



THE HENRYK NIEWODNICZAŃSKI  
INSTITUTE OF NUCLEAR PHYSICS  
POLISH ACADEMY OF SCIENCES



# European Spallation Source and new opportunities for Polish scientists

**Marek Jeżabek**



*21 October 2024*

***SPAS'2024***



# European Spallation Source(ESS ERIC)



the most intense source of neutrons in the world:  
proton beam 2 GeV, pulse length 2.86 ms, repetition rate 14Hz, 5 MW;  
tungsten shield; 22 instruments; 30+ neutrons/collision



To see the smallest objects,  
we must design the largest machines

ESS will enable break-through experiments and bring  
research opportunities that we cannot yet imagine



# ESS: One of the largest RI projects in Europe

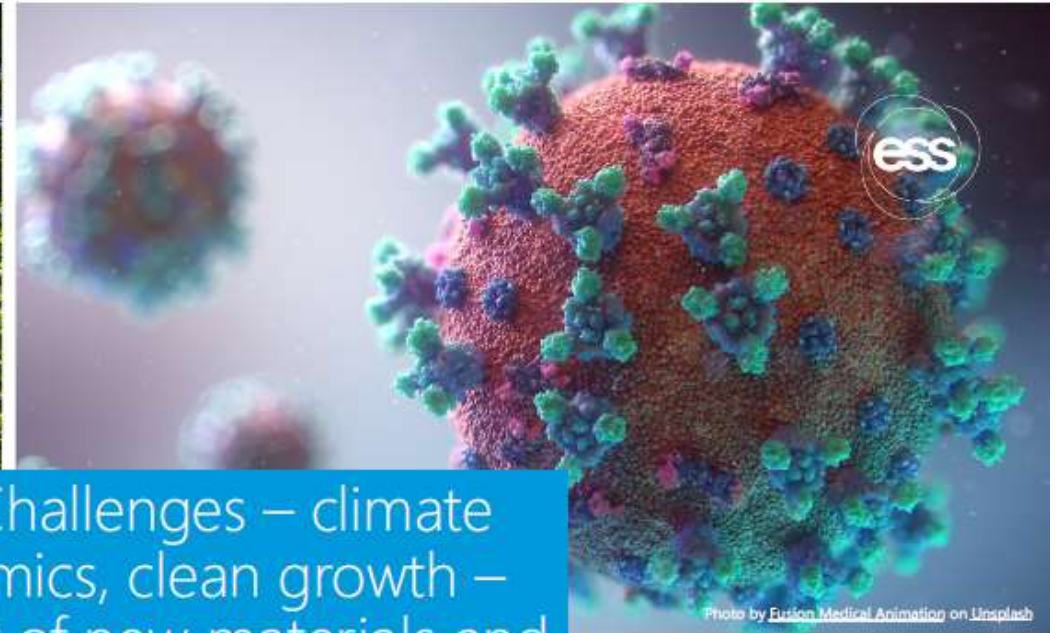


The state-of-the-art facility will unlock the secrets of materials at the atomic level



Photo by Pery Nordeng, ESS





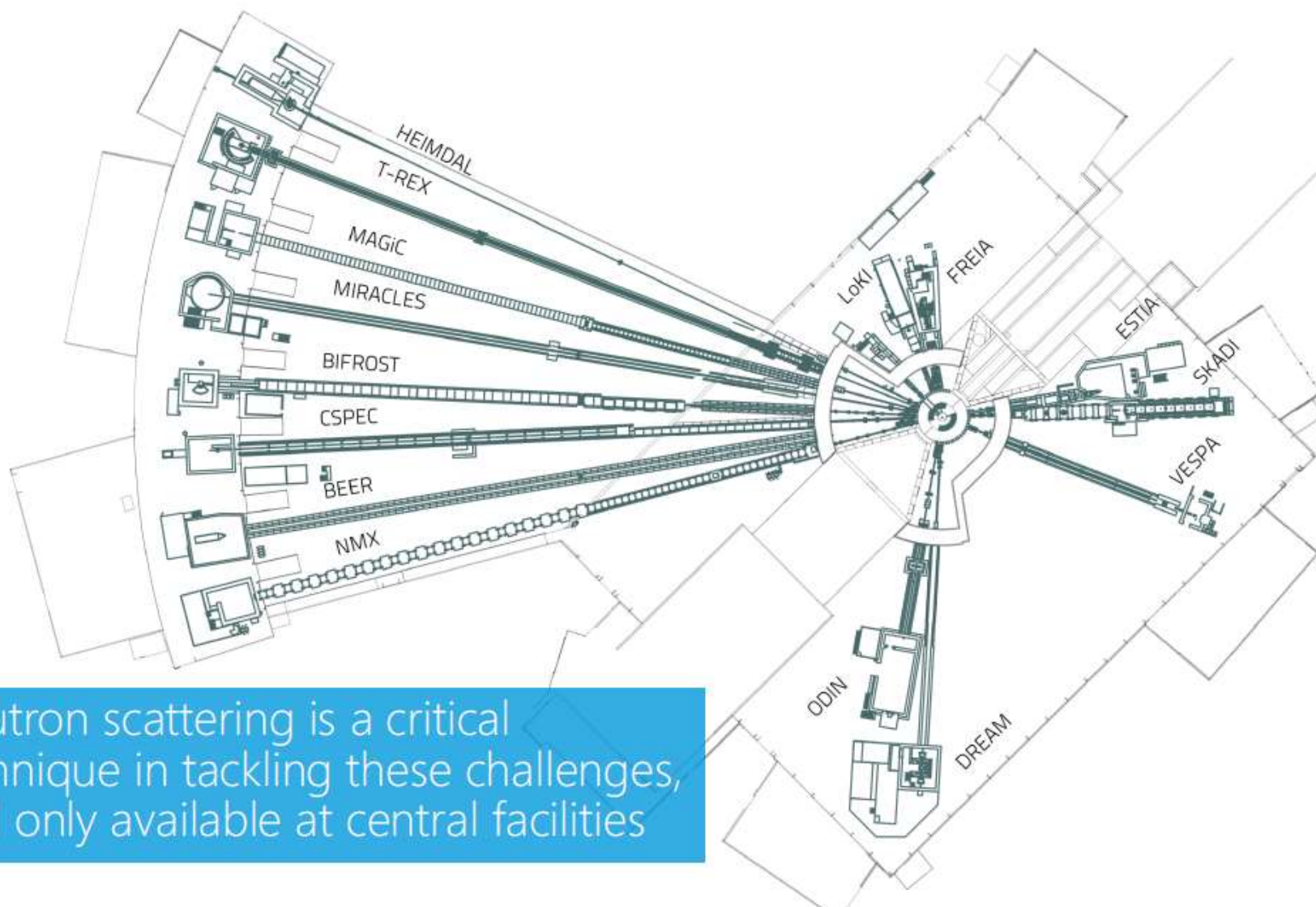
Solutions to Global Challenges – climate emergencies, pandemics, clean growth – require development of new materials and devices and open up important opportunities for economic growth





