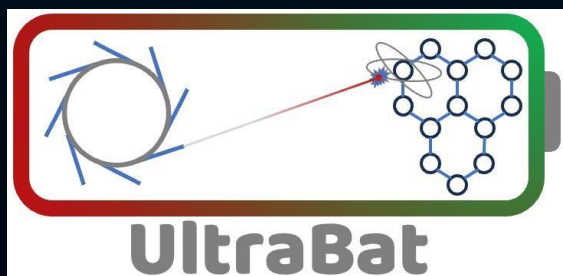
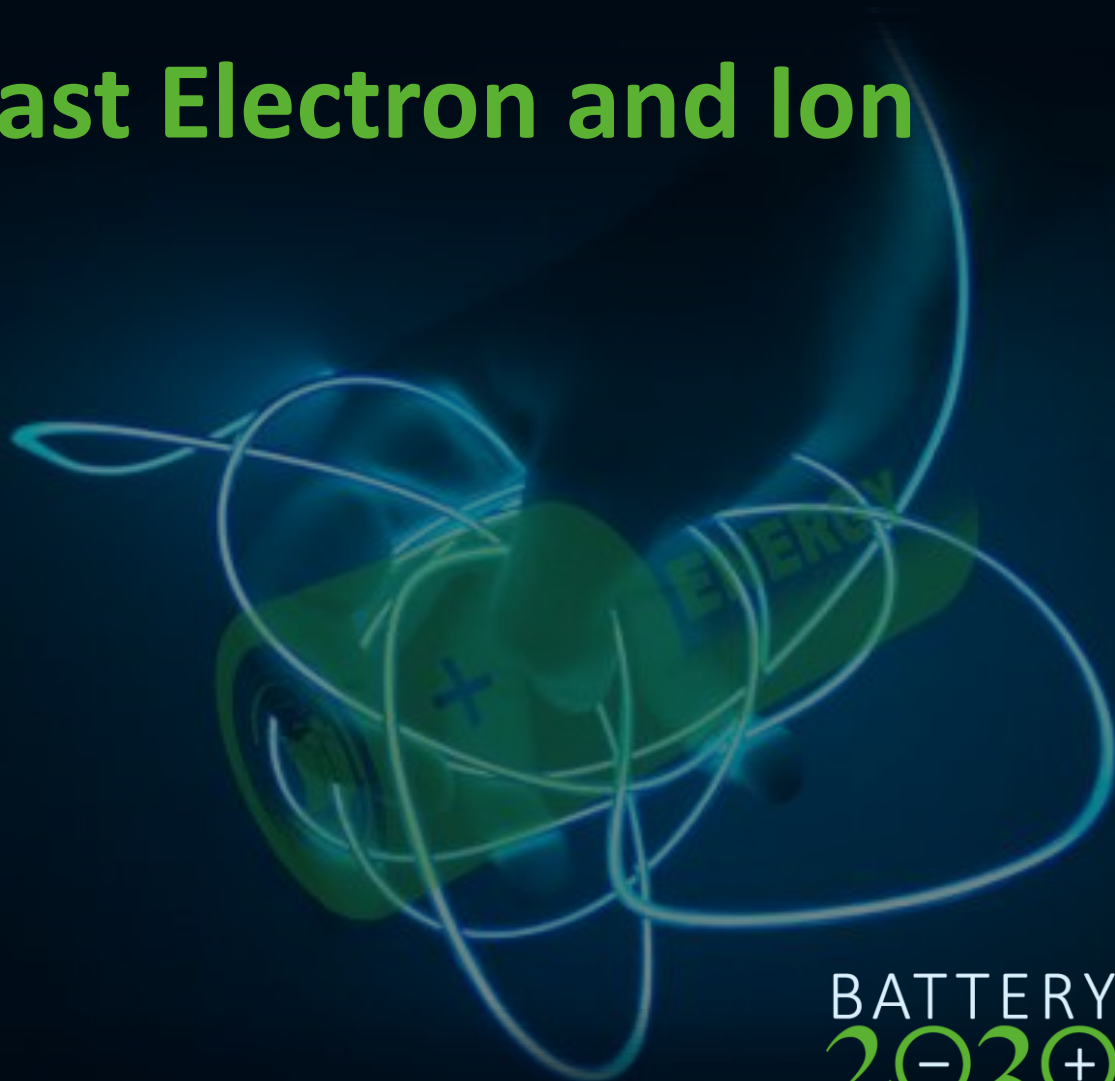




