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Polymer/fiber composite research activities

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Outline

- Introduction Division of Applied Mechanics – research approach
- Example activities related to polymer/fiber composites
- UU overview – where does the materials research take place?

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Department of Materials Science and Engineering

Employees: 153 (41% women)

Teachers and researchers: 81 (32% women), of which 24 are professors

Doctoral students: 75 (48% women)

Source: GLIS (figures refer to 2023)

Our Divisions

Our Department has seven research Divisions that carry out high-quality research in their area of specialisation.

- Applied Materials Science
- Applied Mechanics
- Biomedical Engineering
- Microsystems Technology
- Nanotechnology and Functional Materials
- Solar Cell Technology
- Solid State Physics

https://www.uu.se/en/department/materials-science-and-engineering

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Division of Applied Mechanics

Who?

- 2 Professors (K. Gamstedt & P. Isaksson)
- 3 Associate professors
- 2 Assistant professors and senior lecturer
- 2 Postdocs/researchers
- 5 PhD students

What?

- Teaching
- Computational material modeling
- Lab scale and synchotron based material characterization

Why?

- Material structure-property relationships
- Predictive modeling for material optimization

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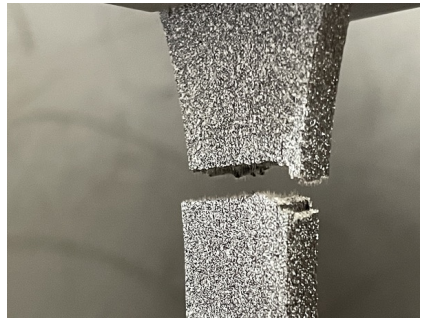
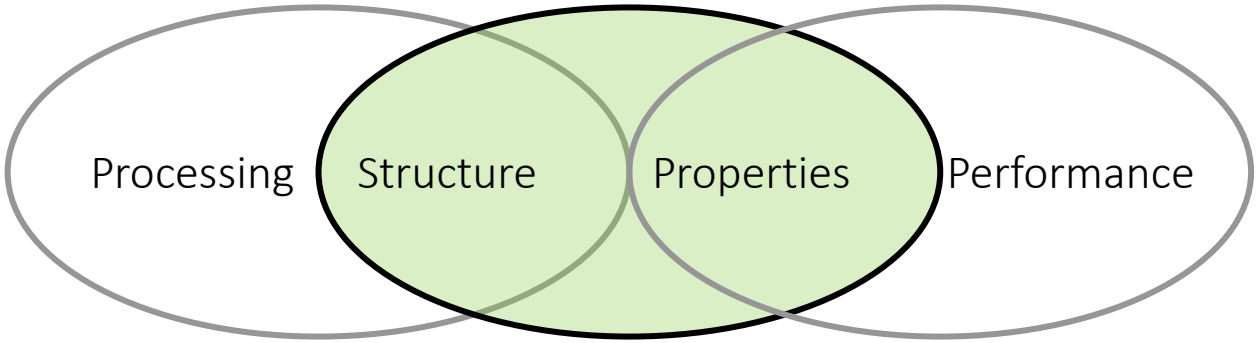
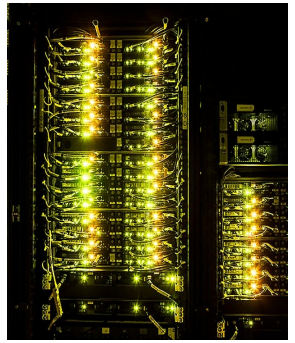
Linking (multi-scale) structure to properties – combining models and experiments



