**2.2 Research project description template**

***EURIZON FELLOWSHIP PROGRAMME***

***“Remote Research Grants”***

**Valid applications need to be submitted through the website:** [**https://indico.desy.de/event/38700/**](https://indico.desy.de/event/38700/) **by the Principal Investigator of the Ukrainian team before May 8th 2023 at 12:00 Pm (noon) CEST time. Before applying please read carefully the Terms of Reference (ToR).**

|  |
| --- |
| **Title[[1]](#footnote-2)of the research project:** *(max 30 words)*  **Machine learning-based defect engineering in silicon structures for thermal management and solar cells applications**  **Machine learning-based thermal management and defect evaluation in silicon structure for photovoltaics and ???? application** |

submitted by

***PRINCIPAL INVESTIGATOR (PI)[[2]](#footnote-3):***

|  |  |
| --- | --- |
| *First name and Family name (English)* |  |

***Please note that the limit in the number of words per each section of this application form constitutes one of the eligibility criteria****, so make sure that all requirements are respected. The template provided must not be modified and the formatting must be kept. All possible tables and pictures must be clearly readable.*

*All fields marked with\* are mandatory. Other fields are optional.*

*This template is part of the application package. It must be filled according to the instructions, signed by all team members, and upload it as pdf file*

***Table of Contents:***

*2.2 Research project description......………………………….…………………………………………………………..2*

*2.3 Collaboration with the European partners, impact, dissemination......................................2 2.4 Research team description and financial plan....………………………………………………………….…..3*

*2.5 Signatures.............................................................................................................................6*

**Please note that the limit in the number of words per each section of this application form constitutes one of the eligibility criteria.**

**2.2 Research project´s full description\*** *(Max 1200 words)*

Please describe the objectives of the research, and whenever possible the methodology to be used, the instrumentation needed (if any), the implementation and timeline.

|  |
| --- |
| The other project’s part deals with impurity evaluation in silicon solar cells (SSCs). One of the most crucial technologies for achieving a society free of carbon emissions is photovoltaics (PV). It is an effective and renewable energy source, but various defects limit solar cells' performance and reliability. Numerous methods have been developed to address this issue, but most of them involve either pre-treatment of the samples or specialized equipment. On the other hand, the measurement of current-voltage characteristics (IVCs) is a widely accepted and straightforward method for determining the parameters of photovoltaic conversion in solar cells. The methods for characterizing defects from IVC measurements and Bayesian parameter estimation [1], or differential coefficients [2], were demonstrated. However, these approaches were too complex for practical use. Therefore, an express IVC-based method of impurity determination is very desirable and extremely promising for wide use. This project's purpose is the development of a machine learning (ML) based approach the defect parameters from IVC.  Lately, the ML's possibility of silicon defect characterization was shown by using lifetime curves [3] or ideality factor [4]. We are planning to use standard photovoltaic parameters (short-circuit current, open-circuit voltage, efficiency, and fill factor) as factors sensitive to the influence of recombination centers. This approach makes it possible to reduce the requirements for IVC measurement. The photovoltaic parameters will be used as input data for ML algorithms, and the defect concentration will be determined as a regression result.  The research will focus on the application of the mentioned approach for the evaluation of iron contamination. Iron is a typical impurity in silicon solar cells, and its properties are well studied. In particular, the iron atom is known to form a complex with the acceptor, and this pair can be easily dissociated, for example, due to illumination. Changes in photovoltaic parameters after pair breakdown will be considered to extract the iron influence. The modeling of the current-voltage characteristics of solar cells with multiple combinations of parameters will be used to generate the dataset. The parameters that vary are base doping degree and thickness, iron concentration, and temperature of IVC measuring. The estimated required IVC number for high-quality ML training is about 30,000.  neural networks  random forest  [*1] R. Kurchin, J. Poindexter, V. Vahanissi et al., How much physics is in a current-voltage curve? Inferring defect properties from photovoltaic device measurements, IEEE J. Photovolt 10, 1532-1537 (2020). (*[*https://doi.org/10.1109/JPHOTOV.2020.3010105*](https://doi.org/10.1109/JPHOTOV.2020.3010105)*)*  *[2] S. Bulyarskiy, A. Lakalin, M. Saurov, and G. Gusarov, The effect of vacancy-impurity complexes in silicon on the current–voltage characteristics of p–n junctions, J Appl. Phys. 128), 155702 (2020). (*[*https://doi.org/10.1063/5.0023411*](https://doi.org/10.1063/5.0023411)*)*  *~~[3] Y. Buratti, Q. Gia, J. Dick, Y. Zhu, and Ziv Hameiri, Extracting bulk defect parameters in silicon wafers using machine learning models, npj Computational Materials 6, 142 (2020). (~~*[*~~https://doi.org/10.1038/s41524-020-00410-7~~*](https://doi.org/10.1038/s41524-020-00410-7)*~~)~~*  *[3] Y. Buratti, J. Dick, Q. Gia, and Z. Hameiri, Deep Learning Extraction of the Temperature-Dependent Parameters of Bulk Defect, ACS Appl. Mater. Interfaces 14, 48647-48657 (2022). (*[*https://doi.org/10.1021/acsami.2c12162*](https://doi.org/10.1021/acsami.2c12162)*)*  *[4] O. Olikh, O. Lozitsky, and O. Zavhorodnii, Estimation for iron contamination in Si solar cell by ideality factor: Deep neural network approach, Prog. Photovolt. Res. Appl. 30, 648-660 (2022).*  *(*[*https://doi.org/10.1002/pip.3539*](https://doi.org/10.1002/pip.3539)*)*  *[1] A. Author, B. Author, and C. Author, Title, Phys. Rev. B 50, pages (year). (DOI as hyperlink, if applicable)* |

