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Data Management Plan

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EXECUTIVE SUMMARY

This document *D4.4 - Data Management Plan* is a deliverable of the **NeuroNanotech** Project, from the HORIZON-MSCA-2023-DN-01-01 call.

The Data Management Plan outlines the data management lifecycle for all data sets that will be compiled, processed, or created as a result of the action. The DMP follows the structure of the Data Management template provided by the European Commission, and is a live document subject to modifications throughout the lifespan of the project.

Partner name (country)	Acronym
Fundación IMDEA Nanociencia (Spain)	IMDEA
Centre National de la recherche scientifique (France)	CNRS-GREYC
Commissariat a l'energie atomique et aux energies alternatives (France)	CEA
Tel Aviv University (Israel)	TAU
Atlas Neuroengineering BVBA (Belgium)	ATLAS
Scuola Internazionale Superiore di Studi Avanzati di Trieste (Italy)	SISSA
Universidad Autónoma de Madrid (Spain)	UAM
Fundación para la Investigación Médica Aplicada (Spain)	FIMA
Stichting Radboud Universiteit (The Netherlands)	RU
Universitetet i Oslo (Norway)	UiO

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INTRODUCTION

The Data Management Plan (DMP) serves as a comprehensive outline of the project's approach to handling research data. It details the types of data that will be produced, the strategies for ensuring their long-term preservation, and the provision on access rights. All research data is expected to follow the "FAIR" principles—findable, accessible, interoperable, and reusable. These principles precede implementation choices and do not necessarily suggest any specific technology, standard or implementation solution.

The DMP encompasses the entire data life cycle within the NeuroNanotech project. Consequently, it is considered a living document and may be updated as the project progresses.

1. DATA SUMMARY

Purpose of data collection

IMDEA: The purpose of the data will be:

- To provide a detailed description of the materials and methods used during the fabrication of the neural-probe prototypes.
- To provide a detail protocol for the fabrication of neural-probe prototypes as proposed in the project.
- Characterize the performance of the fabricated neural-probe prototypes in similar environmental conditions to those of in-vitro and in-vivo experiments.

CNRS-GREYC: The data consists mainly of magnetic sensor properties—such as resistance as a function of field and temperature, noise levels, and frequency response—which need to be saved in order to accurately calibrate and analyse biomagnetic measurements.

CEA: Data will be collected to analyse results of biomagnetic measurements, mainly as magnetic sensor properties.

TAU: To systematically evaluate and optimize soft and adhesive neuronal implants for stable neural interfacing. Data will be collected to characterize the mechanical, electrical, and biological performance of the developed implant systems.

ATLAS: The objective is to integrate a giant magnetoresistance (GMR) sensor array on a flexible probe to perform in vivo recording. The data being generated will be process flows, process recipes, material characterisation data, electrode impedance measurements, long-term stability tests and electro-physiology data.

SISSA: To collect quantitative biological data in order to investigate the impact of neuroinflammation on long-term synaptic plasticity in neuronal circuits, mimicking conditions occurring in vivo during anxiety disorders and epilepsy. The data related to the measures of electrical circuit activity will also help to compare and implement interface recordings via magnetic and electric sensors.

UAM: The purpose of the data collection is to explore the hypothesis stated in the project, detecting experimental evidence that may confirm the initial theoretical hypothesis, thus data collection is essential for achieving project milestones and overall success. Raw data from experimental studies will

be collected and analysed to validate and verify the hypothesis and models, and to provide insights, trends and patterns necessary to make rational educated decisions to achieve the intended goals or abandon unsuccessful research lines.

FIMA: The purpose of the data generation in this project is to quantitatively assess the biocompatibility, stability, and functional performance of nanotechnology-based neural interfaces for smart neuromodulation in animal models of epilepsy and Parkinson's disease. The collected electrophysiological, magnetophysiological, behavioral, and histological data will allow us to evaluate the relationship between neural dynamics and motor behaviour, optimize real-time stimulation strategies, and validate proof-of-concept intelligent neuromodulation frameworks. Data collection is essential to answer the project's core research questions, ensure reproducibility of findings, enable statistical validation, and support the development of translational biomarkers and stimulation protocols.

RU: The purpose of the data collection is to characterize and compare electrical (local field potentials) and magnetic signals generated by neuronal activity in hippocampal brain slices. The generated datasets will enable quantitative analysis of signal generation mechanisms, facilitate reproducibility, and support the development of improved methodologies for localization of neuronal activity, with particular emphasis on epileptogenic zones. In addition, simulation data will be used to test hypotheses regarding current flow and magnetic field generation.

UiO: The data will be used to develop biologically detailed network models for physics-based prediction of electric potentials and magnetic fields generated by populations of neurons, both in vitro and in vivo settings, create biophysically detailed models of electric fields generated by stimulus electrode and to compare/validate these model predictions against in vivo and in vitro recordings done by the consortium partners.