Lab-scale characterisation





National supercomputer resources

NAISS

Synchotron radiation facilities

MAX IV

ESRF
The European Synchrotron

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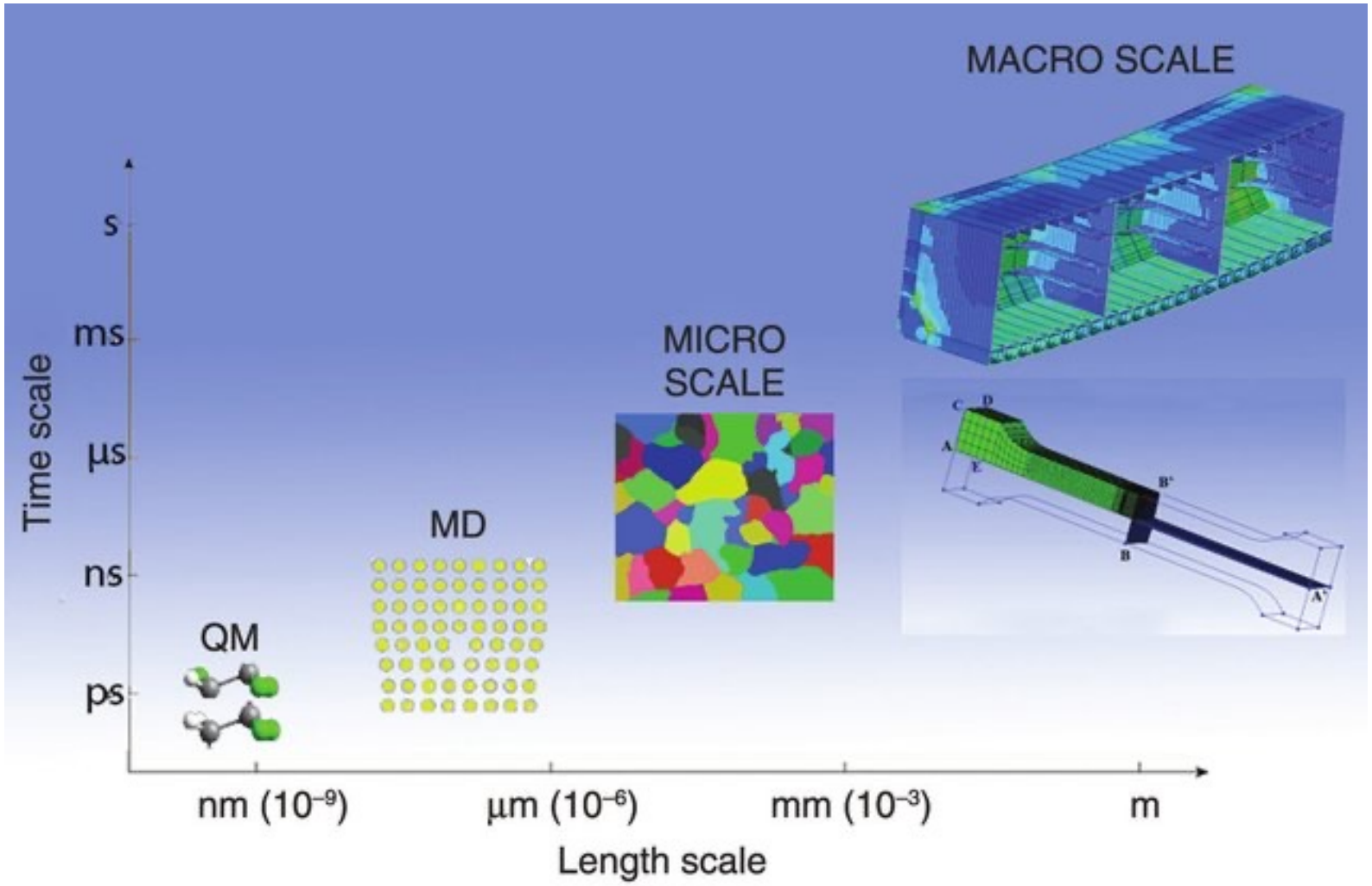
Modelling at multiple length and time scales



