Sodium-Ion Batteries

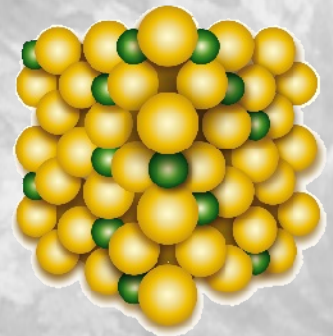
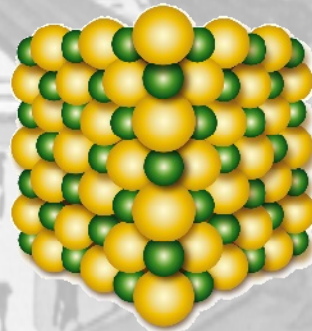
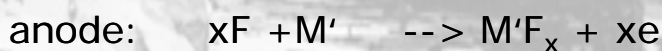
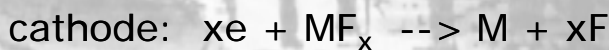
Magnesium Batteries

Fluoride-Ion Batteries



Special consideration will be given on solid state synthesis of anode, cathode and electrolyte materials.

Methodology of synthesis (nano-engineering), characterization (X-ray, TEM, SEM, REM, IS, cycling) and possible applications will be considered.



Tuesday (16th, TUT)

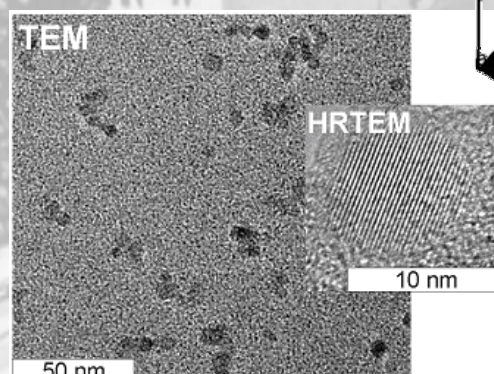
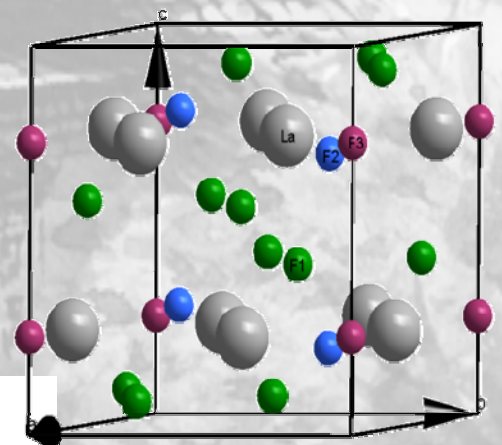
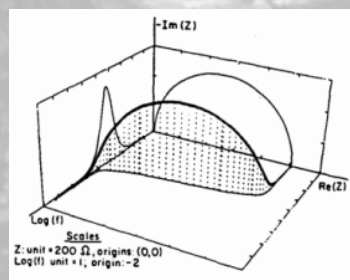
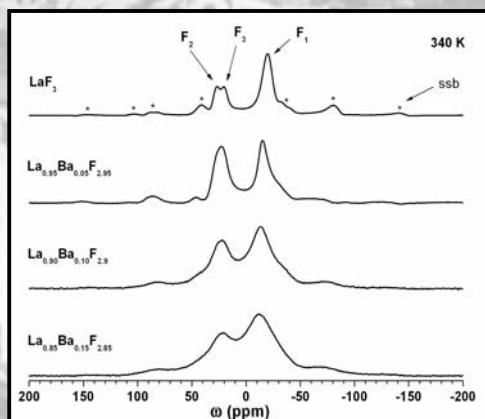
Material Characterization with Focus on Nuclear Magnetic Resonance for Energy Research

Raiker Witter

The structural characterization of energy related nano-composed materials is of certain importance. We will provide brief introduction to standard methods:

- XRD (X-ray diffraction)
- SEM (Scanning electron microscope)
- EDS (Energy-dispersive X-ray spectroscopy)
- XAS (X-ray absorption spectroscopy)
- XAFS (X-ray absorption fine structure)
- XANES (X-ray absorption near edge structure)
- TEM/HRTEM (Transmission electron microscopy)
- TA (Thermal analysis)
- DLS (Dynamic light scattering)
- AFM (Atomic force microscopy)
- SERS (Surface-enhanced Raman spectroscopy)
- SPR (Surface plasmon resonance)
- EIS (Impedance Spectroscopy)
- In situ* investigations

Main focus will be on Solid State Nuclear Magnetic Resonance (NMR) on Energy materials and its application to Li-Ion, Fluoride-Ion, Magnesium-Ion and different hydrogen storage options.