Origin of data

IMDEA: The data will be generated by the following means, all located in the building of IMDEA Nanociencia:

- Scanning Electron Microscopes
- Optical Microscopes
- Magneto optical microscope
- Optical photography
- Potentiostats
- Acquisition devices for electric and magnetic characterization
- Devices for spin-transport characterization
- Data analysis software
- Text-processing software

CNRS-GREYC: Raw data will be acquired using laboratory equipment, e.g. magnetic sensor characterisation set-ups, microscopes, etc. They will be collected by each scientist involved in the project using software adapted to each instrument. Raw data as well as analysed data are always stored. Storage is on servers of the Université of Caen Normandie.

CEA: Data are essentially related to magnetic sensors properties and will be collected by each scientist involved in the project using software adapted to each instrument. Raw data are always stored, but

reduced data or results of the processing and interpretation of these measurements (computer processing) can also be stored. Storage is on servers or computers in the CEA-SPEC building.

TAU: The data generated in this project will originate primarily from experimental work conducted at the Neuro-Engineering Laboratory, School of Electrical and Computer Engineering, Tel Aviv University. Data will be obtained from microfabrication and screen-printing processes used to produce soft adhesive implants; electrochemical and electrical characterization measurements performed using impedance analysers, potentiostats, and electrophysiology systems; ex vivo and in vivo electrophysiological experiments (including retinal recording and stimulation studies); and microscopy imaging used to evaluate structural integrity and tissue–electrode interaction.

ATLAS: The sensor development builds further on in-place process flows and background knowledge from ATLAS Neuro. New processes and characterization data for the GMR sensors will be generated at ATLAS Neuro during the project.

SISSA: The data has been acquired from biological in vitro and/or ex vivo preparations, using equipment (live imaging and electrophysiology set ups, confocal microscope) within the facilities provided by SISSA and present within SISSA building.

UAM: Raw data will be acquired using laboratory equipment, e.g. confocal microscopes. Analysed data will be generated using specific analytic software depending of the nature of the data (e.g. FlowJo software for FACS analysis or GraphPad software for statistical analysis). At this initial phase, we are pinpointing all the experiments to be conducted throughout the implementation, thus readjustments based on data analysis can be considered.

FIMA: All primary data will be generated within the framework of this doctoral project at CIMA (Universidad de Navarra) and the Cajal Institute (CSIC). Electrophysiological and magnetophysiological recordings will be acquired using custom-designed neural probes integrating nanostructured electrodes and spintronic magnetic sensors, combined with real-time acquisition systems developed in-house. Behavioural data will be obtained from video recordings analysed through AI/ML tools together with custom data analysis pipelines. Histological and confocal microscopy data will be generated following tissue processing in institutional core facilities. Any computational data will originate from signal processing pipelines and AI/ML models developed during the project.

RU: Experimental data will be generated through electrophysiological recordings from acute hippocampal brain slices obtained from mice. Local field potentials will be recorded using microelectrode systems, and magnetic field signals will be measured using state-of-the-art magnetic sensors based on spintronics technology. The experimental data acquisition will be conducted in the Huygens building at Radboud University.

UiO: All data will be theoretical and obtained by formulating Python scripts.

Reusing of data

IMDEA: The know-how and experience of the research team will be the base of new device fabrication and characterization. Characterization data of previously fabricated devices might be used for comparison reasons.

CNRS-GREYC: New data will be built upon expertise and knowledge previously acquired and can be compared to previously measured data.

CEA: Comparison data measured on previous magnetic sensors will be used.

TAU: At this stage, the project does not plan to re-use previously generated experimental datasets. All primary data related to implant fabrication, electrode characterization, and electrophysiological validation will be newly generated within the framework of this project. Previously published data and methodological standards may be used for benchmarking, comparison, and experimental design purposes. In addition, knowledge and prior expertise from the research group will inform protocol development and optimization. If any external datasets are reused for validation or comparative analysis, their provenance will be clearly documented, and the Data Management Plan will be updated accordingly.

ATLAS: No data will be reused other than background know-how of ATLAS Neuro.

SISSA: The project has, to date, no plan to re-use any previous data other than the expertise and knowledge defined from the background of the project. Whenever any data (images or datasets) are being re-used, it will be appropriately updated in the Data Management Plan.

UAM: It is not expected to re-use preexisting data. New data will be built upon expertise and knowledge previously acquired.

FIMA: The project does not initially plan to re-use external experimental datasets. All core experimental data will be generated specifically for this project to ensure methodological consistency and experimental control. However, proprietary (already obtained data) and publicly available datasets (e.g., electrophysiological recordings from Parkinsonian animal models or open-source neural data repositories) may be used for benchmarking signal processing algorithms or validating analytical methods when appropriate. If any external datasets are incorporated, their provenance, licensing conditions, and integration strategy will be clearly documented and updated in the Data Management Plan.

