## 1    Binding letter of intent as advance notification of a full proposal

| x | Binding letter of intent (required as advance notification for proposals in 2021) |
|---|---|

## 2    Formal details

- ▪ Planned name of the consortium

  **NFDI Neuroscience**

- ▪ Acronym of the planned consortium

  **NFDI-Neuro**


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  - ▪ DLR - Institut für Datenwissenschaften
  - ▪ EBRAINS AISBL, Brüssel, Pan European
  - ▪ Leibniz Rechenzentrum der Bayerischen Akademie der Wissenschaften, Garching
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## 3    Objectives, work programme and research environment

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

206        Neurowissenschaften

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

NFDI-Neuro aims to foster the **reproducibility of research** and **digitalization of scientific processes**, and to leverage **computational neuroscience as data integrating discipline** that transforms data into knowledge and understanding. The German neuroscience community is spearheading developments for digital RDM and computational workflows on an international scale exemplified by the renowned German Bernstein Network for Computational Neuroscience and the EU Human Brain Project (HBP) with its e-infrastructure EBRAINS that has recently been accepted to the European Strategy Forum for Research Infrastructures (ESFRI) Roadmap, thus upgrading it to a sustainable research infrastructure for neuroscience in Europe.
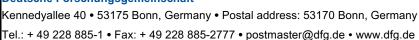
Neuroscience comprises specialized subdisciplines investigating the nervous system from molecular, cellular, systems, clinical, and computational perspectives. This wide scope results in a multi-faceted landscape of research approaches and a large variety of research data. Yet, the common goal is to develop a unified and systematic understanding of brain function in health and disease, and this requires integration of data and knowledge from the various subdisciplines. But

integration and standardized representation of such heterogeneous data and metadata is a conceptual and logistic challenge.

To overcome these obstacles, NFDI-Neuro can build on an excellent repertoire of existing solutions for efficiently managing research data workflows and a major effort will be to transfer them from the experts' world to the labs and individual researchers. NFDI-Neuro will consider the entire data life cycle, implementing RDM measures already when data is acquired. NFDI-Neuro will thus address 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. NFDI-Neuro **Task Areas** will therefore address common cross-domain data management needs:  **TA Metadata & FAIRification** oversees the development of ontologies, terminologies, metadata models and knowledge graphs, domain specific data annotation for microscale data, mesoscale data, macroscale data and clinical data. **TA Provenance** develops user-friendly technology and support for capturing information of the research process, from data acquisition, via preprocessing and analysis, to the visualization of research outputs by combining all data, code, and computational environments in tailored datasets. **TA Infrastructure and Services** is responsible for services for sensitive data, digital workflows, analysis tools, complex visualization, and data publication. Requirements by secondary-data users are carved out in **TA Modeling and Big Data Analytics.** Relating modelling to experimental data requires common standards. Computational – mechanistic and statistical - models are essential for understanding the complex organization of brain function and for the transfer into (clinical) applications. **TA Community and Coordination** coordinates the process of community building, including training and consulting activities, annual meetings, and the communication of offers, services and outcomes of NFDI-Neuro by implementing a community-spanning information network. It will coordinate the formation of new working groups and implement processes for allocating funds for dynamic support actions. Task areas are associated with *transfer teams* that form an interconnected network where developments, information, and expertise are 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 with other NFDI consortia on specific topics. In addition, each transfer team drives forward specific measures aimed at NFDI-Neuro's goal to increase adoption of research data management best practices in the community. Specific measures are developed with community participation and in exchange with other transfer teams, such that emerging solutions are transferable and coherent across NFDI-Neuro and in line with international standards. To structure a process supporting

community-driven co-design and wide adoption of standards, tools, and services, we propose four specific instruments:

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 enable the scientists to utilize infrastructural services for their research and data sharing. This network will provide information, training, and platforms for exchange.

**Transfer teams** who combine knowledge on methods and data types in neuroscience with knowledge on research data management methods will act as contacts for users as well as for providers through low-barrier communication channels and will establish close connections with researchers and infrastructure institutions. 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.

