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EUROPEAN SCHOOL OF MAGNETISM 2023

From Academia to Industry

Insights on the transition

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Document ID.: 20230910_ESM_DSM Rev.: 1.0

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- Goals & Disclaimers
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- Research in Industry (an example)
- Research in Academia vs Industry
- The transition
- Conclusions

Introduction

Goals

- Coarse comparative analysis
- Demystifying research (and life) in industry
- Insights on the transition

Disclaimers

- Based on subjective personal experience…
- …but augmented with external input

Do contribute with your view!

- ABB Research as example
  - Underrepresenting…
  - …but hopefully meaningful

- Motivation for the talk: personal VS ABB PR
- Skewed towards demystifying industry

Background

Bio

- **BSc and MSc in Electronics**
  - University of Alcalá (Spain) & Mälardalens University (Sweden)

- **PhD in Electronics** (4 years)
  - “Distributed optical ranging for robot localization”
  - University of Alcalá (Spain)
  - Research visits: MPG (Germany), University of Havana (Cuba), & ETH Zurich (Switzerland)

- **Postdoc + senior scientist** (8 years)
  - ETH Zürich (Switzerland), Inst. of Geodesy and Photogrammetry
  - Optical metrology: laser ranging, remote spectroscopy, remote material probing…
  - From technical work to research coordination & supervision

- **Senior scientist** (1.5 years)
  - ABB Corporate Research (Switzerland), Sensing & Analytics
  - Sensing for automation, process control, and digitalization of switchgear

Universidad de Alcalá

MÄLARDALENS HÖGSKOLA
ESKILSTUNA VÄSTERÅS

ETH zürich

ABB

Research in Industry (an example)

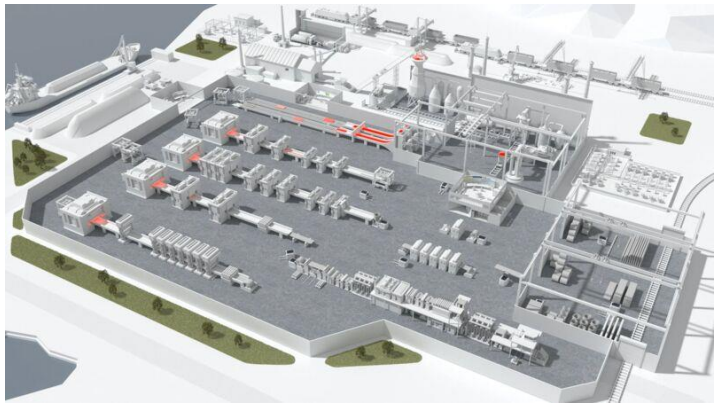
ABB Business Areas

Electrification

Switchgear, transformation, distribution, protection, cabling, sensing, control…

Process Automation

Integrated solutions incl. automation, electrification, control, services…



Motion

Drivers, motors, generation, automation…

Robotics & Discrete Automation

Flexible manufacturing, smart machines…

Research in Industry (an example)

ABB Research

~300 highly qualified scientists and engineers

7 corporate research and technology centers around the world

Business aligned research with **7** core technologies

>200 technology projects and prestudies

>200 FFs and **>200** publications

Technology Areas

- Multiphysics
- Mechatronics
- Power electronics
- Connected systems
- Sensing
- Switching
- Software & control

Research in Industry (an example)

ABB Corporate Research Center Switzerland (CHCRC)

Inaugurated in 1973

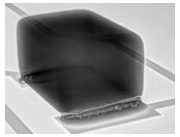
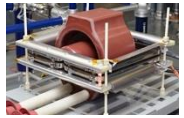
104 Employees (**74** PhDs)
23 nationalities
29 students
99 internal transfers ‘14-23’
19 professors ‘14-23’

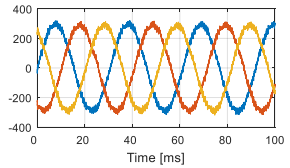
50 labs:
MV/LV switching
Power electronics
Thermal management
Sensing
Materials
Gas and water analytics

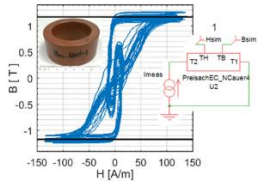
Research in Industry (an example)