RU: No data will be reused.

UiO: There are no plans to reuse existing data. The new data will be based on previous experience and knowledge.

Types and formats of data

IMDEA: The following formats are foreseen: images (.JPG, .TIFF, .PDF), raw data acquisition (.TXT, .DAT, .CSV), analysed data (.TXT, .DAT, .OGS, .XLS, .PDF) and reports/presentations (.DOC, .PPT, .PDF).

CNRS-GREYC: Expected types/formats include: text files (.TXT, .DOCX, .PDF), image/video files (.TIFF, .JPG, .PNG, .DM3, .MP4, .AVI), graph, table files (.TIFF, .JPG, .PNG, .TXT, .DOCX, .XLS).

CEA: our data are always available in .TXT and QTlplot format (.XML).

TAU: The project will generate quantitative, qualitative, and imaging datasets related to implant fabrication, electrode characterization, and electrophysiological validation. The main types and formats of data will include: electrophysiological recordings (.CSV, .TXT, .MCD, or other standard data acquisition formats generated by electrophysiology systems), impedance and electrochemical measurements (.CSV, .TXT, .XLSX, or instrument-native formats), microscopy and imaging data

(.TIFF, .PNG, or .JPG), design and fabrication files (.PDF, .DXF, or other standard design formats), statistical analysis outputs and processed datasets (.CSV, .TXT, .XLSX, and figures in .PDF or .PNG). A structured dataset inventory will be maintained throughout the project and updated as new datasets are generated.

ATLAS: The data being generated will be documented in documents (.DOCX, .PDF), microscopy images (.JPG OR .TIFF) and presentations (.PPT).

SISSA: For confocal microscopy images (.JPG, .TIFF), for live imaging (.ND2) and for electrophysiological recordings (.ATF, .ABF).

UAM: Expected types/formats include: text files (.TXT, .DOCX, .PDF), image/video files (.TIFF, .JPG, .PNG, .DM3, .MP4, .AVI), graph, table files (.TIFF, .JPG, .PNG, .TXT, .DOCX, .XLS), data sets (.PZF, .XLSX), gene sequence data (.DNA, .TXT).

FIMA: The project will generate a wide range of multimodal datasets spanning experimental neuroscience, hardware development, and computational modeling.

Electrophysiological and magnetophysiological signals will be stored in raw binary formats (.BIN, .SMRX, .RHS, etc), MATLAB files (.MAT), Neurodata Without Borders (.NWB), Hierarchical Data Format (.HDF5), and interoperable formats such as .CSV or .JSON for processed datasets. Magnetic sensor outputs and stimulation logs will be stored in .CSV, .TXT, .HDF5 or the previously described raw binary formats. Behavioral recordings will include high-resolution video files (.MP4, .AVI) and, when relevant, synchronized audio recordings (.WAV) to capture acoustic correlates of behavior or environmental cues. Time synchronization across modalities (EPHYS, magnetic sensing, video, audio, stimulation triggers) will be preserved using structured metadata files (.JSON, .XML).

Histological and microscopy data will include high-resolution images in .TIFF (preferred, non-compressed or lossless compressed), with auxiliary metadata stored in .XML or embedded standardized headers.

In addition to experimental data, the project will generate **engineering and hardware development files**, including:

- Electronic circuit schematics and PCB layouts (.SCH, .BRD, .KICAD_PCB, .PCBDOC, .PDF exports).
- Bills of materials (BOM) in .CSV OR .XLSX formats.
- Wiring and interconnection diagrams documenting novel equipment connection schemes (.PDF, .SVG, .DRAWIO, .DXF).
- Embedded system firmware written in **C/C++ (Arduino-compatible environments)** (.INO, .C, .CPP, .H).
- Hardware control and data acquisition scripts written in **MATLAB (.M)** and **Python (.PY)**, selected according to suitability for real-time processing, signal analysis, AI/ML pipelines, or hardware interfacing.

The project will also generate **3D design and fabrication files** associated with neural probes, sensor housings, implantable supports, and custom mechanical adapters, including:

- 3D CAD design files (.IPT, .IAM – Autodesk Inventor; .STEP, .STP; .IGES; .SLDPRT where applicable).
- 3D printable models (.STL).

- Technical drawings (.PDF, .DWG, .DXF).
- Finite element simulation outputs (.VTK, .ANSYS, or equivalent export formats where applicable)

All computational analysis workflows, preprocessing pipelines, denoising algorithms, and AI/ML models will be stored as documented scripts (.PY, .M) and configuration files (.YAML, .JSON), with accompanying README documentation (.MD, .TXT). When feasible, open and standardized formats will be prioritized to maximize interoperability, long-term accessibility, and FAIR compliance.