These complex problems require many scientific and technological developments beyond the state-of-the art to bring detailed understanding from the scale of atoms to the scale of a device

Photo by Ulrika Hammarlund, ESS



Neutron scattering is a critical technique in tackling these challenges, and only available at central facilities

# The science enabled by ESS will be science for society

Examples of research possibilities with selected ESS instruments




  
**SAFER, LIGHTER AND STRONGER ENGINEERING MATERIALS**



How will science help to establish the suitability of new materials for aircraft, high-speed trains and other high-stakes applications?  
The European Spallation Source will enable researchers to observe in unprecedented detail the impact of real-world conditions on promising novel materials, enabling innovative applications across the engineering spectrum.

BEER

  
**NEW BATTERY MATERIALS FOR A RENEWABLE ENERGY FUTURE**



Where will the next breakthrough technology in renewable energy come from?  
Research at the European Spallation Source will help to relieve the energy storage bottleneck, one of the chief obstacles to renewable energy expansion.

HEIMDAL

  
**DELIVERING ON THE PROMISE OF BIG DATA**



How will our future supercomputers process unprecedented volumes of data at increasingly faster speeds?  
Research at the European Spallation Source will help to identify the materials necessary to make the revolutionary leap from classical to quantum computing.

MAGIC

  
**BRINGING THE MOST EFFECTIVE CANCER DRUGS TO MARKET SOONER**





How will innovative molecular mapping help the fight against cancer?  
Fundamental to defeating cancer is the ability to map and describe tumours at the molecular level. Research at the European Spallation Source will help to chart tumour cells in unprecedented detail, providing the basis for a new standard of cancer diagnosis and treatment.



MIRACLES



# Poland and ESS



Sweden & Denmark will co-host ESS  
The ESS Data Management Centre in Copenhagen



Spain signed as a partner on 10<sup>th</sup> June  
Accelerator R&D Centre in Bilbao

Norway  
Advanced Neutron Technologies in Kjeller

Poland, Estonia, Latvia, Lithuania, France,  
Germany, Switzerland, Italy, and...?

ESSS 5<sup>th</sup> Round Table Krakow 14<sup>th</sup> September 2009      A European Organisation for ESS      C.J Carfile 9



Ministry of Education and Research Sweden

State Secretary



Ministry of Science  
Technology and Innovation

8 October 2009

Mrs Barbara KUDRYCKA  
Minister of Science and Higher Education  
1/3 Wspólna Str.  
PL - 00 529 Warsaw 53  
Polen

Invitation to the First European Spallation Source Steering Committee  
meeting 22<sup>nd</sup> and 23<sup>rd</sup> October 2009 in Copenhagen

Dear Colleagues,

The first meeting of the ESS Steering Committee will be held on October 22<sup>nd</sup> at 6 pm to 23<sup>rd</sup> at 3.30 pm. The meeting will be held at the Royal Library at Søren Kierkegaards Plads 1 in Copenhagen.

This invitation is extended to all those 12 countries having declared their interested in participation in the Design Update and construction of ESS in Lund. We foresee a representation of two delegates per country.

Papers will be sent to you during the week before the meeting from the ESS Secretariat in Lund.

Rooms will be reserved for all participants at Hotel Nyhavn 71 in Copenhagen. We look forward to meeting you all in Copenhagen on the 22<sup>nd</sup> of October.

