

Letter of intent

1 Binding letter of intent as advance notification or non-binding letter of intent

	Binding letter of intent (required as advance notification for proposals in 2019)
x	Non-binding letter of intent (anticipated submission in 2020)
	Non-binding letter of intent (anticipated submission in 2021)

2 Formal details

- *Planned name of the consortium*
NFDI Neuroscience
- *Acronym of the planned consortium*
NFDI-Neuro
- *Applicant institution*
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3 Objectives, work programmes and research environment

- *Research area of the proposed consortium (according to the DFG classification system)*

www.dfg.de/download/pdf/dfg_im_profil/gremien/fachkollegien/amtsperiode_2016_2019/fachsystematik_2016-2019_en_grafik.pdf

2 Life Sciences
22 Medicine
206 Neurosciences

The DFG classification system places Neurosciences under the Research Area "Medicine". However, NFDI Neuroscience addresses the whole breadth of core neuroscience disciplines. Although this includes clinical neurosciences, the majority of considered disciplines in NFDI Neuroscience fall under basic research in the life sciences and it would not be adequate to evaluate NFDI-Neuro as a consortium focusing on research data in medicine. We therefore ask to classify our proposal under the broader category of Life Sciences.

- **Concise summary of the planned consortium's main objectives and task areas**

Neuroscience comprises highly specialized subdisciplines attempting to understand brain function from molecular, cellular, systems, clinical, psychological and computational perspectives with the goal to develop a unified, consistent understanding of how the brain works in health and disease. This interdisciplinarity and the wide scope of research questions result in a multi-faceted but also fragmented landscape of research approaches and a large variety of data. NFDI Neuroscience will focus on the formation and empowerment of a community for competent research data management, assisting scientists in performing the digital transformation, addressing all aspects of the scientific data lifecycle at the practical level, and providing a common forum for users and infrastructure providers. NFDI Neuroscience will address in particular the situation in the neuroscientific laboratories, where acquisition and primary processing of the data happens and the decisive action for later re-usability of the data must be implemented by adhering to the FAIR principles. Neuroscientists require practical solutions and readily available building blocks in the form of robust methods, tools, and services, that enable collecting and efficiently managing data and metadata during the everyday data workflows in the laboratory. Therefore the aim of NFDI Neuroscience is to build a community-centered process where scientists both benefit from and contribute to improving the research data management infrastructure. Supporting community-driven co-design of standards, tools, and services is the main overarching theme of NFDI-Neuroscience, aiming at common solutions, based on the development and adoption of standards, and in close agreement with other disciplines.

The implementation of rigorous data management is necessary to overcome current challenges that significantly hinder progress in the neurosciences.

- Understanding of neuronal function requires integration of knowledge across spatial and temporal scales on the basis of structural and functional data collected using highly diverse protocols and experimental approaches. The integration of such heterogeneous data is a conceptual and logistic challenge that is yet unaccounted for. Addressing this challenge has broad implications for data acquisition and analysis, as it requires rigorous and comprehensive representation and annotation of research data.
- Models of neuronal function are essential to understand the complex organization of brain function and are prerequisite for validation of and communication about data. In neuroscience, the heterogeneity and complexity of model descriptions corresponds to that of experimental data. Thus, relating modeling outcomes to experimental findings is difficult to achieve without a consistent framework that facilitates the linking of experimental and simulated data.
- Explorative and comparative data analysis is currently hampered by the use of highly customized code that must be adapted specifically to each particular use case, employing specific tools that are often not interoperable. Common standards and tools for rigorous data and workflow descriptions are necessary to automate data exploration and to enable workflow descriptions with detailed and useful provenance tracking.

To structure a process to overcome these challenges, we propose four specific instruments.

- Many solutions for data management have been developed over the past years in the context of local projects, which would be of use to the wider community. What is lacking is the visibility and an awareness of existing tools, standards and infrastructure. Thus, a key instrument for the NFDI-Neuro consortium is to build a community-based *information network* of users and infrastructure providers working together to bring solutions for FAIR and efficient data management to the labs and empower the scientists to utilize infrastructural services for their research and data sharing. This *information network* will provide information, training, and platforms for exchange.

- To support building this community, a network of experts combining knowledge on methods and data types in neuroscience with knowledge on research data management methods will be established. These *transfer teams* will act as contacts for users as well as for providers and will establish close connections with researchers and infrastructure institutions to ensure a sustained and fruitful communication and information flow within the consortium. Specifically, the *transfer teams* are in tight contact with the researchers and assist them to identify their specific needs and to find partners (among scientists and/or infrastructure providers) to jointly work on solutions. They will proactively seek information, initiate interactions, organize training activities, establish necessary links to other NFDI consortia or inter-/national initiatives for collaboration on common solutions. The *transfer teams* themselves are in regular exchange with the scientists and providers and informed about all use cases and technology developments.
- Community members may form *work groups* within the consortium, where users and providers, including members of other NFDI consortia, collaborate to develop or improve specific solutions. *Interest groups* are mediated by expert members of the *transfer teams* to explore and suggest solutions to a specific problem.
- To efficiently promote adoption and to enable improvement of services, NFDI Neuroscience will implement *dynamic support actions* that provide funding to develop solutions for specific needs in research data management to which a solution is lacking or insufficient. Proposals for such projects will be approved according to criteria that will ensure that the project has a clearly defined outcome that solves a need relevant to the broader community by implementing the FAIR principles. By such measures, gaps and problems in research data management can be flexibly addressed and alleviated as they arise or become apparent in the process of the NFDI development.

