NUPECC Thanks for the Invitation!

The Current Status of the ESS Project

Colin Carlile
on behalf of the ESS team

Lund
The Öresund - Innovation, Tradition and Innovation
A little bit of ESS history

European Spallation Source workshop

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Abstract

A meeting of about 70 experts in condensed-matter science took place in late February at Abingdon, UK, to discuss the scientific opportunities and technological challenges of a new 3rd generation spallation source - the so-called European Spallation Source (ESS).

This Workshop was, in fact, the third in a series: the first, in September 1991 at Simonskall near Jülich, considered the accelerator options; the second in February 1992, in PSI, Villigen, Switzerland, considered the problems of providing targets and monochromators. The meeting opened with talks from S. Martin (Jülich), G. Bauer (PSI) and J. Carpenter (Argonne) on the accelerator, target, and moderator options, respectively. Although the problems are formidable in all areas, there don’t seem to be any insuperable obstacles for building a system with a 5 MW beam of protons with a short pulse length of ~1 μ delivered onto two (or more) stationary targets surrounded by a variety of moderators. The heat load on the target could approach 4 MW/Å, similar to that found in a high-flux reactor, but Bauer pronounced that “it can be done.” The neutron production of such a source would be spectacular, with a peak flux of ~ 10^14 n/sec/cm^2 and an average flux close to that of the ILL.

The project “European Spallation Neutron Source (ESS)”: status of R&D programme

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Abstract

At present the ESS-Project is in its R&D phase (1997-2001) comprising activities in the areas of accelerator (linac and rings), target station (target, moderators, reflector) and instruments. The work is carried out by 14 laboratories and universities in the European Union and Switzerland and co-ordinated by the ESS R&D Council. Intense and fruitful collaborations with partners in the United States, Japan and Russia have been established. In this article, examples of typical results of R&D work on the ESS linac and target will be given. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Neutron sources

1. Introduction

After delivering the ESS Technical Study [1] in November 1996, the project entered the R&D phase with a planned duration of 5 years. The following 14 European institutions contributing to the ESS R&D activities have signed a Memorandum of Understanding (MoU):

Atominstitut der Österreichischen Universität (AIU), Austria, Centro de Investigaciones Energéticas (CIXMAT), Spain, Commissariat a l’Energie Atomique (CEA), France, Consiglio Nazionale delle Ricerche (CNR), Italy, Forschungszentrum Jülich (FZJ), Germany, Hahn-Meitner-Institut (HMI), Germany, Institut für Angewandte Physik der Universität Frankfurt (IAPUF), Germany, Interfacil in der universities Institute (IRI), Netherlands, IRC Polymer Science and Technology (EPSRC), United Kingdom, Istituto Nazionale per la Fisica della Materia (INFN), Italy, Naturwissenschaftlich forsksningsradet (NFR), Sweden, Paul-Scherrer-Institut (PSI), Switzerland, Riso National Laboratory (RIS0), Denmark, Rutherford Appleton Laboratory (RAL), United Kingdom.

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This was just the end of the beginning

Remember the launch of The Vasa
What happened in 2009?
A miracle occurs

May 28th 2009 Brussels
Lund?
Bilbao?
Debrecen?
Nowhere at all?

ESS
Proposed Sites
The view to the South-East in 2025

Malmö

Öresund bridge

Lund

MAX IV

Copenhagen

ESS
The ESS Headlines

• ESS will be the world’s best source of slow neutrons by 2025

• ESS will produce its first neutrons in 2019

• ESS will cost 1479 M€2008 to construct

ESS will be different

• Sustainability & Environmental Responsibility
• Harness Innovations
• Excellent researcher support
• Person-centred
• Prepare for the future
• “More than simply neutrons”
ESS – some numbers

- Superconducting Proton Linear Accelerator
  - 2.5 GeV Proton Energy
- 50mA (2mA) peak (average) proton current
  - 357 kJ/pulse
- 2.86 msec pulse length
  - 14 Hz pulse frequency
- 71.4 msec periods between pulses
  - 5MW proton beam power
- Single Target Station
  - Rotating Tungsten, helium cooled
- 22 instruments
  - High reliability, low losses
Something about Neutrons

Its discovery
James Chadwick
1932
(α,n) reaction

Chadwick's neutron apparatus

NUPECC, NBI, Copenhagen, 15th June 2012  C. J. Carlile
“Whatever the radiation from Be may be, it has most remarkable properties”
Neutrons are beautiful!

