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General Assembly

Work Package 2: A strategy to deliver neutrons for Europe and beyond

Andreas Schreyer

Director for Science, ESS

Mark Johnson

Assoc. Dir. and Head of Science Division, ILL

Lambert van Eijck

Vice-Chair, ENSA; TU Delft

BrightnESS² is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 823867

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 823867

12 February 2020, Brussels

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At its heart, **Work Package 2** is a strategy-led approach to addressing the significant evolutionary change facing the European neutron community.

Its purpose is to help guide the response to declining neutron capacity in Europe and implement solutions that will ensure the **long-term sustainability** of Europe's world-leading neutron science community.

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WP 2 Partners

ESS | ILL | ENSA

TU Delft | ISIS/STFC | FZJ | Wigner RCP | PSI | Necsa
iThemba LABS | TUM | TU Wien | NCBJ

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WP 2 Objectives

Specifically, WP 2 aims to define the best way to provide **neutron instrumentation**, associated **characterisation methods** and **analysis tools** in a strategic and coordinated fashion to the European user community and beyond.

Andreas Schreyer, ESS

2.1 Establish a common roadmap and implementation strategy for future neutron capability.

Lambert van Eijck, ENSA
Peane Maleka, iThemba LABS

2.2 Define the needs of the user communities relative to new neutron-based methods, in alignment with ESS facility capabilities (Europe and South Africa).

2.3 Explore and implement more efficient ways to use neutrons, beginning with pilot programmes targeting engineering and soft matter/life sciences.

Mark Johnson, ILL

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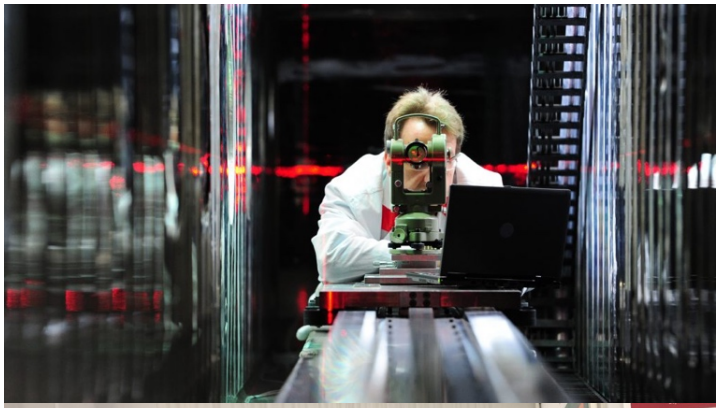

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2.1 Activities: LENS

The League of advanced European Neutron Sources

FIRST GENERAL ASSEMBLY, MAR 2019, LIBLICE

- Major event featuring keynotes from ESFRI, EC, LEAPS, ENSA and two panel discussions
- Statutes signed and Working Group PAs identified
- GA and EB bodies established, and chair (Schober, ILL) and vice-chair (McGreevy, ISIS) selected

WG 1 MEETING, JUN 2019, DÜSSELDORF

- Chaired by A. Schreyer (ESS) and T. Brückel (FZJ)
- **B2 WP2 objectives embedded in LENS priority actions**

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LENS

WG1: Strategy, Promotion & Policy (ESS)
- Promotion and communication
- Neutron strategy/landscape analysis
- New funding schemes
- User access policies

WG2: Neutron Usage and Innovation (MLZ + ISIS)
- Education
- Awards
- User organisation
- Industrial users
- New user communities
- Assessment
- Best practice

WG3: Synergies in Technological Development and Operation (PSI + ILL)
- Moderator systems
- Neutron delivery systems
- Technologies for polarized neutrons
- Detectors
- Sample environments
- Deuteration technologies
- Future sources
- Standardisation

WG4: Computing, Data (ILL + MLZ)
- Artificial intelligence technologies
- Open data, Data DOI's
- Computing/data-management/analysis
- Automatization and robotics
- Instrument control systems
- Joint software repository

Ad-Hoc Group: Compact Neutron Sources (LLB + FZJ)

The CNS group is investigating the possibilities for using compact neutron sources in Europe.

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2.1 Activities: LENS

- **LENS AT ECNS,** JUL 2019, ST. PETERSBURG
  - ENSA's major quadrennial event with global reach
  - LENS Vice-Chair R. McGreevy given prime speaking slot to introduce LENS to user community
  - LENS promotional materials featured and distributed

- **HORIZON EUROPE POSITION PAPER,** SEP 2019
  - First joint statement issued from LENS
  - Opened dialogue between LENS and DG-RTD
  - Handed over at R&I Days session on Excellent Science

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2.1 Activities: LENS

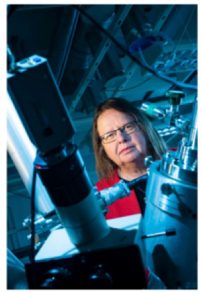
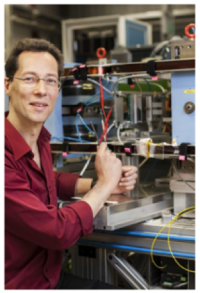
SECOND GA-EB MEETING, OCT 2019, GRENOBLE

- Major step forward for LENS as an operational organisation
- Priority Action's defined and scoped to exploit technical and scientific synergies across facilities
- Coordination on approaches to national and trans-national funding schemes defined

LENS COLLOQUIUM, FEB 2020, BRUSSELS

- First public forum for LENS, signalling a shift in orientation for RIs relative to the EU





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2.1 Activities: LENS

OTHER COLLABORATIVE FIRSTS

- DEC 2019: LENS/ENSA joint press release on potential ‘neutron gap’ + H. Schober editorial in *Research* Europe*
- JAN 2020: LENS *BATTERY 2030+* position paper coordinated with corresponding LEAPS paper

VISION/LANDSCAPE DOCUMENT (D2.10)

- JUL 2019, St. Petersburg: 20 contributors representing LENS, ENSA, South Africa and B2 met to draft **first** outline
- JUL 2019, Telco: LENS Heads of Facilities produced **second** draft outline
- AUG 2019: Online library established for existing European and international neutron strategy documents
- OCT 2019, Grenoble: LENS EB & GA approve WG1’s **third** draft outline

Research Europe | 9 January 2019 Comment | 13

Comment Neutron science

Let the beams shine bright

Research with neutrons is crucial to Europe's ambitions—but facilities are closing

Helmut Schober is director of the Institut Laue-Langevin and chair of the League of advanced European Neutron Sources

Both in the EU and national governments, Europe has set itself the goal of becoming a front-runner in green technology. This is seen as the key to both averting environmental disaster and maintaining economic competitiveness.

facing a reduction in the number of neutron sources.

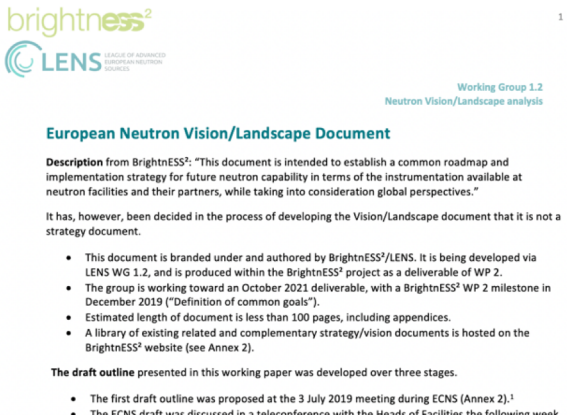
In 2019, three of Europe's neutron facilities closed: BER-II in Berlin, Orphée in Paris and JEEP II outside Oslo. BER-II and Orphée in particular supported large communities of users and

which is under construction in Sweden, was conceived more than 20 years ago and is expected to become scientifically active in 2023.

Europe must ask itself why building large scientific facilities takes so long. In a fast-moving

delays in the fabrication, delivery and installation of equipment.

A further source of fragility is diverging opinions on the appropriate distribution of financial burdens. Europe invests close to half a billion euros annually in building and operating



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Working Group 1.2
Neutron Vision/Landscape analysis

European Neutron Vision/Landscape Document

Description from BrightnESS²: “This document is intended to establish a common roadmap and implementation strategy for future neutron capability in terms of the instrumentation available at neutron facilities and their partners, while taking into consideration global perspectives.”

It has, however, been decided in the process of developing the Vision/Landscape document that it is not a strategy document.

- This document is branded under and authored by BrightnESS²/LENS. It is being developed via LENS WG 1.2, and is produced within the BrightnESS² project as a deliverable of WP 2.
- The group is working toward an October 2021 deliverable, with a BrightnESS² WP 2 milestone in December 2019 (“Definition of common goals”).
- Estimated length of document is less than 100 pages, including appendices.
- A library of existing related and complementary strategy/vision documents is hosted on the BrightnESS² website (see Annex 2).

The draft outline presented in this working paper was developed over three stages.

