Scaling the development of new energy materials

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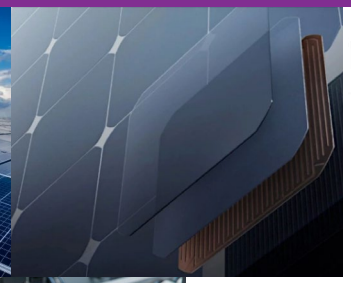
Materials – at the heart of energy technologies

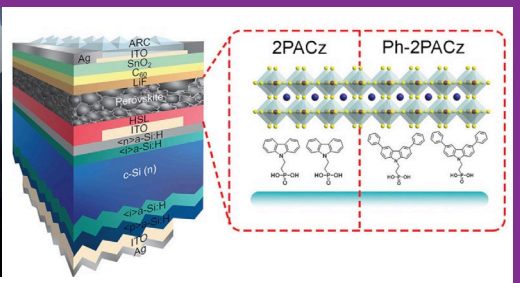
Sustainability

Performance

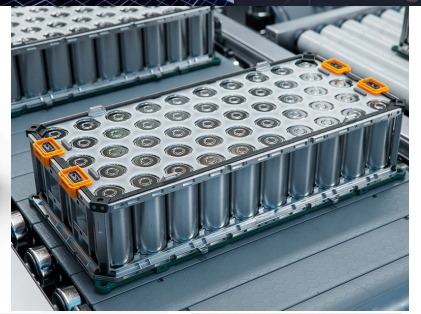
Security

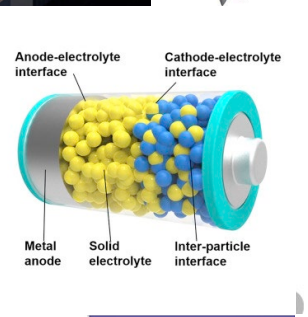


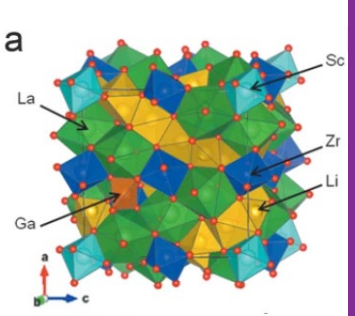






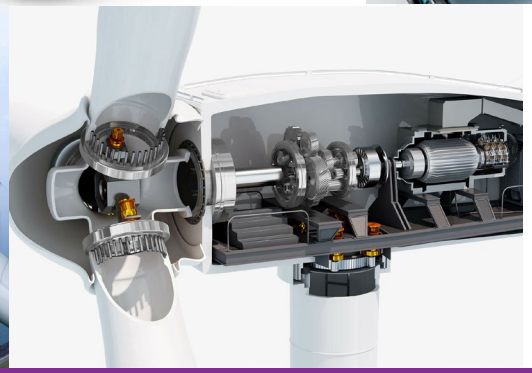


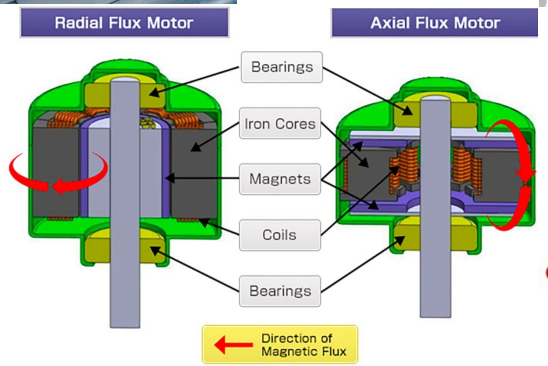


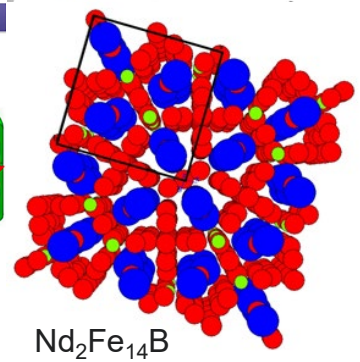


Electric motors
Batteries
Solar cells
Power electronics
Heat transfer/storage









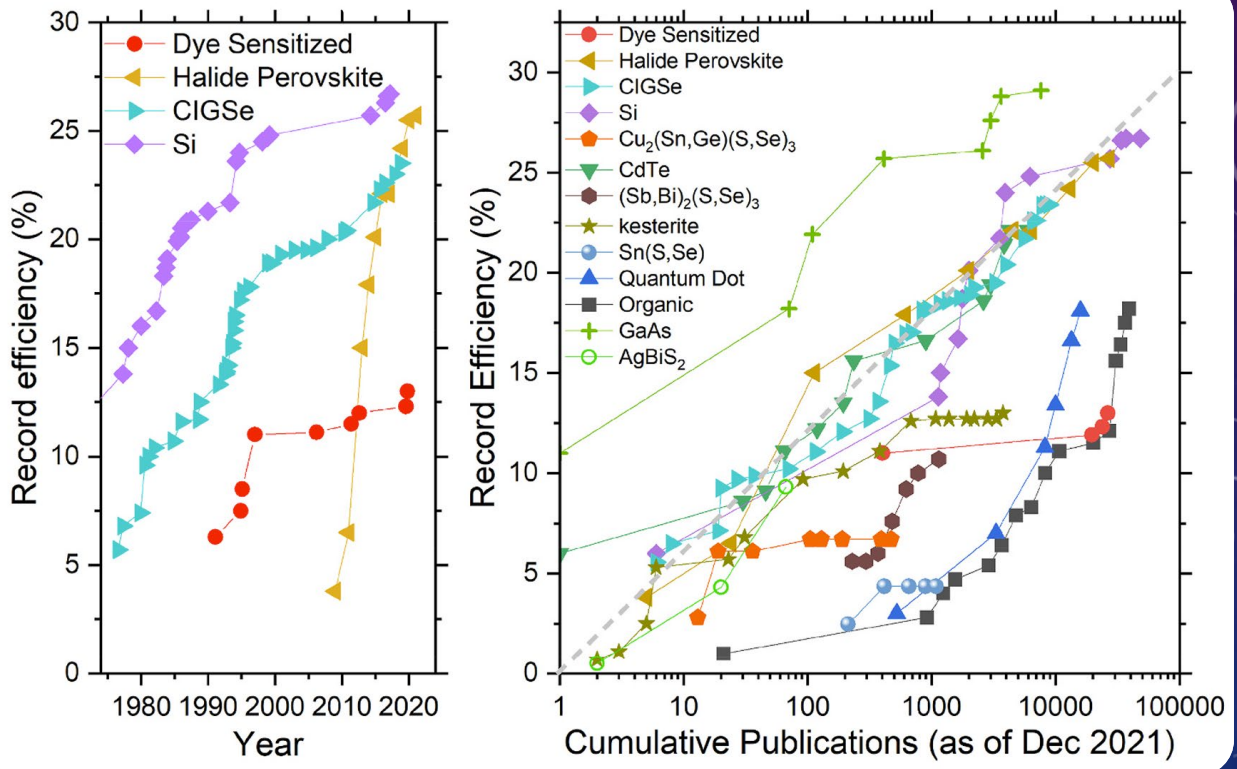
