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## C2E/23/025 ThermoSens: Moving thermal biosensor platforms from principles to applications

*A Data Management Plan created using DMPonline.be*

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**Template:** KU Leuven BOF-IOF

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### Project abstract:

The focus of this project is on two innovative biosensor platforms in which temperature gradients and thermal waves play the central role. Eukaryotic cells display a spontaneous, collective detachment effect with a time scaling that entails information about the cell type, nutritional status, and response to chemical products. The project seeks to unravel the detachment mechanism, the role of the plasma membrane, and the effects of prospective pharmaceuticals for the model case of liver cells. The hot-wire biosensor exploits molecular-scale changes at a solid-liquid interface, which alter the heattransfer efficiency from the solid to the liquid. The project applies the 3 $\omega$  technique to microwires functionalized with a variety of receptors to enable on-site analysis of e.g. drug residues in surface waters. For biotargets such as bacteria, the project aims at a novel receptor-synthesis strategy adapted to wire geometries.

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### 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.

Dataset name / ID	Description	New or reuse	Digital or Physical data	Data Type	File format	Data volume	Physical volume
		Indicate: <i>N</i> (ew data) or <i>E</i> (xisting data)	Indicate: <b>D</b> (igital) or <b>P</b> (hysical)	Indicate: Audiovisual Images Sound Numerical Textual Model SOftware Other (specify)		Indicate: <1GB <100GB <1TB <5TB >5TB NA	
1a	HTM sensor with one compartment	N	P	Physical object			10 cm diameter, 15 cm tall
1b	Optimized HTM sensor with at least 4 = four compartments	N	P	Physical object			maximum 25 cm by 25 cm by 30 cm
1c	Thermal wave sensor, 3-omega principle	N	P	Physical object			Dipstick, 2 cm diameter, < 15 cm long
2a	Construction drawings of HTM sensor with one compartment	N	D	I	.tif, .jpeg	< 1 GB	
2b	Construction drawings of HTM sensor with at least four compartments	N	D	I	.tif, .jpeg	< 1 GB	
2c	Construction drawings of thermal wave sensor (3-omega)	N	D	I	.tif, .jpeg	< 1 GB	
3	Software for operating the sensor devices	N	N	SO	LabView	< 1 GB	
4	Output data of the three sensor types	N	D	N	.txt, .xlsx	< 100 GB	
5	Protocols for bioreceptor synthesis	N	D	T	.docx, .pdf	< 1 GB	
6	Images of the bio-receptor layers	N	D	I	.tif, .jpeg	< 100 GB	
7	Presentations, e.g. at conferences	N	D	A, I	.pptx	< 100 GB	
8	Publications, thesis, reports	N	D	T	.docx, .pdf	< 100 GB	

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:

The software to operate the HTM- and 3-omega sensors will be written new, but not from scratch: We will fall back on earlier versions that are currently in use within the Laboratory for Soft Matter and Biophysics at the Department of Physics and Astronomy of KU Leuven.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, refer to specific datasets or data types when appropriate and provide the relevant ethical approval number.

- No

not applicable

**Will you process personal data? If so, please refer to specific datasets or data types when appropriate and provide the KU Leuven or UZ Leuven privacy register number (G or S number).**

- No

not applicable

**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.**

- Yes

The HTM sensor with (at least) four compartments has potential for valorization in the context of drug screening for pharmaceutical purposes. LRD is aware of this, our contact persons are Pieter Neyskens and Wim De Clercq.

**Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material or 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

not applicable

**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.**

- Yes

The methodology on cell characterization using the spontaneous cell-detachment effect in a heat-transfer device is patented and the patent owners are IMEC and Hasselt University. Patrick Wagner is a co-inventor since the effect was discovered within his research team when he still was at Hasselt University: full time until 2014, part time until 2016. There is a written agreement in place, signed by IMEC and Hasselt University, that research on this topic at KU Leuven can proceed under the "research exemption". The document is kept by LRD. There are no restrictions regarding publishing, but a future valorization for commercial purposes needs to be negotiated between LRD, IMEC, and Hasselt University.

#### 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).**

All data that are created using electronic instruments come automatically with the instrument settings as metadata. "Electronic instruments" includes the sensors (HTM sensor with one compartment, HTM sensor with at least four compartments, 3-omega instrument) and all that is related to microscopic imaging (fluorescence microscope, atomic-force microscope). We will also preserve the instrument settings in physical and electronic lab books and will generate an electronic read-me file that is kept together with the original, measured data.

**Will a metadata standard be used to make it easier to find and reuse the data?**

**If so, please specify which metadata standard will be used.**

**If not, please specify which metadata will be created to make the data easier to find and reuse.**

- No

For this type of project, at the merge of physics and biology, there is no suitable metadata standard. We will keep an electronic metadata folder, along with all raw data, that is structured along the line: i) Project ThermoSense, ii) work package within ThermoSens, iii) year, iv) responsible researcher, v) name of the instrument.

#### **Data Storage & Back-up during the Research Project**

**Where will the data be stored?**

- OneDrive (KU Leuven)
- Large Volume Storage

The data are stored on the laptops of the research group, OneDrive (KU Leuven), and the two (mirrored) backup servers of the Department of Physics and Astronomy.

**How will the data be backed up?**

- Standard back-up provided by KU Leuven ICTS for my storage solution

The backup procedures are fully automated on an at least daily basis.

