CABLESOLAR, a tethered airborne platform dedicated to solar cell characterization

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The main drawback of the electricity production from solar energy lies on its variability. Obviously, its efficiency is strongly reliable to weather forecast, limiting the charge factor (only 15% in France). The solar resource could be even worst in higher latitude regions such as the northern England. To face this issue, airborne solar cells integrated on a tethered balloons can be relevant, mostly because of the extensive and continuous solar radiation available above the clouds. Solar resource at an optimal altitude of six kilometers could be higher to more than three times the one measure at ground zero.

Several concepts of airborne solar farms have been already proposed by the scientific community, where helium balloons are covered by solar cells [1,2]. In this particular case, the electricity produced is gathered to the ground using a tether. Other Studies are dedicated to solar radiation associated with meteorological conditions at such altitude (temperature, wind and cloud coverage) have also demonstrated the feasibility and economic interest of this type of electricity production [3]. However, this domain suffer from a lack of experience where just a few test in real conditions are referenced [4].

Our two-year-project, CABLESOLAR, was funded by the "Chaire Energie Durable" and also supported by E4C (interdisciplinary center "Energy for Climate") of "Ecole Polytechnique" for our final equipment. Started in January 2023, our goal was to develop an aerial test platform dedicated to solar cells characterization. This demonstrator is the first step towards one day seeing photovoltaic balloons in the sky.

This project was at first reinforced by a deep collaboration with the start-up Tankers®, who design and build their first autonomous and high duration balloon who was flying in June 2023. In light of this achievement, we acquired our first aerostat and planned our first flying campaign at SIRTA-IPSL between June and July 2024. Our balloon was equipped with an on-scale, lightweight and flexible module, made from CIGS thin film solar cells, encapsulated and supplied by SolarCloth®. The aerostat was also equipped with photocells and other environmental sensors in order to measure the external conditions (solar array, temperature and humidity). The integration was done using a net, a tent and a cradle was also specially mounted for the event in order to work around our 7m-long and 2.5m-high balloon. Finally, nine flying tests were successfully conducted during this period with some of them were recording data analyses using our own embedded electronic box. We can now present our first data and compare them with the electrical performances collected on ground.

Photography of the airborne platform flying near the SIRTA atmospheric research laboratory inside the Polytechnic School campus. The balloon inflated with helium is equipped with one flexible PV module on top and embedded electronics (27.06.2024).

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