HighNESS - Project Overview, Goals and Objectives

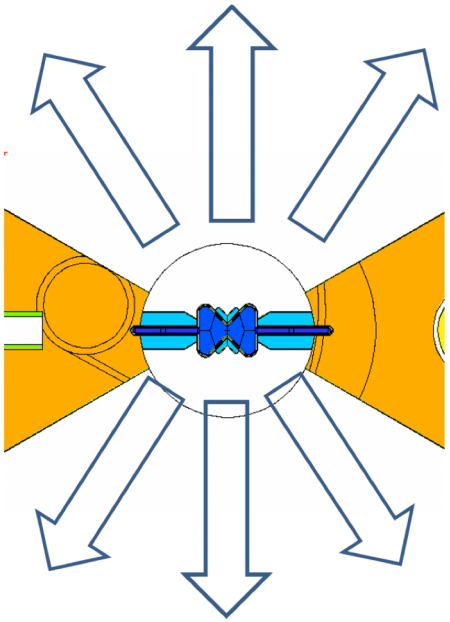
Valentina Santoro

HighNESS kick-off Meeting, 26 October 2020

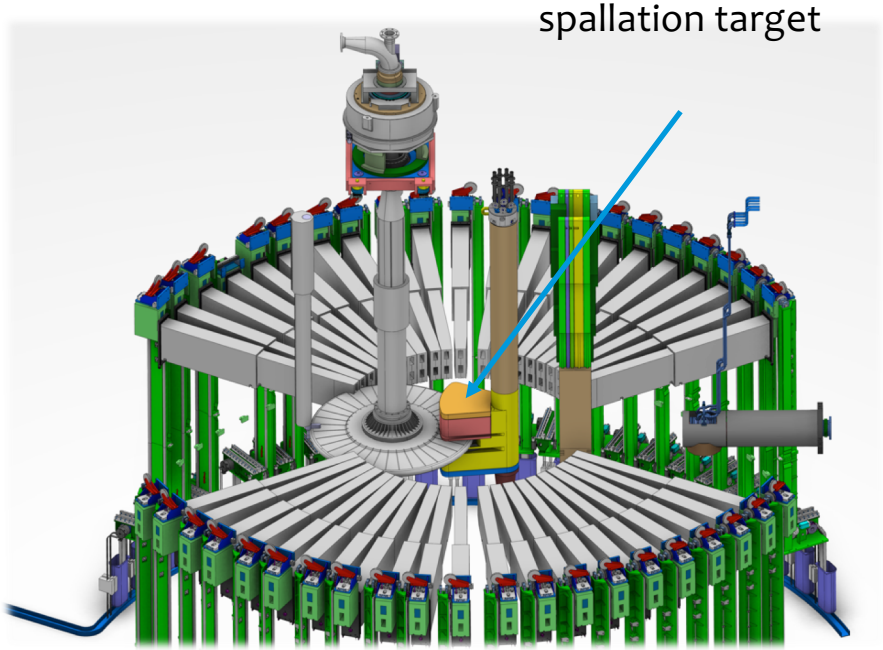
ESS Current moderator

- The design of ESS moderator was based on the novel concept of low-dimensional moderators . It is a single **high-brightness** moderator system placed on top of the spallation target.
- All of the first 15 instruments built, plus a test beam line, will view that moderator

ESS current moderator unprecedent brightness to all the available beamport



moderator located above the spallation target



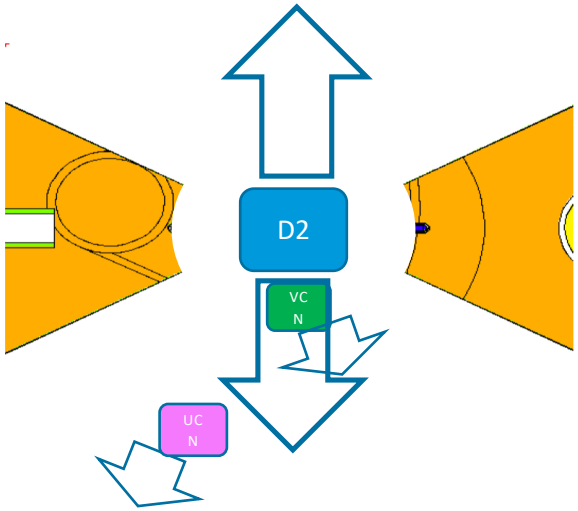
Development of **High** Intensity **N**eutron Source at the **E**uropean **S**pallation **S**ource

The main objective of the HighNESS project is to develop a second neutron source, located below the spallation target, with a high-intensity moderator able to deliver

- a larger total cold neutron flux,
- -provide high intensities at longer wavelengths in the spectral regions of Cold (4-10 Å), Very Cold (10-40 Å), and Ultra Cold (several 100 Å) neutrons

• In particular, ESS would provide the first intense VCN source in the world.