A complete and evolving inventory of datasets, file types, and associated metadata will be maintained and updated throughout the project lifecycle.

RU: Raw electrophysiological recordings will be stored in proprietary acquisition formats (e.g., .ABF from pCLAMP/Clampfit), and exported to open formats such as .CSV, .TXT, or .HDF5 for analysis and long-term storage.

UiO: Expected formats will be in the form of Python scripts (.PY).

Expected size

IMDEA:

- Images: around 1200 kB per unit.
- Raw data acquisition: less than 3000 kB per unit.
- Analysed data: less than 10.000 kB per unit
- Reports: less than 30.000 kB per unit.
- Presentations: less than 100.000 kB per unit.

CNRS-GREYC: Expected total size of the data will not exceed 5Gbytes.

CEA: Total size of the data is estimated to be below 5Gbytes.

TAU: The project will generate experimental datasets of moderate size. Electrophysiological recordings and impedance measurements are expected to range from several megabytes to a few gigabytes per experiment, depending on recording duration and sampling rate. Imaging data may range from 5–300 MB per image, with complete experimental series potentially reaching several gigabytes.

ATLAS: The data being generated is expected to be less than 1 GB.

SISSA: The generated data is expected to be 10 TB.

UAM: Expected size of each dataset is 2MB for images, 50MB for video files, 1MB for graph/table files, 5MB for data sets and 1MB for gene sequence data.

FIMA: The expected data volume will primarily derive from high-sampling-rate electrophysiological recordings (1–30 kHz), which may generate approximately 5–20 GB per experimental session depending on channel count and duration. Behavioural video recordings may generate 1–5 GB per session, and microscopy image datasets approximately 1–10 GB per experiment. The total projected data volume over the PhD duration is estimated to be between 5–15 TB. Data compression, selective

storage of relevant channels, and structured archiving strategies will be implemented to minimize storage demands while preserving scientific integrity.

RU: The project will generate time-series electrophysiological and magnetic recordings. A typical recording session (10–20 minutes, 10–50 kHz sampling rate, multiple channels) is expected to produce approximately 50–200 MB of raw data. Over the course of the PhD project (estimated 500–800 recordings), the total raw dataset size is expected to be in the range of 50–200 GB. Processed data and derived analysis files will add a limited additional storage requirement, bringing the total estimated data volume to approximately 100–250 GB over the project duration.

UiO: The size of data is expected to be about 100 MB.

Data utility

IMDEA: Data will facilitate verification and validation by other researchers and developing companies.

CNRS-GREYC: Data will contribute to the broader knowledge of the scientific community on magnetic signal produced by neurons.

CEA: the data of magnetic sensors properties are not useful without the sensor itself as the detailed stack of the sensors are proprietary.

TAU: The data generated in this project will be useful to the broader scientific and neuroengineering communities. Electrophysiological, impedance, and tissue–electrode interface datasets may support replication, validation, and further development of soft neural interface technologies. The results may also improve biomedical device design, contribute to translational research efforts, and potentially support future intellectual property development, in accordance with ethical and regulatory considerations.

ATLAS: The data might be useful for microfabrication institutes and universities.

SISSA: To facilitate repetition and validation of the study to other researchers and to the scientific community.

UAM: Data will contribute to the broader use of hiPSCs, thereby reducing the reliance on embryonic or foetal stem cells, positively impacting society. Data on neurogenesis and neuronal activity can be useful for big pharma, start-up companies for diagnostics, drug screening and therapy testing.

FIMA: The datasets generated in this project will be valuable to the neuroscience, bioengineering, and neurotechnology communities, particularly researchers working in neuromodulation, Parkinson's disease, epilepsy, neural interfaces, and biomedical signal processing. The data may support the validation of adaptive stimulation strategies, benchmarking of signal processing algorithms, and development of next-generation implantable neural devices. Additionally, the results may contribute to translational research efforts, collaborative studies within the NeuroNanotech consortium, and potential intellectual property development in the field of smart neuromodulation technologies.

RU: The generated datasets will be useful to the broader neuroscience community for replication and validation of experimental findings related to magnetic field generation in neuronal tissue. In addition, the datasets will support the validation of novel magnetic sensors developed within the consortium and may contribute to further technological development in neuro-nanotechnology.

UiO: Data will contribute to the broader knowledge of the scientific community, specifically on biophysical modelling of electric and magnetic signals and stimulation in neuronal networks.

2. FAIR DATA

In accordance with EU guidelines, the data resulting from the NeuroNanotech project will be FAIR, that is findable, accessible, interoperable and re-usable.

2.1. Making data findable

To improve the findability of research data produced during the project, if and when appropriate, datasets will be deposited in reliable repositories and will be described using rich metadata and persistent identifiers. The designated repository for depositing publications will depend on the host institution of each PhD fellow. In any case, the employed repositories will include: the European Open Science Cloud (EOSC), Zenodo (<https://zenodo.org/>) and the Institutional Repository of IMDEA Nanociencia: (<https://repositorio.imdeananociencia.org/>), which is automatically linked to the OpenAIRE portal and e-cienciadatos.