Yours sincerely

Peter Honeth  
Swedish State Secretary

Lars Kolte  
Head of Danish delegation



# ESS Foundation Stone Ceremony Lund 9th October 2014










## ESS ERIC in Lund (Sweden)

Members:


Czech Republic  
Denmark (host)  
Estonia  
France  
Germany  
Hungary  
Italy

Norway  
**Poland**  
Spain  
Sweden (host)  
Switzerland  
United Kingdom

# Schedule (2009)




European Spallation Source  
Scandinavia



LUND  
UNIVERSITY

## A European Organisation for ESS

Colin Carlile  
The ESS Scandinavia Secretariat  
Lund University



ESSS 5<sup>th</sup> Round Table Krakow 14<sup>th</sup> September 2009      A European Organisation for ESS      C.J Carlile 1



European Spallation Source  
Scandinavia



LUND  
UNIVERSITY

## ESS Project Phases

The Pre-construction phase	2010 - 2012
The Construction phase	2013 - 2018
The Completion phase	2019 - 2025
The Operations phase	2026 - 2066
The Decommissioning phase	2067 - 2071



European Spallation Source  
Scandinavia



LUND  
UNIVERSITY

## The Pre-Construction Phase

- (i) Design Update
- (ii) Political Agreements on Construction
- (iii) An MoU & An International Convention



# Construction Phase



**Summer 2018 aerial view of the ESS site showing the initial levels of the target building, the long baseline experimental hall, foundations of other experimental halls and site cleared ready to construct the campus complex**



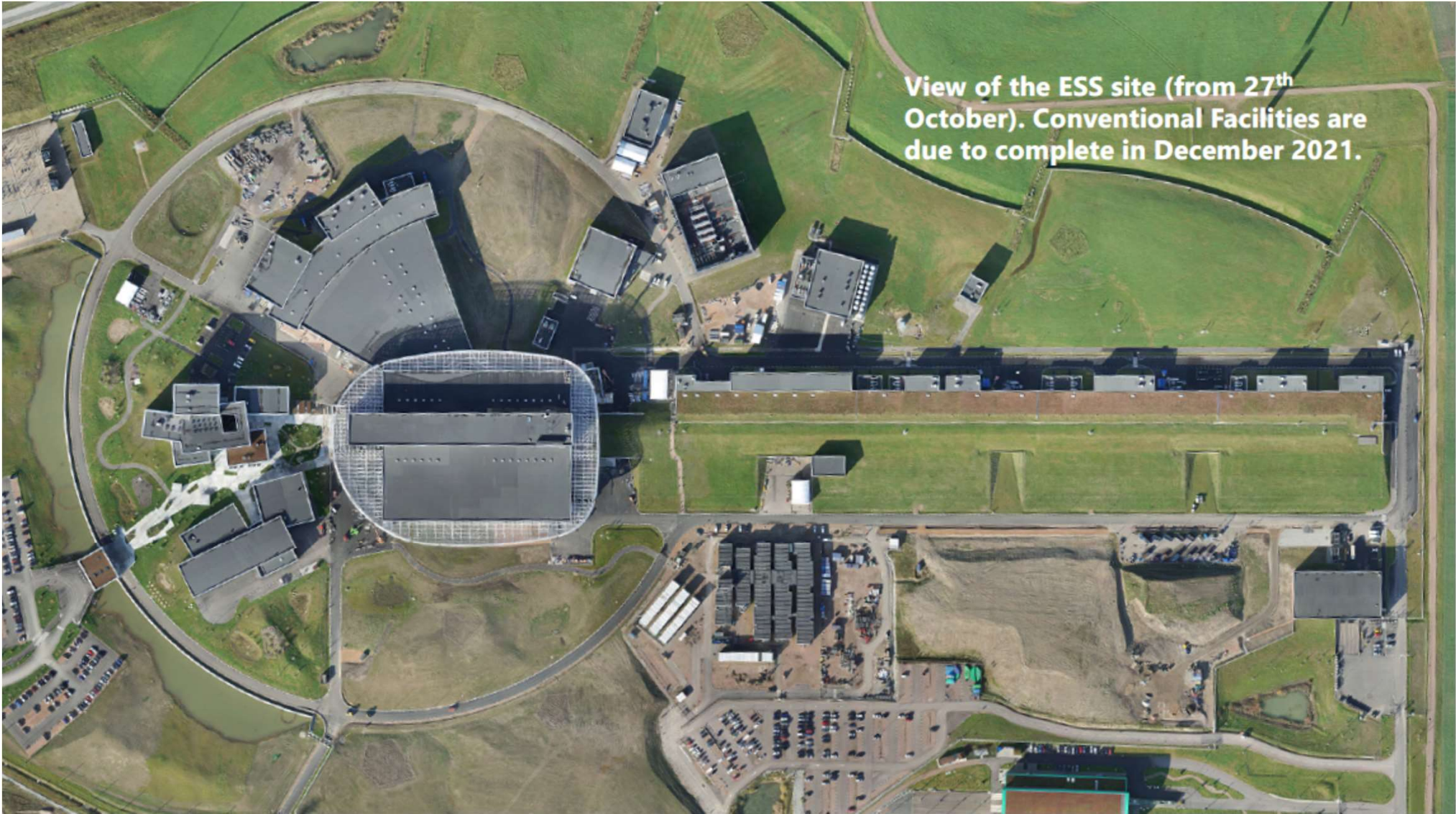




Daily progress on the construction site and in the development of the technical components make it clear that ESS, after 20 years, is a reality

