

# Scientific Conclusions and Closing Remarks

---



Skyler Degenkolb ([degenkolb@physi.uni-heidelberg.de](mailto:degenkolb@physi.uni-heidelberg.de))

*Low-Energy Precision Physics  
Physikalisches Institut, Universität Heidelberg*

ECT\*, Trento, 8 March 2024

# Scientific ~~Conclusions~~ and Closing Remarks

---



Skyler Degenkolb ([degenkolb@physi.uni-heidelberg.de](mailto:degenkolb@physi.uni-heidelberg.de))

*Low-Energy Precision Physics*

*Physikalisches Institut, Universität Heidelberg*

ECT\*, Trento, 8 March 2024

# Scientific Conclusions and Closing Remarks

---



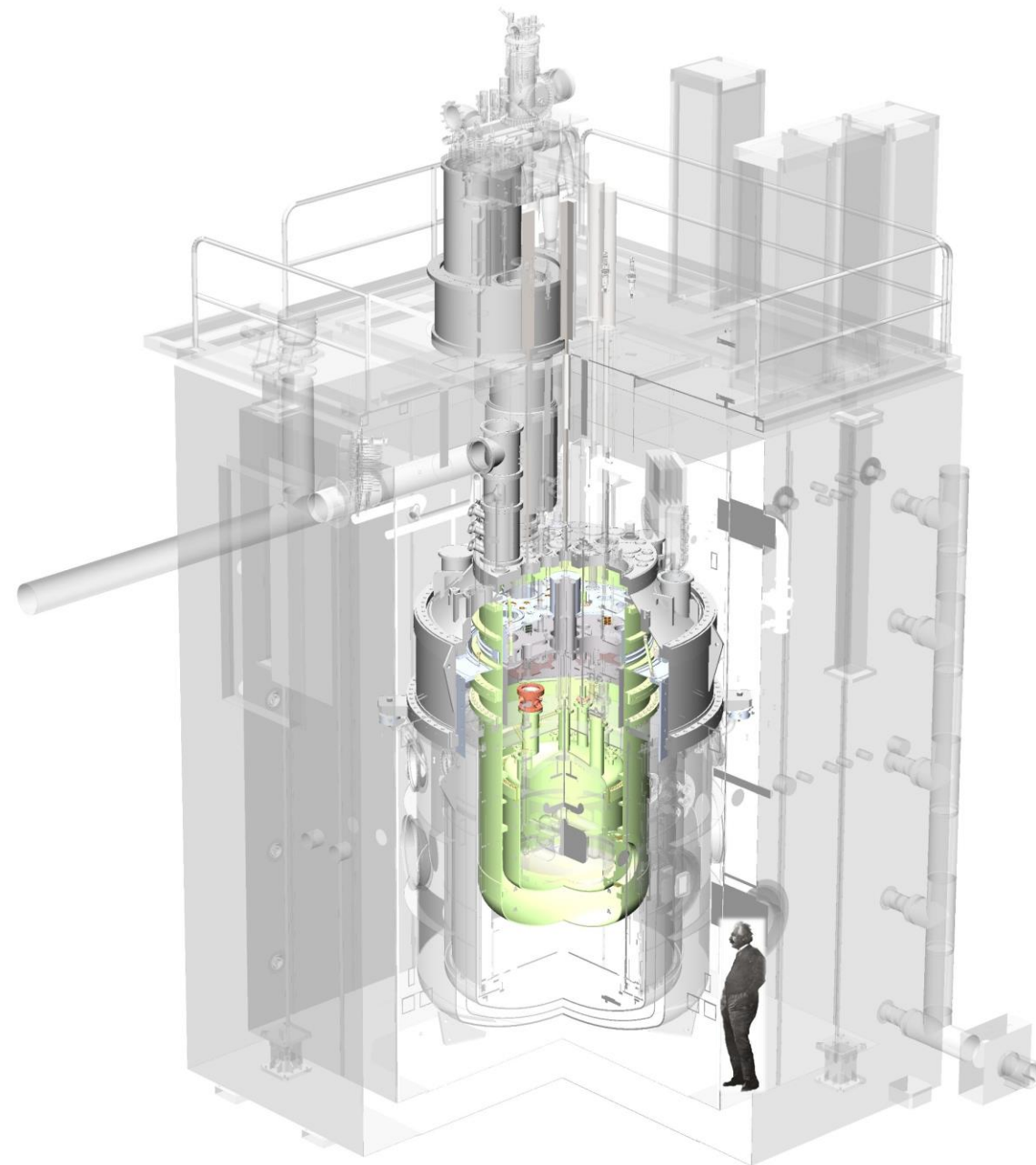
Skyler Degenkolb ([degenkolb@physi.uni-heidelberg.de](mailto:degenkolb@physi.uni-heidelberg.de))