Data deposited in repositories will be identified by a persistent identifier, such as DOI or Handle. This data will be discoverable by means of suitable metadata:

- Identifiers (DOI, Handle).
- Publication type (presentation, dataset, report...etc.).
- Title, authors, affiliation.
- Description of the content, including keywords.
- Description of software and tools needed to read the data. Links to relevant software (whenever possible)
- Associated publication or dataset.
- Funding information: funder, grant number, acronym, and project name.
- License rights: Creative Commons CC-BY or equivalent.

Other persistent identifiers could be used to recognize metadata fields “authors” (ORCID), funding (DOI, Funder Registry ID) and institution affiliation (ROR, ISSN).

Metadata will be stored in repositories in appropriate interoperable formats, following DC-OAI schema (IMDEA Nanociencia Repository), JSON schema (Zenodo), or other interoperable schemas.

The data selected to be deposited will correspond to the final version. When later revisions are required, these updated versions will also be deposited, each assigned its own persistent identifier and linked to earlier versions through appropriate metadata.

All deposited datasets will be uniquely identifiable using standard persistent identifiers such as Handle, DOI, or others (ISSN, ISBN for books). URLs may be used to reference other types of online content, including dissemination materials such as videos.

2.2. Making data openly accessible

Which data will be made openly available

IMDEA: Images, fabrication procedures and analysed data will be made openly available after consideration for intellectual property protection or/and publication in scientific journals

CNRS-GREYC: The data will be made available upon request, as data on sensor properties could be used by third parties to gain information about the design and the battery of the sensors. Following evaluation of the patent, the data can be deposited in IMDEA's repository.

CEA: Data will be available on request, as data of sensor properties may be used by foreign entities to get information on the stack and design of sensors used. After patenting evaluation, data may be deposited on the open access repository of IMDEA.

TAU: Processed datasets supporting published results will be made openly available wherever possible. Raw data may be restricted due to size limitations. If patent protection is pursued, a limited embargo may be applied until protection and publication are secured. No personal or sensitive data will be generated in this project.

ATLAS: Published data will be made publicly available.

SISSA: All data will be made openly available after papers publication, upon reasonable request to papers' authors.

UAM: All data will be made accessible to relevant stakeholders and researchers. If during the course of the project, any data or scientific finding is discovered to be potentially protected, patent application will be explored to ensure protecting intellectual property, promote transparency and knowledge sharing as soon and as much as possible in line with FAIR guidelines.

FIMA: In principle, and in agreement with the NeuroNanotech consortium policies, all research data generated within this project will be made openly available in accordance with FAIR principles and Horizon Europe open science requirements. This includes experimental datasets, processed data, metadata, analysis scripts, and relevant documentation necessary to ensure reproducibility. However, this commitment does not preclude the possibility that certain datasets or results may be subject to temporary embargo. Such embargoes may be applied strictly for the time required to (i) evaluate the need or suitability for intellectual property protection (e.g., patent filing related to neural interface designs, hardware developments, or signal processing innovations), and/or (ii) allow adequate time for the publication of scientific results derived from the data. These restrictions would not stem from legal or contractual prohibitions but from strategic protection and dissemination considerations. Any embargo period will be limited to the minimum necessary duration and will not exceed a maximum of five years, after which the data will be made openly accessible unless overriding legal obligations apply.

RU: Data generated in this project, including simulation data and experimental recordings from hippocampal brain slices (mouse), will be made openly available following publication. This includes raw and processed electrophysiological recordings, magnetic sensor data, and simulation outputs, together with sufficient metadata to ensure reproducibility.

A temporary embargo period (typically up to 6–12 months) may be applied to allow for scientific publication or potential intellectual property protection related to sensor development within the consortium. No legal restrictions related to personal data apply, as this project involves animal

experiments only. In the case of collaborative or consortium-based data, sharing will comply with institutional agreements and MSCA policies. After any applicable embargo period, datasets will be deposited in appropriate open repositories in accordance with FAIR principles.

UiO: All data will be made openly available after publication of the paper.

Restrictions on use

IMDEA: No restriction after patenting or publishing.

CNRS-GREYC: In the event that external entities or individuals request access to the data, a confidentiality agreement will be signed. Access to the data will be granted to all consortium members, who will be able to retrieve, modify, and interact with the files and resources related to the project.

CEA: There is no restriction of use after transmission of data.

TAU: If restrictions apply, access to the relevant data will be provided upon reasonable request, subject to review and, where necessary, a data-sharing agreement.

ATLAS: Process and fabrication recipes won't become publicly available to enable commercial exploitation.

SISSA: No restrictions after papers publications.

