

Designing the Next Generation of Materials for Rare-Event Searches: High-Strength, Ultra-Pure Copper Alloys

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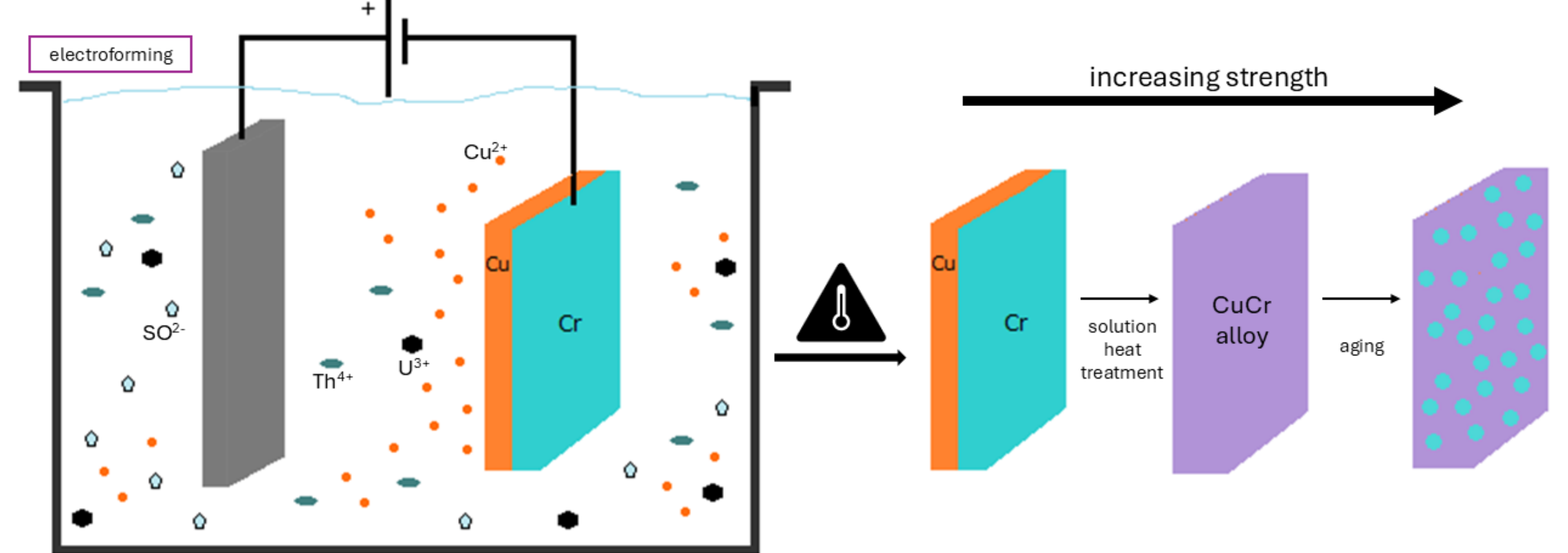
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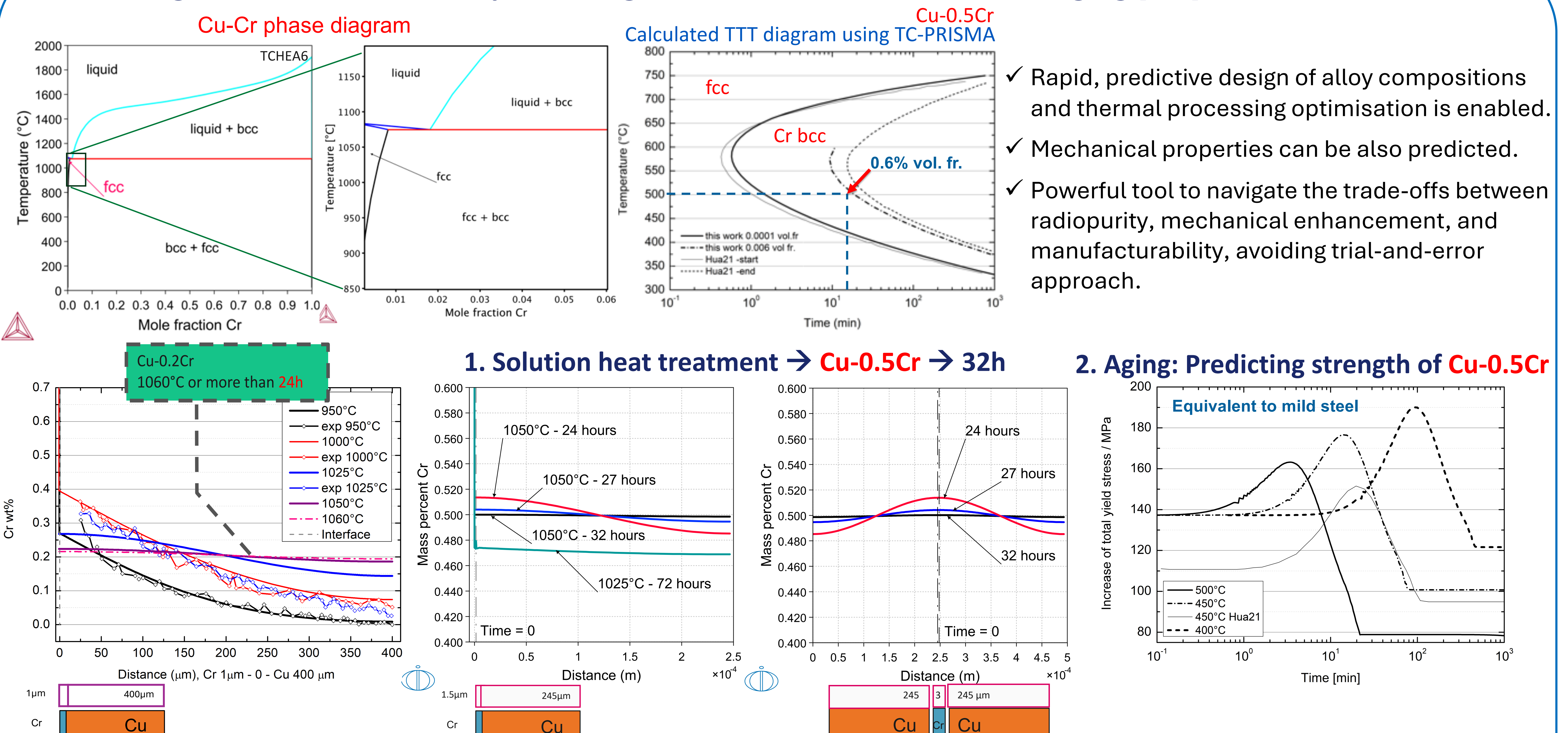
Motivation [1-3]