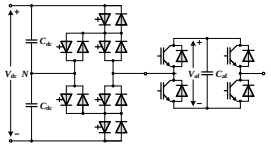
CHCRC Focus Areas

Power Electronics

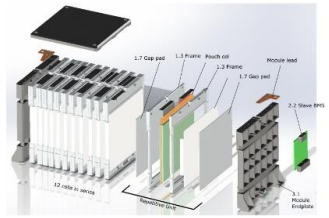





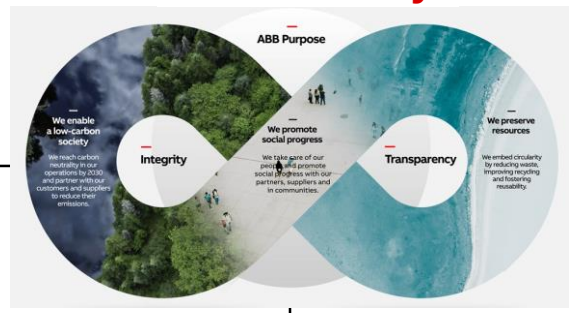




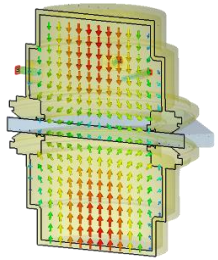
Energy storage

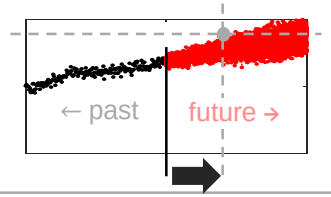


Sustainability

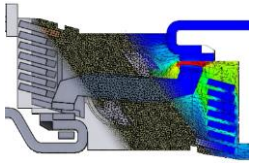
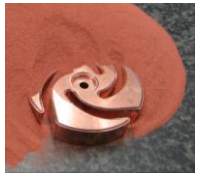


Intelligent Systems



Switching


Research in Industry (an example)

Career paths

Scientific path

- Scientist
- Senior Scientist
- Principal Scientist
- Senior Principal Scientist
- Corporate Research Fellow

Other (relevant) paths

Similar progressions on:

- R&D engineering
- Team/dept. management
- Project/product management

Promotions

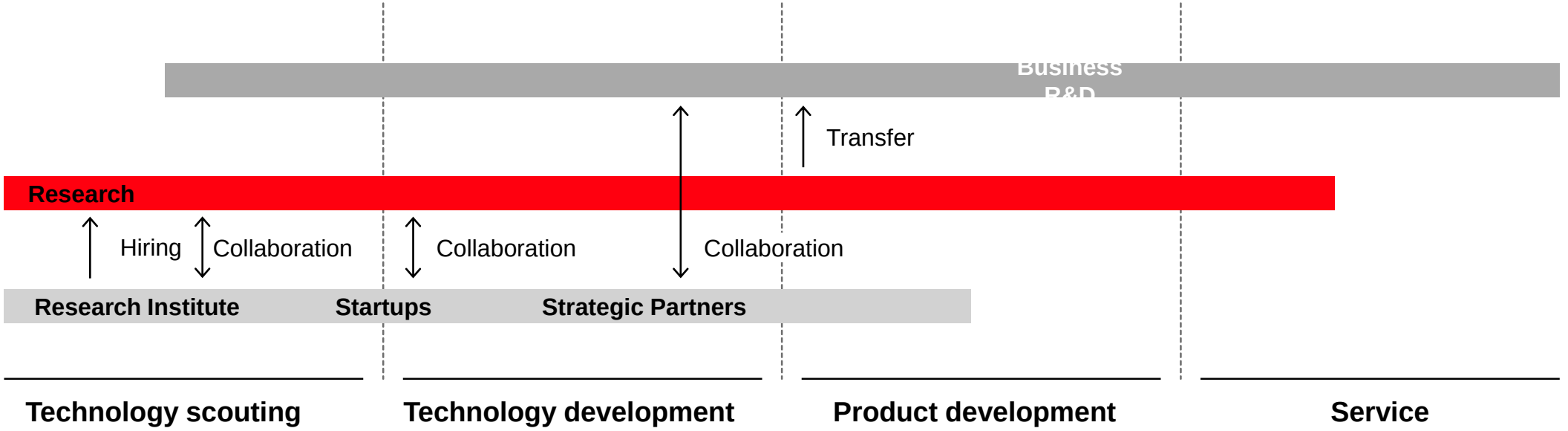
- ➢ Clear regulations on competence assessment for promotions
- ➢ No-competitive promotions