**Is there currently sufficient storage & backup capacity during the project?**

**If no or insufficient storage or backup capacities are available, explain how this will be taken care of.**

- Yes

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

The data are accessible for the two principle investigators of the project (Minne Paul Lettinga and Patrick Wagner), as well as for the currently two Ph.D. students working for the project (Csongor T. Urbán and Soroush Bakhshi Sichani). To access the data, one has to log in to the server via password-protected office- and laboratory laptops.

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

The costs for data storage and labor of the ICT specialists are covered by the allowance (werkingstoelage) that the Department of Physics and Astronomy receives annually from KU Leuven. In case that the allowance would be insufficient, the Department charges a limited internal overhead.

#### **Data Preservation after the end of the Research Project**

**Which data will be retained for 10 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...).**

- All data will be preserved for 10 years according to KU Leuven RDM policy
- Certain data cannot be kept for 10 years (explain below)

All data will indeed be preserved for at least 10 year after the end of the project, except for the physical objects:

The three sensor systems will be designed to last at least until the end of the project, but we cannot guarantee that they will stay fully functional after the project because they are prototypes, fabricated in house. The normal depreciation period of such electronic instruments, when bought from commercial sources, is only 3 years according to LRD. Note also that some sensor chips will be covered with e.g. *E. coli* bacteria after the experiments, meaning that it is more wise to treat those as biologically hazardous materials.

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

- KU Leuven RDR

RDR is the easiest and best accessible option; we will preserve all digital data that are underlying the publications, conference presentations, as well as bachelor-, master-, and Ph.D. thesis that will evolve from the project.

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

The amount of data (see Research Data Summary) will be limited and we will most likely stay below the "50 GB per researcher per year" that RDR offers for free. In case that we would exceed this, we will pay the necessary fee from resources of the research group.

#### **Data Sharing and Reuse**

**Will the data (or part of the data) be made available for reuse after/during the project?**

**Please explain per dataset or data type which data will be made available.**

- Yes, as embargoed data (temporary restriction)
- Yes, as restricted data (upon approval, or institutional access only)

Publications that emerge from the project will be openly available (open access), except in cases for which LIRIAS is setting an embargo period.

All data on sensor development (construction drawings, synthesis protocols, measurement- and data-evaluation software) will be made freely available to members of the Department of Physics and Astronomy, as well as to members of other Departments at KU Leuven that may become involved in the project.

Third parties from outside KU Leuven may get access upon a written request, that must be approved by LRD.

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

Third parties such as companies, research institutes, and universities outside KU Leuven can get access when three conditions are fulfilled: i) a written request to LRD, ii) agreement by the PI's of the project (Patrick Wagner and Minne Paul Lettinga), and iii) approval by LRD.

**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 per dataset or data type where appropriate.**

- Yes, intellectual property rights

The base technology of characterizing cells via their detachment behavior in a temperature gradient (HTM technique) is covered by two patents that are owned by IMEC and Hasselt University. As of today (2024), the technique is considerably more advanced than what is protected by the patents, but still we need to be careful not to give third parties "instruments" at hand that may violate the patent rights of UHasselt and IMEC. For pure research purposes, we are certainly willing to share data after publishing them, or after filing patent applications.

Note: IMEC and Hasselt University are not exploiting the two patents, but they keep them in their portfolio.

#### **Where will the data be made available?**

**If already known, please provide a repository per dataset or data type.**

- KU Leuven RDR (Research Data Repository)

KU Leuven RDR is the preferred option (we are not dealing with "big data").

#### **When will the data be made available?**

- Upon publication of research results

In case that we will make novel discoveries withing the project that appear as "patent worthy", we will contact LRD to assess whether filing a patent is promising and worthwhile. In such cases, results will not be published before a patent application has been filed, for instance to the United Kingdom Patent Office (free of charge, but guarantees having a priority date).

#### **Which data usage licenses are you going to provide?**

**If none, please explain why.**

- CC-BY 4.0 (data)
- Data Transfer Agreement (restricted data)

Regarding publications, we will strive for journal under the CC-BY 4.0 scheme. However, still many journals to not have an open-access option, and those that are publishing in the open-access format can have rather high article processing fees. For publications that do not fall under a CC-BY 4.0 license, LIRIAS will set an embargo.

A Data Transfer Agreement will be drawn up and signed whenever data are made available to companies, research institutes, and universities outside KU Leuven. The details will be arranged by and with LRD.

**Do you intend to add a persistent identifier (PID) to your dataset(s), e.g. a DOI or accession number? If already available, please provide it here.**

- Yes, a PID will be added upon deposit in a data repository

All journal publications come automatically with a Digital Object Identifier. Certain journal do not offer a DOI, but we never publish in those journals.

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

We do not expect costs since all data can be shared via e-mail of WeTransfer; in our type of research, a file with 100 MB is already a very large one.

#### **Responsibilities**

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

Patrick Wagner

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

Dhr. Bert Keyaerts, he is a senior member of the ICT staff of the Department of Physics and Astronomy.

**Who will manage data preservation and sharing?**

Patrick Wagner in cooperation with Minne Paul Lettinga.

**Who will update and implement this DMP?**

Patrick Wagner in his role of project promoter, he will consult the co-promoter Minne Paul Lettinga whenever this is necessary.