- Unprecedented sensitivity is required for the next-generation experiments
- Electroformed copper (EFCu) is the material of choice.
- Limited mechanical strength and ductility of EFCu restrict its application in large-scale, high-pressure, or load-bearing components.
- Manufacturing high-strength, CuCr and CuCrTi alloys is explored by a materials design approach using computational thermodynamics.

Manufacturing process

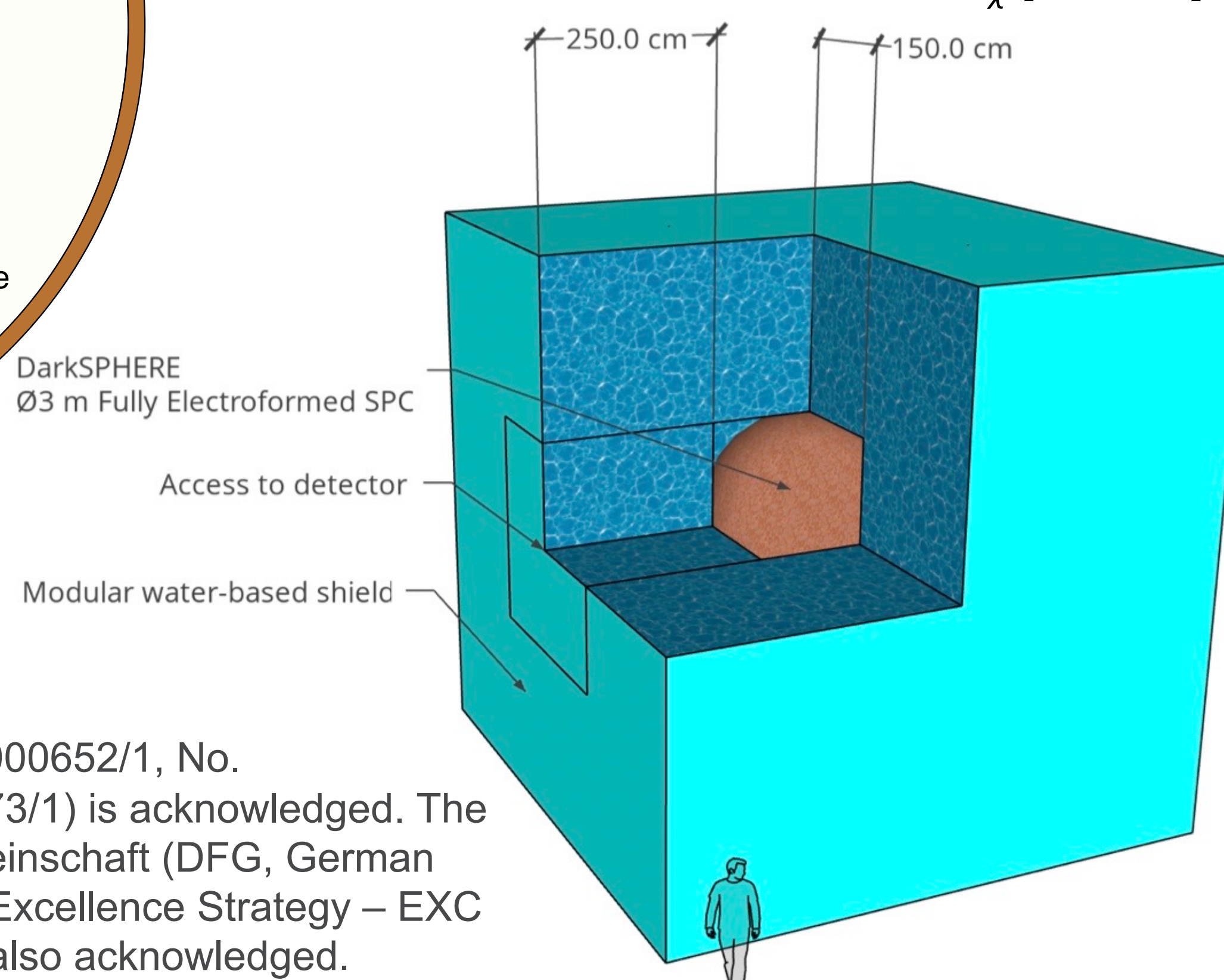
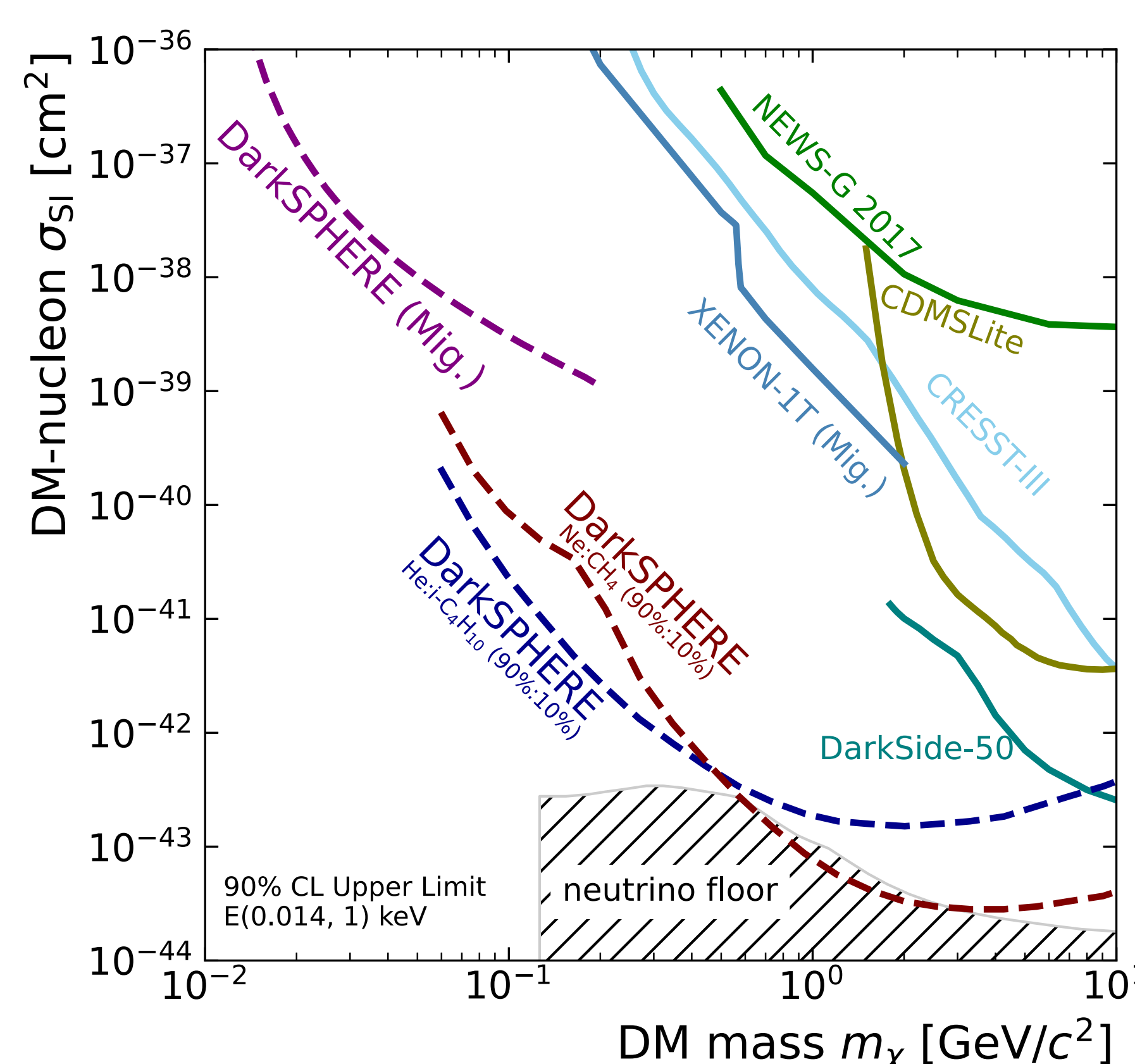
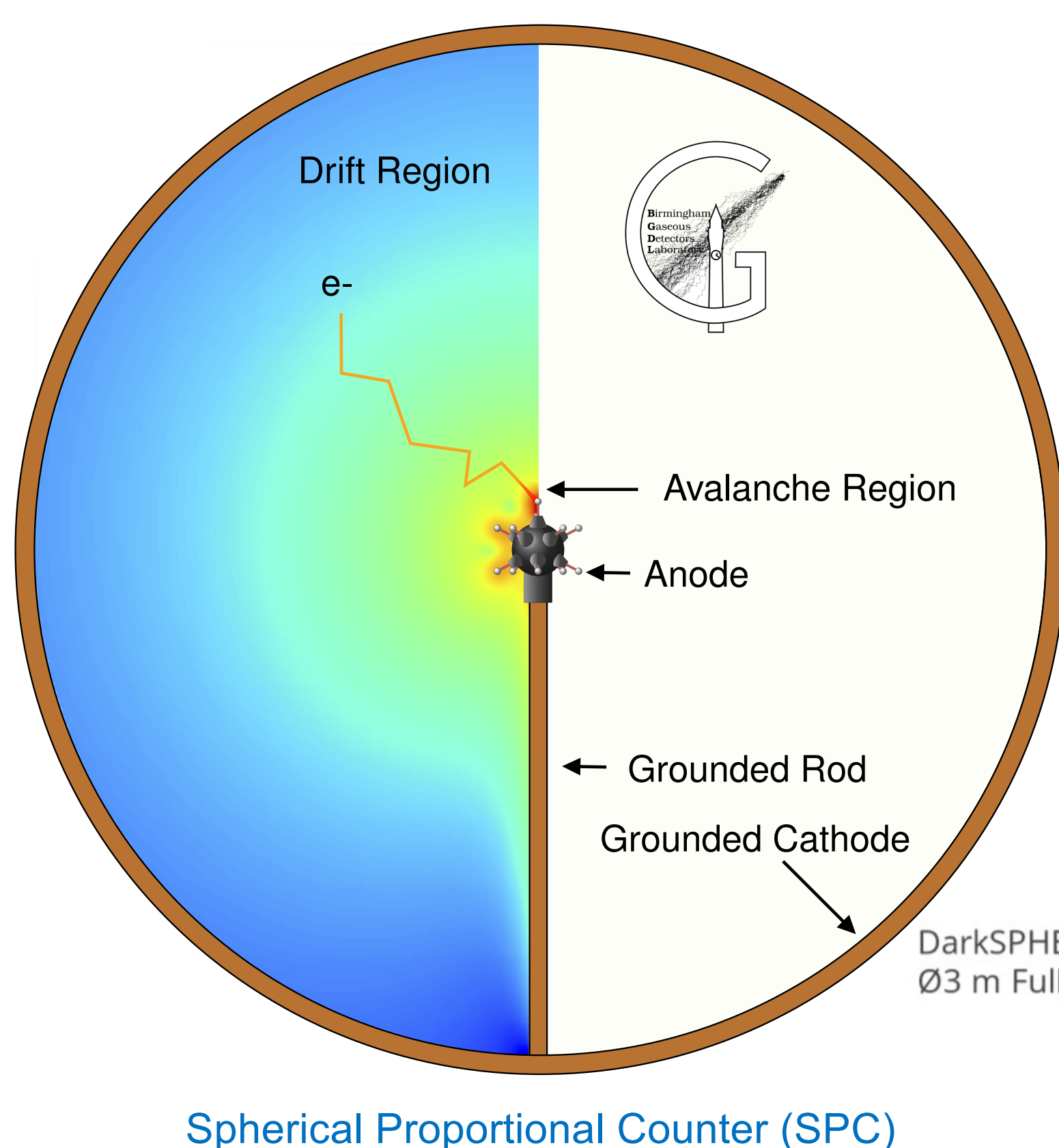