*Low-Energy Precision Physics  
Physikalisches Institut, Universität Heidelberg*

ECT\*, Trento, 8 March 2024

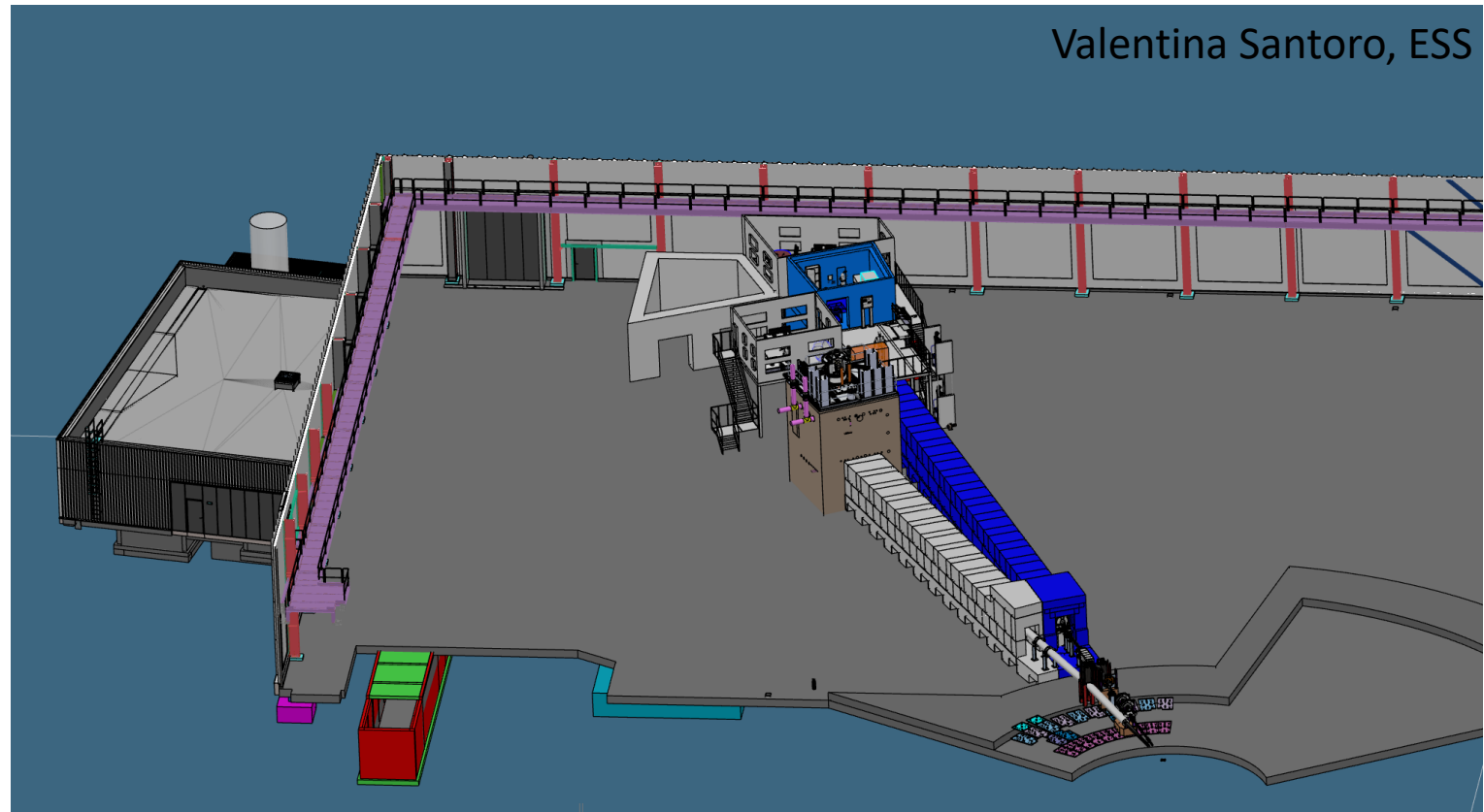
# nEDM@SNS (ESS?)

- A large-scale cryogenic experiment to measure the neutron EDM at a sensitivity below  $3 \times 10^{-28}$  ecm.
- Mostly developed by US Department of Energy and National Science Foundation, but funding terminated in 2023 with construction underway.
- Remaining R&D could be technically completed at ILL and universities.
- Experiment could be installed at ESS for improved precision: beyond the goals at Oak Ridge's Spallation Neutron Source.
- Uses cryogenic techniques to improve many aspects of the experiment
- Production of ultracold neutrons *in-situ* in superfluid  $^4\text{He}$  provides a high density in measurement cells
- The same  $^4\text{He}$  serves as insulator for high voltage, permitting higher electric field than at room temperature
- The Same  $^4\text{He}$  serves as a scintillator to detect light from absorption of neutrons on a  $^3\text{He}$  spin analyzer
- Cryogenic experiment allows precise control of magnetic field conditions



# Relocating the nEDM Experiment to ESS is under discussion

- The nEDM experiment could be installed, e.g., on the E6 beamline at the ESS
- Initial investigations show that the experiment is technically compatible with ESS site (with minor modifications)
- Seeking to collaborate with Europe-based scientists to complete R&D at ILL and obtain future funding



“The ESS is a wonderful machine, offering very broad scientific capabilities from condensed matter to particle physics”

## Ultracold neutron source in the HighNESS project

Valentina Santoro ESS

on behalf of the HighNESS Consortium



PhD in Particle Physics in 2009 University of Ferrara, Italy

From 2006 to 2014 Particle Physics Research in the BaBar experiment at SLAC

In 2014 I moved to the ESS-European Spallation Source ERIC in Sweden

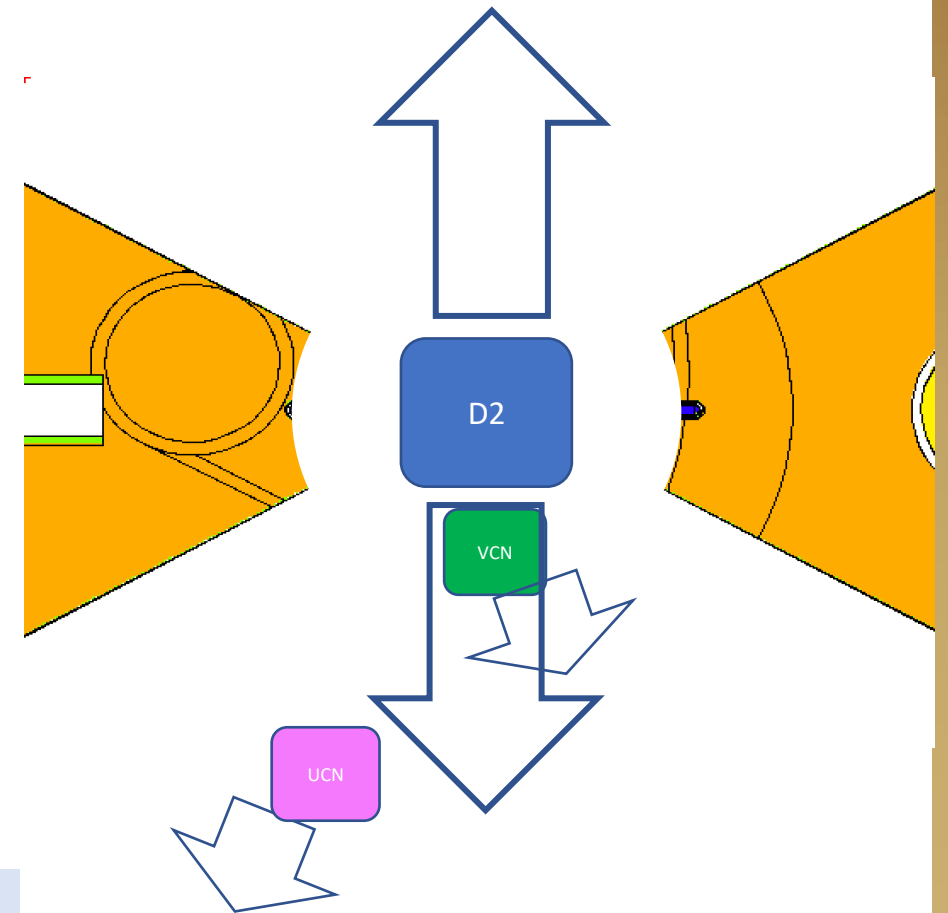
NNBAR/HIBEAM (Neutron antineutron oscillation experiment at ESS) Technical Coordinator