- The first draft outline was proposed at the 3 July 2019 meeting during ECNS (Annex 2).[1]

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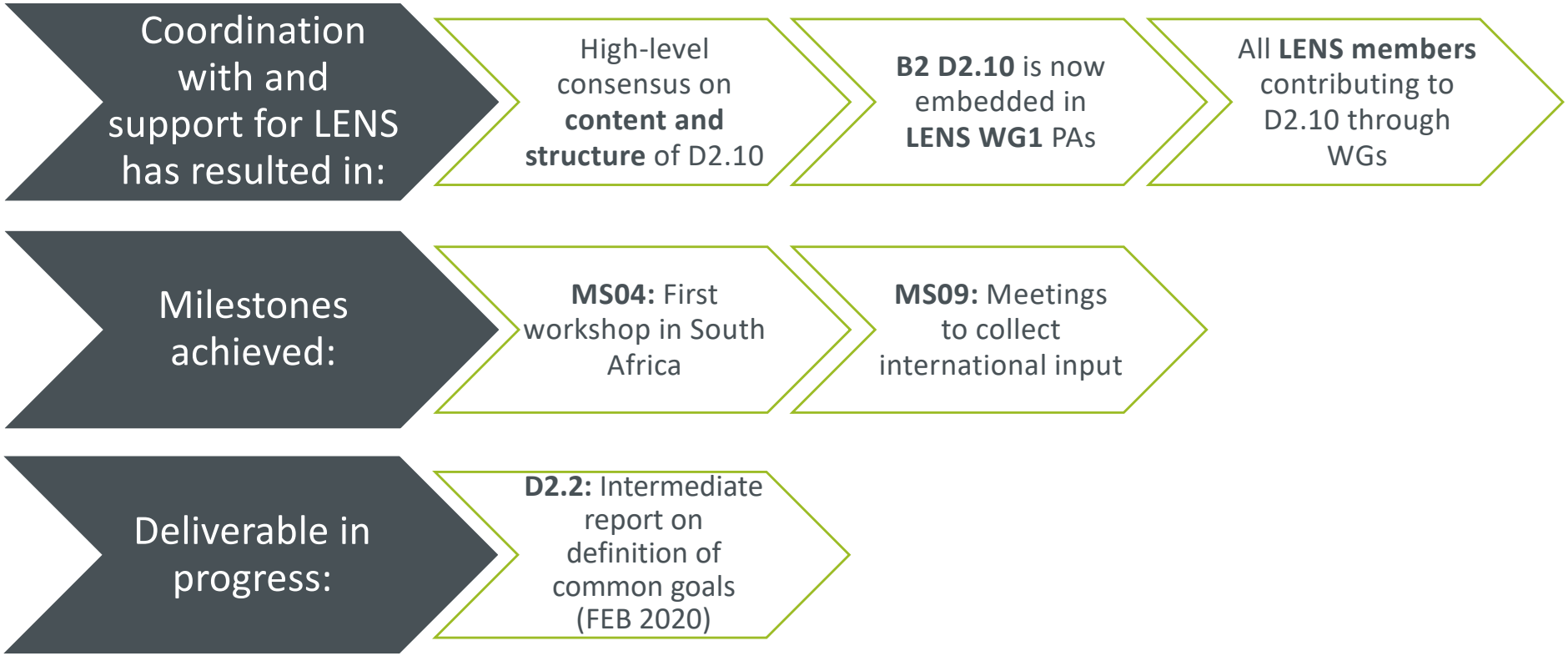
Task 2.1 Progress



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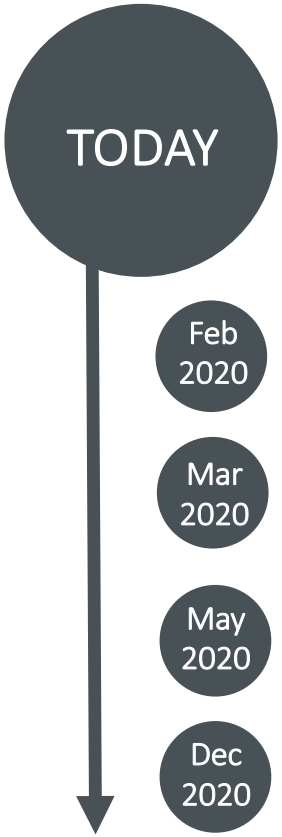
Next steps: LENS Vision/Landscape Document



- **Common meeting between B2 WP2, LENS WG1.2 (Strategy) and LENS Ad-Hoc WG on Compact Neutron Sources (CNS)**
- **Agenda includes: V/L outline, CNS White Paper and writing workshop preparations**

D2.2: Intermediate report on definition of common goals

Writing Workshop at Villard-de-Lans

LENS EB & GA meeting at Didcot, UK

Circulation of first draft

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WP2, Task 2.2: Defining and reporting the needs of the user communities

Lambert van Eijck

ENSA & TU Delft, NL

12 February 2020, Brussels

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Main goals

- Analysing neutron community needs in Europe
  - Sending out ~7000 surveys will yield non-representative feedback and needs
  - More success when survey is targeted to the profile of the scientist, in terms of her/his topics and methods
  - To generate such personalized survey, we first generate a list of European scientists applying neutrons for research, and their respective fields of expertise *(who, when, where)*
  - AI/deep learning of their scientific output will yield expertise, societal topics, experimental methods, on a per-person level *(why, how)*
- Analysis of *neutron trends* in research topics, social relevance, methods, etc.

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ENSA national delegates will liaison with their national communities to communicate and inquire about neutron research infrastructure needs of the current and future scientists.

ENSA data scientist and executive officer, Evgenii Velichko (TU Delft) will generate the community analysis for a person-specific surveys.

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Analysis and visualization of scientific networks

from: https://www.nobelprize.org

The Nobel Prize in Physics 1994

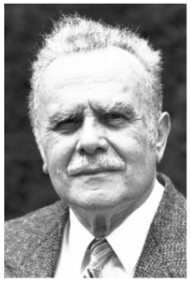
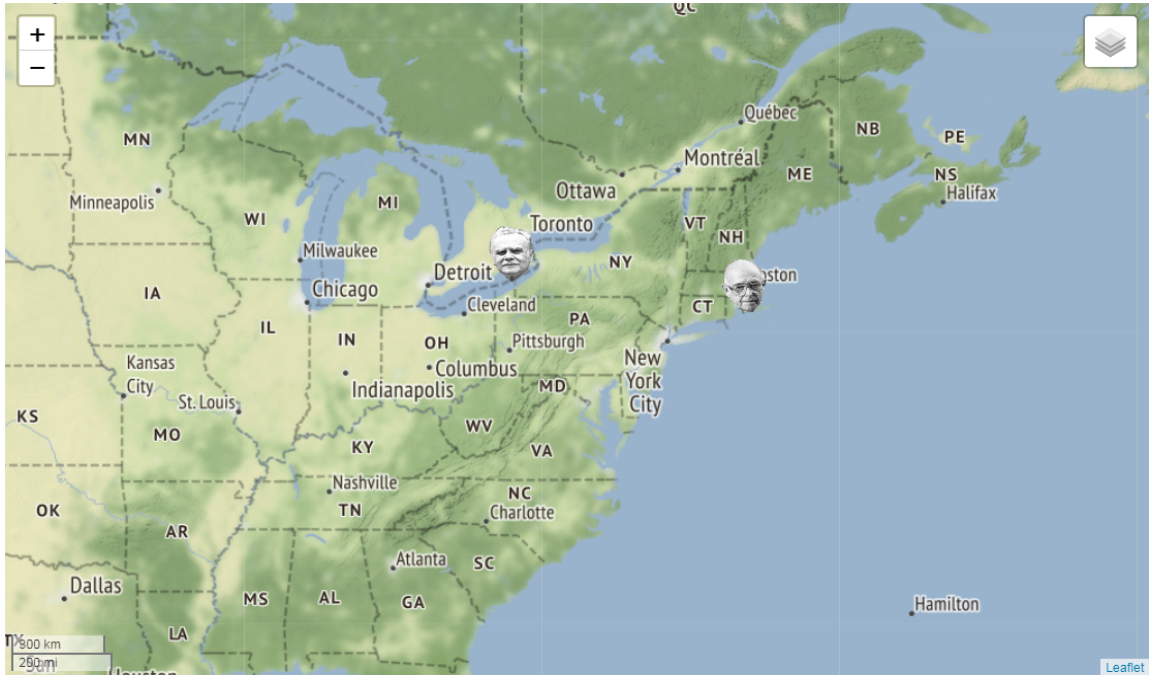


Photo from the Nobel Foundation archive.
Bertram N. Brockhouse
Prize share: 1/2

Photo from the Nobel Foundation archive.
Clifford G. Shull
Prize share: 1/2

In simple terms, **Clifford G. Shull** has helped answer the question of where atoms "**are**" and **Bertram N. Brockhouse** the question of what atoms "**do**".