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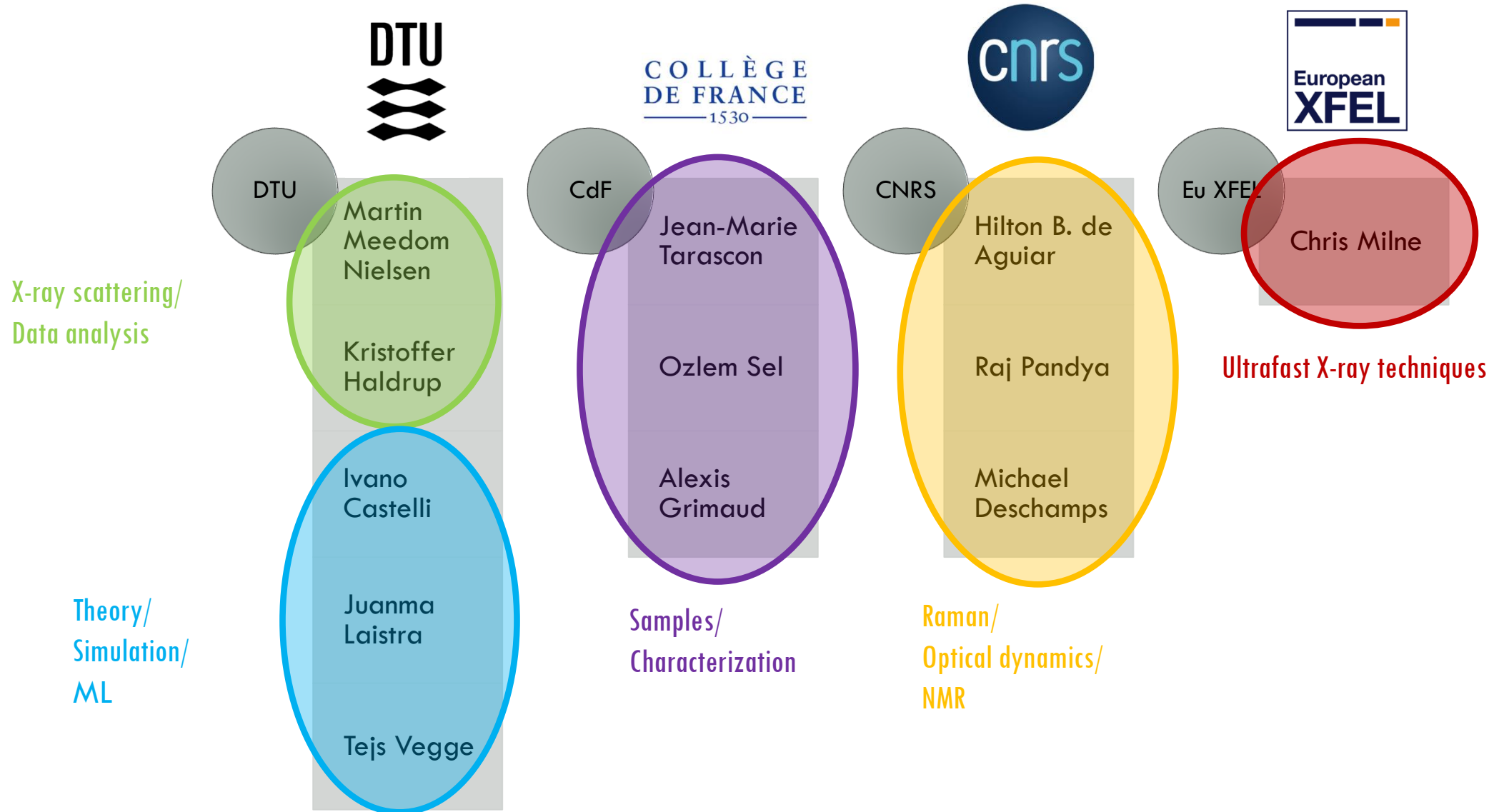
UltraBat: Capturing Ultrafast Electron and Ion Dynamics in Batteries

