→ Preceding presentations:
  – Neutron EDM
  – Neutron $\beta$-decay
  – Hadronic weak interaction
  – $n-\bar{n}$ Oscillations
  – Quantum mechanics (gravity)
Overview

• A bit of `history´ (2009 – 2015)
• Strategy meeting (July 2016)
• Next steps
• More information
• Summary
• Q&A Session
A bit of `history´ (2009)

- Particle physics with cold neutrons: beam station
- Particle physics with UCNs: beam station
- QM with thermal neutrons: beam station
• Particle physics with cold neutrons: beam station
• Particle physics with UCNs: in-pile UCN source
• QM with thermal neutrons: beam station
• Neutron bound $\beta$-decay: through-going beam port
A bit of `history´ (2013)

- Particle physics with **cold neutrons**: beam line
- Particle physics with **UCNs**: UCN sources
- QM with **thermal neutrons**: beam station
- Neutron bound $\beta$-decay: through-going beam port
A bit of `history´ (2014)

- Particle physics with **cold neutrons**: beam line
- Particle physics with **UCNs**: UCN sources
- QM with **thermal neutrons**: beam station
- Neutron bound $\beta$-decay: through-going beam port
- $n-\bar{n}$ Oscillations
Instrument proposals 2014/2015

• 4 Instruments within NSS budget available
• 9 Instrument proposals
  – 8 Neutron scattering instruments
  – **ANI**: A *cold neutron beam facility for particle physics*

<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>Guide &amp; Polarizers</td>
<td>1 000</td>
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<tr>
<td>Radiation shielding</td>
<td>2 000</td>
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<tr>
<td>Magnetic shielding</td>
<td>500</td>
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<tr>
<td>Flux &amp; background monitors</td>
<td>150</td>
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<tr>
<td>Chopper system</td>
<td>2 000</td>
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<tr>
<td>ep/n separator</td>
<td>4 000</td>
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<tr>
<td>Infrastructure</td>
<td>1 850</td>
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<tr>
<td>Manpower</td>
<td>2 300</td>
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<tr>
<td><strong>Total</strong></td>
<td>13 800</td>
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• 2 Letters of interest
  – In-beam UCN facility
  – n-¯n Oscillations
We recommend that the full instrument suite at ESS should include two beamlines for particle physics. 1) a cold beamline (ANNI) as well as 2) a beamline which allows the extraction of a broad angular divergence. The STAP strongly recommends approval of the ANNI proposal now. Furthermore we recommend a second particle physics beamline with broad angular divergence for a UCN facility and/or an nubar experiment, as demonstrated by the letters of interest, with proposals to be submitted in the tranche 3 cycle.
SAC Ranking & Arguments (2015)

• 4 Neutron scattering instruments recommended
• ANNI ranked 8\textsuperscript{th} out of 9:

ANNI is a cold neutron beam facility for investigations in fundamental physics. The proposers presented a technically sound and solid proposal and addressed the broad user base that is present in fundamental neutron physics. The ANNI proposal was well conceived and the support from the STAP to move forward is apparent. ANNI would make full use of the brightness and pulse structure, which are unique to the ESS. This enables an order of magnitude of improvement over a similar instrumentation at other neutron sources, which would be an important leap forward for this community. The SAC strongly supports the view of including fundamental physics instrumentation as well as this vibrant scientific community at the ESS. However, given the limited number of instruments available within the first 16 to be constructed, the SAC felt that the project could not be prioritized to be among the first 16 instruments.
Strategy meeting (July 2016)

Particle Physics at the ESS

Friday, 8 July 2016 from 09:00 to 18:00 (Europe/Stockholm)
at European Spallation Source ERI (Linneasalen)
Tunavägen 24, Lund, Sweden

The meeting addresses proposers, STAP* and representatives of groups that may be interested in neutron particle physics projects at the ESS. The proposal for a fundamental physics beamline at the ESS was well-supported by the STAP but received low priority in the SAC*. The main aim of the meeting is to prepare for successful particle physics projects at the ESS in future. This includes coordination of activities within the scientific community as well as discussions with ESS representatives on how to assure particle physics as part of the ESS.

STAP: Scientific and Technical Advisory Panel for fundamental physics at the ESS

SAC: ESS Scientific Advisory Committee

Organizers:
Hartmut Abele (TU Wien)
Gustaaf Broekaerts (Columbia University)
Mats Lindroos (ESS)
Bastian Märkisch (TU München)
Anders Oskarsson (Lund University)
Torsten Soldner (ILL)
Camille Theroine (TU München)

Particle Physics (PP): STAP, proposers and interested members of the particle physics community.

