

# On-line SPICE-SPIN+X Seminars



**Wednesday, 2nd June 2021, 15:00 (German Time)**

The seminar will be via Zoom ([Meeting ID: 844 8544 4979](#)) and live streamed in the SPICE YouTube Channel.



**Giovanni Finocchio,**

*University of Messina*

## **Spintronic microwave and THz detectors: state-of-the art and future!**

Microwave detectors based on the spin-torque diode effect are among the key emerging spintronic devices. By utilizing the spin of electrons in addition to their charge, they have the potential to overcome the theoretical performance limits of their semiconductor (Schottky) counterparts. Those devices realized with magnetic tunnel junctions exhibit high-detection sensitivity  $>200\text{kV/W}$  at room temperature, without any external bias fields, and for low-input power (micro-Watts or lower). In the first part of the talk, I will discuss our recent results in the field of microwave detectors based on spin diodes and possible implementations of THz detectors based on antiferromagnets.

Another application of spintronic diodes, when they have a broadband frequency response, is as electromagnetic energy harvesting, which offers an attractive energy source for applications in self-powered portable electronics in the “internet of things” era. Here I will show the development of a bias-field-free spin-torque diodes based on a magnetic tunnel junction having a canted magnetization in the free layer, and demonstrate that those devices could be an efficient harvester of broadband ambient RF radiation, capable to efficiently harvest microwave powers of microWatt and below and to power a black phosphorous nanodevice. The frequency response of spin-torque diodes and their current tunability can be also used as building blocks of the hardware realization of neurons and synapses in neuromorphic applications. Finally, I will show how to implement hardware multiplication with spintronic diodes by using the concept of degree of rectification.