Assessed competences:

- Technical & scientific proficiency
- Business context and customer centricity
- Innovation and creativity
- Projects, processes, and tools
- Quality and continuous improvement
- Teamwork, collaboration, and visibility
- Knowledge management
- Intellectual property (IP) management

Research in Industry (an example)

Research processes



Research in Industry (an example)

Research processes

Project organization

- **Drivers & project proposals**
  - [80%] Need from business units (not covered by eng. R&D)
  - [20%] Internal proposals for next-to-next technologies
- **Projects**
  - 2-4 scientists, often multidisciplinary, lead by team member
  - Ca. 1 year
  - Outcomes as knowledge transfer + IP or publication
- **Project management**
  - Gate model (for both agile and waterfall projects)
  - 5 milestones per project (agreement on goals and requirements, plan, approach, validation, transfer)
  - Go/steer/stop on each gate

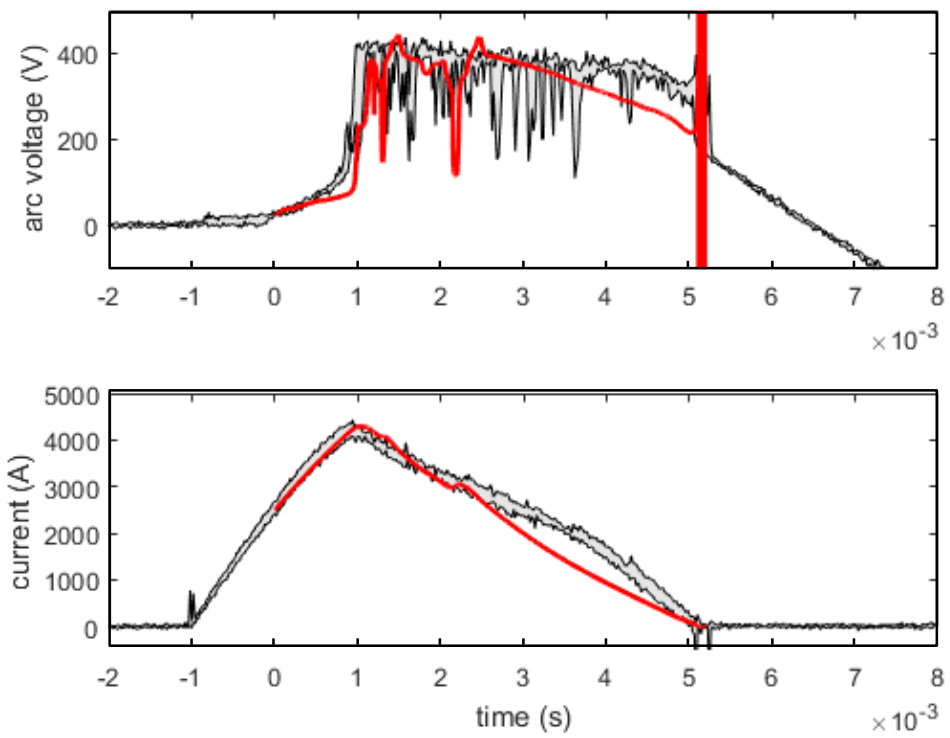
Some typical aspects

- As a scientist, **90% is scientific** work:
  - Knowledge build-up
  - Experiments, simulations, coding,….
  - Documentation: Presentations, reports, papers,…
- We work in **teams**
  - Others are dependent on the results
  - Deadlines have to be kept, for own work and for full project
  - 40h weeks
- Things do **not always work out**
  - Projects are stopped, work-packages scrapped, “failing fast” is important and a result showing something is not working
  - Sometimes urgent task forces in different topics

Research in Industry (an example)