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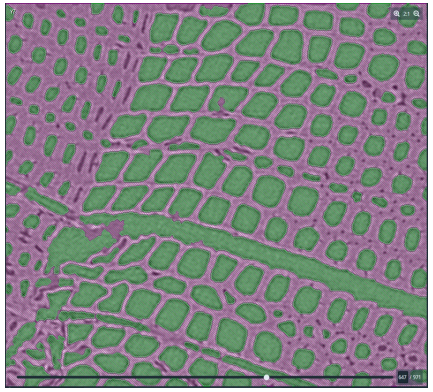
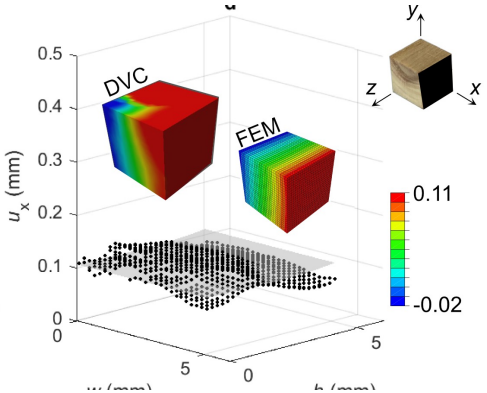
Traidia, Abderrazak & Chatzidouros, Elias & Jouiad, Mustapha. (2018). Review of hydrogen-assisted cracking models for application to service lifetime prediction and challenges in the oil and gas industry. Corrosion Reviews. 36.

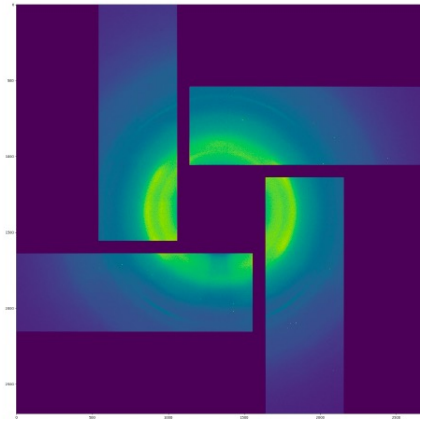
Wood and cellulose based materials research

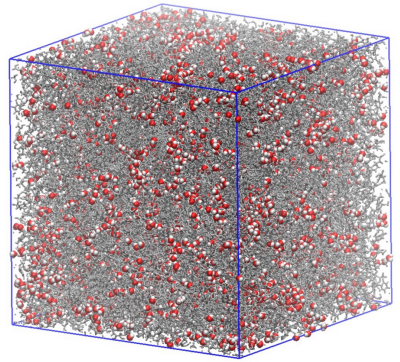


CT /SWAXS



FEM/MD





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Interfacial structure and adhesion in lignin-based thermoset fiber composites

LIGNISET®

Lignin-based thermoset resins with natural fibers

- Current application in traffic signs
- Characterization of interfacial structure
- Linking molecular and microscopic structure to mechanical properties
- Structural characterization, interfacial performance quantification + multi-scale modelling