From 2023 Associate Professor at Lund University



## Development of **High** Intensity **N**eutron Source at the **E**uropean **S**pallation **S**ource

- The HighNESS project (3 MEURO funded by the European Commission) has as purpose the development of the new source that will be installed at ESS >2030
- The new source will be composed by **Liquid deuterium moderator D2**
- The liquid deuterium will serve a **UCN moderator** and a **VCN source**
- The associated condensed matter instruments and the neutron antineutron oscillation experiment NNBAR will also developed in the project
- **Conceptual Design Report of the ESS upgrade is expected delivered in September 2023**



**Complementarity with what is currently available at ESS**



# HighNESS aims at complementing the ESS current moderator in two different aspects

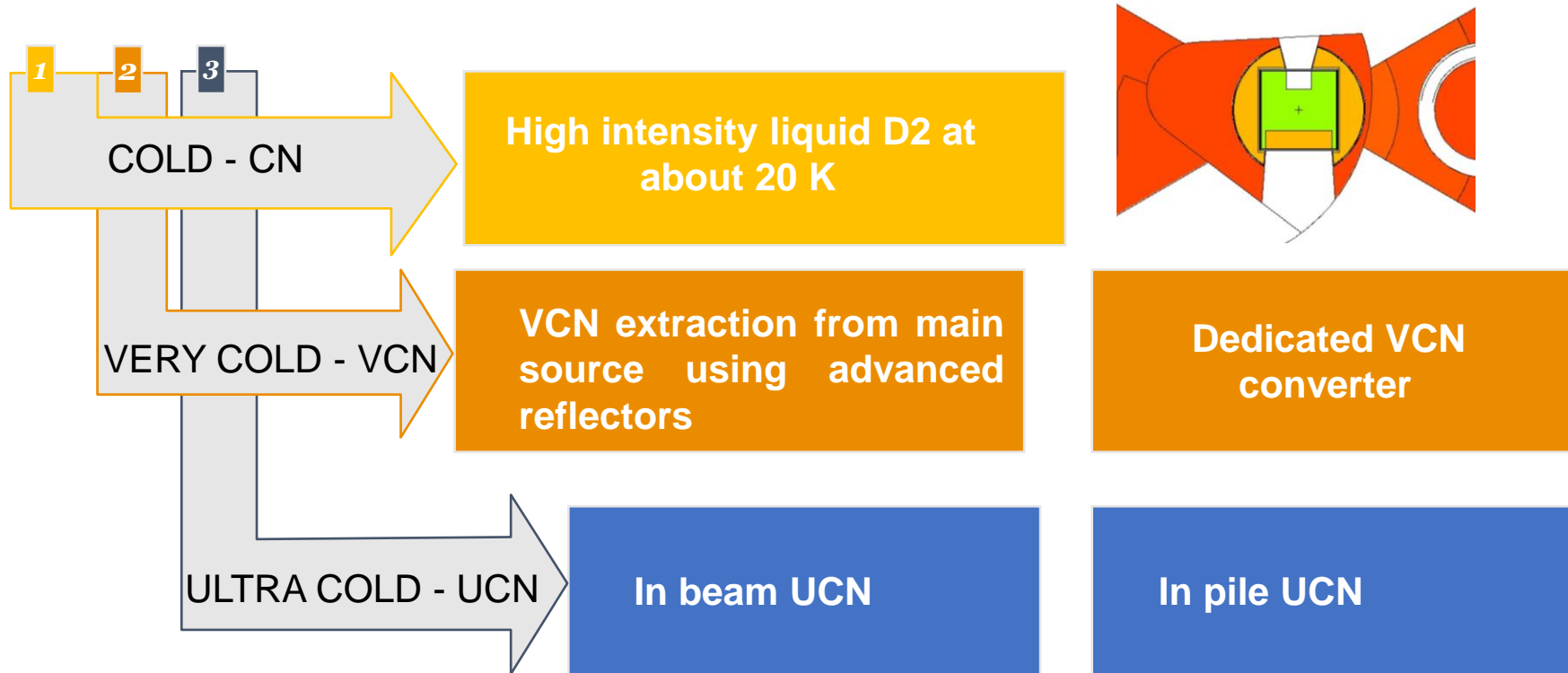
## High Intensity

- We look at applications where total delivery of neutrons is of higher value than the high brightness
- Higher intensity means larger emission surface and bigger moderator

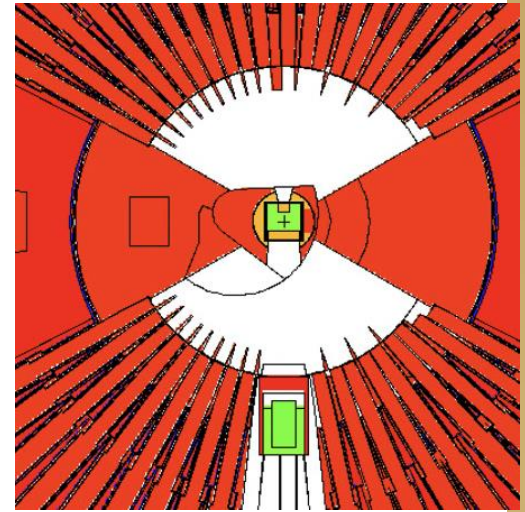
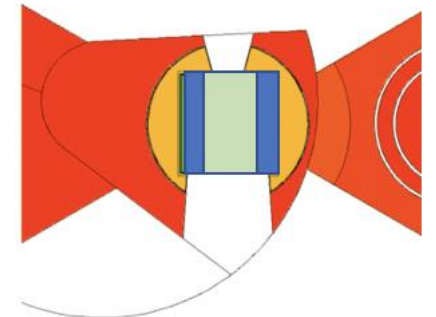
## Shift the spectrum of delivered neutrons to longer wavelengths

- In HighNESS, besides cold neutrons, we are looking at Very Cold and Ultra Cold neutrons
- The main cold source in HighNESS is intended to serve instruments, and secondary VCN and UCN sources