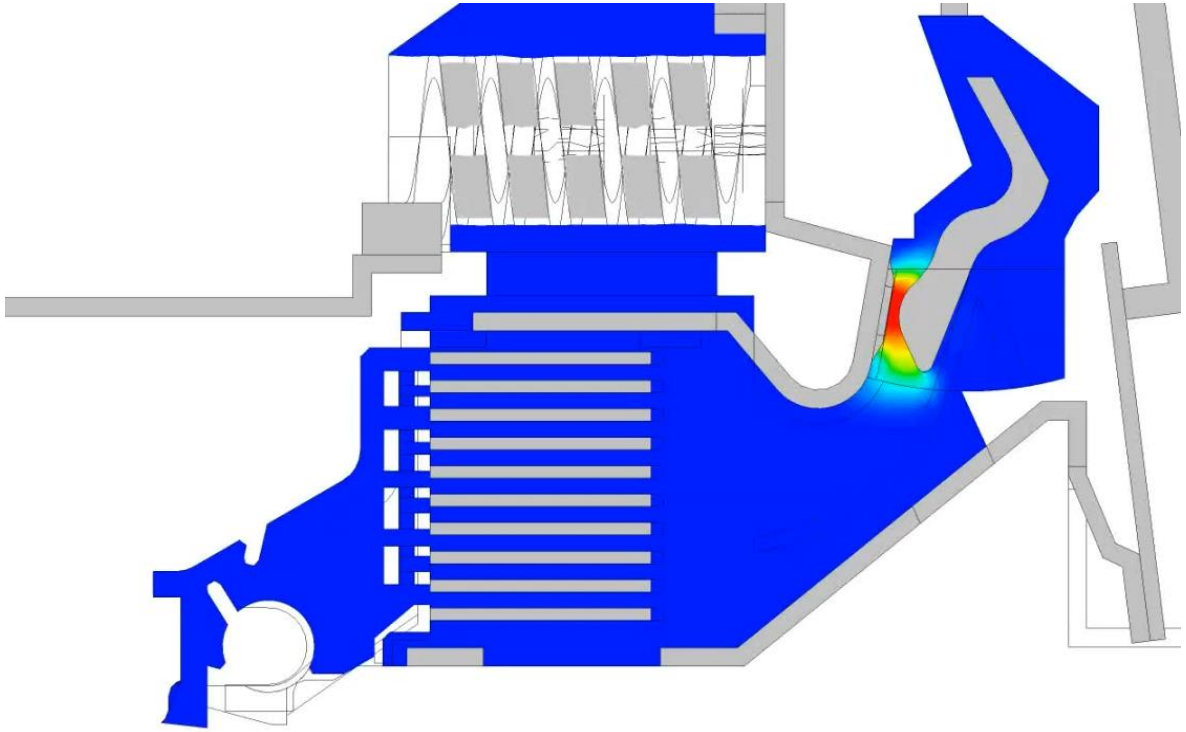
Project examples – **Low Voltage arc simulation**