HighNESS: ESS future moderators
High Intensity moderator
Very Cold Neutron Moderator
Ultra Cold Neutron Moderator

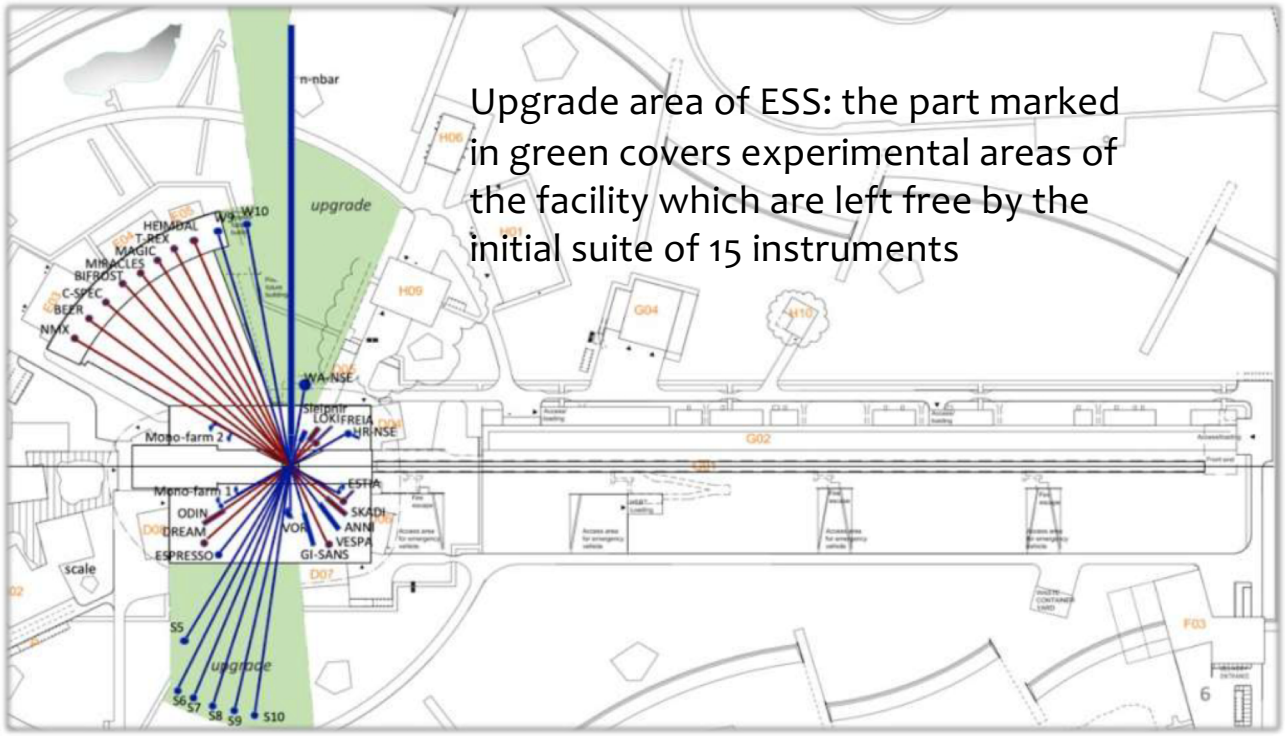


WP4,WP5,WP6

Offering both unprecedented brilliance, flux, and spectral range in a single facility, will make ESS the most versatile neutron source in the world thereby keeping the European scientific community at the forefront of research progress

ESS future instruments

- The design study will fill gaps in the available instruments and capabilities at ESS, including a program of fundamental physics, and design of condensed-matter science instrument that can strongly profit from using neutrons with longer wavelengths
- Many other experiments and applications would strongly profit from a source with different, complementary characteristics, respect to the current ESS source



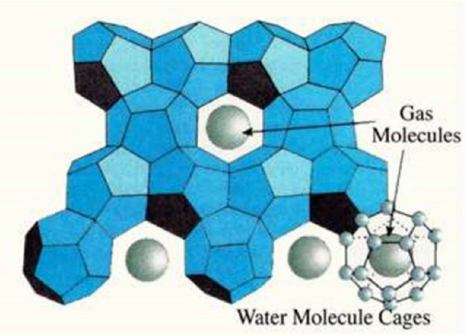
Upgrade area of ESS: the part marked in green covers experimental areas of the facility which are left free by the initial suite of 15 instruments

WP7,WP8

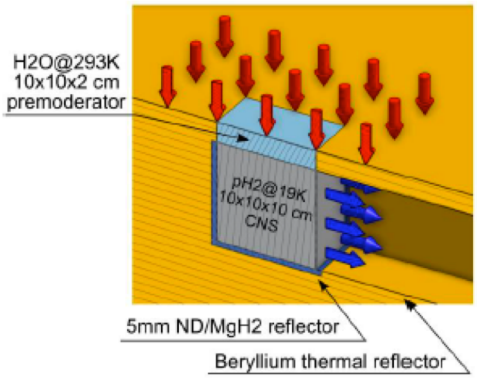
Advanced Reflector

- Recent years have seen intense research towards novel reflector materials both for the moderator and for the beam extraction systems
- In order for these materials to be used at ESS, they have to be characterized. We have a plan to acquire the missing information experimentally (WP3)
- With the input from measurements, in WP2 these materials will be implemented in computer code

