Quantum defects in 2D systems

A Data Management Plan created using DMPonline.be

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Project abstract:

Quantum physics has evolved from pure fundamental physics to an interdisciplinary field where fundamental and applied science go hand in hand. This transition is being driven by tremendous efforts and progress, at an international scale, to address quantum states and to exploit their quantum superposition and entanglement, creating new opportunities not only for fundamental science but also for quantum technologies. This movement is often referred to as the Second Quantum Revolution. One of the main efforts within this revolution is to search for new solid state systems that can be operated as qubit systems, and understand the interplay between their solid state properties (atomic-scale structure, electronic properties, …) and their quantum functionality (quantum coherence, initialization and readout…). This project aims exactly at that, focusing on a particularly promising type of solid state qubit: spin defects in solids. Whereas extensive research has been devoted in the past to well-established defects in 3D (bulk) materials, e.g. NV centers in diamond and donors in silicon, this project deals with new quantum defects in 2D systems (2D materials and surfaces). In particular, we will develop the creation of these new defects using a unique technique, ultralow energy ion implantation, and investigate the relation between their solid state properties and their quantum functionality, opening new opportunities for the development of scalable, spin-based quantum technologies.

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FWO DMP (Flemish Standard DMP)

1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
		Please choose from the following options: • Generate new data • Reuse existing data	*Please choose from the following options:* • Digital • Physical	*Please choose from the following options:* • Observational • Experimental • Compiled/aggregated data • Simulation data • Software • Other • NA	*Please choose from the following options:* • .por, .xml, .tab, .cvs,.pdf, .txt, .rtf, .dwg, .gml, … • NA	*Please choose from the following options:* • <100MB • <1GB • <100GB • <1TB • <5TB • <10TB • <50TB • >50TB • NA	
STM	scanning tunneling microscopy data	Generate new data	digital	experimental	.mi	< 1TB	
STS	scanning tunneling spectroscopy data	Generate new data	digital	experimental	.dat	< 1TB	
AFM	AFM images	Generate new data	digital	experimental	.ibw	< 1TB	
Raman	Raman spectroscopy	Generate new data	digital	experimental	.tvb	< 100GB	
XMCD	XMCD	Generate new data	digital	experimental	ASCII	< 100GB	
AES, XPS	AES, XPS, XRD measurements	Generate new data	digital	experimental	ASCII	< 100GB	
PL	Photoluminescence measurements	Generate new data	digital	experimental	ASCII	< 100GB	
Samples	Crystalline substrates such as Si and Sapphire with thin films of hBN, MoS2 grown on them	Generate new	Physical	experimental			10 dm3

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

NA

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- No

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- No

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

In order to make sure all the data collected and stored will be reliable and reproducible, a text document describing the exact expeimental conditions, including date, time, location of measurements, instruments, sample preparation protocol and measurement parameters etc. This file will be kept in the same folder where the data is stored. For the materials, a list of samples and the location where these are stored will be kept in researcher's logbook.
A description of the sample's characteristics (e.g. sample name, solvent, quantity, date, concentration) will be added to allow rapid identification and reuse.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

Since the data generated by various experimental instruments do not use a standard
metadata, we are unable to use a common format. As a consequence, we have created our own file format that fits to our experimental data. Although most of the generated data files contain metadata specific for that experiment, this is not sufficient and we will supplement this information with a detailed text document (ASCII type) storing the necessary information for finding, understanding and reuse of data. The text file will be placed in every folder containing data or processed data. In the case of processed or analysed data, detailed descriptions on the analysis steps will also be included. The text file and the structure of the folders used to deposit data will have a standard format. This will allow other users to: repeat the experiments or find and retrieve data.

3. Data storage & back-up during the research project

Where will the data be stored?

The data, including raw data, analysis files, as well as reports and electronic logbooks, will be saved on local computers. The data stored on these computers is backed-up daily on a local server. A duplicate of this back-up is made on the back-up server. All researchers involved in the project will have access to the corresponding folder.

How will the data be backed up?

The data stored on the local computers is continuously and automatically backed-up on local servers.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

The amount of data that will be generated in this project should not exceed a few TBs, which is small enough to be stored in local computers and on local servers.

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

The data will be systematically transferred to the local server, with restricted access (managed by the IT responsible). Only the promotor and involved researchers have access to the shared folders where the data, analysis files and reports will be stored. Also, credentials are required to log in to local computers in the laboratories.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

The costs are minimal and are covered by the project budget

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

Physical data in the form samples will be retained for 5 years. Most samples will degrade with time and will not be usable after 5 years. Digital data will be retained for 10 years.

Where will these data be archived (stored and curated for the long-term)?

Samples will be stored for 5 years in dedicated cabinets in the laboratories. Digital data will be retained for 10 years on local data storage facilities. Selected data sets will be stored in longer-term repositories (such as Zenodo and the KU Leuven Research Data Repository).

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

Costs related to data preservation are expected to be negligible and will be covered by accumulated reserves of the supervisor.

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Yes, in an Open Access repository
- Yes, in a restricted access repository (after approval, institutional access only, …)

Any data can be made available if requested by the editor or publisher of a scientific journal or upon request of an individual (e.g. a researcher who intends to reproduce an experiment).

If access is restricted, please specify who will be able to access the data and under what conditions.

NA

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- No

Where will the data be made available? If already known, please provide a repository per dataset or data type.

Upon request any data can be made available on an open repository (such as Zenodo and the KU Leuven Research Data Repository), for example if requested by the editor or publisher of a scientific journal or via restricted access upon request of an individual (e.g. a researcher who intends to reproduce an experiment).

When will the data be made available?

After the research results have been published (with a possible embargo time no longer than one year after the publication of the research)

Which data usage licenses are you going to provide? If none, please explain why.

CC-BY-4.0

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

What are the expected costs for data sharing? How will these costs be covered?

Deposition of smaller datasets in data repositories is usually covered by the repository and for sharing physical data the cost are typically paid by the researcher requesting the materials.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

The researchers who generate the data.

Who will manage data storage and backup during the research project?

The researchers who generate the data, together with the IT team of the research unit, who are responsible for the implementation of the storage and operation of the local servers.

Who will manage data preservation and sharing?

The project PI.

Who will update and implement this DMP?

The project PI.