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## **EuPRAXIA@SPARC\_LAB: the high-brightness RF photoinjector layout proposal**

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After the last decades of R&D activity, the crucial role of high-brightness RF photoinjectors in the fields of radiation generation and advanced acceleration schemes has been largely established, making them effective candidates to drive plasma-based accelerators as pilots for user facilities. Indeed, these photoinjectors are fundamental for the successful development of external injection plasma wakefield accelerators, since the ultimate beam brightness and its stability and reproducibility are strongly influenced by the RF-generated electron beam. At EuPRAXIA@SPARC\_LAB, the unique combination of an advanced high-brightness RF linac and plasma-based accelerator technology will drive a facility for user applications. The main challenge for the photoinjector whereas external injection schemes are considered comes from the request of producing high quality electron beams. The beam dynamics in such high-brightness photoinjector has been explored by means of simulations, resulting in a working point able to provide high-brightness, ultra-short bunches with up to 3kA peak current at the advanced X-band linac booster. A proposal for the EuPRAXIA@SPARC\_LAB high-brightness photoinjector is here reported together with performance optimisation and sensitivity studies aiming to actual check the robustness and reliability of the optimised working point.

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