Asmus Ougaard Dohn, Ivano E. Castelli



BATTERY
2030+

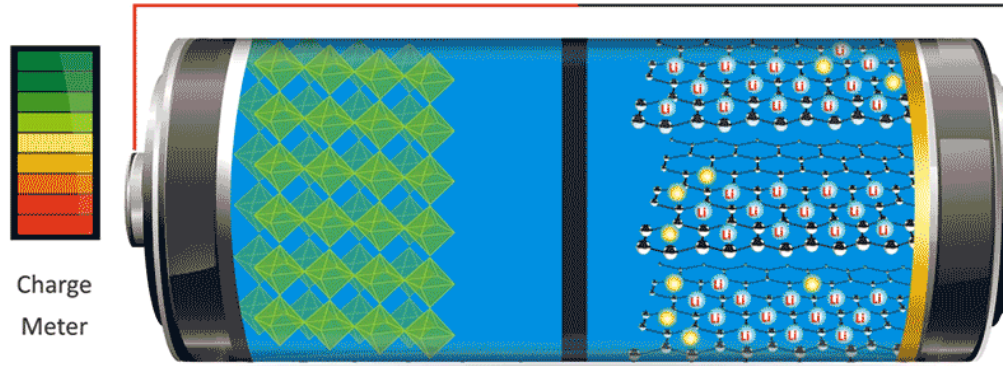
The Consortium



Battery Dynamics

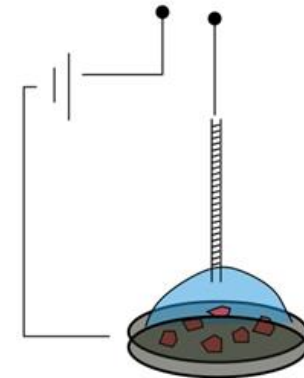
How Lithium-ion Batteries Work

Discharge



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- Batteries are non-equilibrium devices so we need to measure dynamical properties
- Timescales of electrons and ions are fast (fs to ps)
- Length scales of these dynamics are short (\AA to nm)
- To understand such a multi-component system we need a multi-mode, multi-scale approach



