IFAST Innovation Project

A Field Emission Cathode for a Travelling-Wave RF gun for High Brightness Beams in Industrial and Small Research Facility Settings

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and
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Project Outline

- RF guns are a significant piece of technology that have facilitated the generation of high brightness electron beams for many decades.
- Such RF guns overwhelmingly produce their electron bunches using photocathodes which require high peak power lasers to operate. These lasers make a device infeasible for industrial settings as they require much supervision.
- Field emission cathodes are used to generate high brightness, low charge beams for electron microscopes but has yet become a feature of RF guns.
- **This project aims to develop field-emission cathodes for a travelling-wave RF gun that can produce a high brightness beam with low energy spread for industrial and small-research facility applications.**

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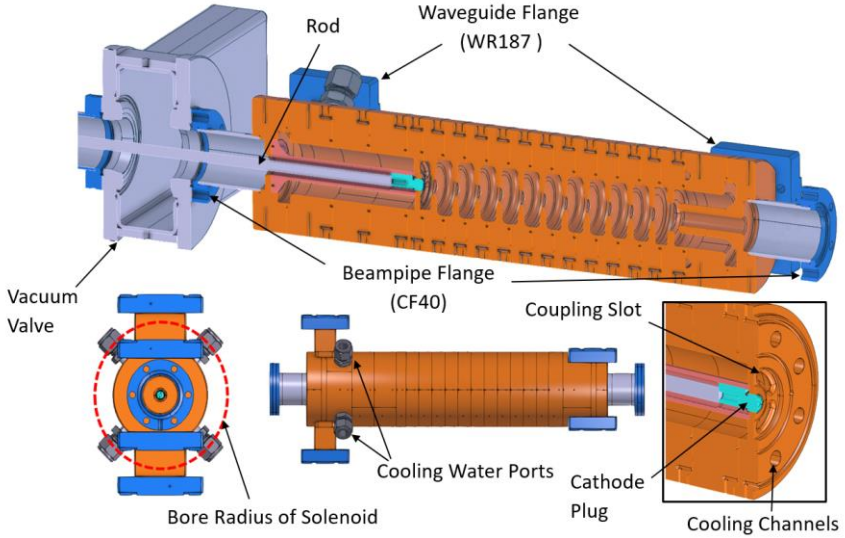
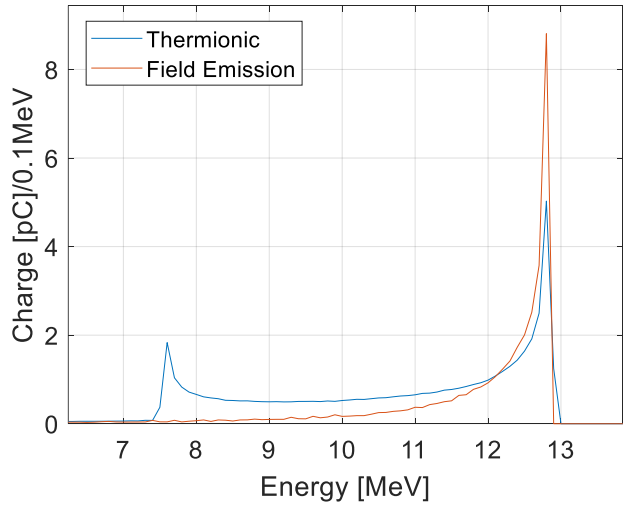
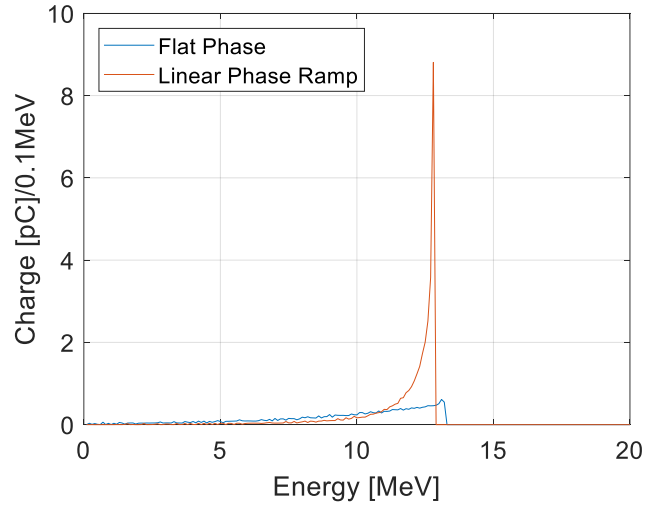
Technical Details

- The experiment will use the travelling-wave gun from IFAST to test the field emission cathode concept.
- New cathodes are designed to have a large local electric field in their centre. This project will produce these cathodes and exchange them for the current photocathode.
- The TW gun allows the phase manipulation which is unachievable in a SW gun. Such manipulation allows for a significant reduction in the energy spread.

Parameter	Value	Units
Energy	10-12.8	MeV
Energy Spread	2	%
Bunch Charge	1-30	pC
Bunch Repetition Rate	5.712	GHz
RF Pulse Repetition Rate	< 100	Hz
Emittance	200	nmrad