Modelling methods for thermal processing; solution heat treatment and aging [4,5]



Case study: DarkSPHERE [5]

A high-purity CuCr alloy with **double the strength over EFCu**, would allow operation at **10 bar** and reduce the required data collection time to **150 days**.



Summary

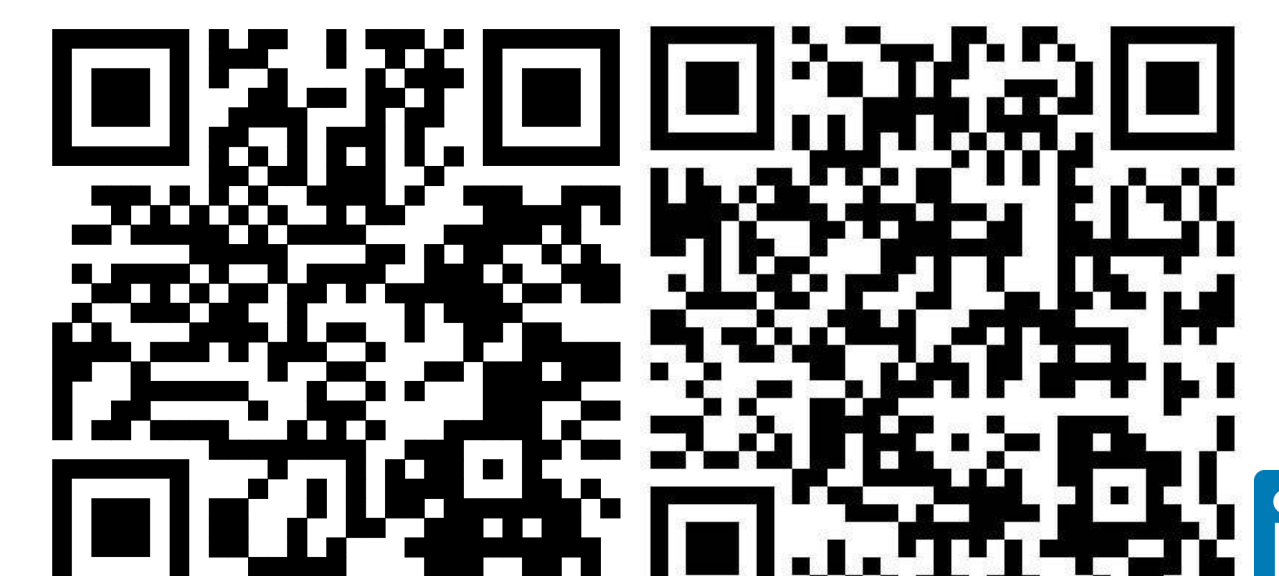
- Based on early experimental trials, synthesis of CuCr alloys is possible using electrodeposition
- We propose a methodology for designing copper-alloys using computational thermodynamics
- We validated solution heat treatment simulations
- Aging time/ duration needs to be validated
- We designed Cr/Cu and Cr/Ti and Cu/CrTi layer configurations to manufacture CuCr and CuCrTi

References

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- Vitale A. et al., Nucl. Instrum. Meth. A, 1003 (2021): 165291
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Acknowledgments

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PureAlloys: dematerializ.github.io