NFDI4Phys

1 Non-binding letter of intent concerning participation in a call for NFDI consortia

☐	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 **Nationale Forschungsdateninfrastruktur für Physik**

Acronym of the planned consortium **NFDI4Phys**

Applicant institution **Physikalisch-Technische Bundesanstalt (PTB)**

Head of the institution **Prof. Dr. Joachim Ullrich**, President

Spokesperson **Dr. Jörn Stenger**, joern.stenger@ptb.de,
Member of the Presidential Board

Co-applicant institution **Leibniz Information Center for Science and Technology (TIB)**

Head of the institution **Prof. Dr. Sören Auer,** Director,
Head of Data Science and Digital Libraries research group

Co-spokesperson **Prof. Dr. Sören Auer**, auer@tib.eu

Co-applicant institution **Deutsche Physikalische Gesellschaft (DPG)**

Head of the institution **Prof. Dr. Dieter Meschede**, President

Co-spokesperson **Dr. Uwe Kahlert**, kahlert@physik.rwth-aachen.de, RWTH Aachen

Research area of the proposed consortium **Research Area 32 - Physics**
with multiple connections to other areas

3 Objectives, work programme and research environment

With the help of consortia from various scientific and technical fields, the aim of the Gemeinsame Wissenschaftskonferenz is to establish a sustainable and widely used national research data infrastructure (NFDI). This requires both a comprehensive understanding of the requirements of all research communities and swift consensus on common methodologies which should be as simple as possible.

The partners of the proposed NFDI consortium, NFDI4Phys, have identified several objectives, most of which are cross-cutting in nature, which would complement the approaches of other emerging consortia. These objectives include the involvement of (sub-) communities which are not yet represented and are too small to start their own consortia, the definition of common basic systematics and standards, and interaction with comparable European and international initiatives in order to ensure compatibility and thus international acceptance.

The diversity, capabilities, research experience, and extensive community connections of the partners – DPG, TIB, PTB and the Konferenz der Fachbereiche Physik (KFP) – complement each other in a unique way, bringing together

- DPG's visibility and communication capabilities in all areas of physics and physics-related disciplines
- KFP's direct influence on teaching and curricula
- TIB's experience in metadata curation, provision of research data services and scientific expertise in the fields of data science and digital libraries
- PTB's broad scientific and technical background, European and international networks and position in the national quality infrastructure.

NFDI4Phys complements other consortia from specific research communities by using a horizontal, cross-cutting approach. It will address fundamental requirements of the NFDI: inclusiveness, consistency across all disciplines, international compatibility and dissemination/training.

Section 3.1 describes how NFDI4Phys will interact in order to understand the various requirements. Section 3.2 describes the key objectives of NFDI4Phys: formulating and testing basic, common standards and methodologies which will have been developed in cooperation with other consortia and with national and international partners. Section 3.3 addresses dissemination activities.

3.1 Inclusiveness

The success of the NFDI will depend on its acceptance by a broad majority of researchers. Our aspiration is therefore to take an integrative approach right from the outset:

- the outcome (structures, standards) must be usable by as many physicists as possible
- the process of establishing an NFDI must itself take into account all kinds of physical research
- concerns of different physics communities must be treated in a responsible way.

Physical research data are heterogeneous both in terms of their qualitative structure and their quantity. In order to avoid a patchwork of isolated data solutions, one must bridge these gaps and pursue an inclusive and integrative science-driven, bottom-up approach. For this purpose, we will pursue a dual strategy:

- to actively build on existing structures and try to develop synergies via close cooperation with other consortia.
- to involve communities which are not (sufficiently) represented in other consortia and/or communities where the importance of data management is not yet fully recognised.

In order to find appropriate solutions, we want to start with best-practice examples and then extend our approach to include other cases to allow the NFDI to become broadly effective.