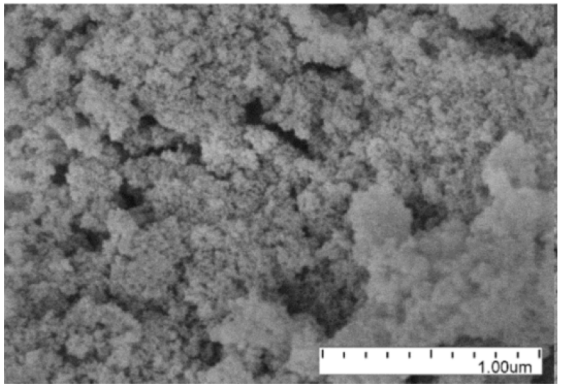
Clathrate hydrates



Magnesium hydride (MgH2)



Nanodiamondas particle



WP2,WP3

The HighNESS Consortium

As required by the cross-disciplinary nature of this work, HighNESS comprises leading experts in simulations, neutronic design and engineering, material characterization using neutron scattering techniques, and the design of instruments/experiments for slow neutrons.

Participant No.	Participant organisation name	Short name	Country
1 (coord.)	European Spallation Source ERIC	ESS	SE
2	Institut Max von Laue – Paul Langevin	ILL	FR
3	Forschungszentrum Julich Gmbh	FZJ	DE
4	Universita' Degli Studi Di Milano-Bicocca	UNIMIB	IT
5	Danmarks Tekniske Universitet	DTU	DK
6	Paul Scherrer Institut	PSI	CH
7	Mirrotron Multilayer Laboratory Ltd	Mirrotron Ltd	HU
8	Stockholms Universitet	SU	SE