- A diversified base of materials is important for innovation
- The possibilities are limitless….
- ….yet most technologies rely on a few established materials; breakthroughs are rare

STandUPforENERGY

Learning in Materials Development

Example in Solar Cells

Dale & Scarpulla, Solar Energy Materials & Solar Cells 251



Materials are **complex** systems
Research must be massively **parallelised**
Interaction mechanism = **publications**



Incentives misaligned: learning rates are slow
Capacity to **explore** is limited

→ Materials development is **not scalable**

Scaling materials development with Self-Driving Labs

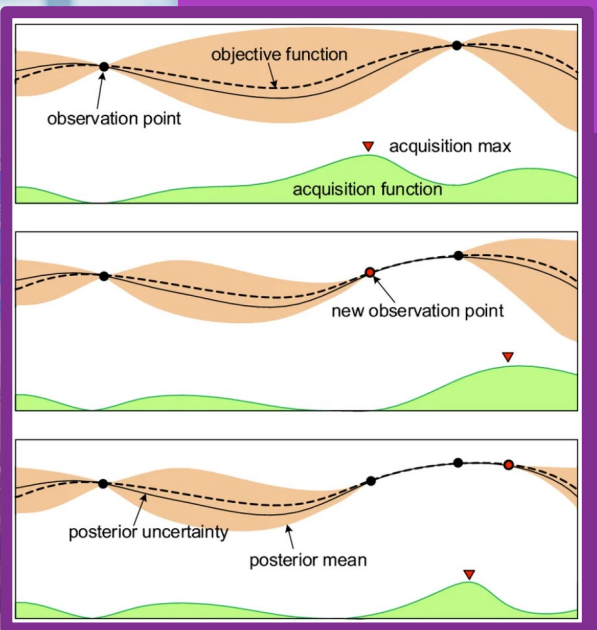
1. Automated experiment
(make/test)