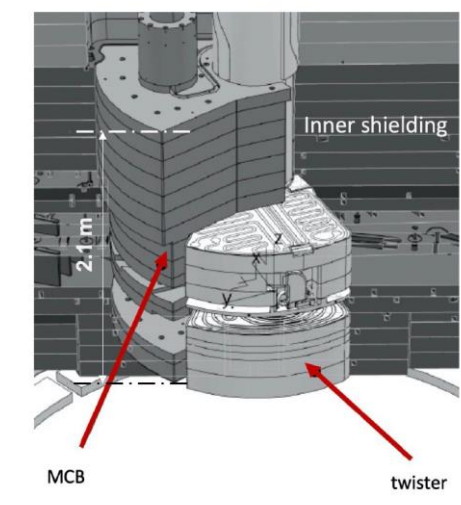
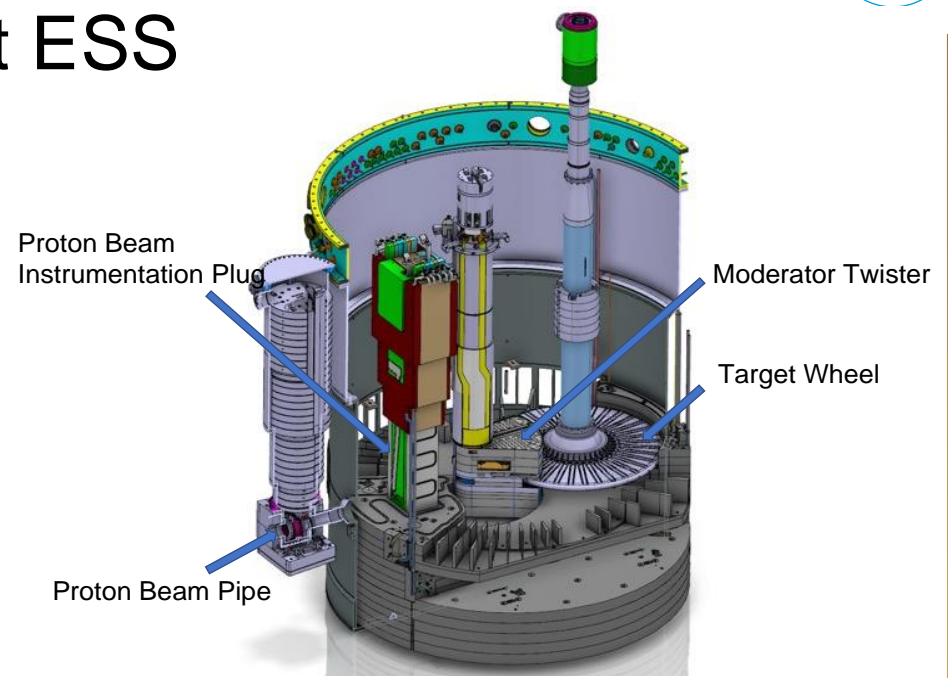
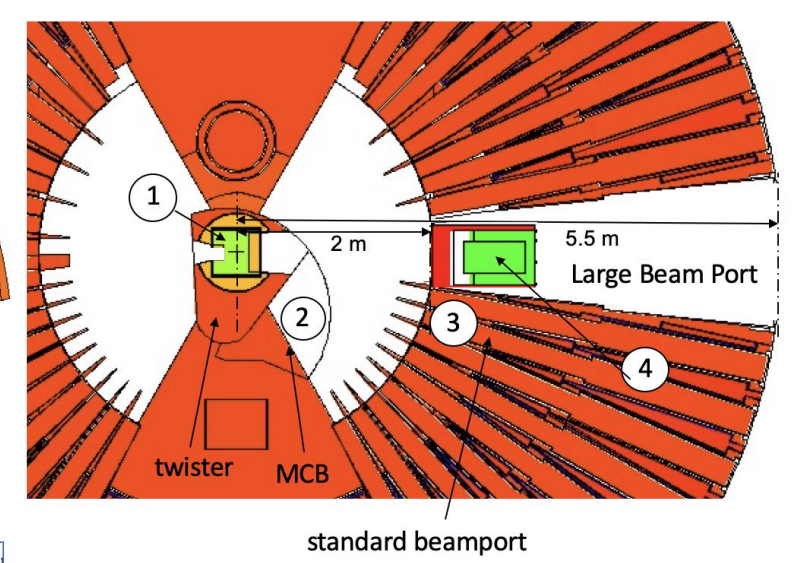
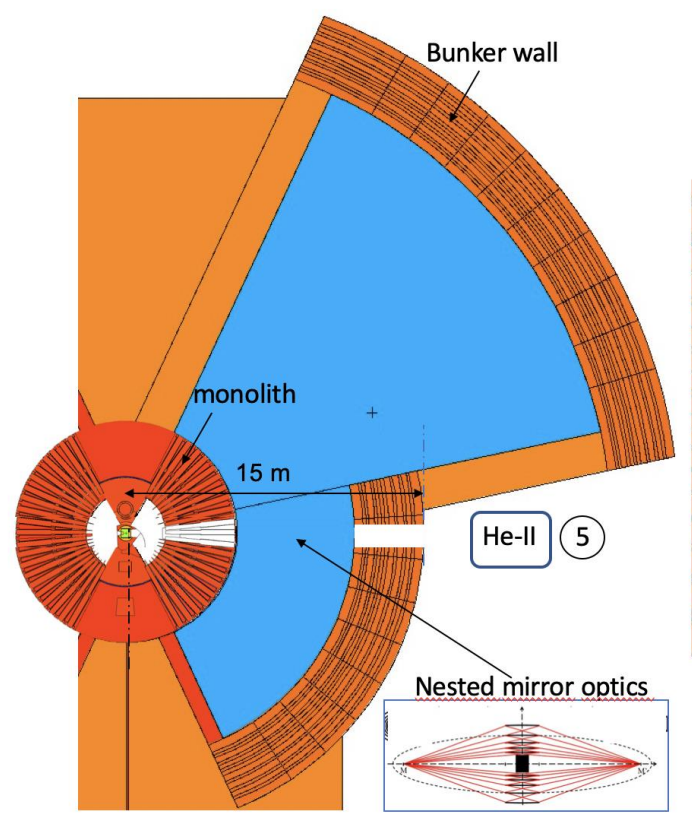
**Goal of the project is to design three sources**