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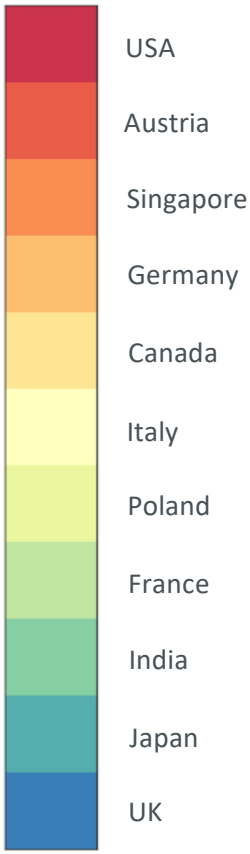
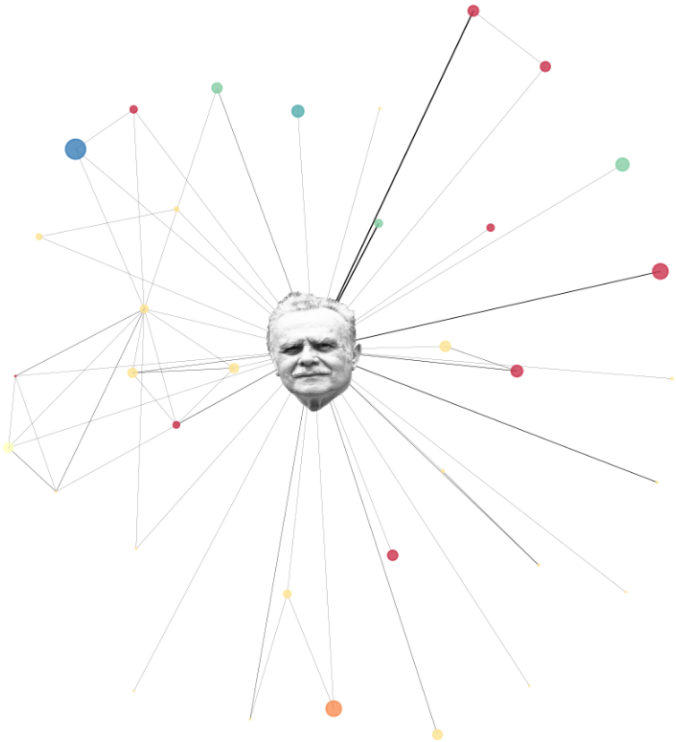
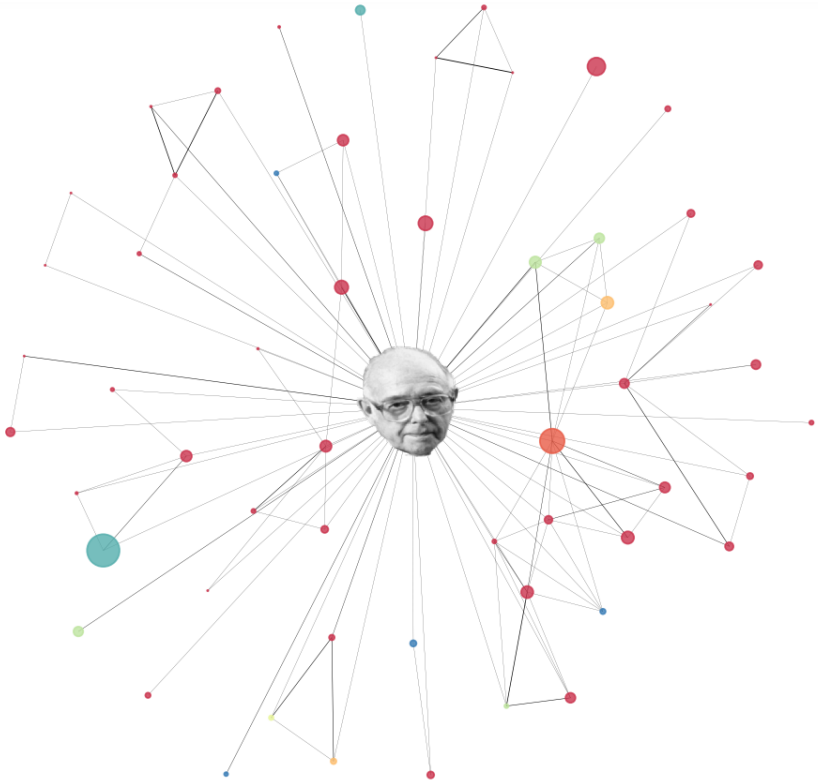
Analysis and visualization of scientific networks







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Analysis and visualization of scientific networks

Network analysis → who, when & where

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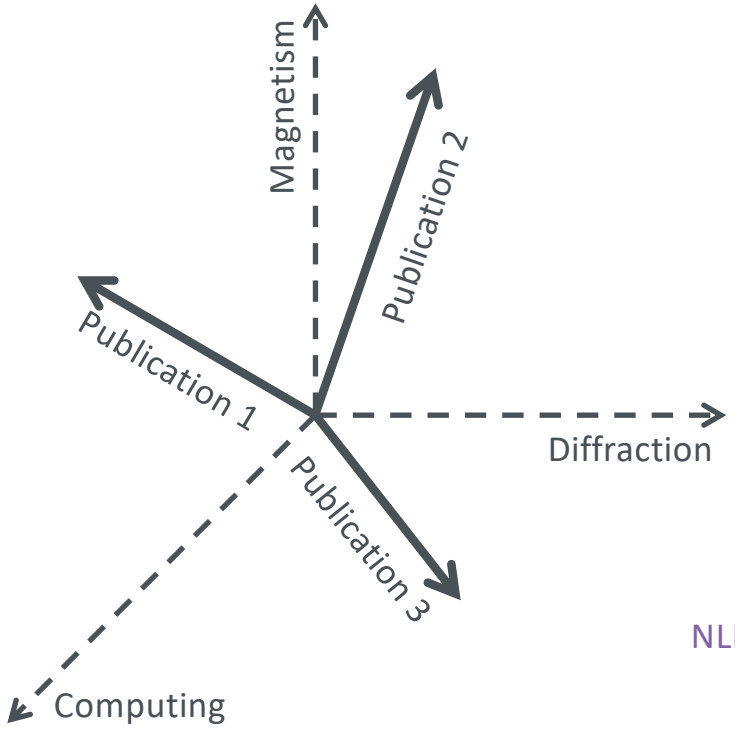
Natural Language Processing (NLP): analysing scientific publications as vectors in n-dimensional token space



NLP → Why, How

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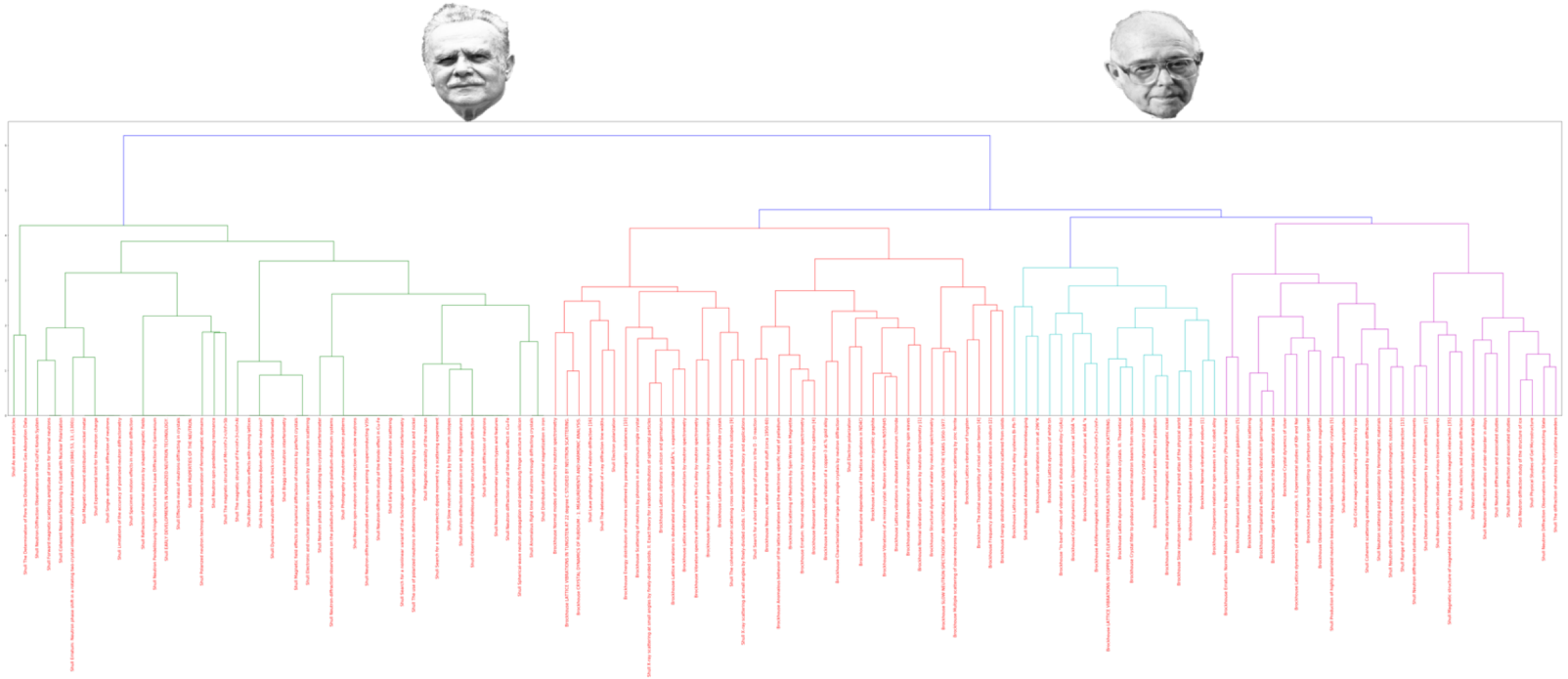
NLP publication dendrogram