Diffractometers - Measure structures — Where atoms and molecules are

Spectrometers - Measure dynamics — What atoms and molecules do

1 - 80 meV
But neutrons, like diamonds, are still rather rare...

**Evolution of the performance of neutron sources**

- Berkeley 37-inch cyclotron
  - 350 mCi Ra-Be source
  - Chadwick 1930

- Effective thermal neutron flux \( n/cm^2-s \)

Neutrons are the Swiss Army Knife of Analytic techniques

Thanks to Dimitri Argyriou
This is our primary product

"Small science at big facilities"
ESS has got the Partners
Sweden, Denmark and Norway
50% of construction costs – 1479 M€

17 Partners today

Spain, France, Germany, Italy, Switzerland, Hungary, Czech Republic, Poland, Netherlands, Estonia, Latvia, Lithuania, Iceland & UK
Cash flow for Construction and Operation Phases

ESS construction timeline

Capital spend

Operations Phase

Operations

Site preparation

- €200M
- €150M
- €100M
- €50M
- €0M


Negotiations phase II & III
Agreement on Lund as site
Negotiations on financing
Funding agreement
Baselining
Construction
First neutrons
Commissioning
Operation
11 Instruments in User mode
22 Instruments in User mode
One evening last July ...

Green field site
Green field thinking
The ESS Conceptual Design Report

We have spared no expense
The Accelerator work is gaining momentum
IPN Orsay – Mats Lindroos & Sebastian Bousson
Superconducting accelerating cavities
Design of accelerator frozen!
Falsterbo Workshop - December 2011
Target Station W/He/H$_2$

Target monolith during target change

- Tungsten target wheel
- Moderator-reflector plug
- Accelerator proton beam window

TRAM Optimisation yielding gains
Possible Instrument Layout
Scientific Activities and Collaborations

ESS Science Directorate

- In-house instrumental development
- External partners
  - Test experiments: rep rate multiplication guides, crystal optics
- Facilities
  - ESS - ILL: 10B detectors, small-sample VacBox
  - ESS - ISIS - SNS: Mantid software ICND

15 scientific publications
5 PhD students

Meetings
ESS Science Symposia
3 in 2011
6 in early 2012
2012 new call

CRISP
- NMI3
- EU projects
- Instrumental collaborations
  - Scientific collaborations
- Outreach
  - Industry liaison
  - Joint detector laboratory
- Regional research infrastructure
  - Joint univ/ESS appointments
  - 10 joint seminars
  - Exhibition Lectures

C J Carlile
Co-location with a high brilliance synchrotron

**MAX IV**

Emittance 0.24 nmrad, cf Soleil 3.0, Diamond 2.74, Petra III 1.0

**NUPECC, NBI, Copenhagen, 15th...**
The ESS Energy Cycle

Renewable Carbon Dioxide: 120,000 tonnes/year saved

Responsible Carbon Dioxide: 30,000 tonnes/year saved

Recyclable Carbon Dioxide: 15,000 tonnes/year saved

Link to the grid
We are seeking more staff.
Vi inbjuder till visning av idéförslag för hur Science Village ska utvecklas.

Utställningen anordnas av fastighetsägaren Lundamark AB.


Utställningen öppnar 28 mars i gamla stationshuset på Lunds central.

Pressvisning kl 10 och allmän visning kl 13

Välkomna!

Bengt Holgersson, styrelseordförande i Lundamark AB