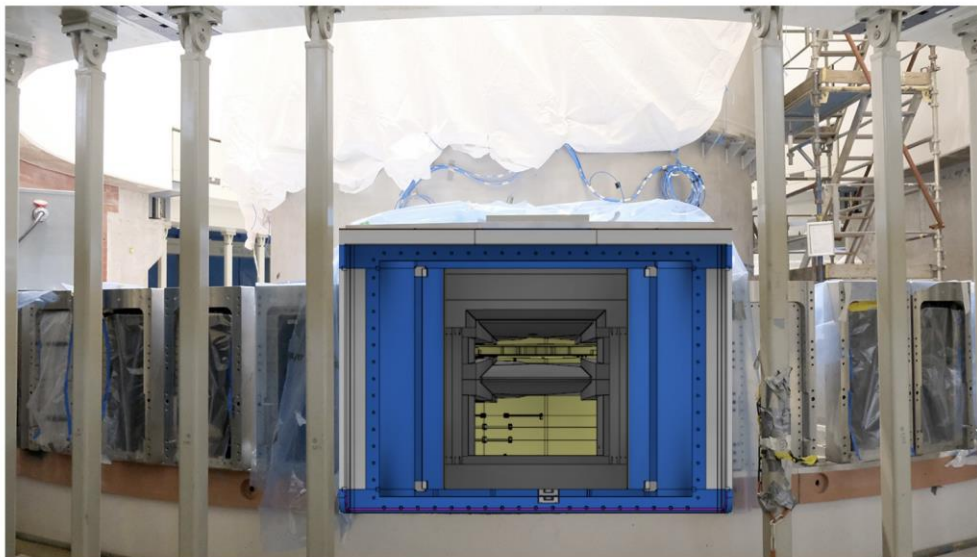
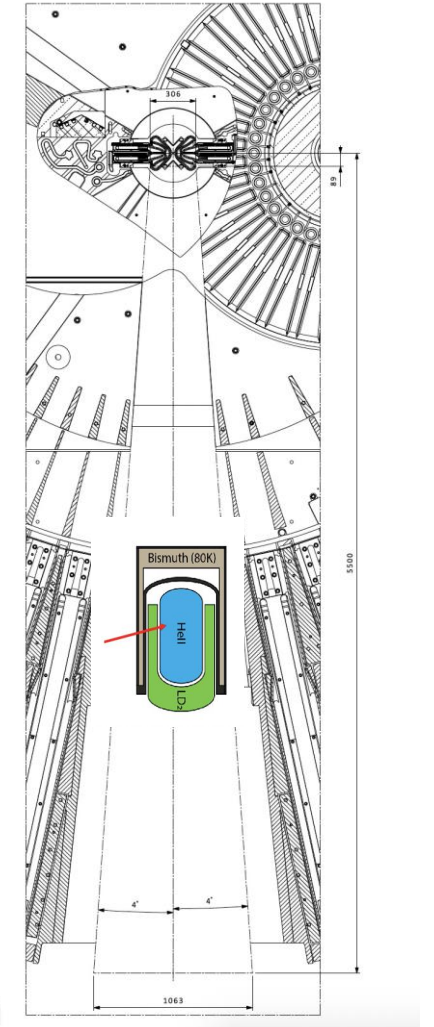
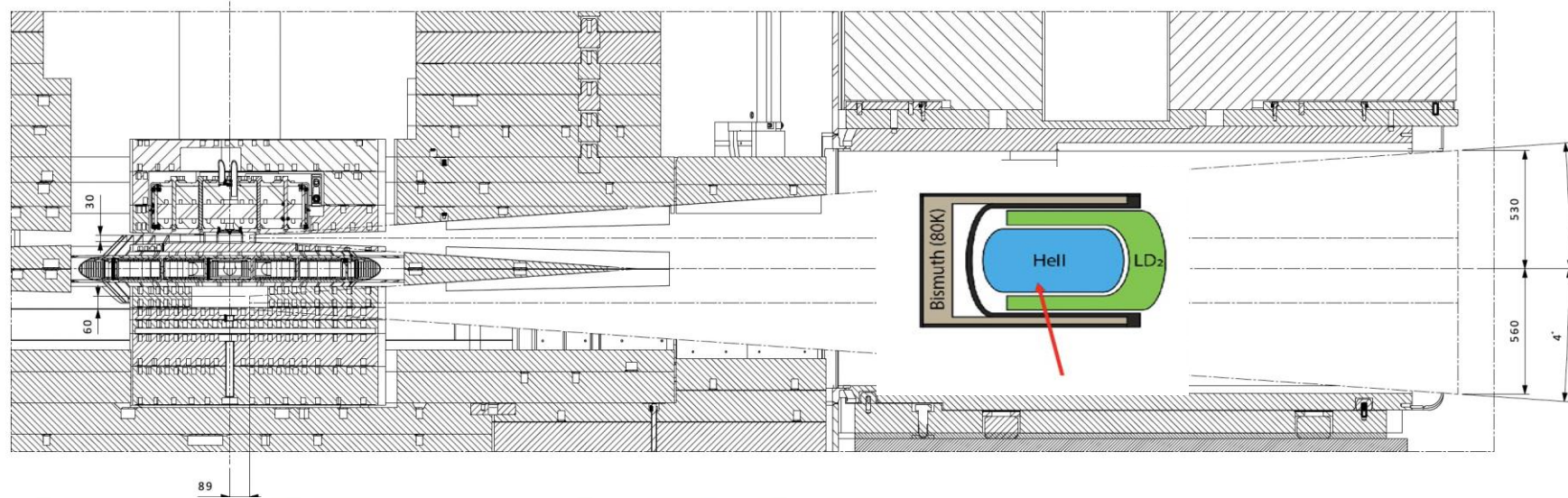
cold	2-20 Å
very cold	10-120 Å
ultracold	> 500 Å