**2.3 COLLABORATION WITH THE EUROPEAN PARTNERS, IMPACT, DISSEMINATION**

**2.3.1 Description of the collaboration with the European partner(s)[[3]](#footnote-4)\*.** *(Max 500 words)*

Please describe the expected role of the European partner and the scope of the collaboration.

*The repartition of work can also be very different, with the Ukrainian team performing most of the tasks, but it is important to explain the role of the European Partners (e.g. joint analysis, support, monitoring, dissemination, etc.).*

|  |
| --- |
| *Please indicate what kind of collaboration is foreseen and if there are specific contributions and/or external funding available for the actions requested (e.g. European partner willing to perform an experiment at their facilities and/or to host and contribute to travel and accommodation expenses of Ukrainian team members).* |

**2.3.2 Expected outcomes of the research project\*.** *(Max 300 words)*

Please highlight the possible positive impact of your research project. Please also highlight if the project could (i) support the operations and/or reconstruction and/or long-term sustainability of Ukrainian RIs and/or (ii) boost possible future collaboration and partnership opportunities with European Research Institutes.

|  |
| --- |
|  |

**2.3.3 Dissemination of the results\*.** *(Max 200 words)*

Please describe how you plan or would like to disseminate the results of the research project.

|  |
| --- |
|  |

**2.3.4 Possible references related to the research proposal (optional) .** *(Max 300 words)*

Citations used in the proposal text have to be listed here. References should be consecutively numbered using the format:

*[1] A. Author, B. Author, and C. Author, Title, Phys. Rev. B 50, pages (year). (DOI as hyperlink, if applicable)*

|  |
| --- |
|  |

**2.4 RESEARCH TEAM DESCRIPTION and FINANCIAL PLAN**

**2.4.1 Description of the roles within the research team\*.** *(Max 500 words)*

Please describe what are the roles, availabilities and tasks of each of the research team members within the research project. *Please note that the qualification, expertise, effort and roles of the members within the research project must be in line with the financial plan of the team. Each team member should have a meaningful role in the project.*

|  |
| --- |
|  |

**2.4.2 Financial plan\*.** *(Max 500 words)*

Please describe how the team suggests to distribute the monthly grants within the team members. *Please kindly note that the monthly grant amount per each team member should reflect on his/her qualifications, years of experience, planned effort and role within the suggested research project[[4]](#footnote-5) [[5]](#footnote-6) [[6]](#footnote-7)*

|  |  |  |
| --- | --- | --- |
| **Please indicate for your research team what are the wished estimated monthly grants per each member** *(within the maximum and minimum amounts described in the ToR ):* | | |
| ***Role*** | ***Name and Surname (English)*** | ***Euro per Month*** |
| **PI:** |  | *Min 700 Max 1,600* |
| **Team Member 2:** |  |  |
| **Team Member 3:** |  |  |
| **Team Member 4:** |  |  |
| **Team Member 5:** |  |  |
|  |  |  |

*If your team is composed by more than 5 Members please add new table lines.*

**2.4.3 Research team members information**

The information of the Principal Investigator (considered as Team Member 1) is already included in the online application form, no need to repeat them here.