ESS: ESS science director and further ESS representatives

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>09:00 - 10:45</td>
<td>PP: Analysis of experience with beamline proposal</td>
</tr>
<tr>
<td>Material:</td>
<td>slides</td>
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<td>10:45 - 11:00</td>
<td>Coffee break</td>
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<tr>
<td>11:00 - 13:00</td>
<td>PP: Particle Physics projects at ESS. Discussion of competition, synergies and possible coordination and cooperation</td>
</tr>
<tr>
<td>Material:</td>
<td>slides</td>
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<tr>
<td>13:00 - 14:00</td>
<td>LUNCH (Ljusgården outside the conference room)</td>
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<td>Catering lunch will be served</td>
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<tr>
<td>14:00 - 16:15</td>
<td>PP and ESS: How to implement particle physics instruments at the ESS. Discussion with ESS representatives</td>
</tr>
<tr>
<td>Material:</td>
<td>slides</td>
</tr>
<tr>
<td>16:15 - 16:30</td>
<td>Coffee break</td>
</tr>
<tr>
<td>16:30 - 17:30</td>
<td>PP: Discussion and decision on next steps</td>
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Participants:
7 ESS, 15 Particle Physics
Presentation by Prof. Schreyer (new ESS science director)

The ESS Neutron Instruments revised layout (June 2016)

Instruments 1-16; funded by NSS construction project
Instruments 17-22; funded by initial operations

Two instruments have moved:
- ESTIA; E1 -> E2 – for cleaner view of source
- SKADI; E8 -> E5 – for more space (= lower technical risk)

Space for ANNI between SKADI and ESTIA reserved
NNbar: possible

Instrument Layout (June 2016)
Presentation by Prof. Schreyer (new ESS science director)

Proposed New Timeline

- Instrument 1
- Instrument 2
- Instrument 3
- Instrument 4
- Instrument 5
- Instrument 6
- Instrument 7
- Instrument 8
- Instrument 9
- Instrument 10
- Instrument 11
- Instrument 12
- Instrument 13
- Instrument 14
- Instrument 15
- Instrument 16
- Instrument 17
- Instrument 18
- Instrument 19
- Instrument 20
- Instrument 21
- Instrument 22

- Construction Project
- Hot Commissioning
- Beam on Target
ESS Statements

• A fundamental physics beamline is missing in the approved ESS instrument portfolio. All other fields of science are already covered.
  → **Fundamental physics should be part of it!**

• Decisions on instruments 17 – 22 could take place from 2019 onwards (tbd)
  → Strategic decision by ERIC council in December 2016
  → No ESS operations funding available for concept development until 2021
  → Enter user programme between start-2027 and end-2028

• ESS requests more SAC members from fundamental physics
Next steps

• Instrument proposals:
  – Update ANNI proposal, *based on new framework conditions*
  – Convert letters of interest into full proposals
  – Explore external funding options

• Further actions:
  – Form task force
  – Write strategy white paper
  – Attend conferences etc., *to involve larger user community*
  – Organize satellite meetings, symposia, & dedicated workshops

→ You are very welcome to join/support FP at ESS!
More information

• Poster session:
  – T. Solder et al.: *Design and performance of the proposed cold neutron beam facility for particle physics at the ESS*
  – E. Klinkby: *Neutron moderators for the European Spallation Source*

• Contact data:
  – ESS: *E. Klinkby, DTU & ESS, Sweden* (moderators),
    *V. Santoro, ESS, Sweden* (particle physics)
  – ANNI: *T. Soldner, ILL, Grenoble*
  – UCN: *O. Zimmer, ILL, Grenoble*
  – NNbar: *G. Brooijmans, Columbia University, US*
Summary

• Instrument proposals 2014/2015
  – ANNI instrument proposal, 2 letters of interest
  – STAP strongly recommended ANNI proposal now
  – SAC ranked ANNI proposal 8th out of 9

• Strategy meeting, July 2016
  – Fundamental physics should be part of instrument suite!
  – Next proposal rounds in 2019 & 2021 (tbd)

• Next steps
  – Complete work on instrument proposals
  – Enlarge involvement of community
  – You are very welcome to join/support FP at ESS
Thank you for your attention

Presentation by Prof. Schreyer (new ESS science director)
Do you have any questions?