Micro-electrodes
Time res $\sim 0.1 \mu\text{s}$

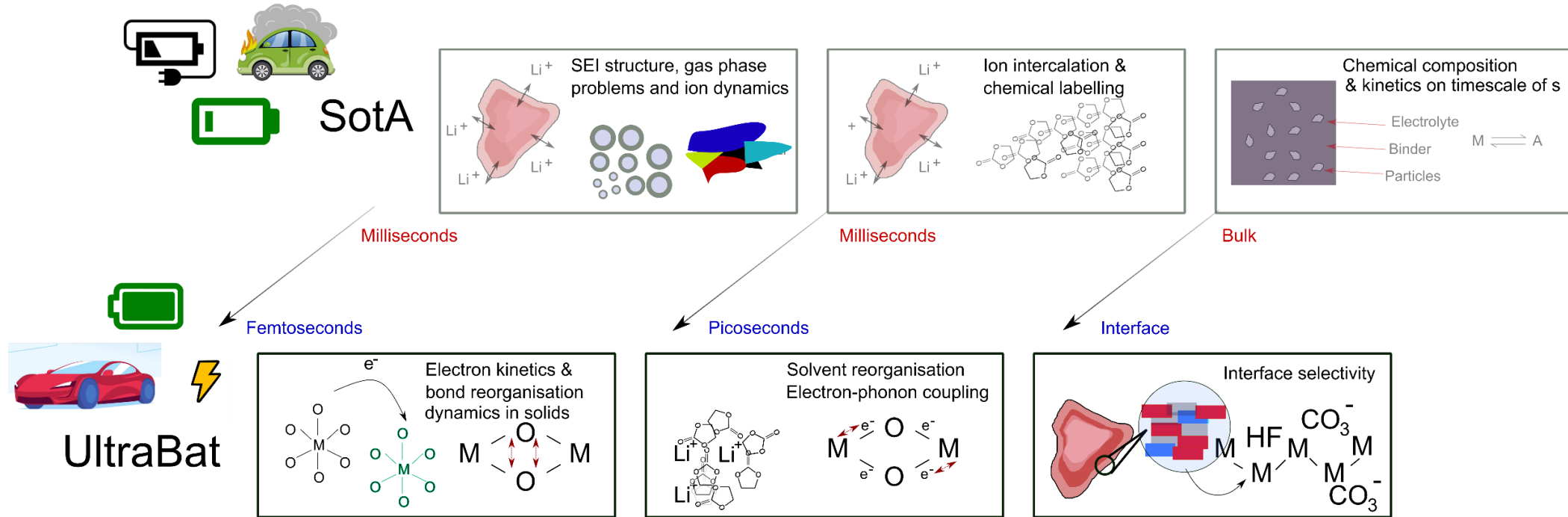


UltraBat (started Sept. 2023)

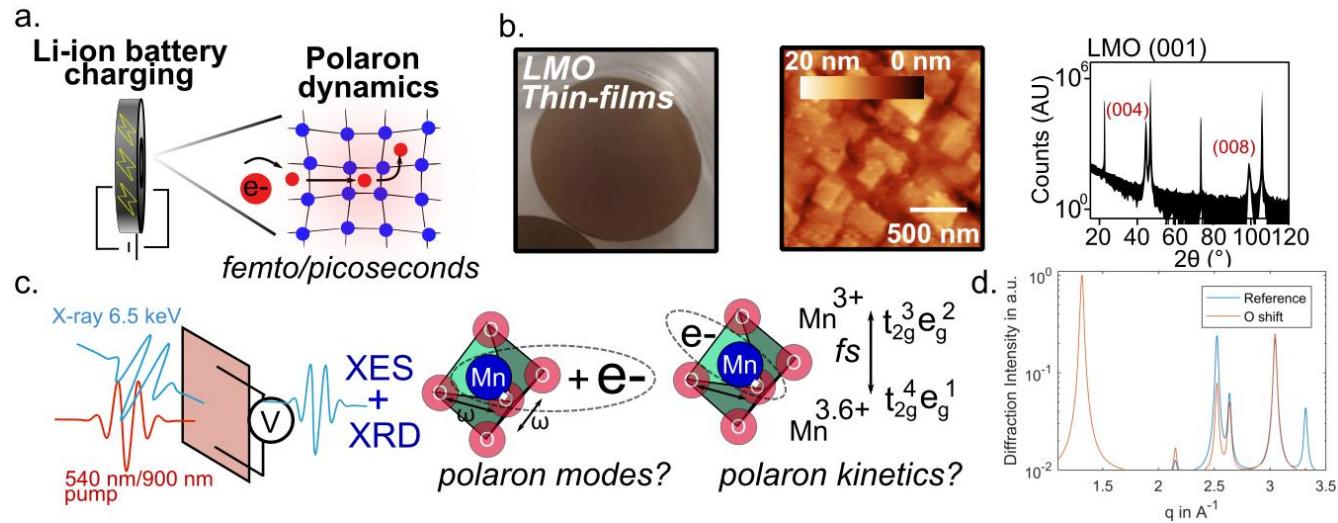
Project content

Vision

To develop novel techniques to probe electron transfer at the solid/liquid interface and between different redox active sites in the bulk of active materials.



Moving Towards Measuring Ultrafast Battery Dynamics



- LMO sample chosen for optical excitation to create polaronic electron hopping dynamics
- XES/XRD should allow polaron formation to be probed
- Preliminary optical data provides charge carrier timescales

QUESTIONS FOR THE COMMUNITY

- Standardized samples (LNO) seem like an excellent idea, are there any open questions on fast timescales that we can work on answering ?
- What are the questions you would want to address on timescales faster than you currently have available ?
- What complementary parallel measurements are important to implement ?



UltraBat and BATTERY 2030+ Roadmap

1) Which objectives of my project could be added to the roadmap goals?

To understand the effects of ion distribution in the dynamics of batteries, and thus provide guidelines necessary for the design and synthesis of the next generation of Li-rich layered compounds.

1) What are the expectations of my project from the future roadmap?

- Homogenize and integrate methodologies
- Standardize choice of materials
- Define common data strategies