Based on merely publication title and abstract

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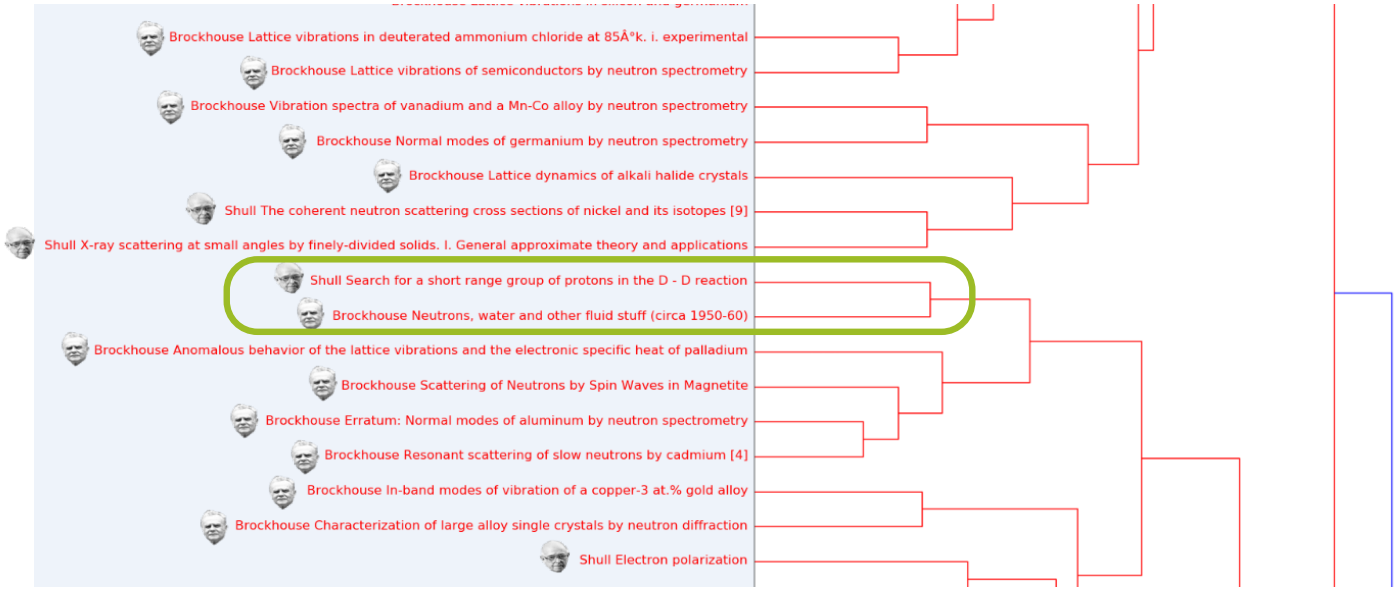
NLP publication dendrogram



Shull: ”Search for a short range group of protons in the D-D reaction”

Brockhouse: ”Neutrons, water and other fluid stuff”

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Based on merely publication **title** and **abstract**

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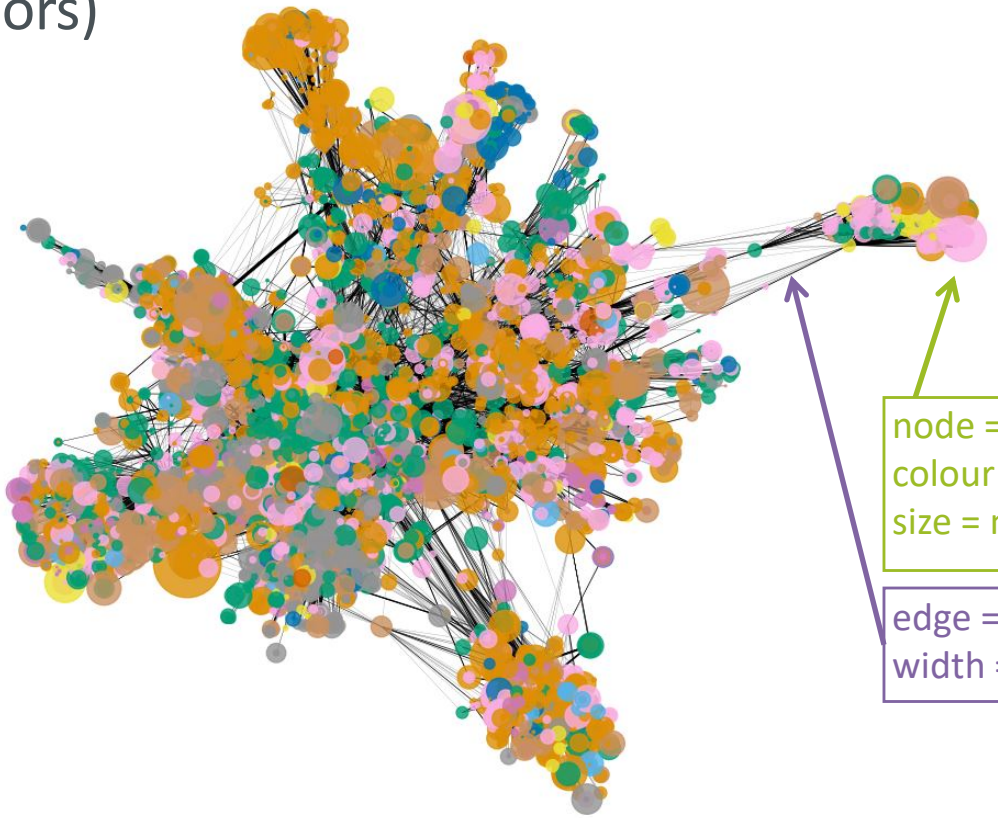
Network visualization of ENSA delegates
(with co-authors)

Without applying any "neutron filters"

the Scopus database query of ENSA delegates yields:

- 2815 publications
- 6171 co-authors in 1238 affiliations around the world
- Average degree of connectivity = 22



node = (co-)author
colour = country
size = number of publications

edge = publication in common
width = number of publications

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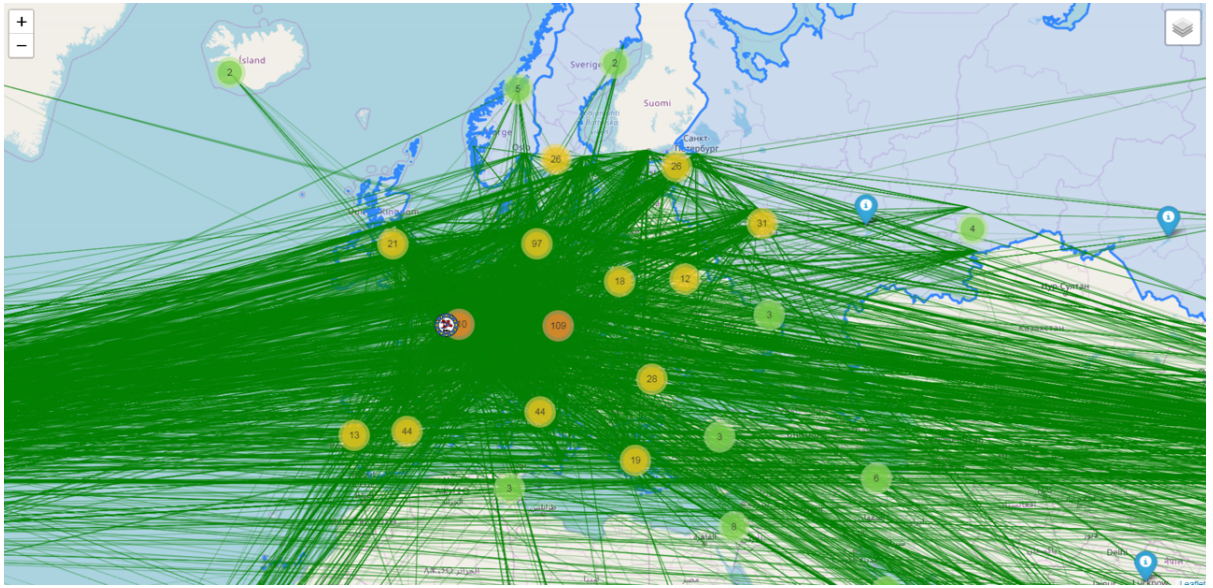
Network visualization of ENSA delegates