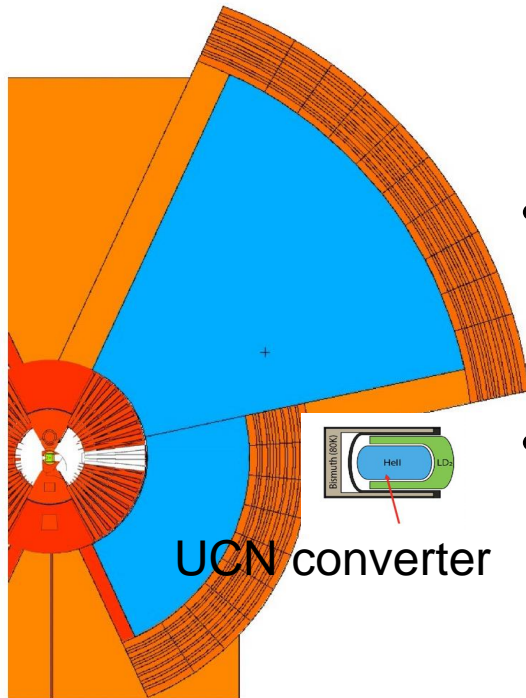
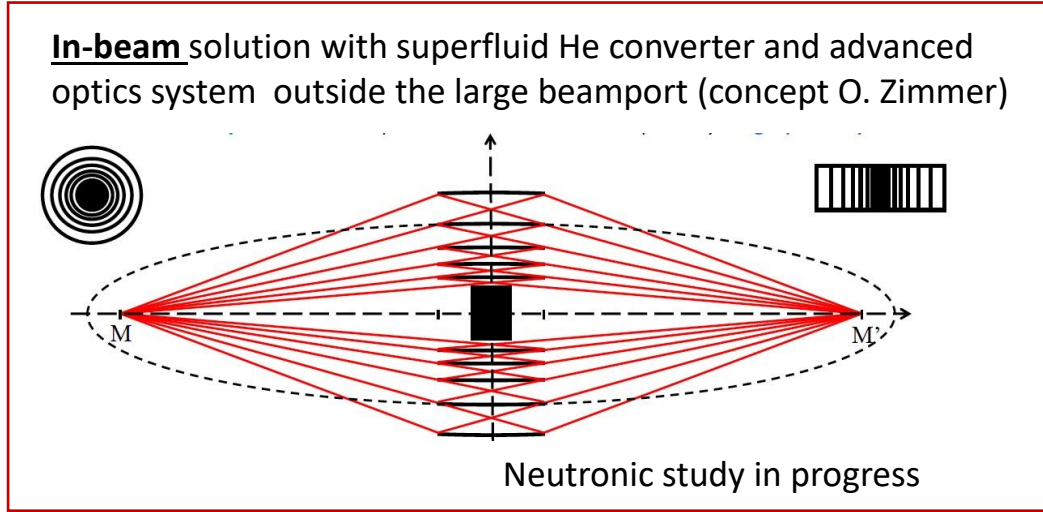
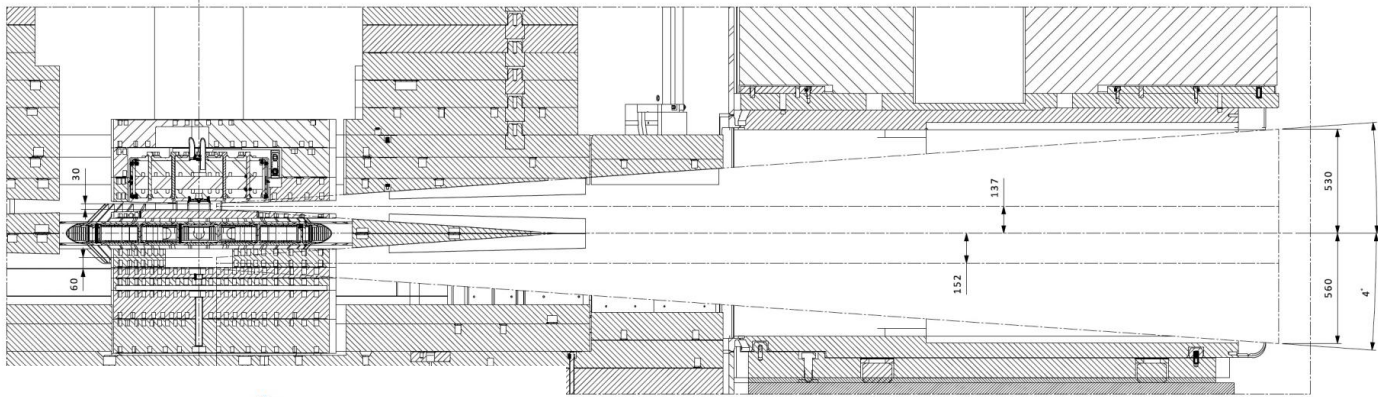
# UCN sources design at the ESS as a part of the HighNESS project : possible locations currently under study at ESS



# The Large Beam port could offer 2 extremely promising UCN design: design 1



# The Large Beam port could offers 2 extremely promising UCN design: design 2



- Need a **neutron delivery system** with high brilliance transfer from moderator to UCN source, with largest technically possible solid angle
- Neutron imaging from the moderator to the UCN source via nested mirrors has been identified as a particularly efficient solution