To implement the proposed instruments, **scientific task areas** are structured around the dominant neuroscience subdomains that cover the breadth of neuroscience. These anticipated task areas include neuroimaging, electrophysiology, neuroanatomy/connectomics, behavioral neuroscience, neurogenetics, cellular/molecular neuroscience, clinical neuroscience, theoretical neuroscience, and robotics/AI. Each scientific task area is mainly associated with a *transfer team* that maintains strong links to the transfer teams of the related subdomains, thus forming a tightly interconnected network where information and expertise is exchanged and utilized efficiently. **Common measures** shared by all *transfer teams* cover the interaction and support of researchers in each subdomain and the networking among *transfer teams*, with national and international institutions and initiatives, and on specific topics with other NFDI consortia. In addition, each *transfer team* drives forward **specific measures**, identified by the community as essential for the subdomains. Each of these specific measures is shared by at least two *transfer teams*, such that solutions emerge that are transferable and coherent across NFDI Neuroscience and beyond. These specific measures are supported by *working groups* that facilitate the community participation.

In addition, **integrative task areas** coordinate activities by continuously building the community and organizing individual transfer teams. The *Outreach Task Area* conducts training and consulting activities and communicates offers, services and outcomes of NFDI Neuroscience to the scientists and the public. As such, this task area is responsible for designing and implementing the community spanning *information network*. The *Coordination Task Area* organizes consortia-wide events, such as annual meetings, hackathons, and seminars, and represents NFDI Neuroscience in the NFDI-Konsortialversammlung. In particular, the *coordination task area* may support the formation of new *working groups* that emerge from the community in the course of the NFDI process. In parallel, this task area mandates *interest groups* to explore solutions and concepts suggested for adoption by NFDI Neuroscience, and implements the mechanism for evaluation and allocation of funds for *dynamic support actions*.

- **Brief description of the proposed use of existing infrastructures, tools and services that are essential in order to fulfil the planned consortium's objectives**

Emerging from various neuroinformatics initiatives, a number of tools already exist that address research data infrastructure needs such as data logistics (e.g., DataLad), metadata collection (e.g., NIDM, odML), dataformats and structures (e.g. BIDS, NIX, NWB), data representation (Neo), data analysis (e.g. Elephant, FieldTrip, Freesurfer, MNE), or simulation (e.g. NEST, Neuron). NFDI Neuroscience will help improving the interoperability of these tools, and will ensure that neuroscientists are aware of their availability.

In the context of the Bernstein Network, domain-specific services have been established such as Simlab Neuroscience at the Juelich Supercomputing Center (http://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/slms/_node.html), supporting neuroscientists in using HPC infrastructure; the German Neuroinformatics Node (G-Node <http://www.g-node.org>), providing services and tools for research data management, sharing and publication; the Bernstein Coordination Site (BCOS <https://www.bernstein-network.de/de/das-netzwerk/Netzwerkpartner/BCOS>), providing information about and support for the activities of the computational neuroscience community in Germany.

At the international level, several large initiatives and consortia have formed that address infrastructure building and standards development in neuroscience, such as the INCF (<https://www.incf.org>), the Human Brain Project (HBP <https://www.humanbrainproject.eu>), and the Allen Brain Institute (<https://alleninstitute.org>). These initiatives and consortia are linked with emerging brain initiatives in the US, Japan, China, and Australia. Multiple platforms provide data hosting and sharing (CRCNS.org, <https://GIN.g-node.org>, <https://OpenNeuro.org>), data analysis (<https://brainlife.io>, <http://www.cbrain.ca>), simulation (<http://www.OpenSourceBrain.org>, <https://www.nsgportal.org>), software (Neuralensemble.org), or training resources (<https://training.incf.org>). Members of the NFDI Neuroscience are already involved in or have well-established collaborations with these initiatives and projects, and are actively integrating and promoting these national and international efforts.

Besides solutions for domain-specific needs, neuroscientists will benefit from generic services, including services offered at the international level within the EOSC (<https://www.eosc-portal.eu>). NFDI Neuroscience will work to establish the necessary interfaces to community tools and the domain-specific services for efficiently utilizing these resources. For these purposes, NFDI Neuroscience will collaborate with other consortia where similarity of data structures suggests the development of common solutions, and with initiatives and consortia dedicated to providing generic services (e.g. GeRDI, BRIDGE4NFDI) as well as international initiatives devoted to research data management such as the Research Data Alliance (<https://www.rd-alliance.org/>) and GoFAIR (<https://www.go-fair.org/>).