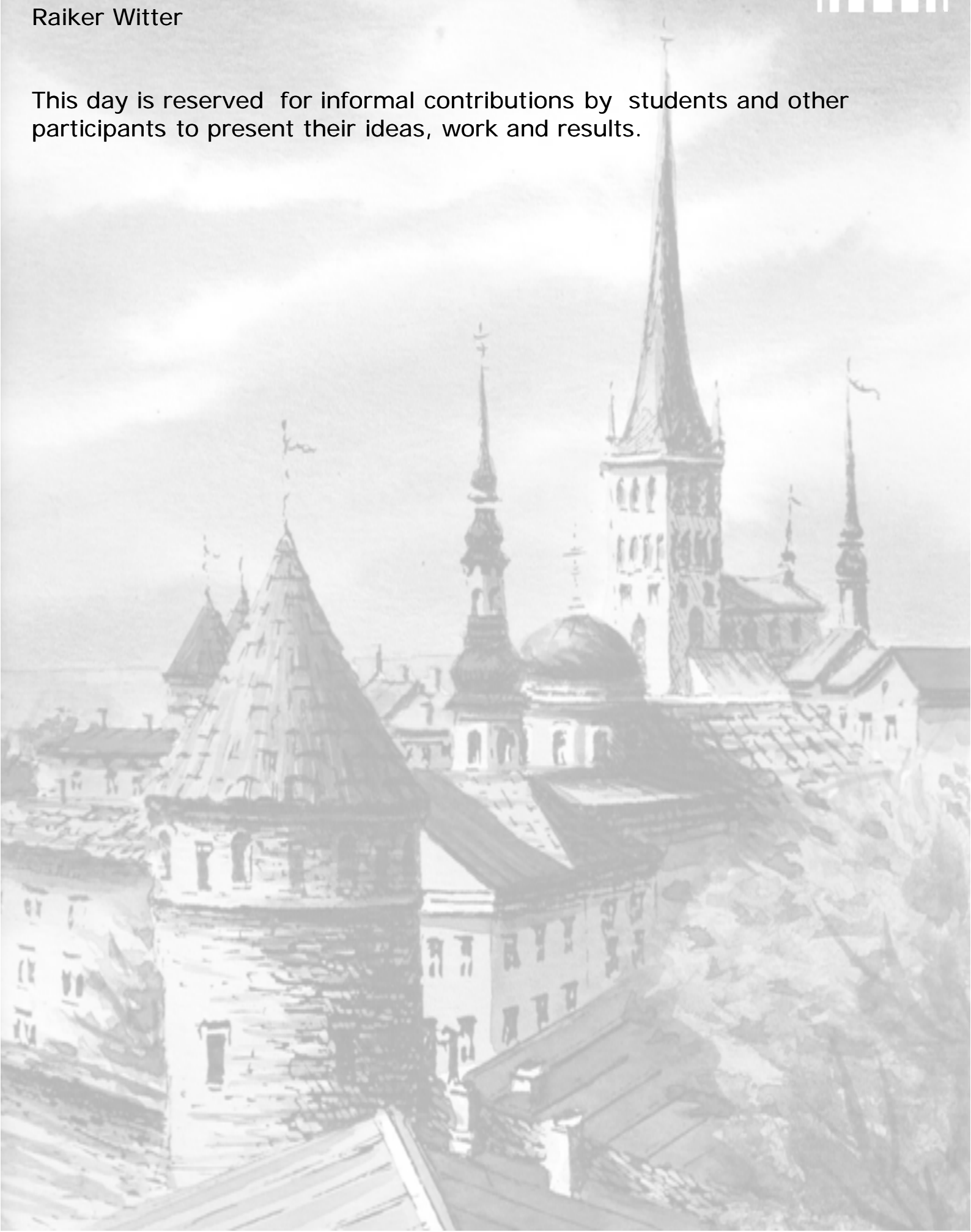


Wednesday (17th, Tallinn TV-Tower)

Selected Presentations

Raiker Witter

This day is reserved for informal contributions by students and other participants to present their ideas, work and results.