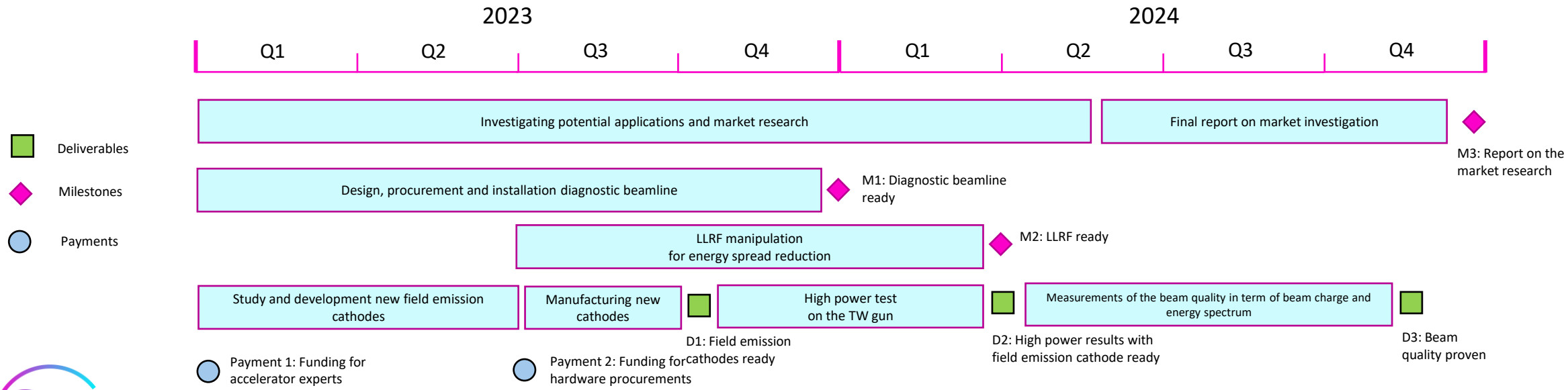




Ref: T.G. Lucas, et al. Towards a Brightness Upgrade to the SwissFEL: A High Gradient Traveling-Wave RF Photogun (Under Review).

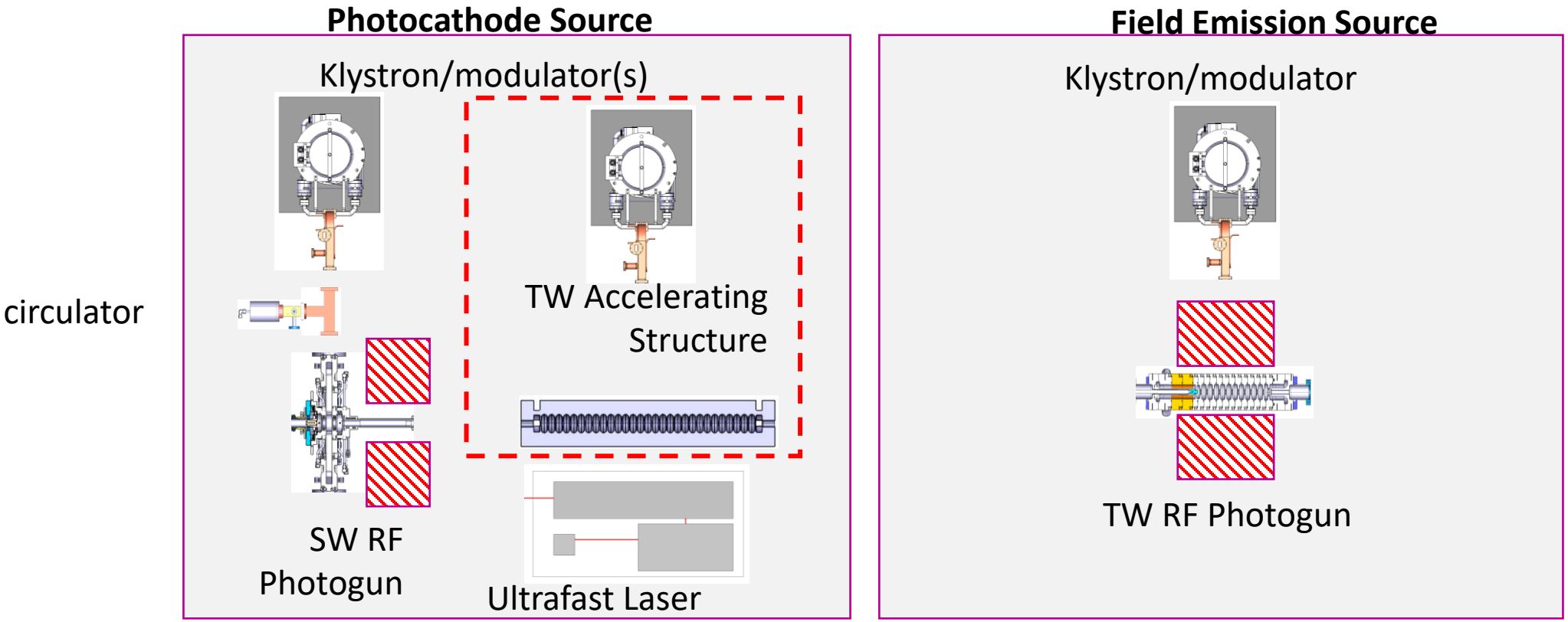
Timeline, Budget and deliverables

- The **funding of accelerator experts at PSI** to spend their time in studying, testing and investigating the properties of this field-emission gun and for the investigation, together with the industrial partner, into the industrialisation of the rf gun, 24 person-months **(150’000 Euro).**
- The **development and production of the field emission cathodes by VDL** for the TW gun **(10’000 Euro).**
- **Production of the diagnostic beamline at PSI’s test facility**, particularly a dipole magnet, screen and vacuum components for the spectrometer **(40’000 Euro).**



Potential impacts on Sustainability

Compactness: The field emission travelling wave gun aims to reduce the size, and significantly reduce the complexity, of high brightness electron sources.



Summary

- A set of field-emission cathodes will be produced and installed within a travelling-wave RF Photogun to illustrate a dependable low emittance source can be produced.
- The combination of the field emission source and travelling-wave technology will allow for the production of a high brightness beam in the 10 MeV regime.
- The system only requires the RF source to generate the electron bunches which means that it is much simpler and can be more compact when compared to a typical rf photogun.