2. Digitalised research data

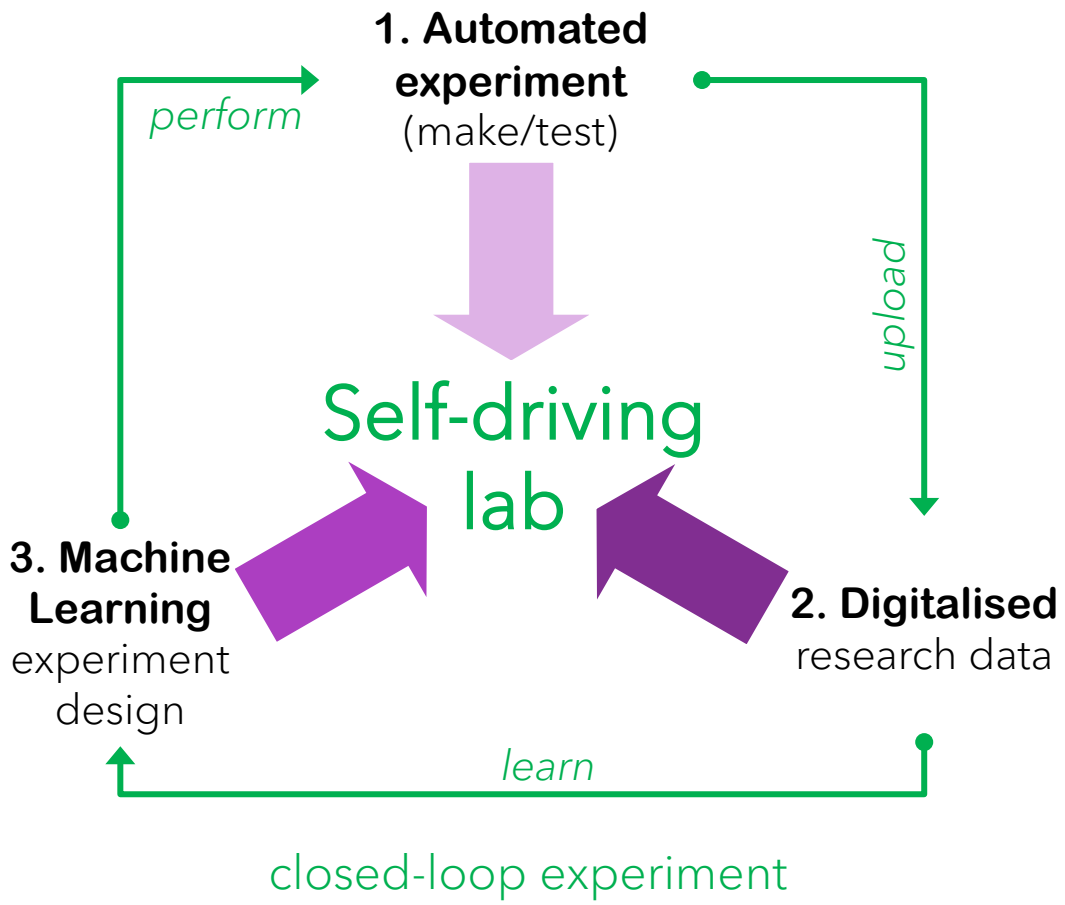
3. Machine Learning experiment design





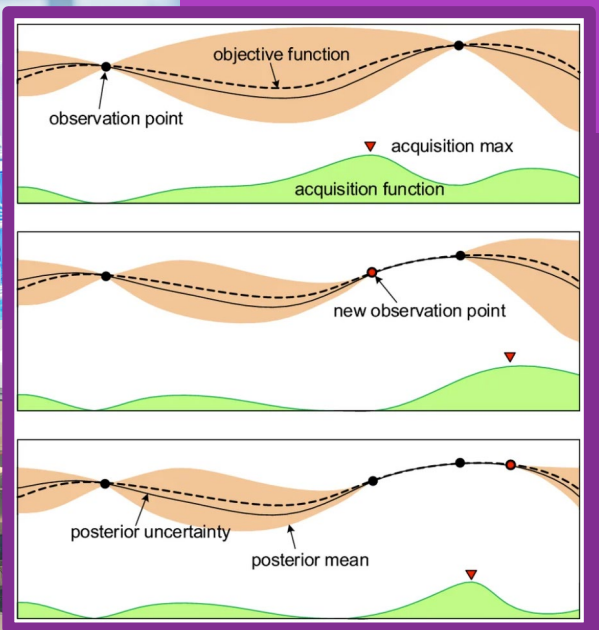


Scaling materials development with Self-Driving Labs









Scales from isolated systems to multi-institutional workflows e.g. BIG-MAP

BIG-MAP

Perspective for SDLs in Swedish Materials Research

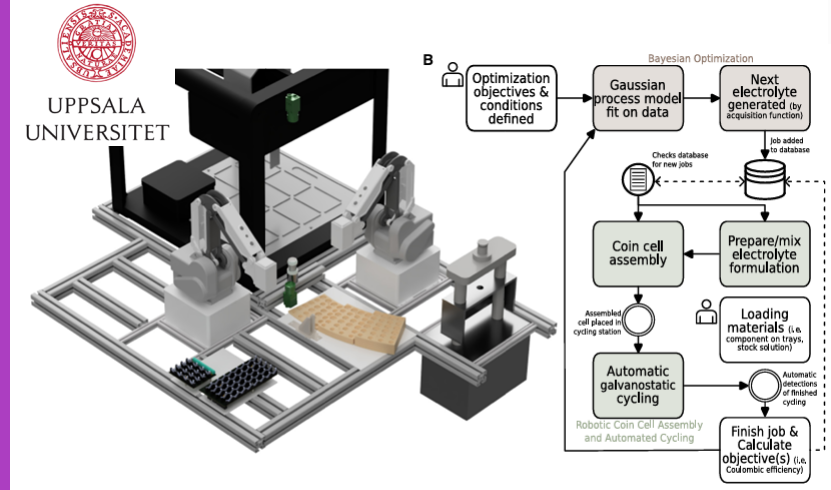
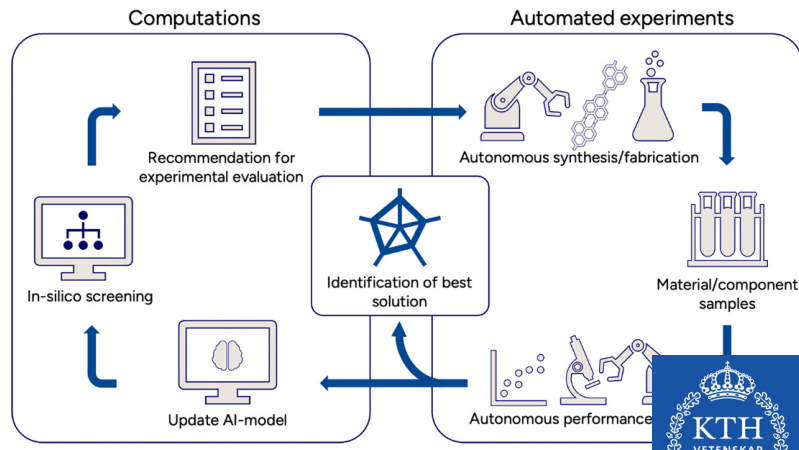


Figure 1. Robotic experimentation and workflow schematic
(A) Rendered robotic platform, ODACell 2, consisting of automated coin-cell assembly, liquid mixing, and cycling.
(B) Workflow schematic depicting autonomous electrolyte discovery.

ODACell 2 – Battery cell assembler

BATTERY 2030+

Polaris – autonomous platform for soft-matter science



The Polaris platform combines computations and automated experiments to identify optimal solution

KTH VETENSKAP OCH KONST

New incentives: datasets as the new currency of research

New capacities: greater potential to deliver new materials

New opportunities: for collaboration, for scientific vision

Needed now: focussed support for infrastructure development

Stiftelsen för Strategisk Forskning

Vetenskapsrådet

Ai4Research

At Uppsala Solar Cell Technology division:

BERTHA: SDL platform for novel optoelectronic materials

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