Monitoring PV modules and CIGS prototype performances in outdoor conditions in the Paris area

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INTRODUCING SIRTA'S PV MODULE TEST BENCH

SIRTA atmospheric observatory [1] (http:/sirta.ipsl.fr), in the campus of Ecole Polytechnique, performs numerous radiative-related measurements (such as solar global, direct, diffuse irradiance components, solar spectrum, ground albedo, aerosol optical depth, etc.) and contributes in the international Baseline Surface Radiation Network (BSRN, https://bsrn.awi.de) since 2003 (Station: PAL).

In 2014, a photovoltaic (PV) test bench was installed [2] (see photo on the right) as a joint collaboration between GeePs, LMD, LPICM and Limsi, which allows the continuous monitoring of the current-voltage characteristics and module temperatures of a range of commercial PV modules of different technologies.

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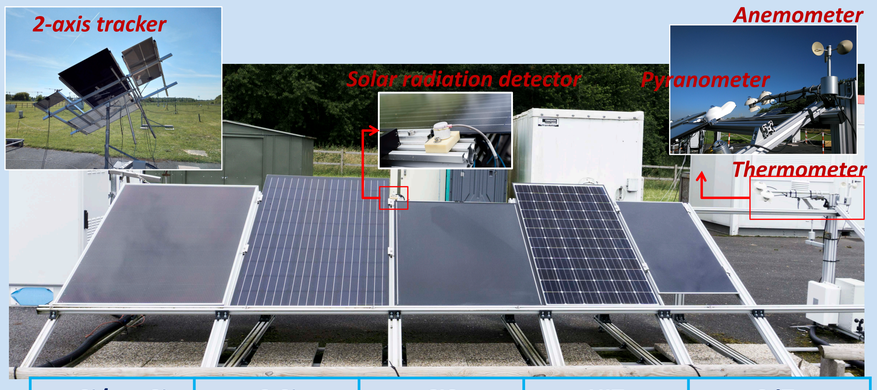
These installations are used both for research and training purposes. Commercial modules of aSi, cSi, CdTe and CIGS are monitored since several years.

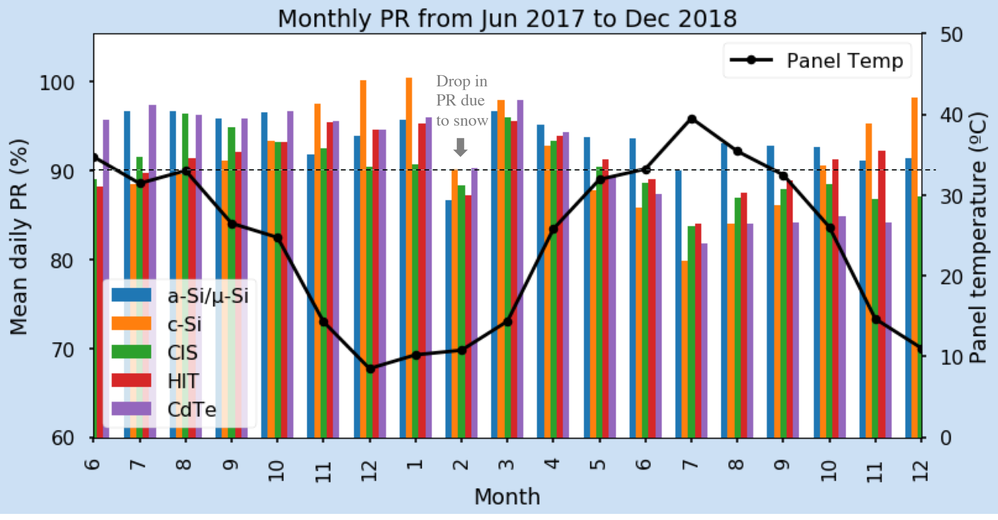
View of the photovoltaic test bench at SIRTA. The purpose of such a PV platform is to help understanding and assessing the yearly performance of various technologies of solar PV module in the local climate; to set relationships between weather-related conditions and PV conversion efficiency; to be able to precisely sort out ageing-related effects from climate-related effects; and also to test local forecasts of PV power generation.v



a-Si/mc-Si	C-Si	CIS	HIT	CdTe
P_M^{STC} = 128 W	P_M^{STC} = 250 W	P_M^{STC} = 150 W	P_M^{STC} = 240 W	P_M^{STC} = 82.5 W
η^*= 9.5%	η = 15%	η = 12.2%	η = 19%	η = 11.4%

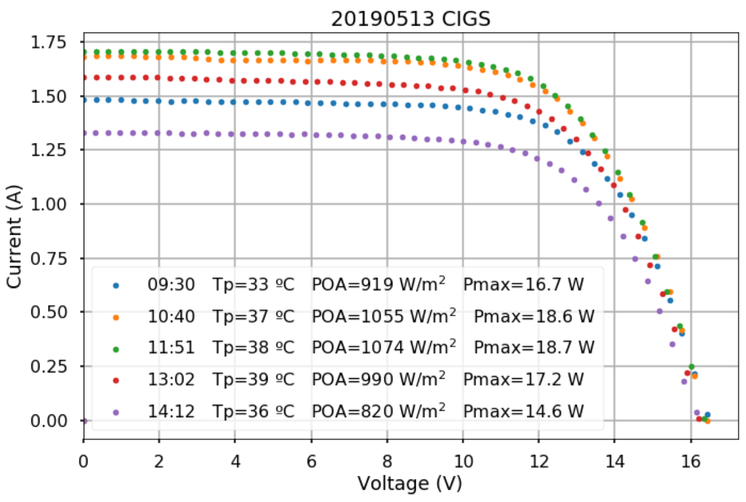
η^*: Efficiency

Monthly module Performance Ratio (PR) for 18 months of measurements at SIRTA with the 5 modules presented above (which were built in 2013). The monthly panel temperature correspond to the c-Si module.

