**Work package description for Networking activity or Joint research activity**

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| **Work package number** |  | | **Start date or starting event:** | | | | |  | | | | |
| **Work package title** | Instrumentation and Detectors | | | | | | | | | | | |
| **Activity Type[[1]](#footnote-1)** | RTD | | | | | | | | | | | |
| **Participant number** |  |  | |  |  |  |  | |  |  |  |  |
| **Participant short name** | DTU | ESS | | ILL | PSI | UoC | STFC | | TUD | NPI | TUM | ESS-B |
| **Person-months per participant:** | 22,5 | 27 | | 6 | 13,5 | 6 | 27 | | 18 | 6 | 7,5 | 13,5 |

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| **Objectives**  The ground-breaking developments of E-science have strongly influenced the way the neutron community sees not only data treatment and interpretation but also the interplay between science and instrumentation. Simulation tools help to optimize an experiment, to design a whole instrument and finally plan the neutron sources of the future such as the ESS. This instrumentation task embraces several e-science related activities, that allow an integrated approach to neutron instrumentation by incorporating neutronics and thus being able to optimise instruments from the source to the sample and the detector. The goal is to combine the world leading European expertise in this field and by fully exploiting this human potential to enable the elaboration of qualitatively new approaches and new developments leading to innovation.  **The work comprises four Tasks: (1) E-Tools between real and reciprocal space, (2) E-tools for holistic simulation using neutronics and Monte Carlo ray-tracing (3) Shielding Concepts and Materials, and (4) Compact Instrumentation for Larmor Labelling applications at the ESS.** |