**Team Member 2 – information**

|  |  |
| --- | --- |
| **First name ENG[[7]](#footnote-8)\*** |  |
| **Family name ENG\*** |  |
| **Date of Birth\*** | *Dd/mm/yyy* |
| **Gender\*** | *M / F / Non-binary* |
| **Phone number(s)** |  |
| **E-mail address(es)\*** |  |
| **Institute of affiliation[[8]](#footnote-9)\*** |  |
| **Affiliation Institute address** | *Street name and street number, city, postal address, country* |
| **Current position[[9]](#footnote-10)\*** |  |
| **Country of permanent residence\*** |  |
| **Country of current residence\*** | *Only if different from permanent residence. In case you live in a different country now, please specify since when.* |
| **Citizenship** |  |
| **Knowledge of English \*** | *Please select between:*  *Excellent – Very good – Good – Fair - Basic* |
| **Highest level of instruction achieved\*** | *e.g. PhD, Master, Bachelor in …(please specify the field)* |

**Team Member 3 – information**

|  |  |
| --- | --- |
| **First name ENG[[10]](#footnote-11)\*** | Vasyl |
| **Family name ENG\*** | Kuryliuk |
| **Date of Birth\*** | *23/07/1982* |
| **Gender\*** | *M* |
| **Phone number(s)** |  |
| **E-mail address(es)\*** | *kuryliuk@knu.ua* |
| **Institute of affiliation[[11]](#footnote-12)\*** | *Taras Shevchenko National University of Kyiv* |
| **Affiliation Institute address** | *Street name and street number, city, postal address, country*  *Volodymyrska Street 64/13, Kyiv, 01601, Ukraine* |
| **Current position[[12]](#footnote-13)\*** | *Head of Department of Metal Physics* |
| **Country of permanent residence\*** | *Ukraine* |
| **Country of current residence\*** |  |
| **Citizenship** | *Ukraine* |
| **Knowledge of English \*** | *Good* |
| **Highest level of instruction achieved\*** | *PhD in Solid State Physics* |

**Team Member 4 – information**

|  |  |
| --- | --- |
| **First name ENG[[13]](#footnote-14)\*** |  |
| **Family name ENG\*** |  |
| **Date of birth\*** | *Dd/mm/yyyy* |
| **Gender\*** | *M / F / Non-binary* |
| **Phone number(s)** |  |
| **E-mail address(es)\*** |  |
| **Institute of affiliation[[14]](#footnote-15)\*** |  |
| **Affiliation Institute address** | *Street name and street number, city, postal address, country* |
| **Current position[[15]](#footnote-16)\*** |  |
| **Country of permanent residence\*** |  |
| **Country of current residence\*** | *Only if different from permanent residence. In case you live in a different country now, please specify since when.* |
| **Citizenship** |  |
| **Knowledge of English \*** | *Please select between:*  *Excellent – Very good – Good – Fair - Basic* |
| **Highest level of instruction achieved\*** | *e.g. PhD, Master, Bachelor in …(please specify the field)* |

**Team Member 5 – information**

|  |  |
| --- | --- |
| **First name ENG[[16]](#footnote-17)\*** |  |
| **Family name ENG\*** |  |
| **Date of birth\*** | *Dd/mm/yyyy* |
| **Gender\*** | *M / F / Non-binary* |
| **Phone number(s)** |  |
| **E-mail address(es)\*** |  |
| **Institute of affiliation[[17]](#footnote-18)\*** |  |
| **Affiliation Institute address** | *Street name and street number, city, postal address, country* |
| **Current position[[18]](#footnote-19)\*** |  |
| **Country of permanent residence\*** |  |
| **Country of current residence\*** | *Only if different from permanent residence. In case you live in a different country now, please specify since when.* |
| **Citizenship** |  |
| **Knowledge of English \*** | *Please select between:*  *Excellent – Very good – Good – Fair - Basic* |
| **Highest level of instruction achieved\*** | *e.g. PhD, Master, Bachelor in …(please specify the field)* |

**Team Member 6 – information**

|  |  |
| --- | --- |
| **First name ENG[[19]](#footnote-20)\*** |  |
| **Family name ENG\*** |  |
| **Date of birth\*** | *Dd/mm/yyyy* |
| **Gender\*** | *M / F / Non-binary* |
| **Phone number(s)** |  |
| **E-mail address(es)\*** |  |
| **Institute of affiliation[[20]](#footnote-21)\*** |  |
| **Affiliation Institute address** | *Street name and street number, city, postal address, country* |
| **Current position[[21]](#footnote-22)\*** |  |
| **Country of permanent residence\*** |  |
| **Country of current residence\*** | *Only if different from permanent residence. In case you live in a different country now, please specify since when.* |
| **Citizenship** |  |
| **Knowledge of English \*** | *Please select between:*  *Excellent – Very good – Good – Fair - Basic* |
| **Highest level of instruction achieved\*** | *e.g. PhD, Master, Bachelor in …(please specify the field)* |