**Aerial view of the construction site, January 2021**

Photo by Perry Nordeng, ESS



**View of the ESS site (from 27<sup>th</sup> October). Conventional Facilities are due to complete in December 2021.**

# An ever-evolving world

While ESS is under construction, and faces challenges, much has changed around it:



## #1

The problems the world needs to tackle



Photo by [Annie Spratt](#) on [Unsplash](#)

## #2

Research Infrastructure landscape



Photo by [Christian Lue](#) on [Unsplash](#)

## #3

How science itself is conducted



Photo by [Perry Nordeng/ESS](#)

A photograph of a large industrial facility, likely a particle accelerator, with a blue text overlay. The scene shows a long, brightly lit corridor with a polished floor. On the right side, there is a complex array of machinery, including metal frames, pipes, and various mechanical components. A blue banner with white text is superimposed over the upper part of the image. In the top right corner, there is a small logo that reads 'ESS'.

ESS has reached an important stage on its journey to becoming a world leading facility and is facing critical questions about funding, scope and schedule



# Poland @ ESS



 Wrocław University of Science and Technology



contribution in-kind to

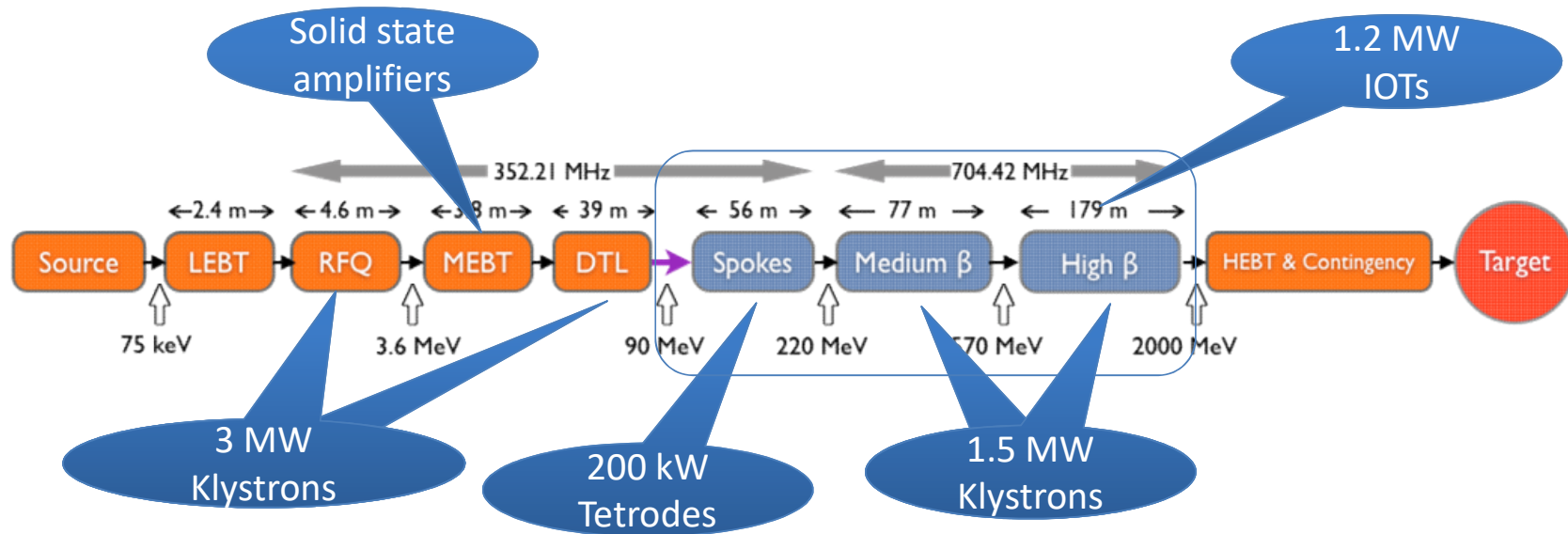


Project	Partner	Technical Annex	Opis
ACCSYS	NCBJ	AIK 6.1	Gamma Blockers
ACCSYS	PEG	AIK 8.2	LLRF System Unit
<b>ACCSYS</b>	<b>IFJ PAN</b>	<b>AIK 8.6</b>	<b>RF Installation Phase 1 and Phase 2</b>
ACCSYS	WUT	AIK 8.7	Phase Reference Line
<b>ACCSYS</b>	<b>IFJ PAN</b>	<b>AIK 8.8</b>	<b>RF Test and Tuning</b>
<b>ACCSYS</b>	<b>IFJ PAN</b>	<b>AIK 10.1</b>	<b>Cryomodule test</b>
ACCSYS	WUST	AIK 11.1	Cryogenic distribution line, elliptical linac and test stand
ACCSYS	WUST	AIK 11.3	Cryogenic distribution line, test stand
<b>ACCSYS</b>	<b>IFJ PAN</b>	<b>AIK 17.3</b>	<b>Power Converter Systems</b>
ICS	LUT	IJK 14.4.3	IPMI EPICS BLM & RTM Software and Firmware Development