Current and Voltage Measurement & Simulation



Experiment

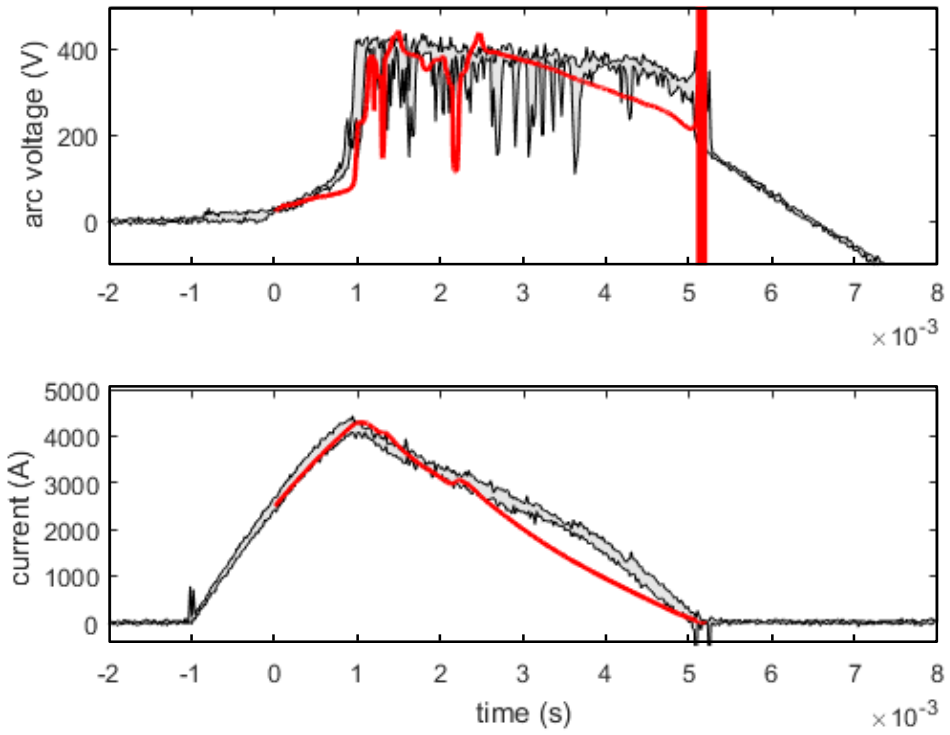
ArcSim



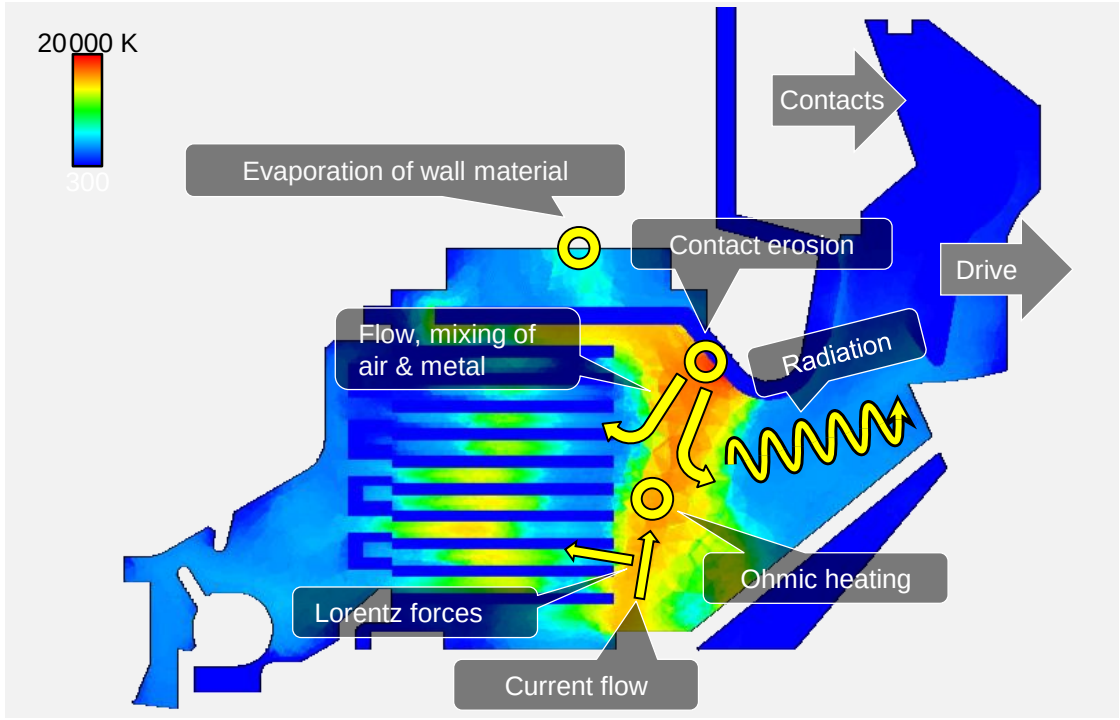
Research in Industry (an example)

Project examples – **Low Voltage arc simulation**

Current and Voltage Measurement & Simulation



Quantities accessible through ArcSim

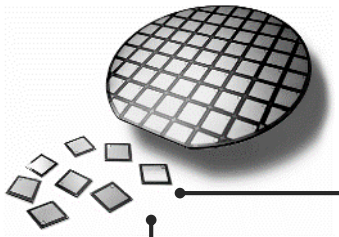


Research in Industry (an example)