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| **Description of work** (possibly broken down into tasks), and role of participants  **Task 1** proposes to bridge the gap between real and reciprocal space measurements by making the link between real space images and reciprocal space scattering spectra as measured by high resolution SANS, including Spin Echo SANS. The goal is to combine these different techniques and thus obtain structural information of complex and multi-scale structures over the whole relevant range of distances, from mm down to nm. The starting point is the existing software tools, which will be adapted to neutron imaging and further developed to eg include polarised neutrons capabilities.  **Needed resources: All partners: travel funds, materials costs: 100 K€**  TUD: 9 PM Contact: C. Pappas (PI)  ISIS: 9 PM Contact: Winfried Kockelmann  DTU: 9 PM Contact: Søren Schmidt  ESS: 9 PM Contact: Markus Strobl  **Task 2** is an activity to develop and assess new e-science tools for very accurate simulation on neutron beam-lines. The activity brings together experts from both (a) neutronics, e.g. MCNPX used for simulating production and transport of neutrons from the target through moderator reflector and (b) Monte Carlo ray-tracing, e.g. McStas, RESTRAX which simulate the transport of neutrons through guides and their interaction with instruments and samples. The combination of these two types of code shall give a unique tool for optimising instruments and experiments from the source to the sample, including shielding and thus background optimisation. This will increase the realism of neutron simulation to a completely new level, since also unwanted spurious scattering signals are modelled, thereby for the first time addressing the signal-to-noise ratio of neutron scattering instruments.  Based on existing prototypes and solutions, the collaboration aims to deliver an easier-to-use and benchmarked solution, as well as establish networking and knowledge sharing between the partners and facilities.  The efforts will be based on existing knowhow within neutronics (ISIS, PSI, DTU, ESS-BilBao) and Monte Carlo raytracing (DTU, ILL, NPI, UoC). Two main target areas of development are these, where prototypes exist:   * The ISIS initiated CombLayer, which allows automation and optimization of neutronics simulation * The DTU-PSI initiated MCNP-McStas interface * The NPI code RESTRAX/SIMRES has very efficient instrument optimization for instrument design   Further, the collaboration aims to share code and knowhow wherever possible, e.g. component models between RESTRAX and McStas.  The developed software will be benchmarked both between codes with similar features (e.g. McStas and RESTRAX), but importantly also experimentally at existing experimental facilities (ISIS, PSI). Further, the collaboration will evaluate signal to noise for two selected ESS instrument designs.  Task 2 will share knowhow and information with Task 3 that addresses other issues related to the instrument performance and background.  **Needed resources: All partners: travel funds, materials costs : 100 K€**  ISIS: 6 PM Contact: Chris Frost (PI), Goran Skoro  ESS: 6 PM Contact: Phil Bentley, Luca Zanini  PSI: 6 PM Contact: Emmanouela Rantsiou  UoC: 6 PM Contact: Kim Lefmann  DTU: 6 PM Contact: Peter Kjær Willendrup  NPI: 6 PM Contact: Jan Saroun  ILL: 6 PM Contact: Emmanuel Farhi  ESS-Bilbao: 6 PM Contact: Jesus Pedro de Vicente  **Task 3** proposes to enhance our understanding on high-energy neutron background, and optimise biological shielding through the development of new materials. The activity combines detailed fast neutron background measurements at PSI and ISIS, which will be carried out using procedures common in the high-energy physics community and which will be confronted with simulations. This work will lead to better neutron instrument design with lower fast neutron background. The development of new shielding materials shall also reduce the costs of neutron instruments, because nowadays shielding is an important fraction of the instrument budgets. The new concepts will be tested at PSI on the BOA beamline, and at ISIS on the ChipIR beamline, before deployment in the field.  **Needed resources: All partners: travel funds, materials costs : 100 K€**  PSI: 7.5 PM Contact: Uwe Filges (PI)  ISIS: 7.5 PM Contact: Chris Frost, Goran Skoro  ESS: 7.5 PM Contact: Philip Bentley  TUM: 7.5 PM Contact: Peter Böni.  DTU: 7.5 PM Contact: Esben Klinkby  ESS-Bilbao: 7.5 PM Contact: Fernando Sordo  **Task 4. Development of new LARMOR Labeling experimental setups.**  **Partners: TUD, ISIS, ESS.**  Larmor labelling is nowadays widely used to increase the resolution of neutron scattering both in energy (neutron spin echo spectroscopy) and momentum transfer (Spin Echo SANS, Larmor diffraction). These techniques can reach very high resolutions even with poorly monochromatized and collimated neutron beams. However, most existing instruments are long, due to homogeneity requirements for the precession areas, and this in fact collimates the beam and consequently dramatically reduces the neutron brilliance and data acquisition rates. This task addresses this issue and aims to investigate the implementation of new magnetic field configurations, eg triangular coils, which may lead to compact Spin Echo SANS and Larmor diffraction instruments and will combine flexibility with high brilliance and high performance. The result will lead be a new instrument design for both monochromatic and TOF operation. This development will be of particular relevance to the ESS, where the proposed flat – pancake – moderator design will result in high intensity compact neutron beams best adapted to small samples and thus to compact instruments.  **Needed resources: All partners: travel funds, materials costs: 100 K€**  TUD: 9 PM Contact: Jeroen Plomp (PI)  ISIS: 4.5 PM Contact: Robert Dalgliesh  ESS: 4.5 PM Contact: Ken Andersen |

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| **Deliverables** (brief description and month of delivery) |

**Table 3.1: List of Deliverables:**

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| **Deliverable (number)** | **Deliverable name** | **Work package number** | **Short name of lead participant** | **Type** | **Dissemination level** | **Delivery date** |
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**KEY**

*Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>.*

*For example, deliverable 4.2 would be the second deliverable from work package 4.*

**Type:**

*Use one of the following codes:*

R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

OTHER: Software, technical diagram, etc.

**Dissemination level:**

*Use one of the following codes:*

PU = Public, fully open, e.g. web

CO = Confidential, restricted under conditions set out in Model Grant Agreement

CI = Classified, information as referred to in Commission Decision 2001/844/EC.

**Delivery date**

Measured in months from the project start date (month 1)

**Table 3.2a: List of milestones**

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| **Milestone number** | **Milestone name** | **Related work package(s)** | **Estimated date** | **Means of verification** |
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**KEY**

**Estimated date**

*Measured in months from the project start date (month 1)*

**Means of verification**

*Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype that is ‘up and running’; software released and validated by a user group; field survey complete and data quality validated.*

**Table 3.2b: Critical risks for implementation**

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| **Description of risk** | **Work package(s) involved** | **Proposed risk-mitigation measures** |
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1. Please indicate one activity per work package:

   MGT = Management of the consortium; COORD = Networking activity; RTD = Joint research activity. [↑](#footnote-ref-1)