# European Spallation Source(ESS ERIC) - accelerator

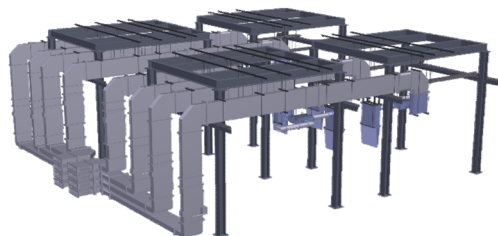




## Polish in-kind contribution by IFJ PAN (2017 – 2027)

### RF installations

- S-tub installations
- LLRF installations
- LPS installations
- RF power distribution installations
- Power Converters installations

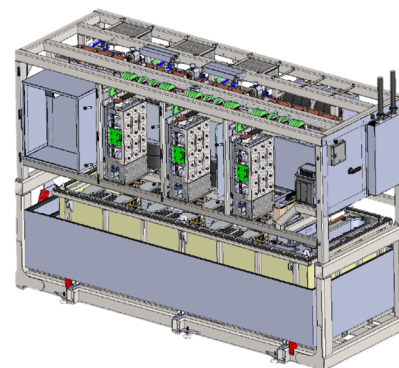


~68 FTE - 5 years (2017-2022)

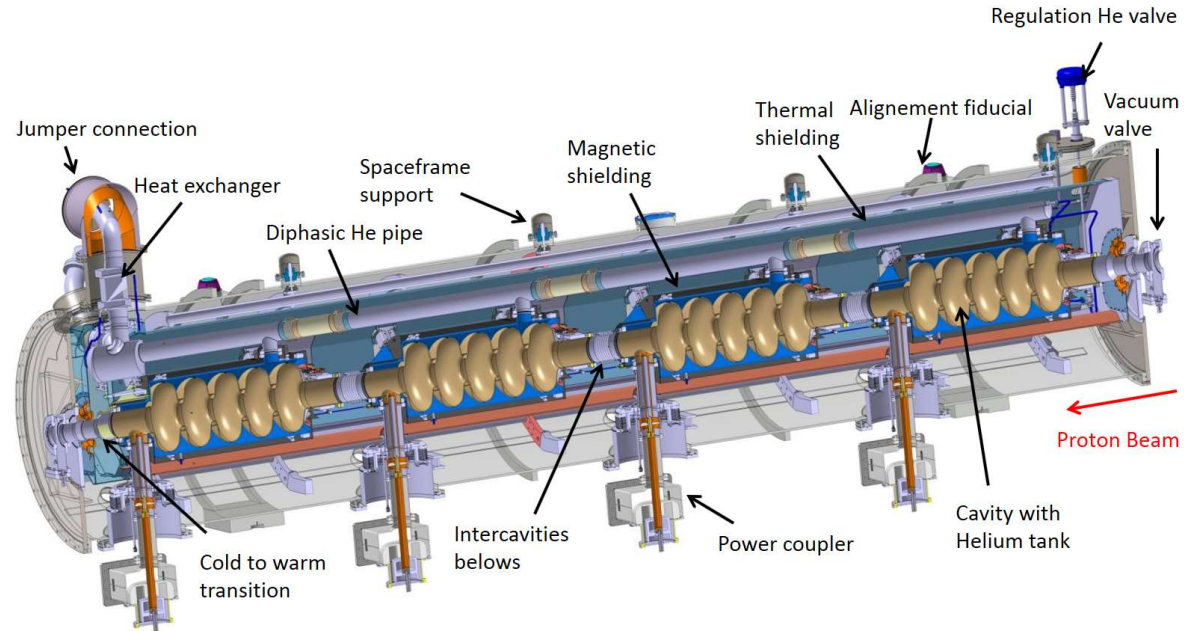
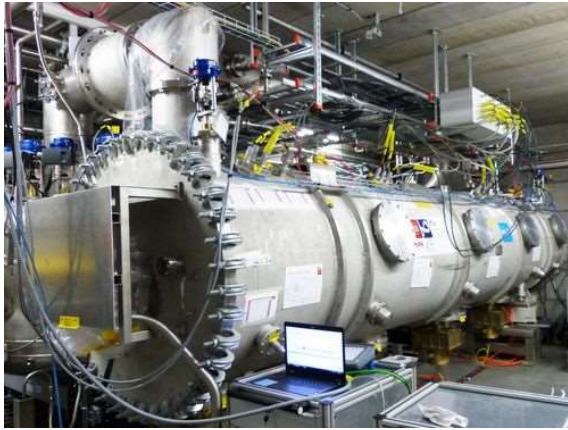


### Power converter installations

- Klystrons Modulators for RFQ i DTL
- Klystron Modulators for Medium / High Beta
- Power converters for magnets