A **network of working groups** where users and providers, community members, transfer teams, and members of other NFDI consortia collaborate to define standards and develop or improve solutions for research data management needs.

**Dynamic support actions** to efficiently promote adoption and improvement of tools and services. These will enable implementation of community-proposed solutions for specific needs in implementing FAIR research data management.


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

The international neuroscience communities in general, and the German community in particular, belong to the pioneers of RDM. In 2005, the International Neuroinformatics Coordination Facility (INCF) was founded and subsequently its German Node (G-Node) was established. One year earlier in 2004, the German Bernstein Network for Computational Neuroscience had been initiated by a funding initiative of the Federal Ministry of Education and Research (BMBF) to promote the integration of experimental data in theoretical frameworks and the transfer of theoretical insight into clinical and technical applications. In 2013, the EU flagship HBP was kicked off and in 2019 its e-infrastructure EBRAINS started its operation. In the present third and final funding period of the HBP, the German neuroscience community receives ca. 20% of the total funding and serves as the scientific project lead. In July 2021, EBRAINS was selected in a competitive process for the ESFRI Roadmap and thus will be maintained as an EU Research Infrastructure for the next 10 to 20 years. The German neuroscience community also contributes to the implementation of the European Open Science Cloud (EOSC) and specifically to the establishment of General Data Protection Regulation (GDPR) compliant digital research
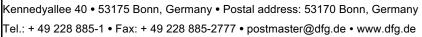
infrastructure for sensitive data such as radiological images or genetic data that contain sensitive personal information ([Virtual Brain Cloud](#), [Virtual Research Environment](#)) Members of the NFDI Neuroscience have longstanding collaborations with international neuroinformatics entities such as the [Allen Brain Institute](#), the [Canadian Open Neuroscience Platform](#), the US initiatives [Repronim](#) and [DANDI](#) which already share basic technical interoperability with NFDI-Neuro. Various internationally accepted neuroinformatics and RDM solutions already exist – often under lead of NFDI-Neuro members and Participants. Foremost EBRAINS and the EOSC infrastructure VirtualBrainCloud with its GDPR compliant Virtual Research Environment, as well as several tools and services, for instance for provenance tracking (e.g., DataLad), metadata standards (e.g., NIDM, odML, openMINDS), data formats and structures (e.g., BIDS, NIX, NWB), data representation (Neo), data analysis (e.g., Elephant, MNE), or simulation (e.g. NEST, Neuron, The Virtual Brain). NFDI-Neuro will be instrumental to improve the interoperability of these tools, and to raise awareness and adoption by an increasing number of neuroscientists. The Bernstein Coordination Site ([BCOS](#))  provides information about and support for the activities of the computational neuroscience community in Germany. NFDI-Neuro will work to establish the necessary interfaces to community tools and the domain-specific services for efficiently utilizing these resources. For these purposes, NFDI-Neuro will collaborate with other consortia where similarity of data structures suggests the development of common solutions, and with initiatives dedicated to providing generic services for research data management, such as the [Research Data Alliance](#) and [GoFAIR](#).

**Interfaces to other funded or proposed NFDI consortia: brief description of existing agreements for collaboration and/or plans for future collaboration**

NFDI-Neuro will bring a broad international experience – and an international network - to the NFDI community. As a result of the interdisciplinarity and the wide scope of topics and approaches, neuroscience research overlaps with neighboring fields in science and engineering, in the life sciences, and in clinical sciences. Consequently, NFDI-Neuro will cooperate with NFDI consortia in these areas on joint developments of common solutions, ensuring efficiency and interoperability. Specifically, NFDI-Neuro will collaborate with **NFDI4Health, GHGA, NFDI4Microbiota, NFDI4Immuno, NFDI4Patho** on common standards, including standards to comply with privacy regulations, (meta)-data, and record linkage. With **NFDI4BIOIMAGE** we plan to co-develop standards for microscopy data. NFDI-Neuro will exchange experiences and concepts regarding the integration of data from different spatial scales with **NFDI4Earth** and **NFDI4BioDiversity** and additionally coordinate with **NFDI4Chem, NFDI4Ing** on common data formats, interfaces, and – as for the latter - on issues related to sensitive data, for example,