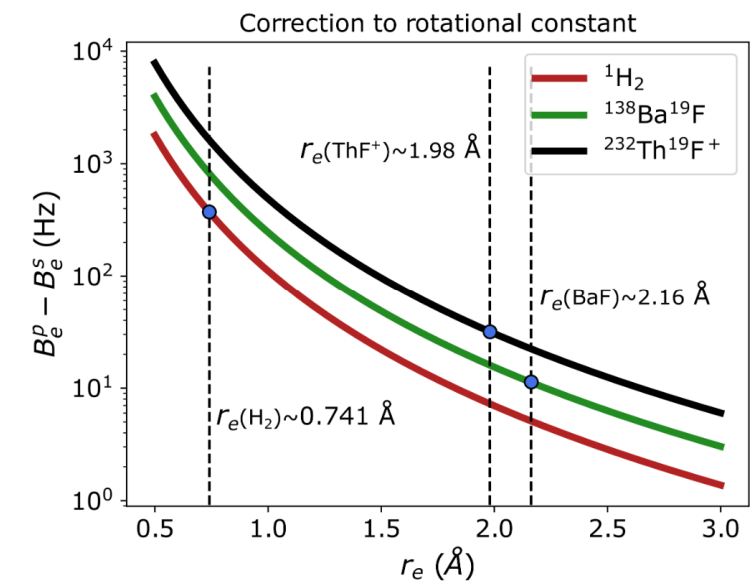
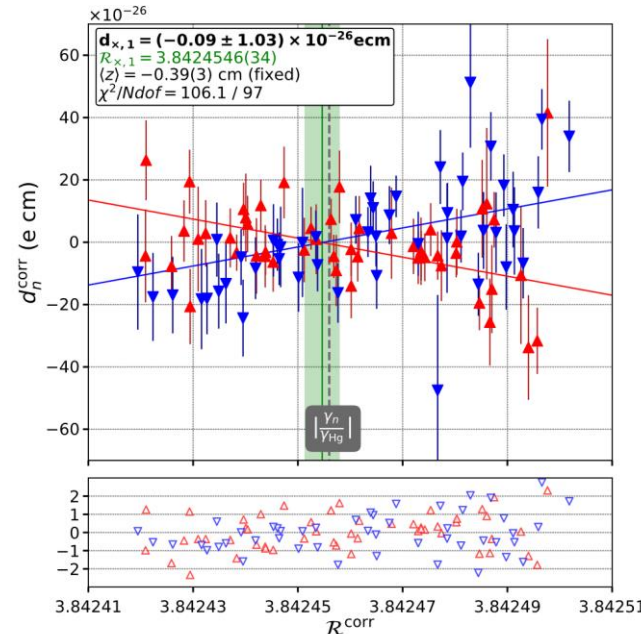
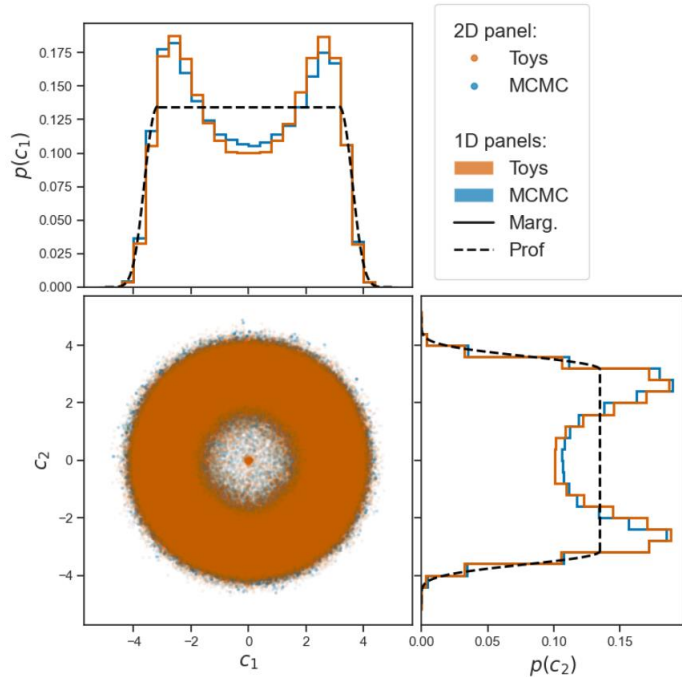
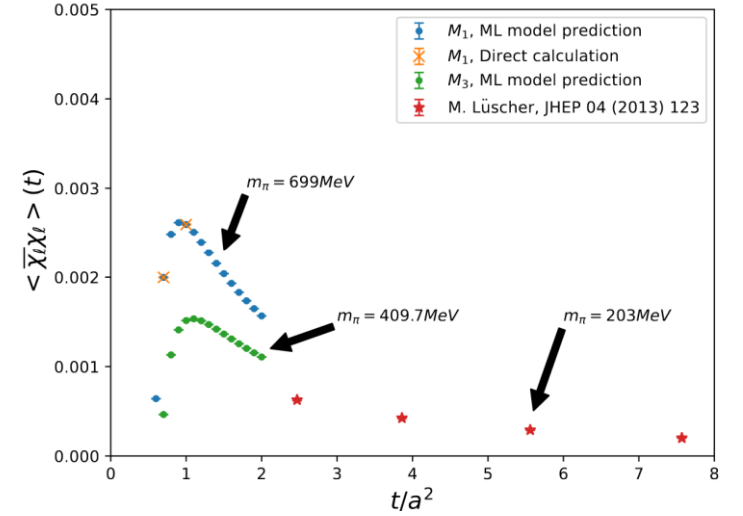
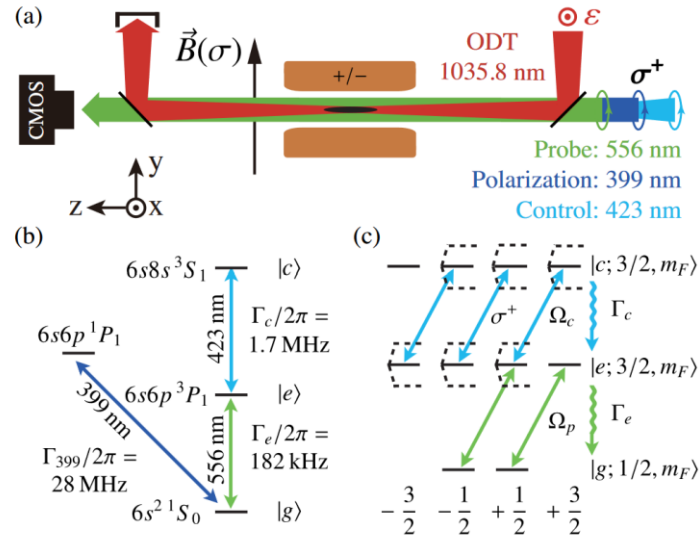
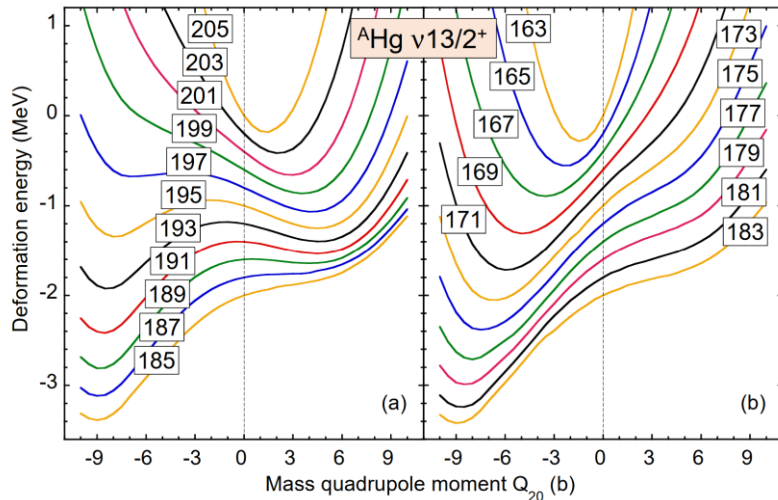
# Questions?