***If you wish to add more team Members, please copy this table, paste it below and add the details of the additional team member(s).***

**2.5 SIGNATURES**

***After completing all the chapters of this form, it shall be signed by the PI and by all research team members, then the PI should upload it together with all other relevant documents (indicated in the Terms of Reference of the call) in the online application form.***

***Please remember that the limit in the number of words per each section of the application form constitutes one of the eligibility criteria, so make sure that all requirements are respected.***

***Disclaimer on Intellectual Property Rights and Copyright****: A proposal for the EURIZON Fellowship programme must respect the fundamental ethical principles for scientific research. EURIZON Secretariat condemns the replication of ideas, data, results without due permission and acknowledgement. Please make sure that the ideas developed in this research proposal are yours (and/or of the people mentioned in the paragraph 2 “Research team”) and that you own or have received the necessary authorizations from the intellectual property rights holders to validly use data and materials that you include in the Application form.*

***Privacy Notice***

*Please, be informed: when applying for the EURIZON Remote Research Grant Fellowship, you agree that the personal data and documents that you provide to the EURIZON Secretariat and Review Panel will be stored and processed for the purpose of participating in the EURIZON Remote Research Grant application procedure. The personal data and documents from all applicants will be stored and processed according to DESY data privacy policy :* [*https://www.desy.de/data\_privacy\_policy/index\_eng.html*](https://www.desy.de/data_privacy_policy/index_eng.html)

***Signature of the PI: Date:*** *dd/mm/yyyy*

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Signatures of all other team members:***

***Name, Family name(English) Signature***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Name, Family name(English) Signature***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Name, Family name(English) Signature***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Name, Family name(English) Signature***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Name, Family name(English)***  ***Signature***

***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

***Please note that this document must be signed by all team members, so if your team is composed by more than 5 members, please add their signatures here below.***

1. Please verify that this information corresponds to the one reported in section 1 of the online application form. [↑](#footnote-ref-2)
2. Please verify this information corresponds to the one reported in the section 4 of the online application form. [↑](#footnote-ref-3)
3. The name and contact details of the European partners are to be mentioned in the Application form (Section 3). [↑](#footnote-ref-4)
4. Each team member will receive a constant amount of monthly grant during the whole duration of the fellowship. [↑](#footnote-ref-5)
5. Candidates that are not in a vulnerable condition or that are already beneficiaries of other support grants/ fellowships (above 1,000 Euro) can participate in the programme but are not entitled to receive the monthly grant. [↑](#footnote-ref-6)
6. Teams should be composed by 2-5 Members (including the PI). Teams can include more than 5 Members, but the maximum monthly grant available for the research project will not exceed 6,500 Euro. [↑](#footnote-ref-7)
7. As mentioned in the ID document, please use English alphabet; [↑](#footnote-ref-8)
8. Please mention if you are still affiliated to that institute or until when you were affiliated; [↑](#footnote-ref-9)
9. Please mention if you are still in the same position or until when you held it; [↑](#footnote-ref-10)
10. As mentioned in the ID document, please use English alphabet; [↑](#footnote-ref-11)
11. Please mention if you are still affiliated to that institute or until when you were affiliated; [↑](#footnote-ref-12)
12. Please mention if you are still in the same position or until when you held it; [↑](#footnote-ref-13)
13. As mentioned in the ID document, please use English alphabet; [↑](#footnote-ref-14)
14. Please mention if you are still affiliated to that institute or until when you were affiliated; [↑](#footnote-ref-15)
15. Please mention if you are still in the same position or until when you held it; [↑](#footnote-ref-16)
16. As mentioned in the ID document, please use English alphabet; [↑](#footnote-ref-17)
17. Please mention if you are still affiliated to that institute or until when you were affiliated; [↑](#footnote-ref-18)
18. Please mention if you are still in the same position or until when you held it; [↑](#footnote-ref-19)
19. As mentioned in the ID document, please use English alphabet; [↑](#footnote-ref-20)
20. Please mention if you are still affiliated to that institute or until when you were affiliated; [↑](#footnote-ref-21)
21. Please mention if you are still in the same position or until when you held it; [↑](#footnote-ref-22)