HighNESS

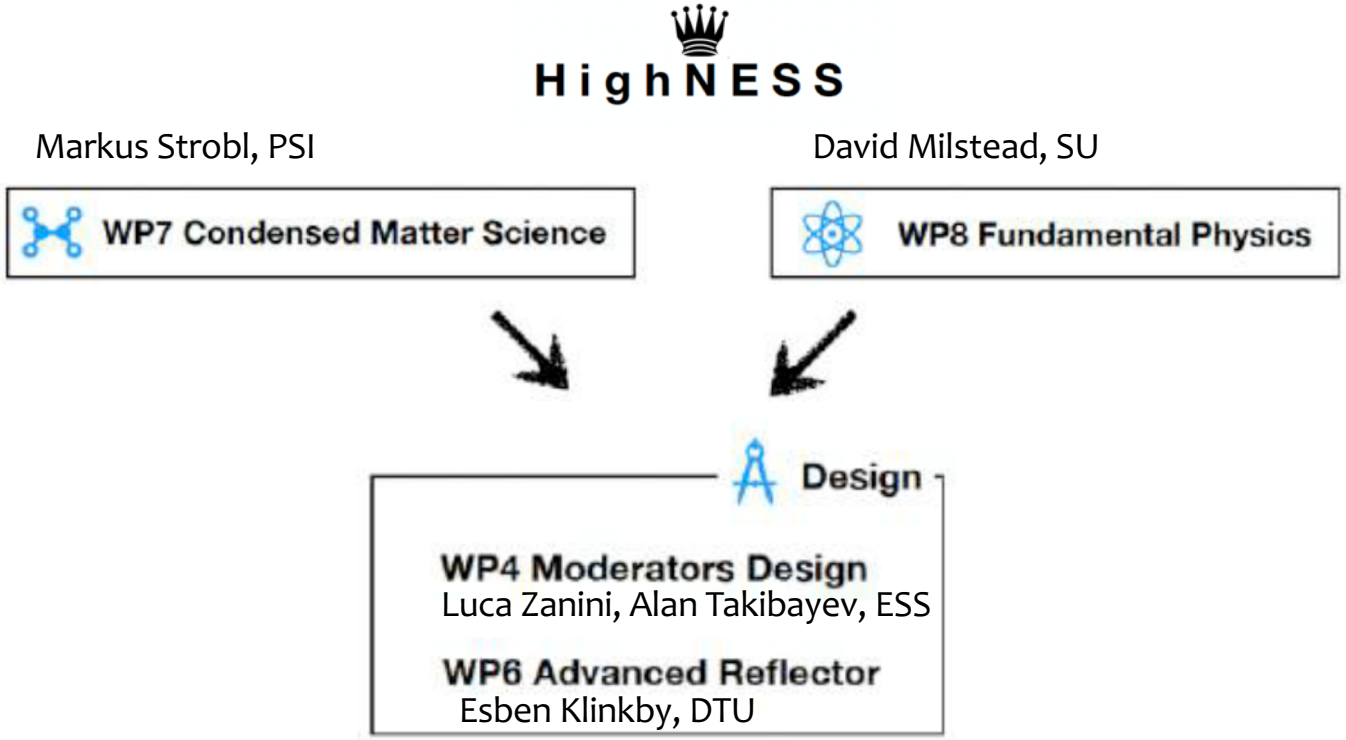
Design

WP4 Moderators Design

Luca Zanini, Alan Takibayev, ESS

WP6 Advanced Reflector

Esben Klinkby, DTU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David Milstead, SU
WP7 Condensed Matter Science