# RF Cryomodule Tests



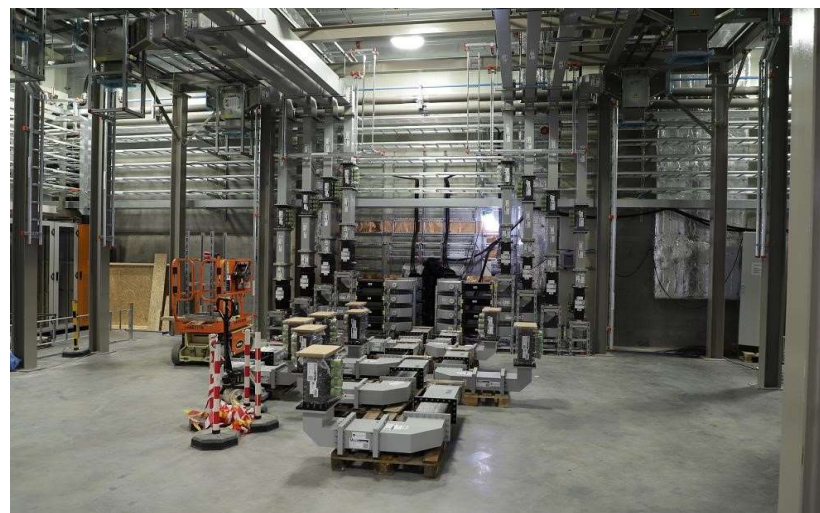
**Preparation and execution of qualification tests of 30 cryomodules**

*~57 FTE - 5 years (2022-2027)*



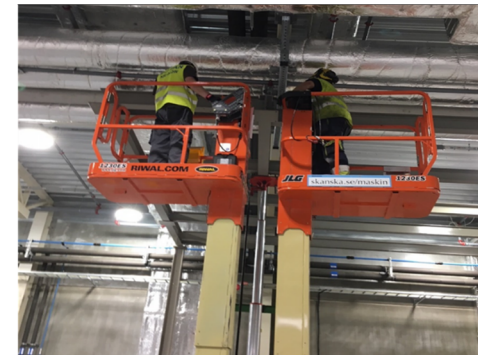
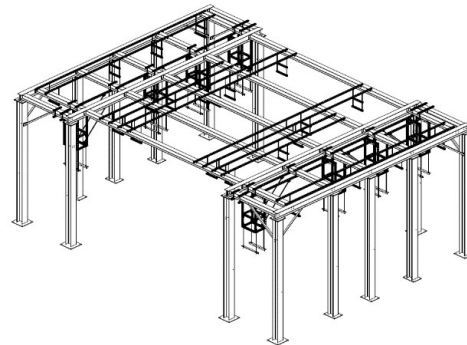
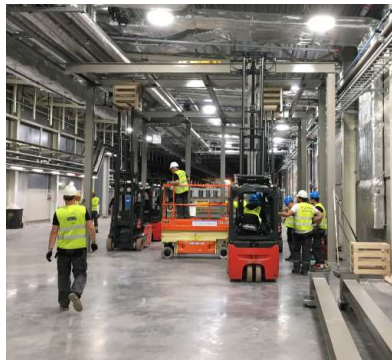


# 7 years of construction of ESS infrastructure by IFJ PAN





## Installation of Supporting Structures



Supporting Structure

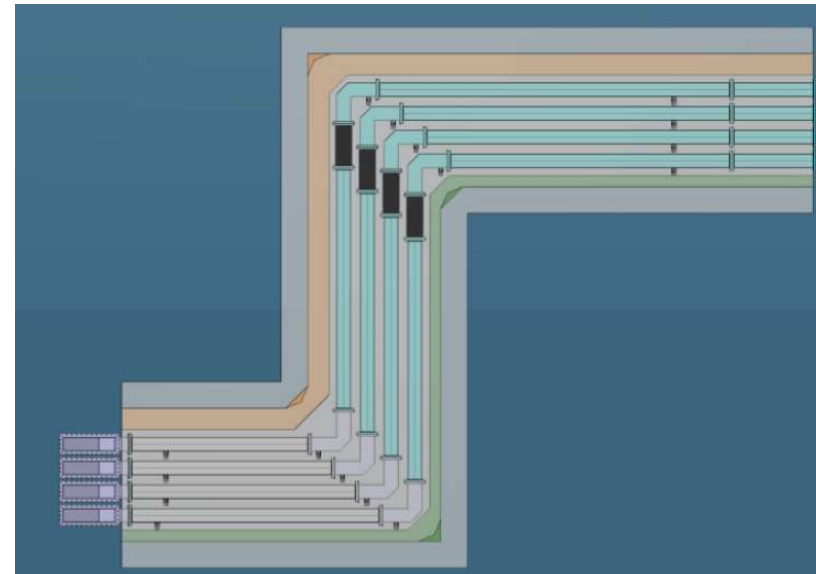
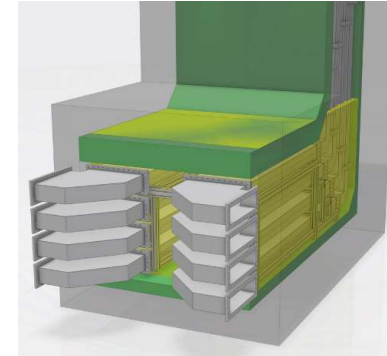