RENFUEL
LIGNIN BIO OILS & MATERIALS

Collaboration with Renfuel

Contact: Malin Wohlert, Kristofer Gamstedt

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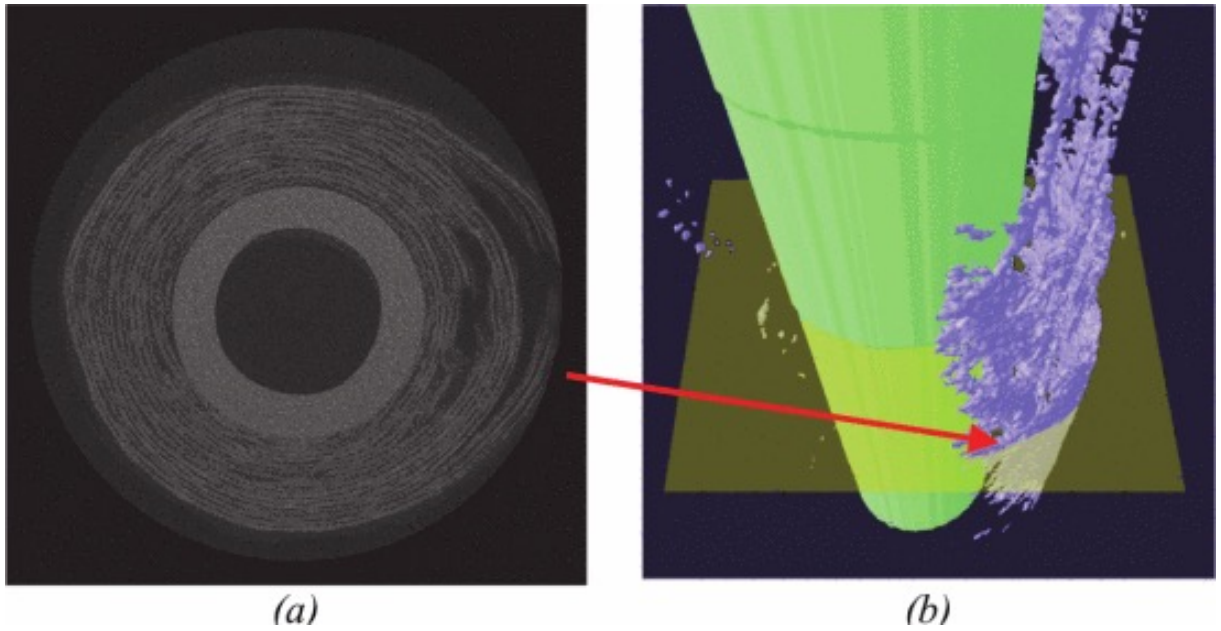
Failure mechanisms in electrical motors' composite insulation



Mica/glass fiber/epoxy composite

- Use CT and image analysis to identify weak links in electrical breakdown in composites
- Identifying the mica layer to act as a barrier
- Suggest improvements

(Saxén, Gamstedt, Afshar, Paulsson and Sahlén, "A micro-computed tomography investigation of the breakdown paths in mica/epoxy machine insulation", *IEEE Transactions on Dielectrics and Electrical Insulation*, 2018)

Collaboration with ABB Motion – Motors and Generators

Contact: Reza Afshar, Kristofer Gamstedt

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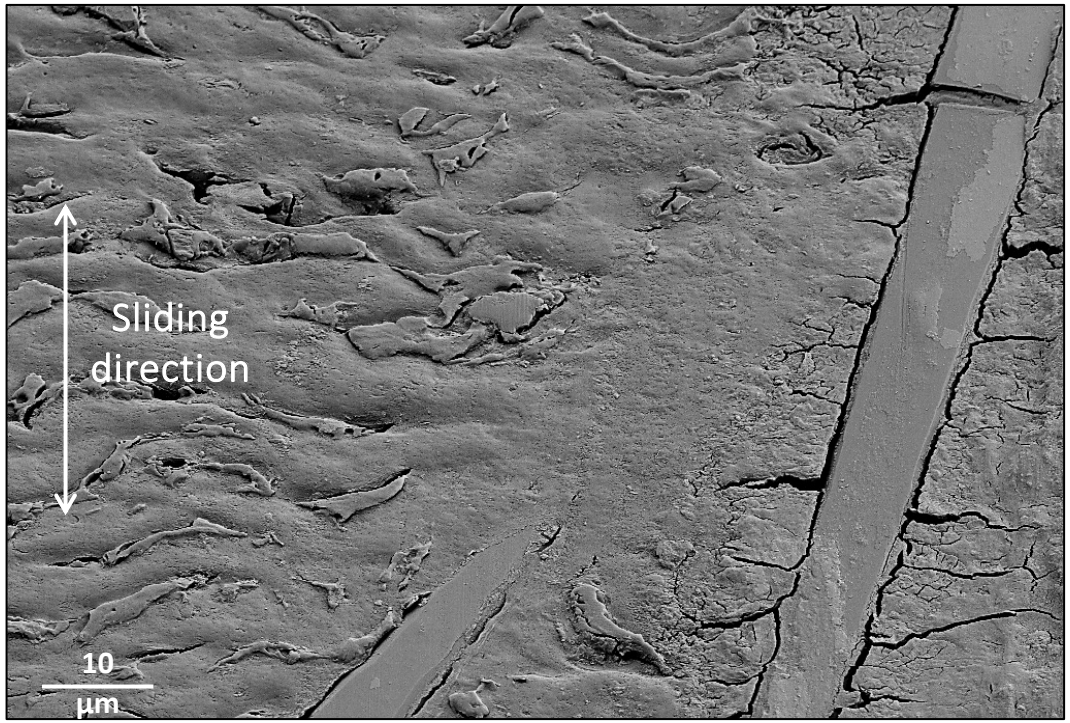
Energy saving transmission control for heavy duty vehicles