recorded sensor data. Collaborations with **NFDI4DataScience** on knowledge graphs will be established as well as requirements for secondary data use. Collaboration is also planned on a case study of **MarDI** on mathematical model representations in neuroscience**.** With **NFDI4Phys** we will exchange on representations of networks and complex dynamical systems as well as on the concept of information.    **NFDI4Culture** and NFDI-Neuro plan to cooperate in the standardization of image metadata and image formats, as well as the joint development of image analysis tools in the field of computer vision. With **DataPLANT** 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.

## 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.**

The majority of topics addressed in the Leipzig-Berlin Declaration on cross-cutting topics are relevant for NFDI-Neuro. Specifically, NFDI-Neuro anticipates collaboration with NFDI consortia and cross-cutting initiatives on the following topics:

- (Meta)Data, Findability, Terminologies, Provenance
- Research Data Commons, Infrastructure, Interoperability, Interfaces, Provenance
- Training & Education
- Ethical & Legal Aspects in General /Person related
- Common Vision & Strategy
- User-driven development
- Governance & Sustainability
- Quality Management & Assurance
- Cultural Change
- Policy advice & Consultation
- Internationalization
- HR

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

NFDI-Neuro will bring strong expertise in the field of **internationalization and sustainability**. The neuroscience community in Germany holds leading roles in international research data management projects such as the EU Flagship HBP with its EBRAINS infrastructure and in the European Open Science Cloud such as The Virtual Brain Cloud – an infrastructure for sensitive data. With the latter NFDI-Neuro contributes solutions with respect to **ethical and legal** aspects of RDM, specifically of **personal and sensitive data** in compliance with applicable data protection law. NFDI-Neuro brings in existing distributed **interoperable digital research infrastructure**

solutions, such as EBRAINS and Virtual Brain Cloud with its Virtual Research Environment. These infrastructures provide rich platform functionality to enable researchers to store, process and share complex data. Scientists can plug in their own workflow containers, utilize high performance computing backends, use work benches to operate workflows and data and generate workspaces for secure collaboration. These **open-source** modern research platforms undergo open user-driven agile software development with wide contributing **research software communities** – mirroring the central principle of participatory actions in NFDI-Neuro. An example of s**ustainability** of digital research infrastructures is the inclusion of EBRAINS in the ESFRI Roadmap that enables maintenance of the research infrastructure over long time periods up to 20 years. Data discoverability is leveraged through the development of **Knowledge Graphs** where we have working solutions in place such as the EBRAINS Knowledge Graph for data discovery or other types of Knowledge Graphs containing for instance the results of automated text mining such as detailed signaling cascades derived from the literature or other complex entity relations (e.g., ScaiView data base containing > 30 million annotated articles, NeuroMMSig pathway inventory).

A major RDM challenge in neuroscience shared with other disciplines is the heterogeneity and complexity of datasets in terms of content and metadata. This variety places high demands on the level of detail of data descriptions that represent a measure of **data quality** in terms of data accessibility and reuse in the spirit of the FAIR principles. NFDI-Neuro brings in strong expertise in the development of **automated containerized processing pipelines and provenance tracking** to achieve reproducible research workflows. Further cross-cutting topics of relevance for NFDI-Neuro include generic **self-describing file formats**, portable versioned **data storage** solutions, standards for **computational model descriptions**, and in the coordination and development of internationally adopted **metadata schemas**. With its INCF and EBRAINS backgrounds, NFDI-Neuro will contribute excellent expertise in developing **training and support paradigms** as well as maintaining active community **working groups** to tackle RDM challenges on an **international scale**. Finally, NFDI-Neuro members have a track record in linking up with **policy makers**, e.g., by organizing EU parliament lunch time debates (for instance on data sharing in dementia / Virtual Brain Cloud) or holding science exhibitions in the German parliament (Human Brain Project).