3.2 Standards and structures of the NFDI

To be sustainable and widely used, an NFDI must have consistent regulations, terminologies and approaches among scientific fields. Services to be established must be usable across disciplines to fully exploit their potential. The key objectives of NFDI4Phys are:

- to identify and define fundamental common standards which apply to everyone, such as on the use and metadata representation of quantities, units, numerical values and data quality indicators *(PTB and TIB)*
- to ensure interoperability via properly curated metadata as well as via controlled terms which can be used in all areas of physics and beyond by
  - providing automated workflows for the generation and collection of metadata
  - integrating existing individual vocabularies into one interoperable system of controlled terms used and maintained by scientific communities *(mostly TIB).*

NFDI4Phys will work mostly with the consortia in physics, engineering, chemistry and material sciences, but will also interact with consortia in other areas. It will

- establish links between consortia via individual participations and building platforms *(DPG, TIB, PTB)*
- observe the developments in all consortia.

At an early stage, the proposed standards and structures will be tested under real-life conditions in cooperation with partners and by using PTB's capabilities in different research areas. This will ensure the practicability of the proposed solutions.

Most written standards are driven by industry and are produced in standards development organizations (SDOs). In fact, industrial producers of measurement hardware and software often set de facto standards for data acquisition, data processing and storage that are relevant to the NFDI. SDOs provide well-established mechanisms from which NFDI consortia can learn and benefit. Therefore, NFDI4Phys will

- liaise with key industries which are relevant for the NFDI *(PTB)*
- liaise with standardization organizations such as DIN/DKE to explore their possible role and contributions *(PTB).*

Most research is international, and the need for efficient NFDIs (and related activities) also exists in other countries. An NFDI in Germany which is conform to the FAIR data principles can only exploit its full potential if it is internationally compatible. Therefore, NFDI4Phys will

- liaise with European and international key players such as European initiatives and organizations (e.g. national metrology institutes), the European Commission (EC), bodies under the international Metre Convention, and international key players like NIST, USA *(mostly PTB).*

3.3 Dissemination

The importance of professional data management has not yet been recognized throughout the entire physics community. We will therefore

- develop proposals for the implementation of physics courses in university curricula
- contact both doctoral students and established researchers on various occasions (workshops, summer schools, DPG spring meetings, etc.)
- test tools and standards we have developed in selected working groups in order to further improve them and then offer and disseminate them on a larger scale
- develop data policies for physics in close consultation with other physics consortia and DPG sections.

However, the most important key to the acceptance of the NFDI will certainly be to respond to the needs and demands of researchers from the bottom up and from the outset – i.e. the “inclusive approach” that specifically characterizes us.

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

PTB

The national metrology institute PTB is an essential part of the German quality infrastructure. Mandated by the Units and Time Act and several other acts and ordinances, it develops and holds the highest measurement standards and provides calibration services and conformity assessments (mostly for industry). Internationally, it contributes to the harmonization of metrology – for example, PTB was one of the driving forces behind the redefinition of the SI units. It responds to demand from industry via services and research cooperation projects and is very active in standardization.

With its staff of more than 2000, a large number of unique measurement capabilities and 60 % R&D, PTB is also an important part of the German research landscape.

Given the background of its mission, its scientific and technical capabilities, and the fact that it works so closely with academia, industry, regulation authorities and research institutions on a national, European and international level, PTB is in a privileged position to contribute to the NFDI.

TIB

The Leibniz Information Center for Science and Technology (TIB) is a member of the Leibniz Association and unites research and infrastructure within one organizational unit:

- As the German National Library for Science and Technology, TIB contributes its expertise acquired over many years in curating metadata and in developing standardized and interoperable metadata schemes tailored to special use cases.
- TIB has contributed a set of services to accompany the research data life cycle which includes the PID services DataCite and ORCID. These services will support the consortium's aim of establishing workflows for data publications with DOIs as well as interlinking articles and data.
- TIB’s research groups work on terminology services and automatic semantic data annotation – for example, via automatic extraction of metadata from datasets stored in

repositories using ML techniques. The research groups will contribute their experience in the field to the development of planned services.