# 7 years of construction of ESS infrastructure by IFJ PAN

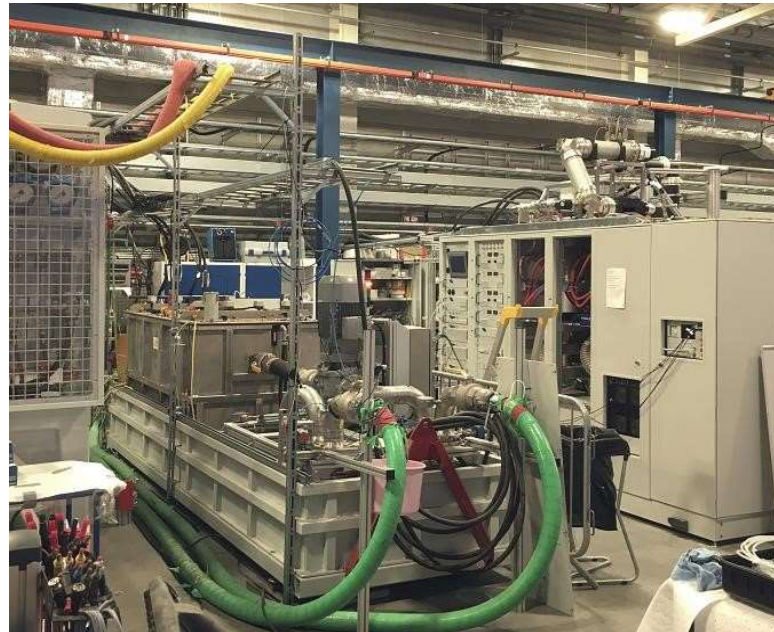


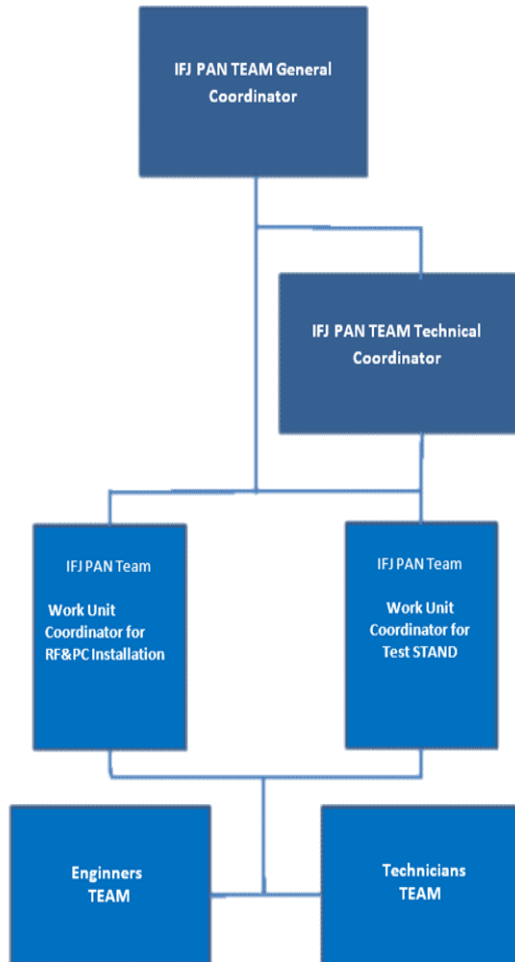
**Installation of waveguides gallery-tunnel**

**All waveguides have been installed**



## Installation of power converters





## IFJ PAN Team at Lund

**Institute of Nuclear Physics Polish Academy of Sciences (IFJ PAN)**  
**in-kind contribution to the ESS construction**  
Organizational structure of the IFJ-PAN Team at ESS

### PERSONNEL:

**GENERAL Coordinator:** Dariusz Bocian

**Technical Coordinator** – Jacek Świerblewski

**Work Units Coordinators:** – Leszek Hajduk, Michał Sienkiewicz,  
Krzysztof Myalski, Marcin Wartak



# 7 years of construction of ESS infrastructure by IFJ PAN



July
2024



Construction Executive Summary		TA No.	Value Euro <sub>2013</sub>	Percentage
	<b>Total Project IK Commitment</b>		<b>578 306 000</b>	
	<b>Member State IK Commitment</b>		<b>26 140 039</b>	<b>4,5%</b>
	<b>Member State over IK allocation *</b>		<b>0</b>	<b>0,0%</b>
	<b>Projected Member State IK**</b>	<b>10</b>	<b>26 140 039</b>	<b>100,0%</b>
	<b>Accredited</b>	<b>5</b>	<b>9 163 239</b>	<b>35,1%</b>
	<b>Approved / Recommended</b>	<b>5</b>	<b>16 976 800</b>	<b>64,9%</b>
	<b>Planned / Potential</b>	<b>0</b>	<b>0</b>	<b>0,0%</b>
	<b>The Henryk NiewodniInstitute of Nuclear Physics (IFJ PAN)</b>	<b>4</b>	<b>12 016 200</b>	<b>46,0%</b>
	<b>Wroclaw University of Science and Technology (PWR)</b>	<b>2</b>	<b>7 190 000</b>	<b>27,5%</b>
<b>The National Center for Nuclear Research (NCBJ)</b>	<b>1</b>	<b>136 839</b>	<b>0,5%</b>	
<b>Polish Electronic Group (PEG)</b>	<b>1</b>	<b>4 877 000</b>	<b>18,7%</b>	
<b>Warsaw University of Technology (Warszawa UT)</b>	<b>1</b>	<b>1 470 000</b>	<b>5,6%</b>	
<b>Technical University of Łódź (Lodz)</b>	<b>1</b>	<b>450 000</b>	<b>1,7%</b>	