UAM: Data access will be granted to all consortium partners, that will be able to retrieve, modify and interact with project-related files and resources. In case where external entities or individuals shall request access to data, a confidentiality agreement would be executed.

FIMA: If restrictions on use apply, access to the data will be managed through controlled-access repositories during and, if necessary, after the end of the project. While the project's objective is to ensure broad and open availability of research data, it is understood that such data must not be used for harmful, malicious, or unethical purposes, particularly in contexts involving biomedical technologies and neuromodulation systems. Where appropriate, access may require user registration and agreement to specific terms of use. A usage monitoring system may be implemented to keep a record of who downloads the datasets and for what declared purpose, ensuring transparency and traceability. Furthermore, the ethical implications of purely commercial exploitation of the data will be carefully evaluated in coordination with the NeuroNanotech consortium and in alignment with Horizon Europe/MSCA program directives. Any restrictions will be proportionate, clearly justified, and consistent with open science principles while safeguarding responsible research and innovation.

RU: No restrictions on use are currently foreseen. Data and research products will be made available in accordance with open science principles, subject to institutional policies, ethical approvals, and applicable regulations for animal research.

UiO: There is no restriction of use after the publication of the paper.

REPOSITORY

How the data will be made available

IMDEA: The data will be available via the open access IMDEA Nanociencia Repository. IMDEA Nanociencia Institutional Repository is a trusted repository by OpenDOAR, regularly harvested by main

aggregators, such as OpenAIRE, offering their content via the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). The IMDEA Nanociencia Institutional Repository assigns a persistent identifier Handle to each item deposited.

CNRS-GREYC: Open access repository of IMDEA or CNRS Research Data institutional repository will be used.

CEA: Open access repository of IMDEA will be used.

TAU: The main results, including detailed methods, processed data, and representative figures, will be published in peer-reviewed open-access journals. Where appropriate, curated datasets supporting publications may be deposited in an open-access repository. Raw electrophysiological recordings and large experimental files will not be routinely deposited due to size and technical constraints but can be made available upon reasonable request through controlled access mechanisms, in accordance with publication, intellectual property, and institutional policies.

ATLAS: The data related to the publications will be made available through the publisher's webpage or shared via common platforms like Github.

SISSA: Data generated within SISSA will be available via the open access "SISSA Open Data" repository.

UAM: Institutional repository Biblos-e Archivo (<https://hdl.handle.net/10486/129079>) will be used. This repository assigns a persistent identifier Handle to each item deposited.

FIMA: We understand that, if IMDEA Nanociencia will centrally manage the deposition and dissemination of datasets through its Institutional Repository, it may not be necessary to duplicate the same datasets in additional repositories (e.g., Zenodo). Provided that Horizon Europe compliance, visibility, and persistent identification are ensured, we consider a single, coordinated repository strategy to be sufficient and more efficient.

RU: The data will be available via the open access repositories of choice, preferably the IMDEA Nanociencia Repository, but also Zenodo, or other relevant data repositories. Repositories should be accessible through a free and standardised access protocol.

UiO: The data will be available via the open access IMDEA Nanociencia Repository.

METADATA

License to metadata

IMDEA: IMDEA Nanociencia Institutional Repository makes metadata openly available and licensed under CC0.

CNRS-GREYC: IMDEA Nanociencia Institutional Repository and CNRS Research Data institutional repository make metadata openly available and licensed under CC0.

CEA: IMDEA Nanociencia Institutional Repository makes metadata openly available and licensed under CC0.

TAU: Metadata describing the deposited results will be licensed under CC0 or similar public domain license.

ATLAS: IMDEA Nanociencia Institutional Repository makes metadata openly available and licensed under CC0.

SISSA: SISSA Repository makes metadata openly available and licensed under CC0.

UAM: UAM institutional repository Biblos-e Archivo will make metadata openly available.

FIMA: We agree with the metadata licensing framework proposed by IMDEA Nanociencia. If metadata are made openly available under CC0 or an equivalent public domain license through the Institutional Repository, this approach is fully acceptable and aligned with open science requirements.

RU: Metadata describing the deposited results will be licensed under CC0 or similar public domain license at the IMDEA Nanociencia Institutional Repository.

UiO: data and code files will be stored in the IMDEA repository, which makes metadata openly available and licensed under CC0.

How long will the data remain available

IMDEA: Datasets are expected to remain accessible and reusable in the long term. See Section 4 for more information on long term preservation.

CNRS-GREYC: Institutional repositories are long-term archival solutions for the project, maintaining the data available for years after the project's conclusion.

CEA: all data is stored for at least 10 years.

TAU: Data will remain accessible for at least 10 years after publication, subject to repository preservation policies and institutional guidelines.

ATLAS: Datasets are expected to remain accessible and reusable in the long term. See Section 4 for more information on long term preservation.