projected on the map of Europe



Community is connected throughout Europe

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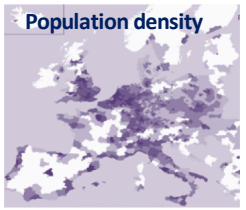
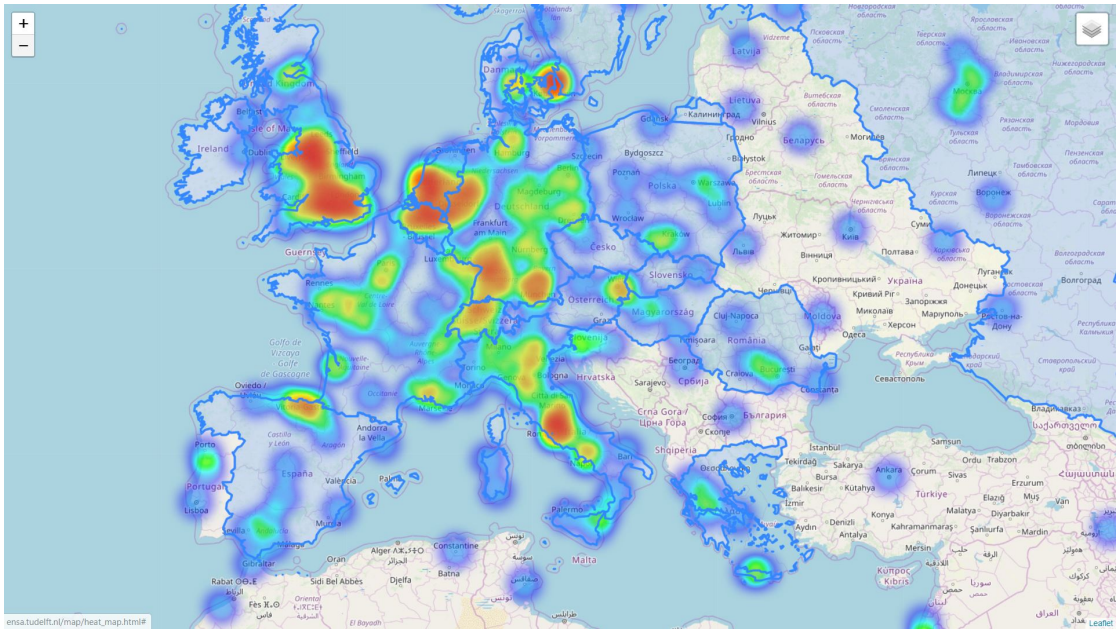


Network visualization of ENSA delegates

as a heat map projected on the map of Europe



(Population density biases the interpretation)

Separate heat maps for experimental methods, scientific topics and social relevance.

Time evolution can be visualized as **'weather forecast' maps**.

Deep learning on past and present to train for prediction towards the future.

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General Assembly

WP 2.2: Establishing a common roadmap and implementation strategy for future neutron capability

WP 2.3: Neutron Quality Label for residual stress

Andrew Venter
Necsa SOC Limited, Pretoria, South Africa

Peane Maleka
NRF-iThemba LABS, Cape Town, South Africa

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12 February 2020, Brussels

Overview of WP 2.2

- Defining and reporting the needs of the neutron scattering community in South Africa
  - Activities:
    - D2.3 - MS4: 1st workshop in SA (Month 6); Rescheduled for Month 8
    - D2.4 - MS10: 2nd workshop in SA (Month 15); Rescheduled for Month 18
  - Partners involved: Necsa and NRF-iThemba LABS

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science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

D2.3 - MS4: 1st workshop in SA

Partners Involved: NRF-iThemba LABS and Necsa

- The NRF was established through the National Research Foundation Act (Act No 23 of 1998),

NRF is an entity of the Department of Science and Innovation (DSI) of the Republic of South Africa, to promote and support research through funding, human resource development and the provision of National Research Facilities in all fields of natural and social sciences, humanities and technology.

NRF National Research Foundation 20 1999-2019 iThemba LABS Laboratory for Accelerator Based Sciences

- Necsa is State Owned Company, In terms of Section 13 of the Nuclear Energy Act, No. 46 of 1999,

Necsa is mandated to: undertake and promote research and development (R & D) in the field of Nuclear Energy and Radiation Sciences and Technology and, subject to the Safeguards Agreement, to make these generally available.

necsa We're in your world

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WP2.2: 1st SA Workshop held at iThemba LABS (13 – 14 August 2019)

The aim of the workshop (as mandated by DSI and NRF):

- to familiarise potential new users to the existing research prospects that neutron sciences can offer;
- compilation of a database of all relevant role players (researchers and institutions) within the area of neutron research in SA; the available expertise, current researchers that are actively involved, capabilities and infrastructure;
- agree on the areas on neutron research of relevance to SA;
- agree on the need to enter into a partnership with ESS to enhance the neutron research capacities and capabilities in SA; and
- agree on the high impact research areas that will form the basis for the collaboration with ESS.

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First South African Workshop on Capacity Building: Neutron Research in Collaboration with BrightnESS² partners		
Date	**Day 2: 14 August 2019**	
Venue	**NRF-iThemba LABS Auditorium**	
Convenor	**Department of Science and Technology**	
Time		
09h00 - 09h30	Workshop briefing	DST delegate
09h30 - 11h00	Breakaway discussions: Slow/Thermal Neutrons	venue to confirmed
	Breakaway discussions: Fast Neutrons	venue to confirmed
11h00 - 11h30	Coffee/Tea break	All
11h30 - 12h30	Breakaway discusions and reporting	All
12h30 - 13h00	SA topical champions and Action Plans for Workshop 2	All
13h00 - 14h00	Lunch break	All
14h00 - 16h00	iThemba LABS Facility Tours	
14h00 - 16h00	Departure to Airport*	
16h30 - 17h00	Departure to Hotel*	

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First South African Workshop on Capacity Building: Neutron Research in Collaboration with BrightnESS² partners		
Date	**Day 1: 13 August 2019**	
Venue	**NRF-iThemba LABS Auditorium**	
Chairperson(s)	**Dr. Peane Maleka (iThemba LABS) and Prof. Andrew Venter (Necsa)**	
Time		
08h30 - 09h00	Arrival and Registration	All
09h00 - 09h10	Safety brief and Induction	NRF-iThemba LABS RSHEQ Department
09h10 - 09h30	Welcome Address	Dr. Nxomani (NRF-Deputy CEO)
09h30 - 10h30	Opening Address	Dr. Adams (DST Chief Director)
10h30 - 11h00	NRF-iThemba LABS overview	Dr. Nchodu (NRF-iThemba LABS Deputy Director)
11h00 - 11h30	Coffee/Tea break	All
11h30 - 12h00	ESS Introduction and Overview	Prof. Dr. Andreas Schreyer (ESS Director of Science)
12h00 - 12h30	ESS Instruments for slow, thermal and fast Neutrons: Current and future Opportunities	Ken Andersen
12h30 - 13h00	Life Science and Pharmaceutical Research	Zoë Fisher
13h00 - 13h30	Soft Matter Challenges	Andrew Jackson
13h30 - 14h30	Lunch break	All
14h30 - 15h00	Structural and Light Weight Materials	Robin Woracek
15h00 - 15h30	Chemistry, Catalysis and Energy	Monika Hartl
15h00 - 16h00	Time for general Q & A	ESS Delegation
16h00 - 16h20	Cofee/Tea break	All
16h20 - 16h35	NRF-iThemba LABS neutron beam facility	Zina Ndlovu
16h35 - 17h05	Radiation Biophysics at NRF-iThemba LABS	Charlot Vandevoorde
17h05 - 17h35	Neutron diffraction at SAFARI-1 complemented by X-ray diffraction	Andrew Venter
17h35 - 18h00	Neutron Radiography at Necsa	Frikkie De Beer
18h00 - 20h00	Social Event	All
20h00 - ??	**Departure to Hotel**	

WP2.2: 1st SA Workshop held at iThemba LABS

Government	Research Institutions & industry	Universities
DSI	CSIR	Central University of Technology
NRF	Mintek	Nelson Mandela University
	NRF-iThemba LABS	University of Cape Town
	Necsa SOC Ltd.	University of Johannesburg
	SASOL	University of Pretoria
		University of South Africa
		University of Stellenbosch
		University of the Western Cape
		University of the Witwatersrand

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D2.4 - MS10: 2nd workshop in SA: June 2020

Working Groups and Thrust Coordinators (subject experts):

These thrust Coordinators will organize (invite/populate/plenary lecture) their sessions (2nd Workshop). The following have been identified:

1. Neutrons for Engineers
2. Magnetism
3. Crystallography (inorganic)
4. Paleo sciences
5. Geo sciences
6. Life sciences and biology
7. Chemistry/crystallography
8. Catalyses
9. Nano materials

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Next steps

- D2.4 – MS10: 2nd Workshop in SA scheduled for 23 - 24 June 2020; M18
- Deliverables: Report on user needs in South Africa / SA position paper on Neutron Scattering (Envisaged M30)
- Risk factors:
  - Effectiveness of Thrust Coordinators to mobilise research community
  - Level of participation by SA delegates
  - Adequate inputs from community to formulate position paper

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Overview of WP 2.3 activities

Experimentally-validated Neutron Quality Label for residual stress

- Activities: Partners involved: ISIS, MLZ, ILL, Necsa
  - D2.1 Prel. report on Engineering: calibration protocol (Month 6);
  - MS13: Specs and requirements (Month18)
  - Round Robin investigations on 3 standard samples

Results:

- Necsa Round Robin investigations completed on calibration samples M13
- Regular Skype meetings with project collaborators (in-person meetings)

Next step:

- D2.1 – MS13: In-person participate with measurement campaign at MLZ; M14
- Necsa to participate with D2.6: Results with industrial partners; M24

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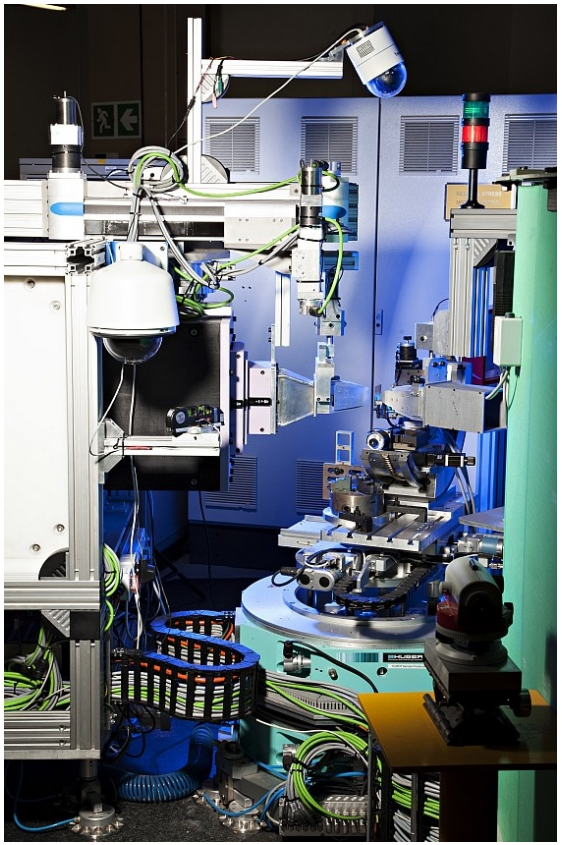
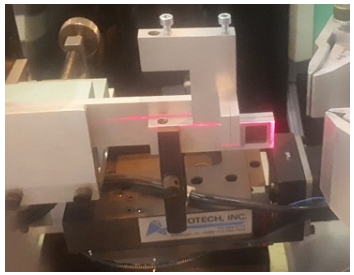
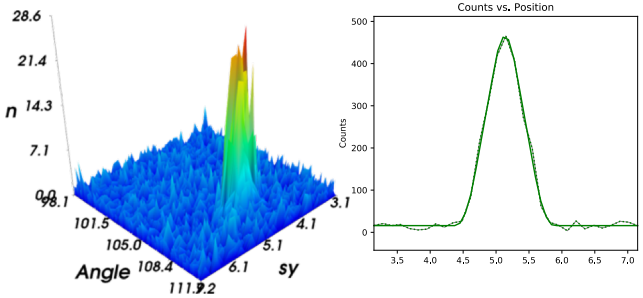
WP2.3: BrightnESS^2 Beamtime Campaign - Necsa contribution



- Smart foil:

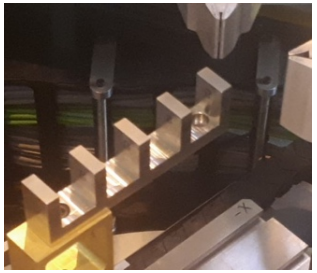
0.3 mm thick Ferritic steel

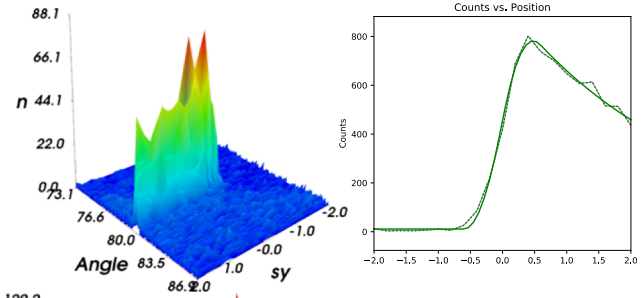




- 5-wall sample:

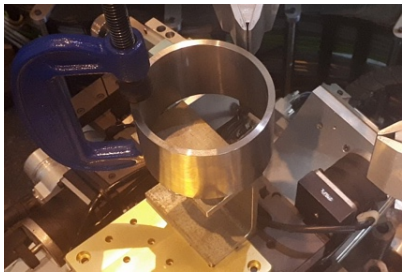
8 mm thick Austenitic Steel

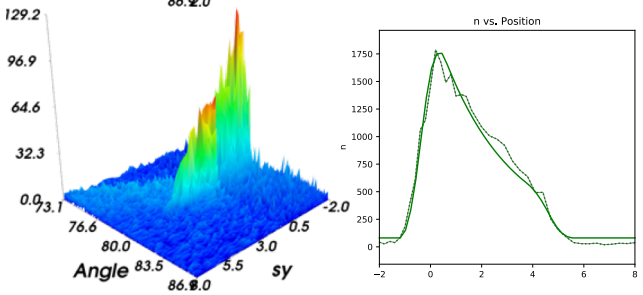




- Tube:

100 mm od, 5 mm thick Austenitic Steel





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General Assembly

WP2, Task 2.3: Exploring and illustrating new ways of working for the most efficient usage of neutrons in the engineering and life sciences

Mark Johnson

Assoc. Dir. and Head of Science Division, ILL

12 February 2020, Brussels

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Overview of Task 2.3
Pilot Programmes

- Research **results** can be obtained more **reliably**, **faster** and **cost efficiently** by linking sample preparation, experiment validation and analysis tools, and recognizing that **methodological specialisation** is required to cater to various **user communities**.
- The pilots are resulting in **direct and specific benefits** to the neutron user community.
- The collaboration itself defines a path for the further integration of additional support laboratories to **increase efficiency across neutron and non-neutron RIs**.
- These activities are now embedded in **LENS WG 3 priority actions** defined for **Health** and **Energy**.

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Task 2.3 [A]: Engineering Science

Pilot project for a common *Neutron Quality Label* for residual stress analysis

S. Cabeza, R. Ramadhan (ILL)

Overview of Pilot

Strain scanning by neutron diffraction is one of the most versatile and powerful analysis tools for various industries developing metal and ceramic products, particularly in **aerospace** and **transport** sectors.

- Besides **precision**, important quality factors are **reliability** and **reproducibility** of the results independent of the neutron strain-scanning instrument at different facilities.
- This pilot will create a ***Neutron Quality Label*** as internal certification within the participating neutron facilities in Europe (ILL, STFC, TUM) and South Africa (Necsa), and eventually ESS.
- This common *Neutron Quality Label* would promote the **confidence of industry** and raise the **excellence-level** of their product.

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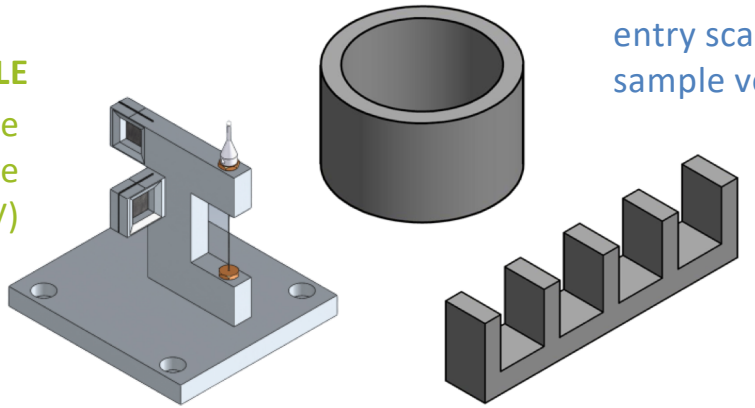
Overview of Pilot: Step 1

Internal certification of neutron strain scanning instruments

Standard samples and procedures will be developed, allowing the evaluation of physical parameters of the specific measuring configuration such as lateral-, strain- and time-resolution, reproducibility, accuracy and precision of strain values.