**CONSTRUCTION**

Work Package Details				Contract Value & Status EURO <sub>2013</sub>			Supporting Info				
Project	Partner	Technical Annex	Description	Accredited	Approved/ Recommended	Planned/ Potential	Contract Status	IKRC Recommended Date	Agreement Type	Council Accredited Date	Latest Amendment Version No.
ACCSYS	The National Center for Nuclear Research	AIK 6.1	Gamma Blockers	136 839			Approved - Final Report Accredited	05 okt 2016	IKC Technical Annex	05 dec 2019	2
ACCSYS	Polish Electronic Group	AIK 8.2	LLRF System Units		4 877 000		Approved by Council	05 okt 2016	IKC Technical Annex		2
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 8.6	RF Installation Phase 1 and Phase II	5 281 200			Approved - Final Report Accredited	05 okt 2016	IKC Technical Annex	10 jun 2022	
ACCSYS	Warsaw University of Technology	AIK 8.7	Phase-Reference Line	1 470 000			Approved - Final Report Accredited	05 okt 2016	IKC Technical Annex	04 jun 2024	2
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 8.8	Support work for installation, testing and commissioning	972 000			Approved - Final Report Accredited	02 dec 2021	IKC Technical Annex	04 jun 2024	
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 10.1	Manpower for cryomodule tests in Lund		6 949 800		Approved by Council	05 okt 2016	IKC Technical Annex		
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 10.1	Manpower for cryomodule tests in Lund		-1 500 000		Transfer of allocation	NA	NA		
ACCSYS	Wroclaw University of Science and Technology	AIK 11.1	Cryogenic distribution line, elliptical linac and test stand		6 650 000		Approved by Council	13 dec 2016	IKC Technical Annex		4
ACCSYS	Wroclaw University of Science and Technology	AIK 11.3	Cryogenic distribution line, test stand	540 000			Approved - Final Report Accredited	13 dec 2016	IKC Technical Annex	02 dec 2021	2
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 17.3	Power Converter Systems of the ESS Linac Project (PC Installation Phase I & II)	313 200			Approved - Final Report Accredited	05 okt 2016	IKC Technical Annex	10 jun 2022	
ICS	Technical University of Łódź (Lodz)	IIK 14.4.3 #1	IPMI EPICS BLM & RTM Software and Firmware Development	450 000			Approved - Final Report Accredited	04 okt 2017	IKC Technical Annex	10 jun 2022	4
<b>Total</b>				<b>9 163 239</b>	<b>16 976 800</b>	<b>0</b>					



**INITIAL OPERATIONS**

**Work Package Details**

**Contract Value & Status EURO<sub>2013</sub>**

**Supporting Info**

Project	Partner	Technical Annex	Description	Accredited	Approved/Recommended	Planned/Potential	Contract Status	IKRC Recommended Date	Agreement Type	Council Accredited Date	Latest Amendment Version No.
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 17.12	SRF and Cryogenics Support		648 000		Approved by Council	22 jun 2023	IKC Technical Annex		
ACCSYS	Wroclaw University of Science and Technology	AIK 19.1	Cryomodule installation support		324 000		Approved by Council	11 okt 2023	IKC Technical Annex		
ACCSYS	Technical University of Łódź (Lodz)	AIK 19.2	Software for superconducting cavities characterisation and the ESS TS 2 cryomodule programme		490 000		Approved by Council	11 okt 2023	IKC Technical Annex		
<b>Total</b>				<b>0</b>	<b>1 462 000</b>	<b>0</b>					

**COMPLETION OF CONSTRUCTION**

Project	Partner	Technical Annex	Description	Accredited	Approved/Recommended	Planned/Potential	Contract Status	IKRC Recommended Date	Agreement Type	Council Accredited Date	Latest Amendment Version No.
ACCSYS	The Henryk NiewodniInstitute of Nuclear Physics	AIK 10.1	Manpower for cryomodule tests in Lund		1 500 000		Transfer of allocation	NA	NA		
<b>Total</b>				<b>0</b>	<b>1 500 000</b>	<b>0</b>					

## Acknowledgements:

I would like to thank **Darek Bocian, Jacek Świerblewski** and all colleagues from **ESS, IFJ PAN** and other involved institutions for their material, information and support.



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[Marek.Jezabek@ifj.edu.pl](mailto:Marek.Jezabek@ifj.edu.pl)

# **European Spallation Source and new opportunities for Polish scientists**

**Abstract:** Poland supplies a significant contribution to the construction and operation of scientific centres in European Research Area. A new world class infrastructure will start its operation in Lund in 2028. A brief history of European Spallation Source (ESS), its construction, scientific potential and plans for Steady State Operations (SSO) will be presented. A coordinated effort of Polish research groups from universities and research institutes is necessary to fully profit from nearly two decades of our involvement in this project.