DPG

With its 22 topical divisions, the DPG covers the entire field of physics and brings together physicists from all types of research institutions in Germany including industry and even school teachers. Within its sections and groups, the DPG is able to engage a critical mass of data producers and users to provide them with an assisted bottom-up process. More than 10,000 physicists meet annually at the spring meetings of the DPG. The divisions and spring conferences of the DPG are broad grassroots forums which are well suited to the discussion of a suitable infrastructure for research data, which we intend to use consistently for this purpose.

Furthermore, DPG is closely connected to the Konferenz der Fachbereiche Physik (KFP) and the Fachbereichstag Physikalische Technologien (FPT), which bring together 60 university faculties and 26 faculties of universities of applied sciences. This encompasses nearly all universities in Germany where physics or physics-related subjects can be studied and where physical research data are generated. Moreover, KFP and FPT are the most important bodies in Germany where the topic of “data management training” in university physics courses could be discussed.

The DPG has two locations at its disposal for hosting workshops and conferences: the Physikzentrum in Bad Honnef where the DPG head office is located and the Magnus Haus in the centre of Berlin. Both locations are well-known and widely accepted places of scientific discussion and exchange.

Interfaces with other proposed NFDI consortia

Immediately after the first NFDI conference, after all consortia had been described in detail, we initiated an exchange between all consortia relevant for physics. This discussion has already led to some adjustments within and collaboration and coordination between these consortia. The partners of NFDI4Phys have already begun cooperating with the following emerging consortia.

DPG is participant in the consortia DAPHNE and PAHN-PaN and is in close contact to FAIRMAT and Astro-NFDI.

TIB is strongly involved in NFDI4Chem, NFDI4Ing and NFDI4Earth which are further consortia with high relevance to physics, making (in-house) networking easy. TIB is also a participant in DAPHNE, PAHN-PaN and FAIRMAT.

PTB is participant in the consortia NFDI4Ing and DAPHNE and is in close contact with NFDI4Chem.

It is a key objective of NFDI4Phys to establish and develop interfaces between the consortia.

4 Cross-cutting topics

The overall objectives of NFDI4Phys are cross-cutting. The partners of NFDI4Phys are primarily associated with the area of physics. However, all of them have mandates, capabilities and expertise that complement each other, and which, taken together represent a unique opportunity to contribute to the development of the basic standards and methodologies of the NFDI.

NFDI4Phys will provide solutions in line with its two key objectives, i.e.,

- to identify and define fundamental common standards

- to ensure interoperability via properly curated metadata as well as via controlled terms which can be used in all areas of physics and beyond.

This will be done with the help of:

- inclusive, broad communication with researchers from all areas of physics
- cooperation with most of the other consortia
- cooperation with key industries and standardization organizations
- liaisons with European and international partners.

5 Annex

For each (co-)spokesperson listed above, please add a list of all persons and/or institutions with whom the (co-)spokesperson collaborated closely during the last three years.

Dr. Jörn Stenger

Hans-Arne Froystein, JV, Norway
Prof. Dr. Erkki Ikonen, MIKES, Finland
Dr. Beat Jeckelmann, METAS, Switzerland
Dr. Maguelonne Chambon, LNE, France
Dr. Duncan Jarvis, EURAMET, Europe (based in Germany)
Dr. Gustaf Winroth, EU Commission
Dr. Martin Milton, BIPM, international (based in France)

Prof. Dr. Sören Auer

Prof. Dr. Jens Lehmann, Universität Bonn, Fraunhofer IAIS
Prof. Dr. Amit Sheth, Wright State University
Violeta Ilik, University of Columbia
Dr. Sebastian Hellmann, Universität Leipzig
Dr. Michael Martin, InfAI, Leipzig
Dr. Christoph Lange, Fraunhofer FIT
Dr. Steffen Lohmann, Fraunhofer IAIS
Prof. Dr. Thomas Riechert, HTWK Leipzig
Prof. Dr. Wolfgang Nejdl, Leibniz Universität Hannover
Prof. Dr. Harald Sack, KIT und FIZ Karlsruhe

Dr. Uwe Kahlert

No close collaborations within the last three years.