SISSA: Data will be stored for ten years after publication.

UAM: UAM institutional repository is a long-term archival solution for the project, maintaining the data available for years after the project's conclusion.

FIMA: We agree to follow IMDEA Nanociencia's institutional policy regarding long-term preservation and availability of the data. Provided that datasets remain accessible in accordance with Horizon Europe requirements and institutional repository standards, we consider this framework appropriate for ensuring sustained availability and compliance.

RU: 10 years.

UiO: Datasets are expected to remain accessible and reusable in the long term in the IMDEA Nanociencia repository.

2.3. Making data interoperable

Vocabularies, standards, formats and methodologies

All datasets will be accompanied by standard descriptive metadata to support interoperability, indexing, and discoverability. Each deposited dataset will include comprehensive information detailing the data collection methods and analytical procedures, ensuring clarity, reproducibility, and the verification of

Additionally, the partners will convert all shareable data from proprietary formats into widely used and well-documented open formats. This approach facilitates data exchange and reuse across researchers, institutions, organisations, companies, and countries. When data processing relies on specific software, the deposited materials will also contain full explanations and usage instructions.

2.4. Increase data re-use

The shareable data will be distributed under licenses that allow full reuse of the datasets in their entirety by other researchers and stakeholders. When appropriate and when the nature of the data allows, datasets will be released under a Creative Commons “No Rights Reserved” (CC0) license or equivalent open license.

Data that do not require protection and can be openly disclosed will be deposited in the designated repositories as soon as possible. In some cases, an embargo period may be applied to allow the research team sufficient time to fully exploit the results.

Data quality will be ensured through multiple approaches, including repeating measurements and the use of standard statistical methods to identify and analyse errors or inconsistencies.

Each dataset will be deposited together with a readme file containing:

- Date and location of collection.
- General description of the dataset, file inventory, relationships between files, and data-cleaning procedures
- Version information and links to earlier versions (if available).
- Any reuse limitations, (if relevant).
- Methods and experimental conditions used during data collection.
- Required software or tools for accessing and processing the data, including version numbers
- Lists of variables, abbreviations, and units of measurement.

3. OTHER RESEARCH OUTPUTS

IMDEA: Protocols for fabrication and prototypes of the neural probes developed during the project can be made available upon request after patenting/publications of the research results.

CNRS-GREYC: The suitability for patent protection of research results obtained during the execution of the project, whether in digital format or in tangible form, will be evaluated.

CEA: CEA has a policy of patenting innovation as soon as possible. Afterwards, CEA will make sensors available upon request on a fair basis to external users.

TAU: The project may generate additional research outputs such as fabrication protocols, experimental workflows, data analysis scripts, and implant design files. These digital materials will be properly documented and stored in institutional systems, and where appropriate, described in peer-reviewed publications or shared via recognized repositories. Physical outputs (e.g., prototype implants and coated electrodes) will be managed within the laboratory according to institutional safety and traceability procedures. All outputs will be handled in line with FAIR principles where applicable, while respecting intellectual property and institutional policies.

ATLAS: We anticipate no other research outputs.

SISSA: No other research products are foreseen by SISSA activities. In the case any additional digital or physical outputs are generated during the project development these will be handled in line with the FAIR principles.

UAM: If research results, whether in digital formats (e.g., software, workflows, protocols, models, etc.) or tangible forms (e.g., new materials, culture devices, etc.), emerge during the project's implementation, their eligibility for patent protection will be assessed.

FIMA: The management of additional research products generated within the project — including digital assets such as software, signal processing workflows, hardware control firmware, computational models, and experimental protocols, as well as physical outputs such as neural interfaces, electronic prototypes, and fabricated components — has been outlined in the section “**Types and Formats of Data**” under Section 1 (Data Summary). These research products will be documented, version-controlled where applicable, and handled in accordance with FAIR principles. Digital components will be stored in open or widely adopted formats and, when possible, shared via appropriate repositories, while physical developments will be accompanied by sufficient technical documentation (design files, schematics, specifications) to ensure transparency, reproducibility, and potential reuse.

RU: Biophysical neuron models (e.g., Hallermann, Hay, and other published axon and pyramidal cell models) will be implemented and extended using simulation environments such as NEURON and LFPy. These models will be used to simulate extracellular electric potentials and magnetic fields generated by neuronal activity.

- Findable: Code and computational models will be deposited in public repositories (e.g. GitHub) with version tracking and DOI assignment where applicable.
- Accessible: Open-source licensing (e.g., .MIT or .GPL) will be used where possible to ensure accessibility.
- Interoperable: Standardized formats (e.g., Python scripts, .JSON configuration files, .HDF5 data structures) will be used to ensure compatibility with commonly used neuroscience simulation tools.
- Reusable: Detailed documentation, metadata, and dependency specifications (e.g., requirements files or environment specifications) will be provided to facilitate reuse by other researchers.