Fiber/polymer composites used in automotive components close to the engine (eg glass fiber/PPS)

- Sliding steel ball on top
- Analysis of worn surface
- Suggestions to decrease friction wear

Collaboration with Kongsberg Automotive
Contact: Jonna Holmgren, Jannica Heinrichs Lindgren
Division of Applied Materials Science

[Holmgren, Kassman Rudolphi, Heinrichs Lindgren, "The influence from PTFE on surface and sub-surface damages of glass fiber reinforced PPS", *Tribology International,* 194, 2024

Education and Research in Three Disciplinary Domains

Humanities and Social Sciences

6 faculties

Medicine och Pharmacy

2 faculties

Science and Technology

1 faculty

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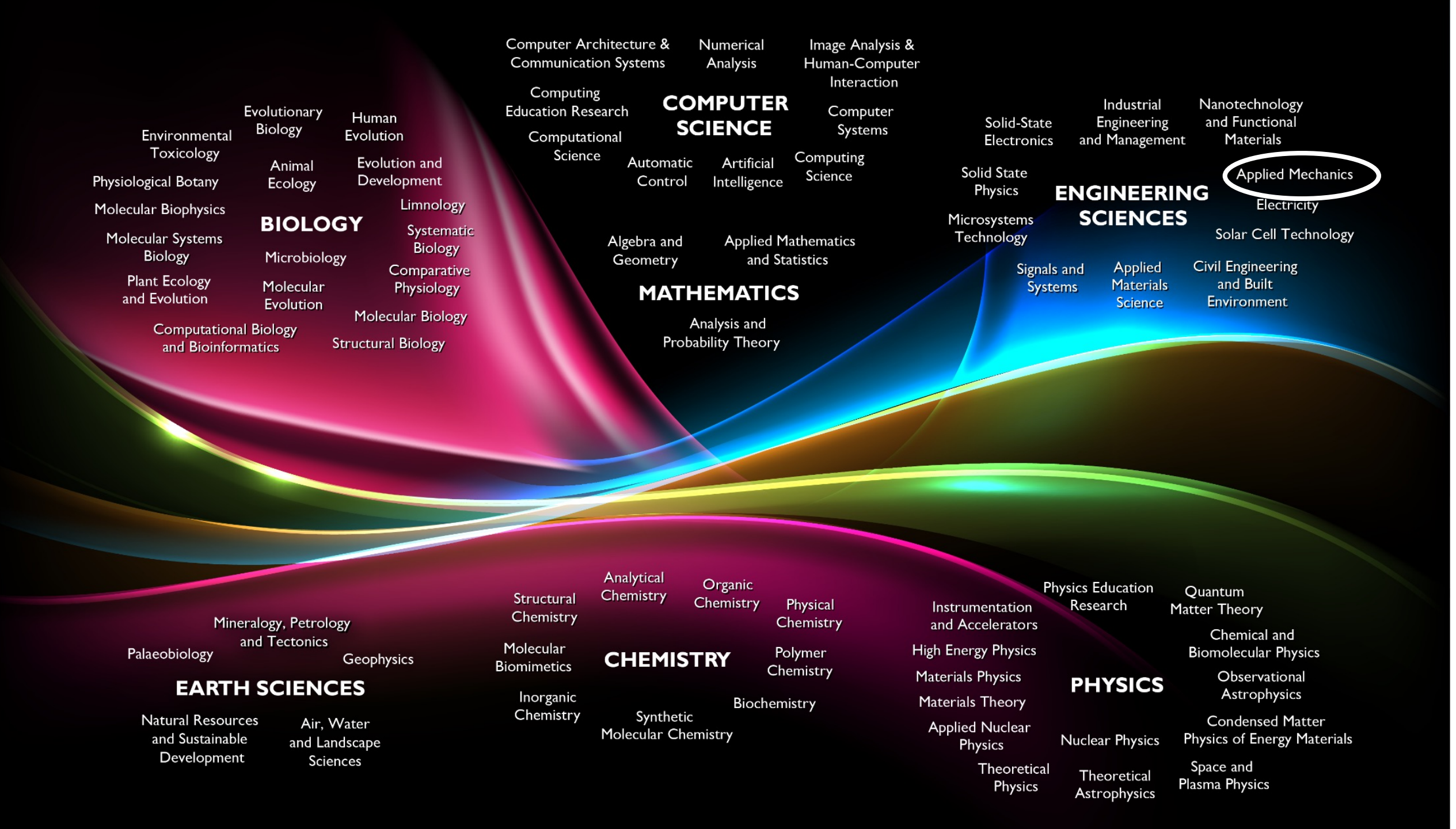
Computer Architecture & Communication Systems
Numerical Analysis
Image Analysis & Human-Computer Interaction
Computing Education Research
COMPUTER SCIENCE
Computer Systems
Computational Science
Automatic Control
Artificial Intelligence
Computing Science
Evolutionary Biology
Human Evolution
Environmental Toxicology
Animal Ecology
Evolution and Development
Physiological Botany
Limnology
Molecular Biophysics
BIOLOGY
Systematic Biology
Molecular Systems Biology
Microbiology
Comparative Physiology
Plant Ecology and Evolution
Molecular Evolution
