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Towards a scientific strategy for the French neutron scattering landscape

The French Neutron Scattering Association (SFN) represents the scientific community of neutron users and neutron professionals in France with 400 members and 700 list subscribers. A study by the European Neutron Scattering Association (ENSA) from 2011 testified that the French community represents about 30% of the European neutron users¹ (1750 frequent users²). Thus, the French neutron scientists constitute **one of the most important and most dynamic communities on the European scene**. They contribute substantially to the international visibility of French research.

The French neutron scientists (physicists, chemists, engineers, etc ...) cover a wide range of scientific fields from magnetism to soft matter as well as materials science or biology³. The information provided by neutron scattering responds to the great societal challenges such as fundamental research, materials and energy as well as food science, environment or health. The exceptional competencies of the community are supported by a large range of techniques (diffraction, reflectivity, small angle scattering, neutron spectroscopy and imaging). The **scientific and technical expertise** of the French community was built up during the last decades based on construction and use of two sources on French soil that offer about 6000 instrument days per year at present. Over the years, the community moved from a “pioneering phase” (construction of the ILL) to the latest “neutron innovations” (construction of the ESS in Sweden, recent instrument renewal programs at ILL and LLB) thanks to a strong national strategy based on the Laboratoire Léon Brillouin and its reactor Orphée. This dedicated national facility has been, is and will be an essential contributor to French excellence in this domain⁴ with regards to training, research and industrial liaison.

Last May budgetary constraints from recent years led CNRS and CEA to officially announce the **end of the operations of the Orphée reactor at the end of 2019**. This communication anticipates on the recommendations of the High Council on Large Scale Infrastructures, whose report from 2013 underlines the “strong international position” of the French community. Despite this statement, the report suggests the closure of Orphée by the end of 2020, the operation of ILL up to 2030 and a “reasonable implication” in ESS (without any detailed justification of any of these three points). The **result of such a scientific policy** is quite simple. In 2020 the access of the French community to neutron techniques will be reduced by more than half and this development will very likely induce an unsustainable competition for beam time at the other sources, including at the ILL. Apart from this fact, France will choose to be the only strong European neutron scattering nation that has no

¹ Germany and the United Kingdom (who both have national sources) have communities of similar size.

² This term comprises all users who have published at least 5 papers in the period 2001-2011 that contained neutron scattering results.

³ See the recent review edited by the SFN: “Neutrons, Sciences and Perspectives”, EPJ ST, Vol. 213, 2012.

⁴ The AERES evaluation report of LLB in 2014 states that 60% of the French scientific production in neutron scattering research are linked to LLB (30% are based on work at ILL and 10% on work at other neutron facilities).



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national source⁵. At the horizon 2030 the access to neutrons will be reduced by a factor 20 assuming ESS running at full power (which will deliver several hundred instrument days per year⁶). The ESS is a pioneering project that responds to the needs of excellence and innovation in neutron scattering research, but the project will be unable by far to provide the capacity that is required to support the high quality work of the French community. The community will diminish dramatically and irrecoverably in just a few years; apart from the reduction (or loss) of research efforts, this development will have an evidently impact on the training of the community, on the activity of the entire European community and more specifically on the French investment in the new source that is in the middle of its construction phase⁷. Hence, these decisions and recommendations will put the **French community into an extremely critical situation – or even into danger – with regards to its implication in neutron techniques, its activity and its international position.**

Therefore, it appears unavoidable to complement the present road map by a **national neutron strategy that is scientifically ambitious** and which contributes to the improvement of the international positioning of French research in the field. The heart of the scientific activity resides in users, represented by the SFN. The national source is the indispensable foundation (neutrons are only available from large scale facilities). In this perspective, the SFN offers to participate in the development of such a road map for the French community and several interdependent key issues have to be considered:

- The national facility will need the means (instrumentation and scientific/technical environment) to maintain the activity of the community in accordance with its present high level (research, training and industry), to respond to the scientific commitments towards construction and use of the new European source and to prepare the launch of a new national source that is aimed to succeed Orphée.
- These objectives cannot be met within the next 4 years⁸ with a reduction of the capacity (instrument days) for the community: **the operations of the Orphée reactor have to be maintained up to 2025⁹** in addition to ILL operations at the highest possible level. The construction of an alternative has to be based on an optimum use of the present national source (provision of fuel, number of operation days, reactor power, etc.), a national strategy of CRGs¹⁰ at the existing sources and the possible development of a prototype or demonstrator based on an accelerator (“small source”). The implementation of such a model requires an optimum distribution of the available instrumentation over the different sources¹¹, as well as a unique and efficient user portal for the access to the national neutron scattering instruments. Finally, the development of a small source and the experience gained in connection with the French participation in the construction of the ESS instruments will

⁵ Germany and the United Kingdom will keep their respective national sources, FRM-II and ISIS.

⁶ The present scenario foresees about 320 instrument days assuming a French contribution of 10% to the running costs of ESS, 16 instruments and 200 beam days per year.

⁷ At present the French contribution is foreseen to be 8% (about 140 M€), including accelerator AND instrumentation.

⁸ Assuming a reactor stop in 2019.

⁹ The ESS user programme will not start before 2023.

¹⁰ Collaborative Research Group.

¹¹ As a general example: spectroscopy and diffraction at the reactors, imaging and macromolecular structure at the small source.



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- create a solid base in view of a “next generation” source.
- At the horizon 2025-2030 an **ambitious national project for a next generation source** will have to be developed and constructed. This timing implies substantial preparatory work to which the entire community will have to contribute in order to meet its requirements and scientific specifications¹². The plan requires innovations in instrumentation and in the use of neutron beams in the perspectives of a network of European neutron sources¹³. Based on its experience the French community has to be at the forefront of a reasoned development of neutron sources based on research reactors, spallation or any other emerging technique.

In this perspective, the critical situation of neutron scattering in France offers an exceptional opportunity to find new scientific challenges, be it in fundamental or applied science, by proposing a project that is constructed in synergy with the French users of neutron scattering.

Dr. Arnaud DESMEDT
Chairman of the French Neutron Scattering Society
On behalf of its Administrative Council.

¹² The SFN offers to participate in the creation of a “scientific case” to be delivered in 2016.

¹³ In accordance with the ESFRI road map.