

# WG5: Fundamental Physics

*introduced by*

Skyler Degenkolb, Leah Broussard, Dave Milstead

## **How should we settle on a source design?**

Two approaches: (1) “single experiment optimized” vs. (2) “Swiss army knife”

## **Identify general facility support needs**

R&D, test beams, and demonstration work  
Other UCN sources / contact to ILL and elsewhere

## **What do specific experiments need from the facility and the UCN/VCN sources?**

## **Discussion of our favorite experiments**

Landscape: what is planned, and what is on the horizon?  
Who can participate? Who can drive them?

## **Where do we see the community of UCN/VCN users in 10 years?**

## **Tomorrow, proceedings, and follow-up meetings**

Points for tomorrow: 1 main action, 3-4 outcomes

Later this year

GENERAL



SPECIFIC



PLANNING

# A challenge to the community:

*“Don’t expect too much: most things have not changed since the 1980s-90s when Golub wrote his book.”*

# A challenge to the community:

*“Don’t expect too much: most things have not changed since the 1980s-90s when Golub wrote his book.”*

Or:

*How can we make progress without a significantly brighter thermal/cold source, or significantly improved backgrounds?*

# WG5: Fundamental Physics

Selected feedback: frequent, interesting, or contentious points

- Every UCN experiment right now is statistics-limited (flux or stored density)
- Extraction and transport loss are major limitations of current implementations
- Some science projects are redundant; we need to understand sources better
- The good science cases in fundamental physics are big projects: 10+ years
- Critical needs: space, time, resources for R&D, staged development approach
- Duty factor and reliable operation are absolutely critical
- We seem to be missing young people who rely on ESS for their major projects

# Fundamental physics topics

- EDM
- lifetime
- $n$ - $\bar{n}$  and  $n$ - $n'$
- decay correlations
- gravitational state spectroscopy
- CRES
- Interferometry
- Spin-mass couplings
- Axion searches
- ...

## Further considerations

- *What big questions are we trying to answer?*
- *Complementarity to thermal/CN program*
- *Complementarity/interaction with scattering*
- *Relationship to other facilities*
  
- *Interactions of “fundamental” topics/instruments*
  - *What “basis” is needed?*
- *Topics outside of “neutron” physics?*

# Source strategy, in view of user experiments

## Swiss Army Knife

- It is very important to have a source arranged to supply not just the one “chosen” project: both technological test work and multiple science projects are needed.
- A reliable multi-user facility can “ride successive waves” of science

## Dedicated optimization

- The source should be optimized for a specific flagship experiment that sells the science. Pick the highest science-priority experiment possible.
- Concentrated and sustained efforts are needed to successfully conclude major projects

# General facilities and support needs

- Utilities: power, water, gases, cryo, ...
- Off-line work (backgrounds, setup changes, ...)
- Background environment
- Support/framework for prototyping and development
- Beamtime and other access for R&D
- Engineering/design needs?
- Local technicians? Workshop support?
- Radiological and/or safety support?
- ...

# Specific UCN/VCN needs for experiments

- Most figures of merit  $\sim T \cdot N^{0.5}$
- Flux (beams) vs density (storage)
- Spectrum: energy and momentum  
*Use of full spectrum? Tunability?*
- Time structure, buffer volumes



Further points about our favorite experiments

# Proceedings and follow-up

- Review paper on “opportunities for fundamental physics” at ESS  
(\*not a strategy document\*)
- Special JNR issue for this workshop
- UCN/VCN source intended to be designed within HighNESS (1.5yr left)
- Follow-up workshops
- Main messages to report tomorrow

Further discussion

# ILL and fundamental neutron physics in Europe

- „Das Zusatzübereinkommen sieht einen Betrieb des ILL bis Ende 2030 vor. 2027 wird über einen möglichen Weiterbetrieb bis 2033 entschieden, an den sich der Rückbau der Neutronenquelle anschließen wird.“
- *The renewal agreement provides for operation of the ILL until the end of 2030. In 2027, a decision will be taken on **possible continued operation until 2033, which will be followed by the dismantling** of the neutron source.*

<https://www.bmbf.de/bmbf/shareddocs/pressemitteilungen/de/2021/09/150921-Neutronenforschung.html>