TITLE

Solar Energy harvesting to power an RF communicating system

LAB & PEOPLE

- **Name of the hosting lab:** Lab-STICC Laboratory (« Laboratoire des sciences et techniques de l'information, de la communication et de la connaissance ») UBO UMR 6285, MATRF department, DH team.
- **General activities of the lab:** Microwave Devices for telecommunications systems, sensor systems and radar imaging
- **Website:** https://labsticc.fr/fr or https://labsticc.fr/en/teams/dh
- **Number of staff / PhD:** 264 permanent members (Researchers, Professors, Assistant Professors (124 allowed to steer research), 230 PhD and Post-PhD. Focused on DH team : 26 permanent members, 18 PhD and Post-PhD.
- **Supervisor name and contact:** Rozenn Allanic (Rozenn.Allanic@univ-brest.fr) , Denis Le Berre (denis.le-berre@univ-brest.fr) and Cédric Quendo (cedric.quendo@univ-brest.fr)

TOPIC OF THE INTERSHIP

Scientific context of the internship (max 20 lines)

Small low energy devices are more and more present in our everyday lives. Smart objects have become indispensable to our society, in the field of health to home automation allowing the control of domestic energy, passing through the realms of the automobile connected windscreens and tires. But also the environment with smart garden hubs or agricultural sensors to follow the requirements of crops and reduce unnecessary treatments. Batteries used to power these devices have a limited life span, sometimes difficult to replace, and use expensive and rare metals. The impact of our consumer society on the environment is an important issue and we urgently need to work towards creating green, renewable and low energy technology limiting the greenhouse gas emissions. Engineers have steadily worked to reduce the energy requirements of devices, opening the way for innovative power sources using ambient electromagnetic waves. Rectennas have been used since the 70's for wireless power transmission and research in this domain could create the leap forward in technology required to solve the energy crisis. In the short-term battery-less devices and in the long-term maybe energy transfer modules for wireless communicating systems and perhaps for energy transfer to satellites.

This subject proposes to use the co-design method of reconfigurable microwave components on a semiconductor substrate [1]- [5] to think on a global design of solar energy harvesting to power communicating microwave systems. Overcoming the problems of additional components and impedance mismatches, a global design will permit to decrease footprint and increase the efficiency.

Keywords

Microwave components, RF Antenna, semiconductor junctions, semiconductor physics, silicon technology.

Bibliography

[1] R. Allanic *et al.*, "A Novel Approach to Co-Design microwave Devices with Distributed Switches," in *Proc. Asia–Pacific Microw. Conf.*, 2016.

[2] R. Allanic *et al.*, "Temperature Dependence of Tunable Resonators on FR4 and

Silicon," in *Proc. Asia–Pacific Microwave Conf.*, 2017, pp. 8–11.
[3] R. Allanic *et al.*, "Three-State Microwave Tunable Resonator Integrating Several Active Elements on Silicon Technology in a Global Design," *IEEE Microw. Wirel. Components Lett.*, vol. 28, no. 2, pp. 141–143, 2018.
[4] R. Allanic *et al.*, "Impact of the doped areas sizes in the performances of microwave SPST switches integrated in a silicon substrate," in *2018 IEEE 22nd Workshop on Signal and Power Integrity (SPI)*, 2018, pp. 1–4.
[5] R. Allanic *et al.*, "Continuously Tunable Resonator Using a Novel Triangular Doped Area on a Silicon Substrate", *IEEE Microw. Wirel. Components Lett., pp. 1–3, 2018.*

Tasks and duties entrusted to the student:

The student will rely on the knowledge developed at Lab-STICC in terms of co-design method based on a co-simulation between two commercial software allowing to describe both the transport of charges in semiconductor junctions (Silvaco) and the effects of propagation of electromagnetic waves (HFSS). Linked to a thesis (2022-2025) carried out at UBO on "Design of microwave energy harvesting system on semiconductor substrate". The student will focus solar energy harvesting to power communicating microwave systems.

A state-of-the art on solar energy harvesting and rectennas will be carried out to have an overview of the solar solution and the way to convert electromagnetic waves to electrical currents. Then, once the semiconductor properties have been mastered, the junctions will be studied and simulated in order to propose a solution to power an RF antenna.

Skills to be acquired or developed:

Photonics, Semiconductor physics, Simulation and Modelization of electrical junctions and microwave devices, Measurement (oscilloscope, network analyzer).

PROFILE OF THE DESIRED STUDENT

- **Minimum level of study required:** in 1st or 2nd year of Master
- **Field(s) of study:** Solar Energy, RF communicating systems
- **Scientific skills:** Solar Energy, Microwave components, RF antennas,
- **Language skills required:** english

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): 5
Desired Starting date of the mission: between September 1st and February15th
Indicative weekly schedule: *35h / week*
Remuneration: 600€/month, paid on national SEA-EU funds for a maximum of 5 months. Additional Erasmus grant could be asked to your own university.

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:
If you're interested please send your CV and letter of motivation to the scientist in charge, email Rozenn.allanic@univ-brest.fr before January 31st 2024.