Thursday (18th, Seaplane Harbour)

Advanced and new Concepts in NMR

Raiker Witter

Fundamentals of solid state Nuclear Magnetic Resonance and Magic Angle Spinning (MAS) will be introduced on this day, followed by advanced techniques to access intrinsic electrode and electrolyte material morphologies/properties:

Activation energies

Hopping times

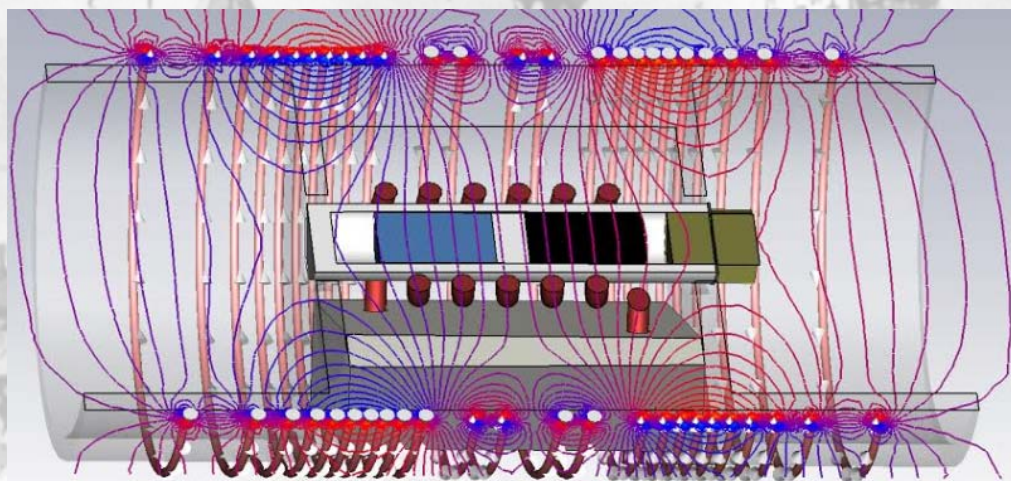
Site/crystallite/surface/grain-boundary structure

Proximities

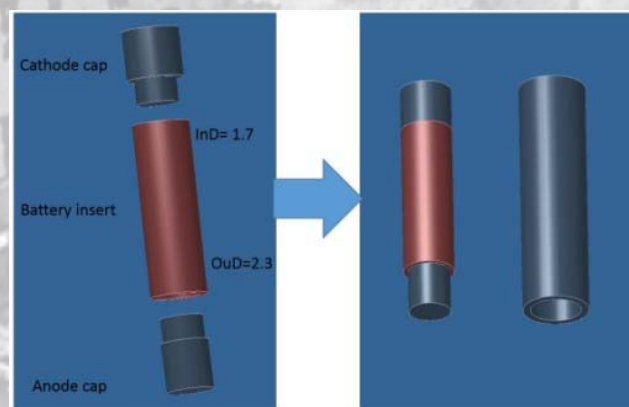
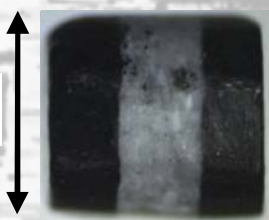
Side educts/products

In situ NMR investigations

Spatial resolved reactions



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Friday (19th, Glehn Castle)