WP8 Fundamental Physics
Design
WP4 Moderators Design
Luca Zanini, Alan Takibayev, ESS
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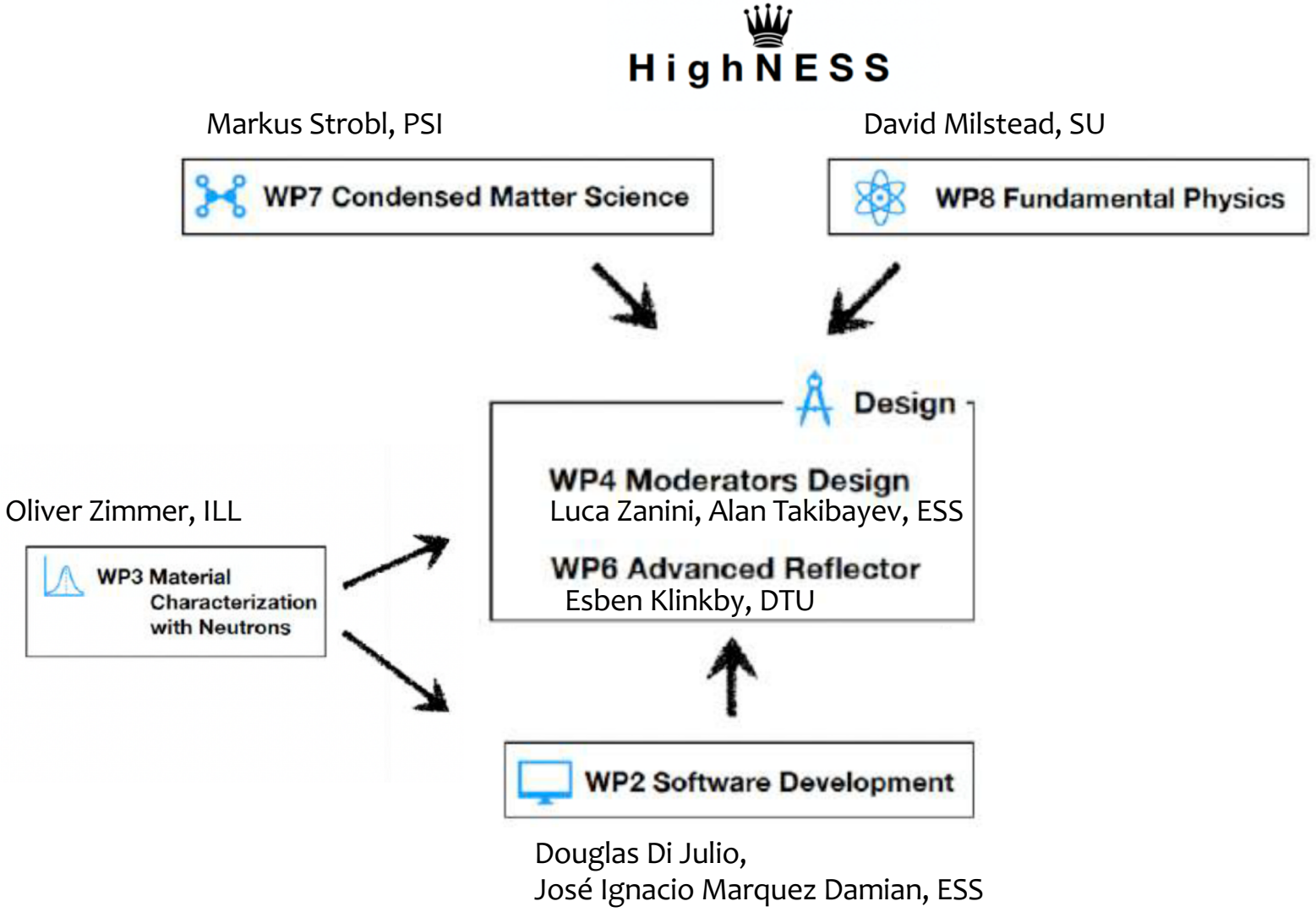
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WP2 Software Development