Project examples – **EMC-Modeling of power converters**

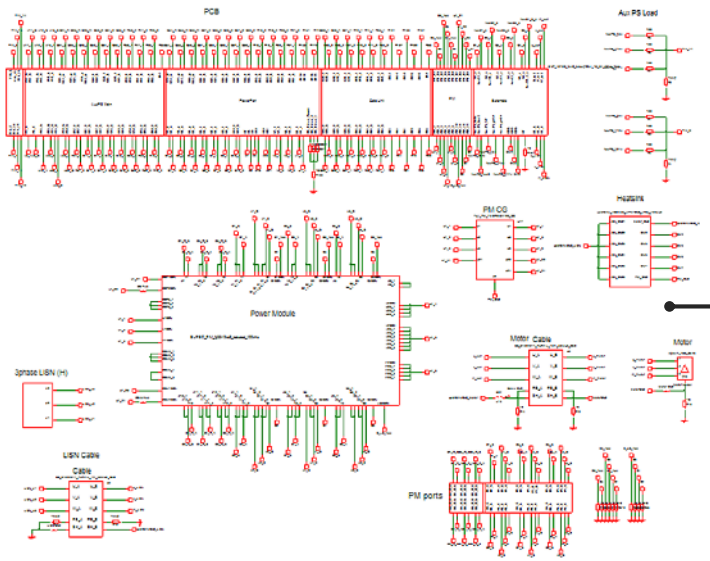
System level:
Circuit simulation (SPICE) with component compact models (sub-circuits)

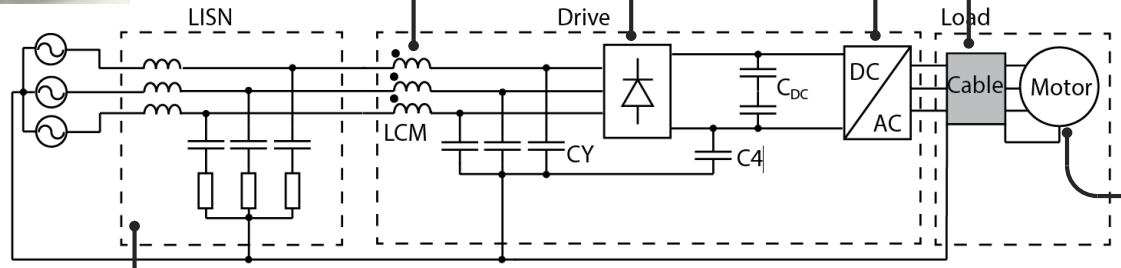
Chokes modeling



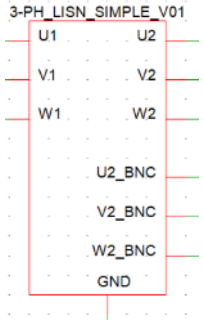
Device models & control

Cables modeling

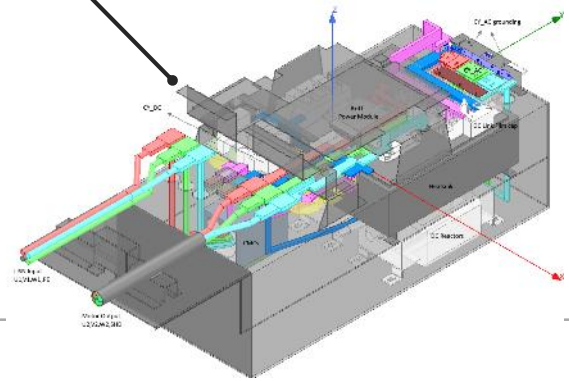




Motors modeling



LISN and EMI receiver model



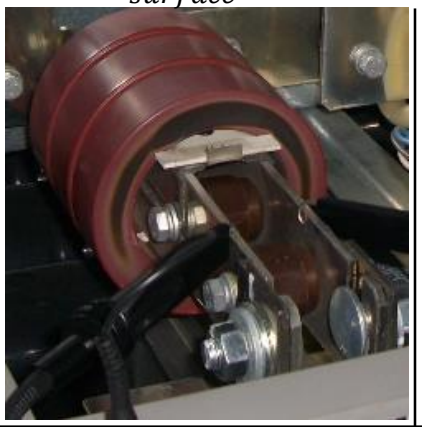
Impedance extraction for PCBs, bus bars and modules (e.g. Ansys Q3D)