# Next Steps & Concluding Remarks



# Reminder





# Next Steps & Concluding Remarks



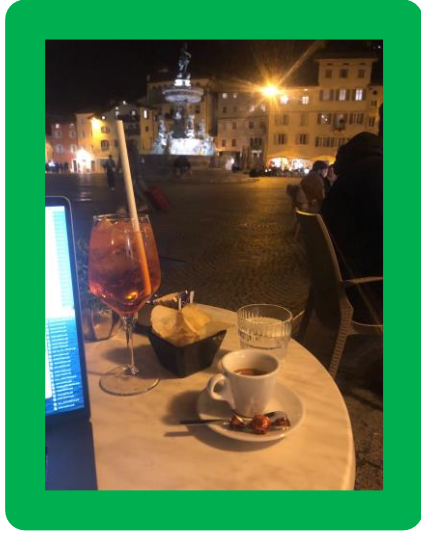
Skyler Degenkolb ([degenkolb@physi.uni-heidelberg.de](mailto:degenkolb@physi.uni-heidelberg.de))

*Low-Energy Precision Physics*

*Physikalisches Institut, Universität Heidelberg*

ECT\*, Trento, 4 March 2024

# Some Remarks



Skyler Degenkolb ([degenkolb@physi.uni-heidelberg.de](mailto:degenkolb@physi.uni-heidelberg.de))

*Low-Energy Precision Physics*

*Physikalisches Institut, Universität Heidelberg*

ECT\*, Trento, 4 March 2024

# Next Steps

---

- Indico survey! (Please fill out...)

# Next Steps

---

- Indico survey! (Please fill out...)
- Mailing list: [enedmr@lists.psi.ch](mailto:enedmr@lists.psi.ch)
  - Announce workshops/conferences, training/schools...
  - Job openings
  - Requests and opportunities for collaboration
  - Sharing latest progress and new results

# Next Steps

---

- Indico survey! (Please fill out...)
- Mailing list: [enedmr@lists.psi.ch](mailto:enedmr@lists.psi.ch)
  - Announce workshops/conferences, training/schools...
  - Job openings
  - Requests and opportunities for collaboration
  - Sharing latest progress and new results
- Webpage: soon!

# Next Steps

---

- Indico survey! (Please fill out...)
- Mailing list: [enedmr@lists.psi.ch](mailto:enedmr@lists.psi.ch)
  - Announce workshops/conferences, training/schools...
  - Job openings
  - Requests and opportunities for collaboration
  - Sharing latest progress and new results
- Webpage: soon!
- Summer and winter training schools

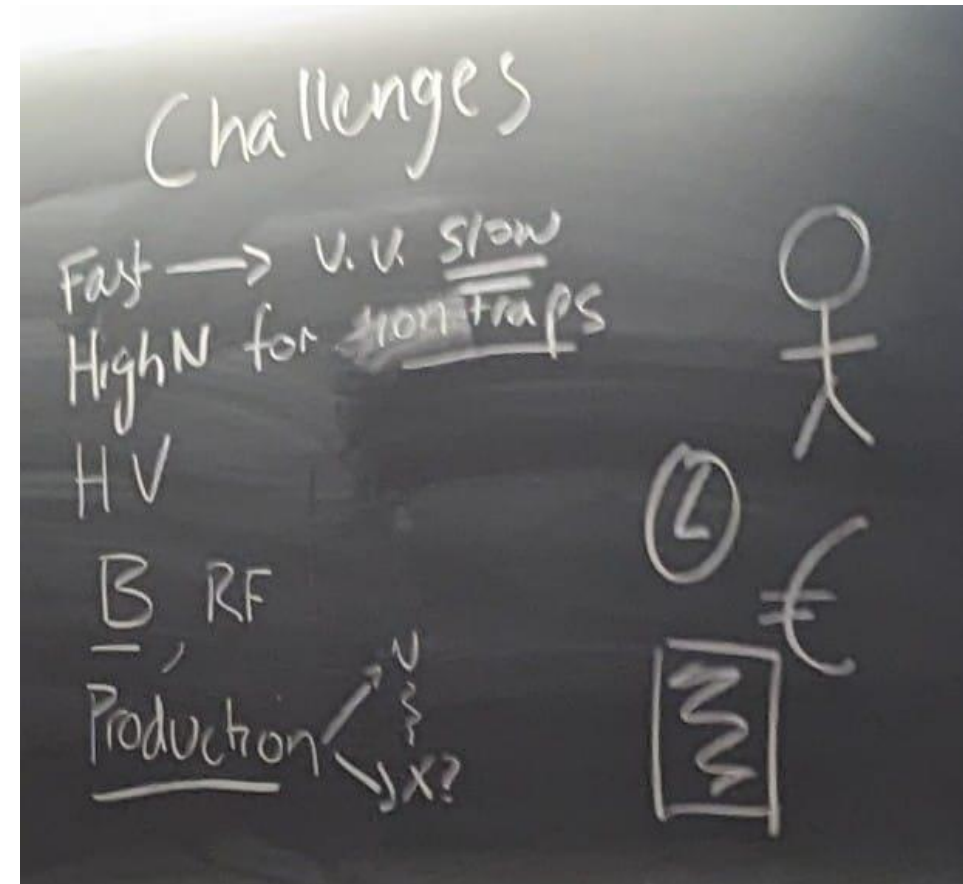
# Next Steps

---

- Indico survey! (Please fill out...)
- Mailing list: [enedmr@lists.psi.ch](mailto:enedmr@lists.psi.ch)
  - Announce workshops/conferences, training/schools...
  - Job openings
  - Requests and opportunities for collaboration
  - Sharing latest progress and new results
- Webpage: soon!
- Summer and winter training schools
- MSCA network application

# Next Steps

- Indico survey! (Please fill out...)
- Mailing list: [enedmr@lists.psi.ch](mailto:enedmr@lists.psi.ch)
  - Announce workshops/conferences, training/schools...
  - Job openings
  - Requests and opportunities for collaboration
  - Sharing latest progress and new results
- Webpage: soon!
- Summer and winter training schools
- MSCA network application





# Thanks and Acknowledgements

- Jordy, Guillaume, Philipp, and Robert



...and Bira



# Thanks and Acknowledgements

---

## Funding:

- ECT\*
- Eurolabs
- EUSTIPEN



# Thanks and Acknowledgements

---

Most Importantly:



*thanks Ines and Susan!*