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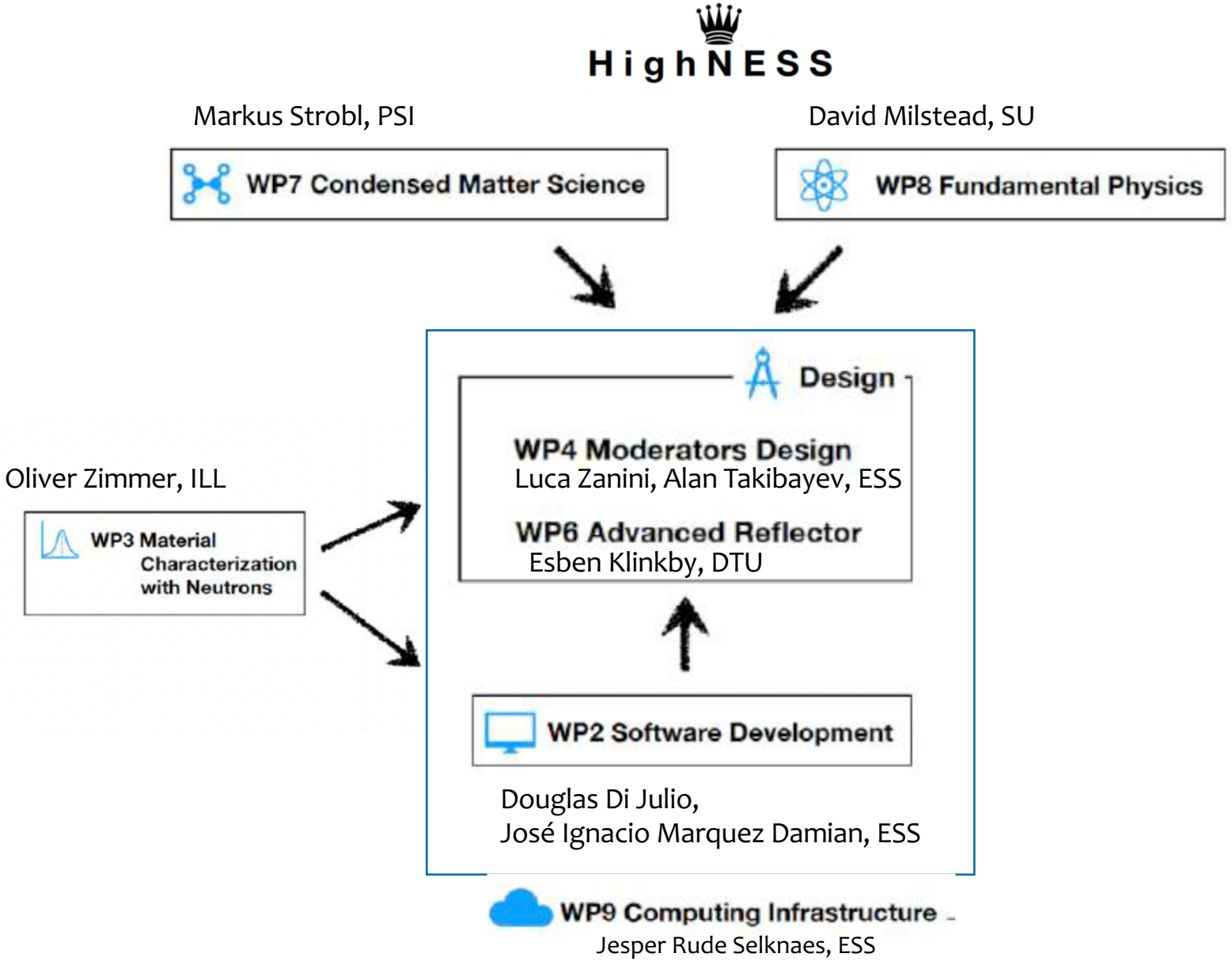
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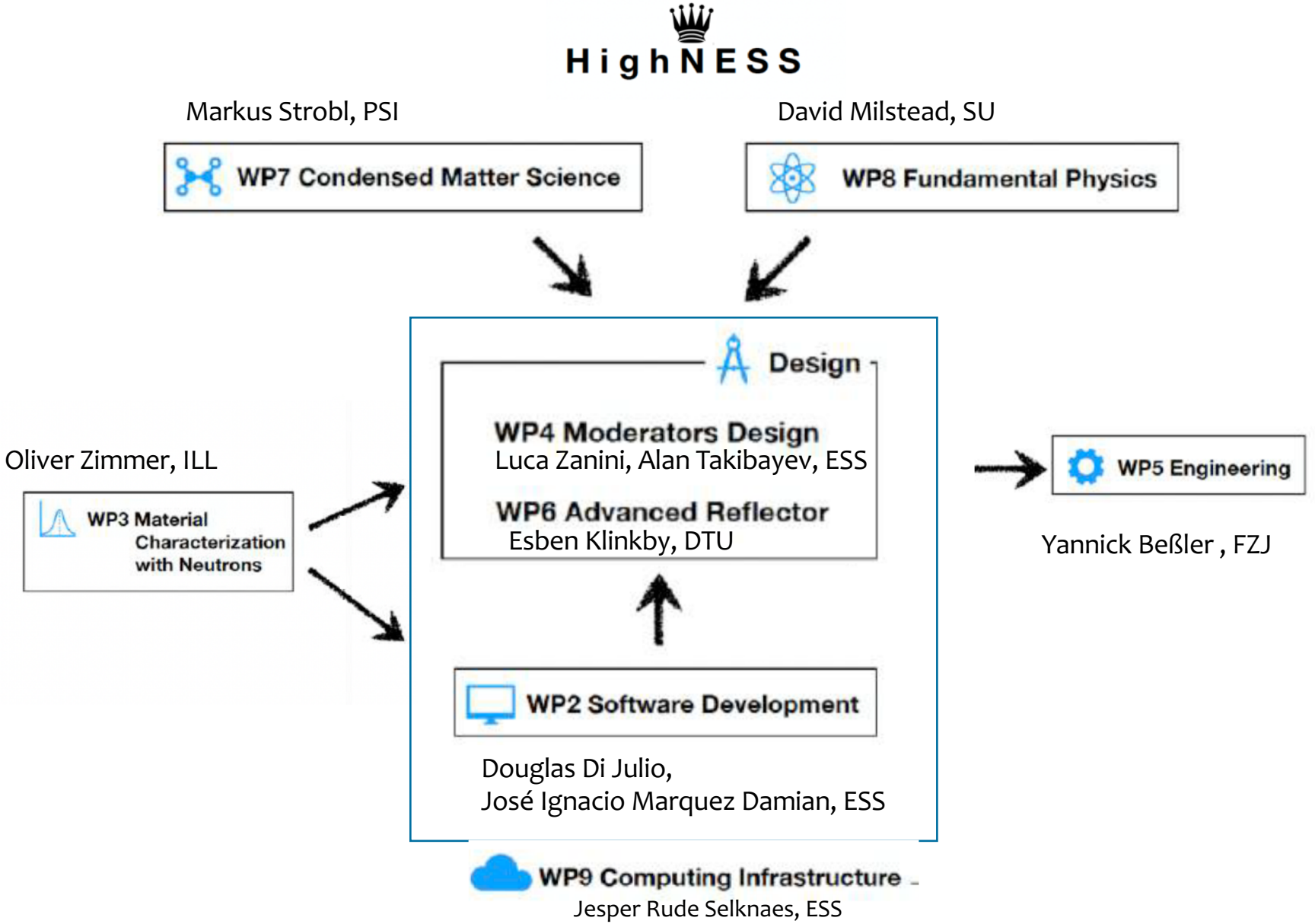
WP9 Computing Infrastructure