- ***Interfaces to other proposed NFDI consortia: brief description of existing agreements for collaboration and/or plans for future collaboration***
 - NFDI4Health and NFDI-Neuro will share standardization policies and processes including standards to comply with privacy regulations and ethics principles. In the field of neuroscience, both consortia coordinate their activities with the aim to develop common (meta)-data, quality and record linkage standards and interfaces.
 - NFDI4BIMP aims to provide generic and domain-spanning services for storage and management of light-based imaging data. NFDI-Neuro will utilize these resources for light microscopy data in neuroscience, and will collaborate with NFDI4BIMP on developing and harmonizing metadata structures and ontologies.
 - NFDI4Ing will coordinate with NFDI-Neuro on topics such as common data formats for interfaces and issues related to sensitive data, e.g., recorded sensor data.
 - ForumX has the goal to develop common infrastructure for experimental research data. Furthermore, its concept foresees a strong role of the scientific community in shaping the NFDI process, similar to the concept of NFDI-Neuro. We intend to collaborate on developing standards and services to implement the FAIR principles, and to interact on matters of governance and coordination.
 - DataPLANT and NFDI-Neuro are both highly focused on the needs of the users. We intend to collaborate on developing standards and services for improved data workflow management, and to interact on matters of governance, data publication, and training.
 - NFDI4Culture: Since image data play an important part in NFDI4Culture and NFDI-Neuro, both consortia plan to cooperate in the standardization of image metadata and image formats as well as in the joint development of image analysis tools in the field of computer vision.
 - NFDI4Medicine: Both consortia could jointly address the heterogeneity of medical data by developing and exchanging overarching metadata standards and ontologies, and collaborate on standards to comply with privacy regulations and ethics principles.
 - NFDI4Life: NFDI-Neuro plans to contribute to developments on cross-discipline topics that emerge in the life sciences (in particular: NFDI4BioDiversity, NFDI4Health, NFDI4Microbiome and NFDI4Agri) under the coordination and counseling provided through the NFDI4Life umbrella.
 - NFDI4Earth & NFDI4BioDiversity: NFDI-Neuro plans to exchange with these consortia experiences and concepts regarding the integration of data from different scales, e.g., genes to ecosystems and cells to brain regions.
 - NFDI4Microbiome & DeBioData & GHGA: NFDI-Neuro plans to utilize the infrastructures for genetic/genomics and molecular data provided by the three consortia.
 - Astro-NFDI: NFDI-Neuro will propose an exchange on topics such as model/simulation descriptions and standards for training data for machine learning applications
 - BRIDGE4NFDI: We plan to collaborate on the development of interfaces to facilitate the use of generic data and metadata infrastructure by the neuroscientists.

4 Cross-cutting topics

- *Please identify cross-cutting topics that are relevant for your consortium and that need to be designed and developed by several or all NFDI consortia.*

A number of common topics related to research data management are of particular interest for NFDI Neuroscience. A challenge that is severe in neuroscience but is also common in other fields of science is the high degree of heterogeneity and complexity of datasets in terms of content and metadata. This variety requires detailed descriptions of the data acquisition to be recorded in an understandable and standardized manner to avoid errors in the future re-use of the data. To measure the degree to which data complies with such requirements, NFDI Neuroscience will develop and adopt sophisticated methods to assess **Data Quality**. The complexity of the data and metadata acquisition process makes extensive planning of the workflow a necessity. Therefore, development of guidelines and tools to provide meaningful **Data Management Plans**, that practically assist scientists in setting up these workflows, are an important topic for NFDI Neuroscience. In addition to a sufficient level of description, several other aspects related to **Data Publication** provide important points of cross-cutting collaboration, like the description of datasets that must include spatial anchoring in coordinate systems (e.g., for brain atlases) such that relationships between datasets can be performed based on brain location, or the establishment of self-describing file and database formats to enable easy browsing of both structural and dynamical data for viewers across disciplines. Finally, at a more general level, NFDI Neuroscience shares the need to develop useful **training and support** paradigms to push the adoption of RDM solutions in the individual laboratories.

In addition, a number of *specific topics* related to subsets of partnering NFDI consortia are expected to play an important role for NFDI Neuroscience. These topics include:

- Solutions to handle privacy and ethics concerns with respect to patient data are expected to be related to challenges in other consortia with a clinical focus, such as NFDI4Health and NFDI4Medicine.
- Data and Metadata standards for imaging data, as obtained from microscopy studies, as handled by NFDI4BIMP.
- Genetics related data, obtained in molecular neuroscience or used by neuroscience technologies such as optogenetics, as addressed by NFDI4Life and the specific consortia assembled under that umbrella.
- Discipline-agnostic definitions and implementations of rigorous and reproducible analysis and brain modeling pipelines that should be co-designed among consortia containing computational elements.

- *Please indicate which of these cross-cutting topics your consortium could contribute to and how.*

NFDI Neuroscience will contribute to all of these topics with its expertise originating from solutions that have been or will be developed in the field. A specific alignment of cross-topics with tasks in other NFDI consortia will be performed in the context of defining NFDI Neuroscience focus tasks for individual transfer teams. Examples of existing and emerging solutions as candidates for cross-discipline topics are: generic self-describing file formats, versioned data storage solutions, definition of cross-discipline standards for computational model descriptions, and joint definition and coordination of a growing list of metadata schemata/ontologies.