Research in Industry (an example)

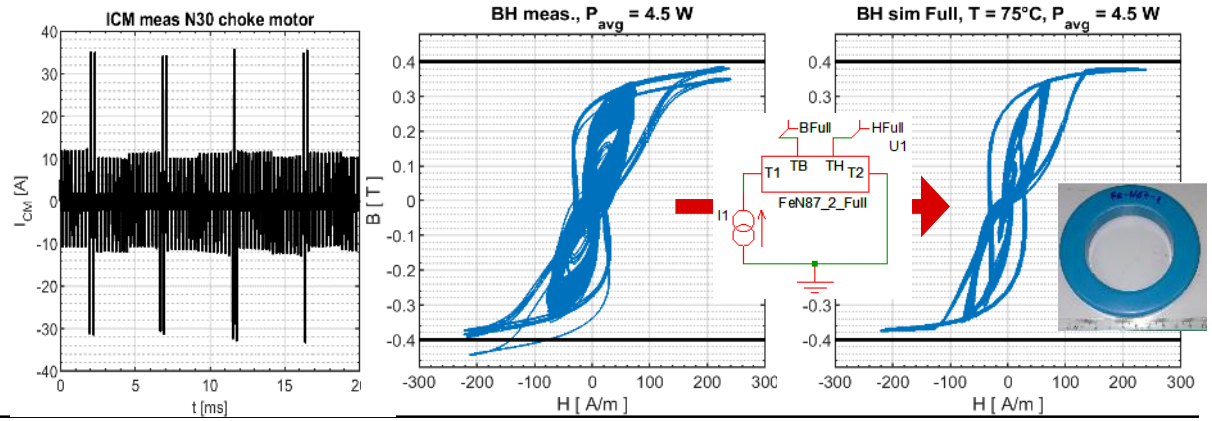
Project examples – **EMC-Modeling of power converters**

- Spice circuits of cores including saturation, hysteresis & eddy currents
- CM-chokes **overheated** due to core losses
- Need of circuit model to predict **filter performance** and **core losses**
- Strong nonlinearity of **ungapped core**, CM current waveform uncontrolled
- Accurate **model** based on physical model