Alternative Developments and Applications

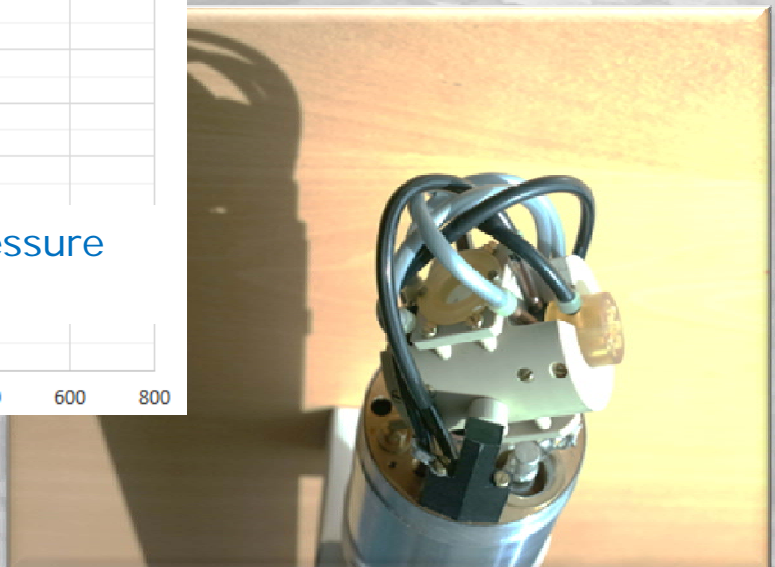
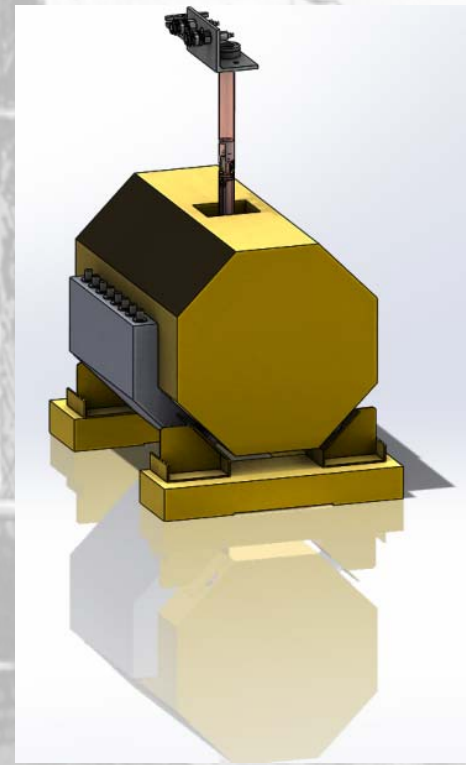
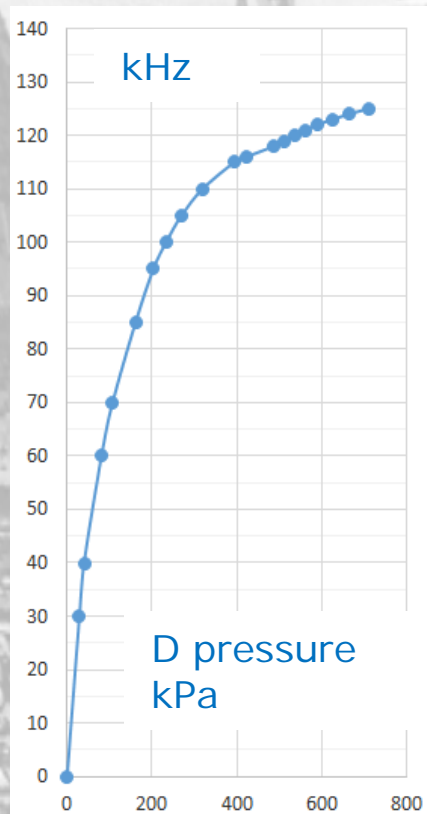
Ago Samoson, Raiker Witter

Nuclear Magnetic Resonance in Tallinn is traditionally known for ultra high magic angle spinning speed and low temperature magic angle spinning.

Recent developments and applications will be presented:

- Ultra fast MAS: 100 kHz and above
- LASER assisted sample heating (300-400 C)
- 9mm bore radius, 60 MHz MAS system
- Flow MAS NMR for *in situ* catalysis
- Double angle rotation
- Dynamic nuclear polarization

A conference bus will take participants to Riga



Saturday (20th)

Departure after Breakfast



Our breakfast we will take very early in the morning in a hotel close to the Airport of Riga.

Following Departures are considered:

Frankfurt-Hahn:	10:45
Mailand Bergamo:	11:10
London Stansted:	11:30



Sponsors

DAAD

This event is specially supported by the German DAAD. As student you can apply to get 580€ stipend:

<http://goeast.daad.de>

(Deadline for stipend application is 30th of April 2015 with possible extension.)

Online registration:

<http://www.nmri.ttu.ee/upcoming-events>

(Deadline for registration is 1st of June 2015.)