Molecular Biology
Computational Biology and Bioinformatics
Structural Biology
Algebra and Geometry
Applied Mathematics and Statistics
MATHEMATICS
Analysis and Probability Theory
Solid-State Electronics
Industrial Engineering and Management
Nanotechnology and Functional Materials
Solid State Physics
Applied Mechanics
ENGINEERING SCIENCES
Electricity
Microsystems Technology
Solar Cell Technology
Signals and Systems
Applied Materials Science
Civil Engineering and Built Environment
Analytical Chemistry
Organic Chemistry
Structural Chemistry
Physical Chemistry
Molecular Biomimetics
CHEMISTRY
Polymer Chemistry
Inorganic Chemistry
Biochemistry
Synthetic Molecular Chemistry
Mineralogy, Petrology and Tectonics
Palaeobiology
Geophysics
EARTH SCIENCES
Natural Resources and Sustainable Development
Air, Water and Landscape Sciences
Physics Education Research
Quantum Matter Theory
Instrumentation and Accelerators
Chemical and Biomolecular Physics
High Energy Physics
Materials Physics
PHYSICS
Observational Astrophysics
Materials Theory
Applied Nuclear Physics
Condensed Matter Physics of Energy Materials
Nuclear Physics
Theoretical Physics
Theoretical Astrophysics
Space and Plasma Physics

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Thank you!

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