UiO: No other research outputs are expected.

4. ALLOCATION OF RESOURCES

Estimated costs for making the data FAIR

We estimate the following costs for making data and other research outputs FAIR:

- **Making a DMP.** We estimate a cost of 3 working hours. The costs are covered by NeuroNanotech project.
- **Data description and storage.** We estimate 130 hours to prepare and collate materials for deposit. The costs are covered by NeuroNanotech project.
- **Data archiving and preservation.** Datasets will be deposited by the administrators of the repositories, with an estimated cost of 0.5 h. IMDEA Nanociencia Repository does not charge extra costs to deposit, the costs are assumed by the institution.
- **Data security:** IMDEA Nanociencia does not charge its users for depositing and preserving files, although the total cost for depositing and preservation is estimated in 14€/dataset.

These costs will be covered by the author and/or co-authors of the publication and shared with the institution/service provider.

Responsibilities for data management

The authors can upload content in repositories of their choice. The dissemination of research results will be curated and approved by the coordinator of NeuroNanotech, IMDEA Nanociencia. The responsibility for the deposited data management lies on the administrators and data stewards of each institutional repository.

Long term preservation

All data files deposited in institutional repositories will be available for the lifetime of the repositories. In case of closure of such repositories, NeuroNanotech will make best efforts to integrate all content into suitable alternative institutional and/or subject based repositories. An alternative is Zenodo, hosted in CERN, which currently has an experimental programme defined for the next 20 years at least.

5. DATA SECURITY

Data shared among partners will exclude any sensitive information unless it has been anonymized.

In the initial phase, data generated by each partner will be stored on secure devices—such as computers, laptops, intranets, or hard drives—that require login credentials, updated regularly in accordance with national data-security regulations. These systems will be protected by up-to-date antivirus software and firewalls, and will undergo regular backups to prevent accidental data loss. No project data will be left inadvertently accessible. When external storage devices (e.g., backup drives) are used, they will be kept in secure locations accessible only to authorized researchers or encrypted using dedicated software.

Cloud-based storage will be used to facilitate data sharing among team members, with routine backups ensuring data recovery as well.

In the subsequent phase, data files will be transferred to the data centres or servers of the repositories identified in this document. Long-term preservation of public data is guaranteed by the repositories' established preservation policies.

For example, the IMDEA Nanociencia Repository stores files on institutional servers that are backed up weekly to an internal cabin, with incremental copies created throughout the week. An additional weekly backup is performed on external servers operated by EMPTIC, an ITC company located on the Cantoblanco Campus in Madrid. The repository portal employs SSL security to ensure the integrity of the data it provides.

6. ETHICS

If personal data is collected during the NeuroNanotech project, such as email lists used for dissemination of information, under no circumstances will it be shared or deposited in an open archive, in order to guarantee the protection of personal information.

The research activities of NeuroNanotech will comply with the ethical principles of relevant nations, and with EU and other international legislation, including the Charter of Fundamental Rights of the European Union (EU) and European Convention (EC) on Human Rights and its Supplementary Protocols.

The project involves the generation and processing of data derived from three ethically sensitive domains:

- Human stem cell research
- Laboratory animal experimentation
- Studies involving human participants

All data management activities will comply with applicable European, national, and institutional ethical frameworks. Ethical considerations apply throughout the entire data lifecycle, from collection to long-term preservation and controlled access.

The proposal includes an observational study in human participants carried out by TAU. This beneficiary is from Israel, a non-EU country listed as “Third countries associated to Horizon Europe” and therefore Legal entities from associated countries can participate under equivalent conditions as legal entities from the EU Member States. This study includes the skin electronics test in human participants and it does NOT include clinical trials or interventional studies in human participants. The work will not begin until approval is granted by Institutional Review Board (IRB).

The proposed study will comply with principles of The European Charter of Fundamental Rights relevant in the context of research: Art 3. On the right to integrity of the person, Art.7 On respect for private and family life, and Art.8 on protection of personal data. Voluntary participation in this research will be founded in three key components: adequate information to participants, voluntariness and competence. All personal data will be safe from unforeseen, unintended or malevolent use. Data protection will include both measure with regard to access to data and the conservation of data. All identifiable information will be protected to guarantee personal privacy.

Data involving human participants will be collected and processed in accordance with the **General Data Protection Regulation (GDPR)** and relevant national legislation.

- Only data strictly necessary for the research objectives will be collected (data minimisation principle).
- Personal data will be pseudonymized at the earliest possible stage; identifying information will be stored separately under restricted access.
- Informed consent procedures will clearly describe data uses, storage duration, sharing conditions, and participants' rights (access, rectification, withdrawal).
- Sensitive data (e.g., health-related information) will not be shared openly. Access will be granted only under controlled conditions and through secure repositories that support restricted-access workflows.