CALIBRATION SAMPLE

steel pin and foils to calibrate instrument optics (i.e. centre and GV)



CYLINDER SAMPLE

entry scan on a curved sample versus wall results

WALL SAMPLE

entry scan (wall finding) versus sample alignment methods and at different motor positioning and rotations

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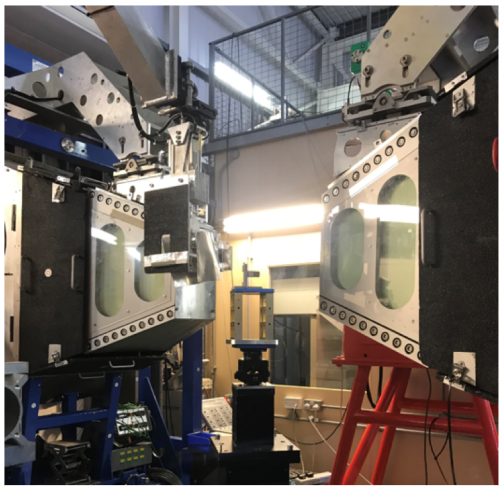
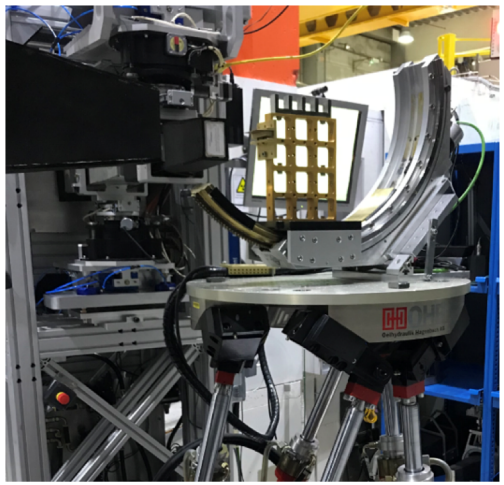
Measuring campaigns:

ENGIN-X @ ISIS



SALSA @ ILL



MPISI @ NECSA
January 2020

STRESS-SPEC @ FRM-II
February 2020

Findings so far:

- **More efficient calibration procedures** with similar samples
- Accuracy of instrument's ω-rotation: **< 200 µm**
- Agreement between 2θ and ω rotation, SALSA: **< 100 µm**
- Accuracy of sample alignment system: **< 150 µm**
- Robustness of data analysis for entry scans: **< 100 µm for flat samples**

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Overview of Pilot: Step 2

Common calibration and reporting protocols


R. Ramadhan


T. Pirling


S. Kabra


S. Cabeza

- **Draft in progress** from the first two measuring campaigns
- Group meeting in Munich, **April 2020**
- **D2.1:** M6 June 2019 → M15 March 2020 → **M18 June 2020**

Preliminary report on engineering: *Calibration protocol for all strain scanning instruments and definition of criteria for the* Neutron Quality Label


J. Rebelo


M. Hoffman


A. Venter

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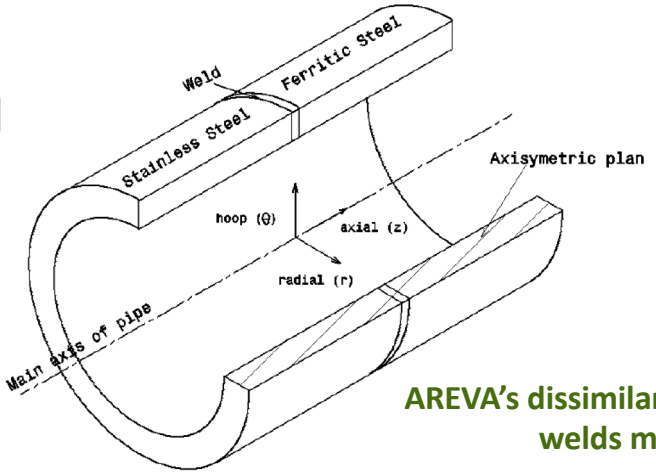
Overview of Pilot: Step 3

Application of the *Neutron Quality Label* in demonstration measurements with industrial partners

Potential sample coming from NET group as industrial sample experiment

EDF – R&D
Vincent ROBIN
Ingénieur Chercheur Expert – Fabrication & Réparation
Laboratoire de Soudage et de Fabrication Additive
Modélisation et Simulation des Procédés de Fabrication



AREVA's dissimilar metal welds mock-up

D2.6: M24 → **M27 (March 2021)**

Final Report on engineering: *Results from experiments with industrial partners and* Neutron Quality Label *applied*

Proposed measurement schedule

ISIS - May 2020
FRM II - August 2020
ILL - October 2020
Necsa - December 2020

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Task 2.3 [B]: Deuteration Pilot for Soft Matter and Life Science

Pilot project aiming to improve neutron usage for soft matter and life sciences by increasing access to high quality deuterated samples

Anna Leung (ESS)

brightness²

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 823867

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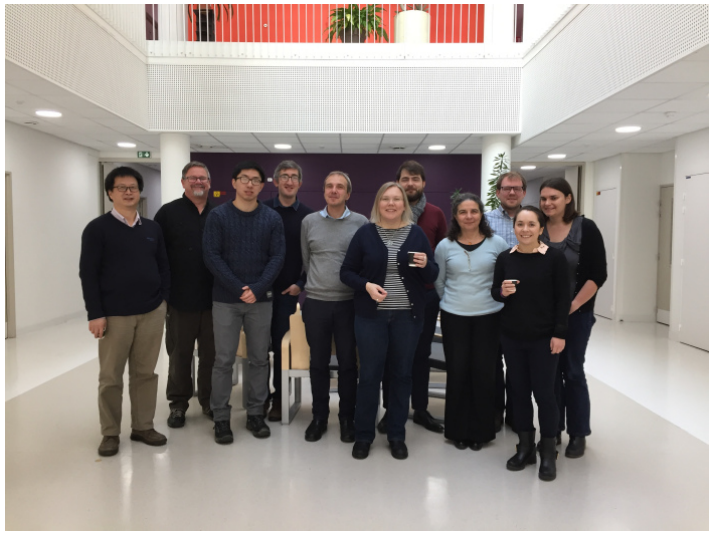
Deunet



Overview of Pilot

In the soft matter community, a key requirement for performing meaningful neutron experiments is the **availability of relevant samples**, which are often **deuterium-labelled** and produced at specialised biology or chemistry laboratories at neutron facilities.

- The suite of deuterium-labelled molecules of interest to the community is huge, and the range of skills required to fulfil this is equally far-reaching.
- Acknowledging this, the various deuteration laboratories around Europe, in Australia and in Japan, have begun working together to reduce the need for duplication of specialised skills such as those in the areas of polymer chemistry (well established at FZJ) and biochemistry (a new area of research at ESS).
- Collaborative projects between deuteration laboratories facilitate the production of materials for neutron experiments that a single laboratory could not produce alone and thus facilitate neutron experiments that are otherwise not possible

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Science & Technology Facilities Council
ISIS

ess EUROPEAN SPALLATION SOURCE

Overview of Pilot

Lipids: naturally-occurring small molecules with a big impact in soft matter science

- medicinal chemistry and drug mechanism studies
- food and pharmaceutical formulation science

Deuterium-labelled lipids are used in neutron scattering experiments at ISIS and other neutron sources, **but some are challenging to make**

This pilot aims to use
biological catalysts (enzymes)
to improve their synthesis

specific	mild
non-toxic	efficient

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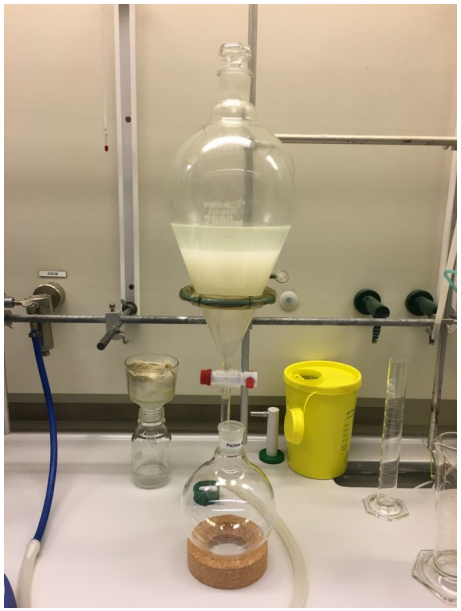
Overview of Pilot



- Timeline: January 2019 (M1)-June 2021 (M30)

- Considerations within this time period:

  - Availability of personnel at ESS: BrightnESS^2-funded engineer initially employed until December 2019

  - Long shutdown at ISIS (beginning September 2020)

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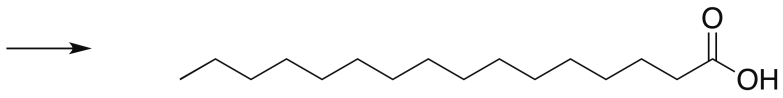
Overview of Pilot