Jesper Rude Selknaes, ESS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Yannick Beßler , FZJ
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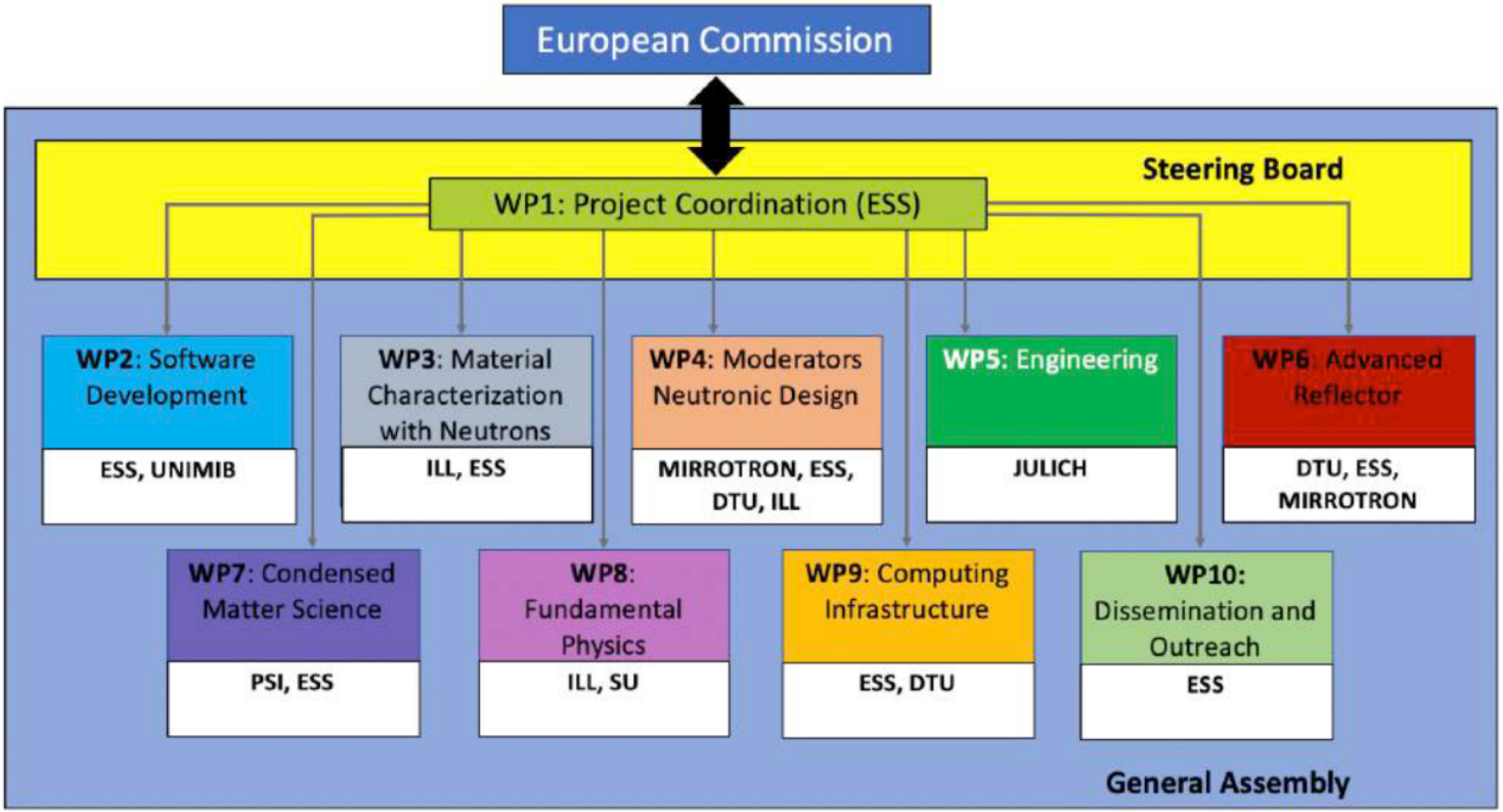
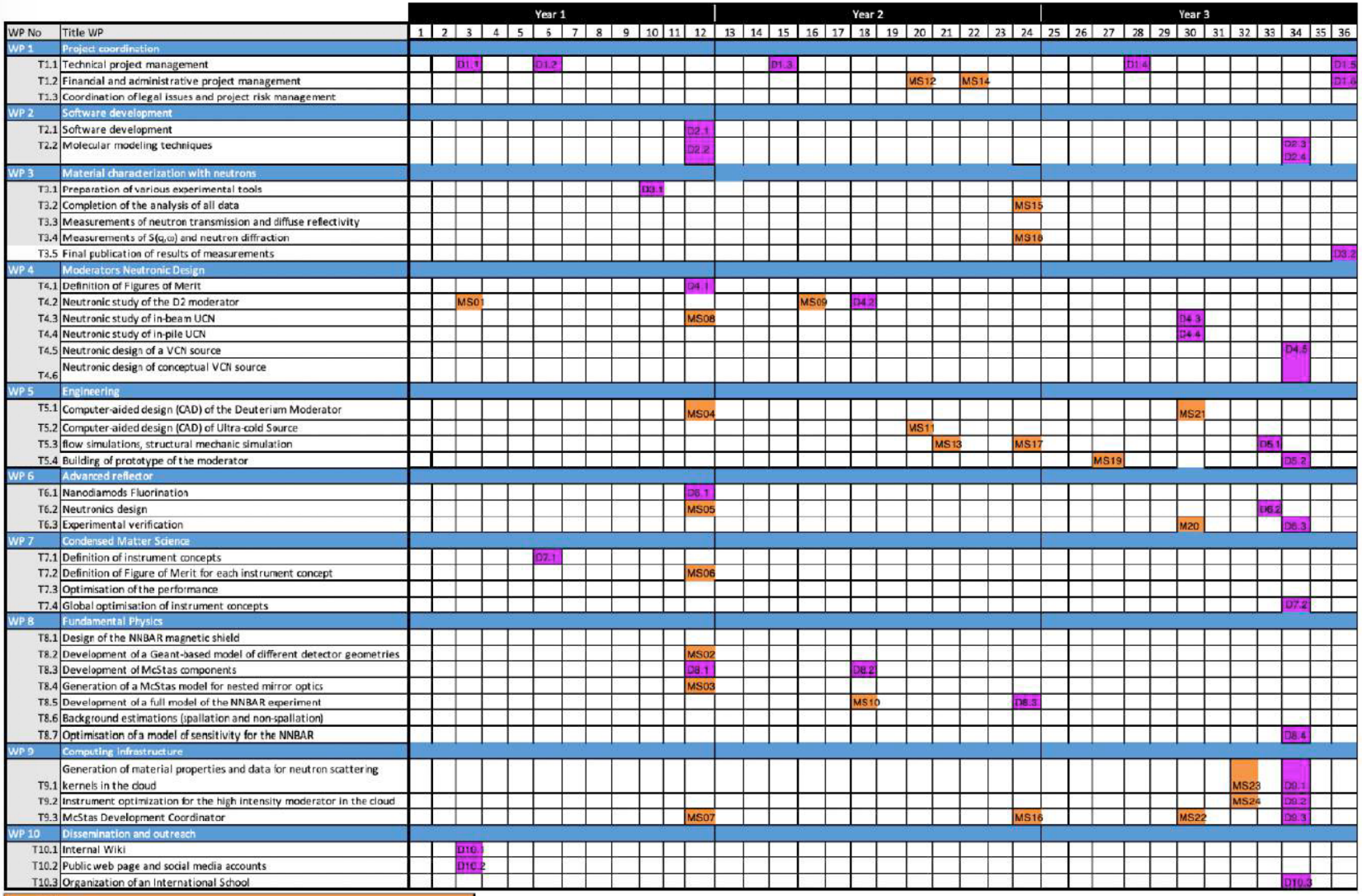
Governance of the Project