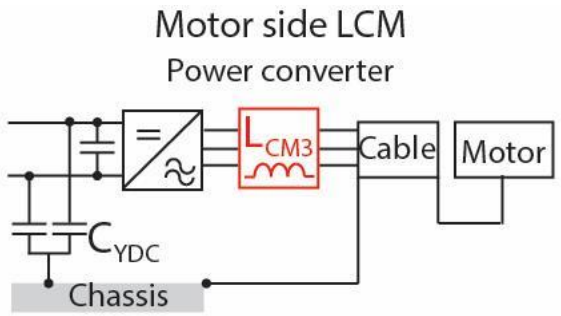
$T_{surface} = 130°C$

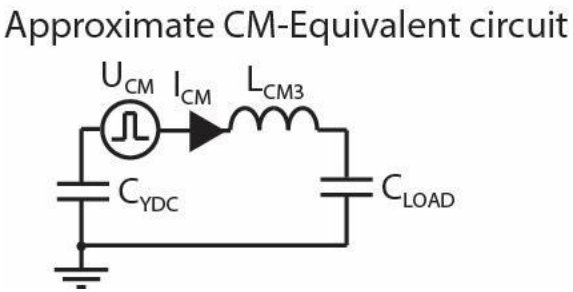


Prediction of core losses for arbitrary excitations: Ferrite N87

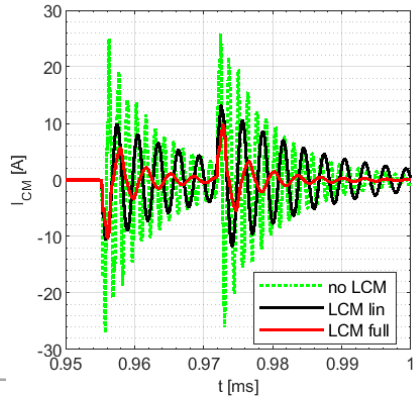


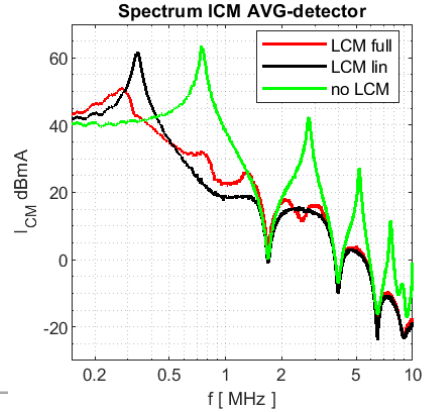
BH characteristics of CM choke on motor cable





Improved filter performance due to nonlinearity : Ferrite N87





Research in Academia vs Industry

Some typical differences

Academia	Key differences	Industry
• **Make new science** – Focus on covering knowledge gaps – Long-term meaningful – Vague outcomes – As deep as necessary	**Research focus**	• **Make science useful** – Focus on acquiring and applying knowledge – Often useful = profitable – Short-term results – Clear materialized outcomes
• **(Mostly) Individual work** – Personal, intrinsic motivators – Independent – Less technical and emotional support	**Work dynamics**	• **(Mostly) Teamwork** – Extrinsic motivators – Many dependencies – Team support & energy, joint success
• **Long & (often) coarsely managed** – Up to Prof. & individual skills – Prone to feeling unfinished/stagnant	**Project management**	• **Short & (often) strictly managed** – Structured & dynamic – Progress control, fail fast

Research in Academia vs Industry

Some typical differences

Academia	Key differences	Industry
• **Small groups** – Ad-hoc or inexistent processes – Flexibility vs support	**Structure**	• **(Often) big organization** – Established processes – Support vs barriers to execution
• **(Often) single line manager** – Clear responsibilities but hard to escalate – More arbitrary	**Leadership**	• **Distributed & (often) hierarchic** – Different stakeholders for different tasks – More control of capabilities
– Uncertain until tenure, few fitting options – More flexible schedule, tasks, and topics	**Career & life balance**	– Stable, time counts, more options – More rigid schedule, tasks, and topics
– Life in campus is fun	**Environment**	– Finish and go home
– Known expert in international community	**Visibility**	– In-house expert with little external visibility

Research in Academia vs Industry

Typical preconceptions towards industry

- **Working for the dark side**
  - It is all indeed driven by business
  - Most sustainability & inclusivity PR is questionable
  - External competition but internal collaboration
- **No proper science**
  - The majority of PhDs are in industry
  - The vast majority are not failed professors
  - Highly-qualified experts without external visibility
- **No freedom**
  - Given and clearly defined goals…
  - …but freedom to select the approach (convince the receivers)
- **No resources**
  - Largely different for large company VS startup, but generally sufficient

The transition

Realizing & translating your acquired skills for industry positions

Exploration & search process

- **Identify what you enjoy the most and are good at**
  - Technical work, coordination, support, communication, outreach…
- **Think broader: your capabilities go well beyond your PhD field of expertise**
- **Consider the diversity of roles beyond pure research**
  - Applied R&D, tech. lead, project management, consulting…
- **Scout options to materialize the opportunities…**
- **…and try out!**

Profile adaptation (CV & interview)

- **Translate your skillset to the receiver's expectations**
  - Transferable knowledge: Broader field of expertise
  - Learning capacity
  - Transferable soft skills: Project and time management, independence, inherent motivation, interdisciplinary communication, teamwork…
- **Counter typical biases toward academic experience**
  - Strong motivation for teamwork and collaboration
  - Curiosity to work in an applied direction
  - Ability to get into new topics fast and efficiently
- **Show what you have done as a proxy to what you can do**

Conclusions

- **The majority of options after graduating are not in academia**
  - Industrial research + other paths
  - Big pros and cons (weight strongly subjective)

- **There are many opportunities**
  - Unfortunately not everywhere…
  - … but less geographically restricted for industry

Trust the process and set up experiments to explore options!


ABB