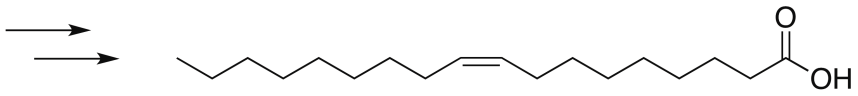
- Activities January 2019-February 2020:
  - chemical synthesis of deuterated fatty acids (ESS)

A Parr reactor for high-temperature, high-pressure chemical synthesis



palmitic acid-d_{31}

Simple; efficient → routine for deuteration labs



oleic acid-d_{33}

Challenging; inefficient → far less routine

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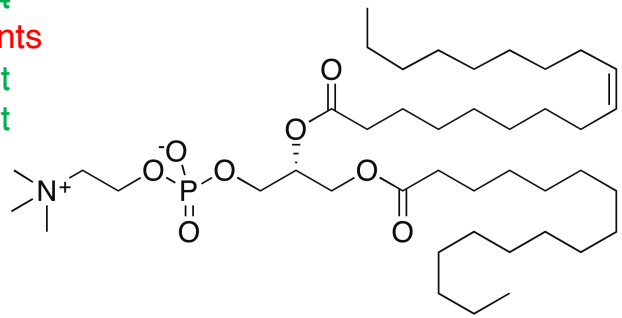
Overview of Pilot

- Activities January 2019-February 2020:
  - Enzymatic synthesis of complex deuterated lipids (ESS):

An incubator for enzymatic reactions under mild conditions

~~1. enzyme catalyst~~
1. chemical reagents
2. enzyme catalyst
3. enzyme catalyst



target lipid, POPC-d_{64}

Not currently used in deuteration labs

Rhiozmucor miehei lipase provided by:

novozymes®

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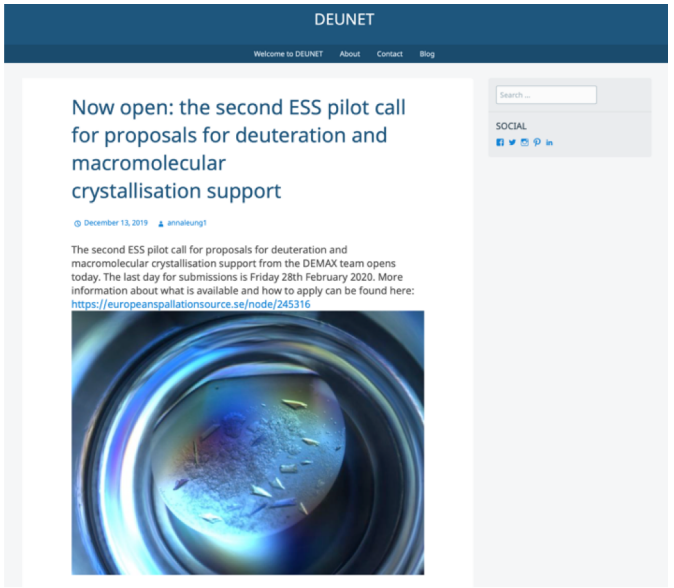
Results



- **Chemical synthesis** of deuterated fatty acids (ESS):

- **Enzymatic synthesis** of complex deuterated lipids (ESS): **Excellent progress**
  Target lipid produced using enzyme catalysts for 2/3 reactions

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Issues experienced:

Delivery of one enzyme catalyst was delayed by 12 months (received January 2020)

- The approach was modified in order to produce the material in an alternative way, to ensure the lipid was ready to use in an experiment before ISIS's long shutdown
- The employment of our engineer has been extended until August 2020 to allow continuation of the work at ESS

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Next steps

- Planned activities during the next 6 months:
  - Use of **POPC-d_{64}** in a neutron reflectometry experiment (SURF @ STFC):

    As a model for skin lipids. *Transdermal drug delivery is non-invasive; can be slow-release, permit self-administration, and improve patient compliance. One of the greatest challenges for transdermal delivery is that only a limited number of drugs can penetrate the skin, but this can be facilitated by surfactants/detergents. This experiment will focus on the interactions between model membranes and surfactants that impact transdermal drug delivery.*
  - Continued establishment of **enzymatic catalysis for complex lipid synthesis** (ESS)
- **Deliverable 2.7:** Report on deuteration for soft matter and life sciences: experimental results (M30)

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Work Package 2
Summary slides

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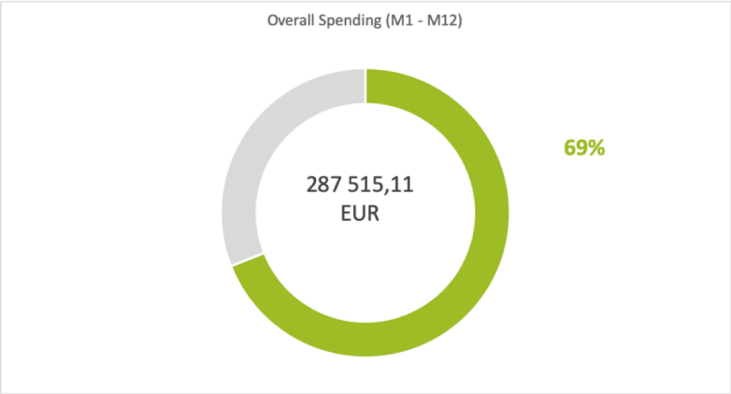
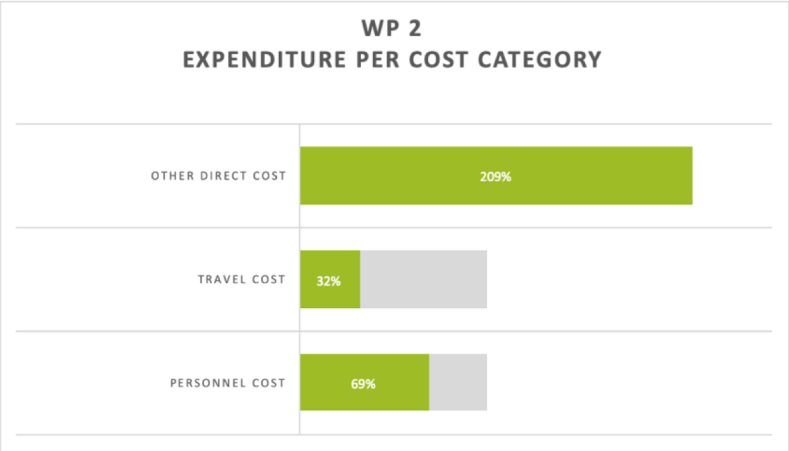
Outlook 2020: Milestones and Deliverables

2020 Milestones		
Code	**Title**	**Due Date**
MS09, Task 2.1	Meeting to collect international input	JAN 2020
MS13, Task 2.3	Specifications and requirements ready	JUN 2020
MS14, Task 2.2	Presentation of D2.3 by ENSA in preparation of D2.5	JUL 2020
MS10, Tasks 2.2 & 2.3	Second workshop in South Africa	OCT 2020

2020 Deliverables		
Code	**Title**	**Due Date**
D2.2, Task 2.1	Intermediate report on definition of common goals	FEB 2020
D2.1, Task 2.3	Preliminary report on engineering: Calibration protocol for all strain scanning	JUN 2020
D2.3, Task 2.2	Report on user needs	JUN 2020
D2.4, Task 2.2	Report on user needs in South Africa	JUN 2020
D2.5, Task 2.2	Intermediate report on methodological needs	DEC 2020

Overall 2019 spending against a linear budget





- A 69% underspend as some tasks will take place later in 2020 and will increase spending.
- STFC has transferred some of its Task 2.3 costs to ILL. This task has been delayed due to operational circumstances and a delay in recruiting the personnel who will work on the engineering pilot.
- STFC has not yet reported any personnel costs for Task 2.2, increased spending is expected in 2020.
- ENSA ramping up participation following TU Delft entering the project in late 2019.
- High direct costs associated with 1st South African workshop (iThemba LABS); Necsa's major expenditures will be during 2020 for the 2nd Workshop

PARTNER	USE OF BUDGET (%)
ESS	86%
ILL	106%
STFC	3%
TUM	108%
FZJ	77%
Wigner RCP	66%
PSI	44%
NCBJ	88%
iThemba LABS	114%
Necsa	59%
ENSA	31%
TUD	36%

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WP2 Progress Summary: The European Neutron Science Community

1. Cooperation among European and national research infrastructures has entered a new era of accelerated change. B2 has ensured that neutron sources have kept up with the pace, and is working to help them prepare for the future.

2. B2 has been instrumental in bringing LENS from a concept to an operational organisation, but there is a long road ahead.

3. B2 has established a systematic working relationship between LENS and ENSA.

4. B2 is opening up European neutron science to South Africa, enabling it to become a valued member of the community.

5. B2 has initiated the process of defining new ways of working across facilities to increase efficiencies.

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