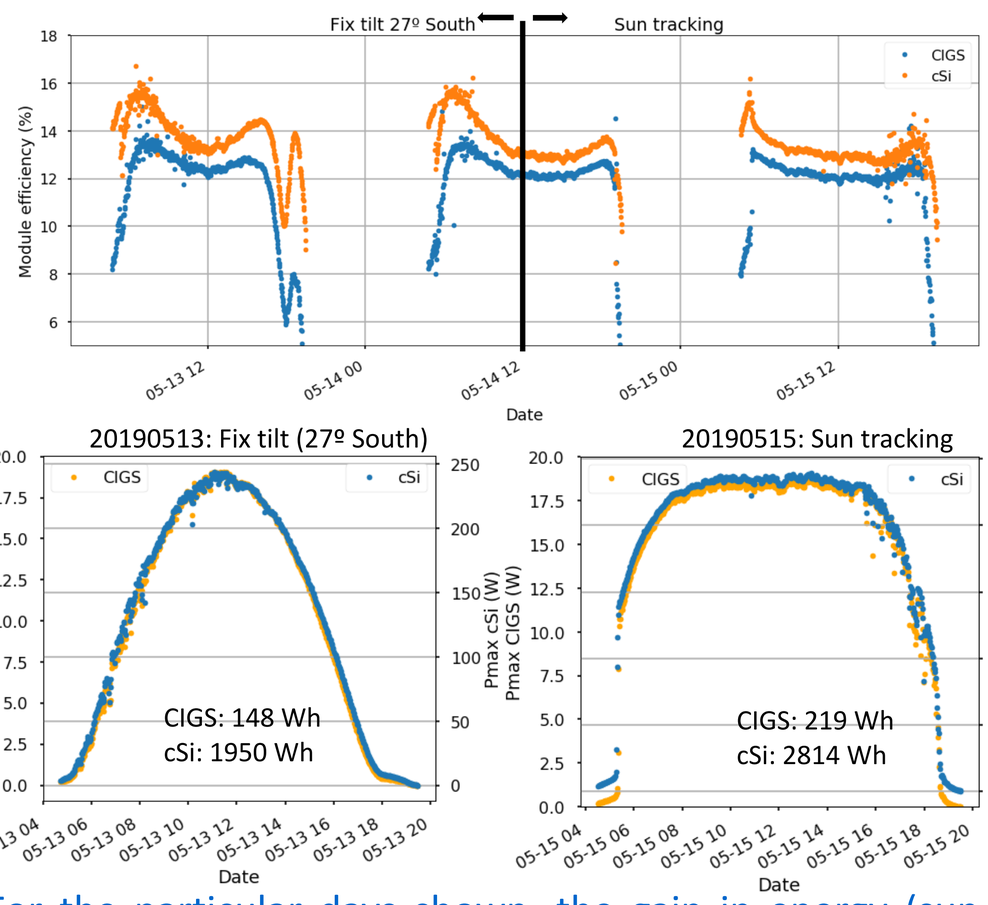


MONITORING A CIGS PROTOTYPE PANEL

A CIGS prototype module from Nexcis that was built in 2014, based on an innovative electrodeposition technology [3], has been installed for continuous outdoor monitoring since March 2019. The measurements are done in fixed tilt and sun tracking modes. Preliminary results are shown in the figures and they are compared with a SolarWorld cSi 250 Wp panel (built also in 2014).



The measured efficiency (considering only the active surface) for the Nexcis panel was 12.4% at 11:51 and the Fill Factor was 67.2%



For the particular days shown, the gain in energy (sun tracking over fix tilt) is +48% for the CIGS panel and +44% for the cSi panel

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REFERENCES

[1] Haeffelin, M., Barthès, L., Bock, O., Boitel, C., Bony, S., Bouniol, D., ... & Drobinski, P. (2005, February). SIRTA, a ground-based atmospheric observatory for cloud and aerosol research. In Annales Geophysicae (Vol. 23, No. 2, pp. 253-275).
[2] Migan, A., Mambrini, T., Badosa, J., Haeffelin, M., Nassar, J., Pavlov, M., & Bourdin, V. Multi-technology photovoltaic module test bench on the SIRTA meteorological and climate observatory.
[3] Statistical Process Control for Cu(In,Ga)(S,Se)2 electrodeposition-based manufacturing process of 60x120cm² modules up to 14,0% efficiency C. Broussillou, C. Viscogliosi, A. Rogee, S. Angle, P.P. Grand, S. Bodnar, C. Debauche, J.L. Allary, B. Bertrand, C. Guillou, L. Parissi, S. Coletti, IEEE Journal of Photovoltaics (2015).