Year 1
Year 2
Year 3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
WP No
Title WP
WP 1
Project coordination
T1.1 Technical project management
T1.2 Financial and administrative project management
T1.3 Coordination of legal issues and project risk management
WP 2
Software development
T2.1 Software development
T2.2 Molecular modeling techniques
WP 3
Material characterization with neutrons
T3.1 Preparation of various experimental tools
T3.2 Completion of the analysis of all data
T3.3 Measurements of neutron transmission and diffuse reflectivity
T3.4 Measurements of S(q,ω) and neutron diffraction
T3.5 Final publication of results of measurements
WP 4
Moderators Neutronic Design
T4.1 Definition of Figures of Merit
T4.2 Neutronic study of the D2 moderator
T4.3 Neutronic study of in-beam UCN
T4.4 Neutronic study of in-pile UCN
T4.5 Neutronic design of a VCN source
T4.6 Neutronic design of conceptual VCN source
WP 5
Engineering
T5.1 Computer-aided design (CAD) of the Deuterium Moderator
T5.2 Computer-aided design (CAD) of Ultra-cold Source
T5.3 flow simulations, structural mechanic simulation
T5.4 Building of prototype of the moderator
WP 6
Advanced reflector
T6.1 Nanodiamods Fluorination
T6.2 Neutronics design
T6.3 Experimental verification
WP 7
Condensed Matter Science
T7.1 Definition of instrument concepts
T7.2 Definition of Figure of Merit for each instrument concept
T7.3 Optimisation of the performance
T7.4 Global optimisation of instrument concepts
WP 8
Fundamental Physics
T8.1 Design of the NNBAR magnetic shield
T8.2 Development of a Geant-based model of different detector geometries
T8.3 Development of McStas components
T8.4 Generation of a McStas model for nested mirror optics
T8.5 Development of a full model of the NNBAR experiment
T8.6 Background estimations (spallation and non-spallation)
T8.7 Optimisation of a model of sensitivity for the NNBAR
WP 9
Computing infrastructure
T9.1 Generation of material properties and data for neutron scattering kernels in the cloud
T9.2 Instrument optimization for the high intensity moderator in the cloud
T9.3 McStas Development Coordinator
WP 10
Dissemination and outreach
T10.1 Internal Wiki
T10.2 Public web page and social media accounts
T10.3 Organization of an International School
D1.1
D1.2
D1.3
D1.4
D1.5
MS12
MS14
D1.6
D2.1
D2.2
D2.3
D2.4
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D8.4
MS23
D9.1
MS24
D9.2
MS07
MS22
D9.3
D10.1
D10.2
D10.3
M = Milestone
D = Deliverable
DM = Deliverable and Milestone

Conclusions

- HighNESS project has just started
- Several new young people have been hired and are already part of the projects. Their training is on-going or will start soon
- Several meeting already happening:
  - Bi-Weekly meeting with the WP-leaders
  - WP internal meeting
  - Meetings between different WPs

INFRADEV-01-2019-2020 –Design Studies

TITLE	ACRONYM	PROJECT ID
Clock Network Services - Design Study	CLONETS-DS	951886
DESIGN STUDY FOR A EUROPEAN VACCINE INFRASTRUCTURE	TRANSVAC-DS	951668
Development of High Intensity Neutron Source at the European Spallation Source	HighNESS	951782
Future Circular Collider Innovation Study	FCCIS	951754
Gliders for Research, Ocean Observations and Management: Infrastructure and Innovation	GROOM II	951842
Joint European Research Infrastructure of Coastal Observatories - Design Study	JERICO-DS	951799
Observatory for Political Texts in European Democracies - A European Research Infrastructure	OPTED	951832
Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies - Design Study	SLICES-DS	951850
Superconducting magnets for the European Magnet Field Laboratory	SuperEMFL	951714
Towards an Atacama Large Aperture Submillimeter Telescope	AtLAST	951815

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