Ultra Fast Electron Sources A New Conclusion

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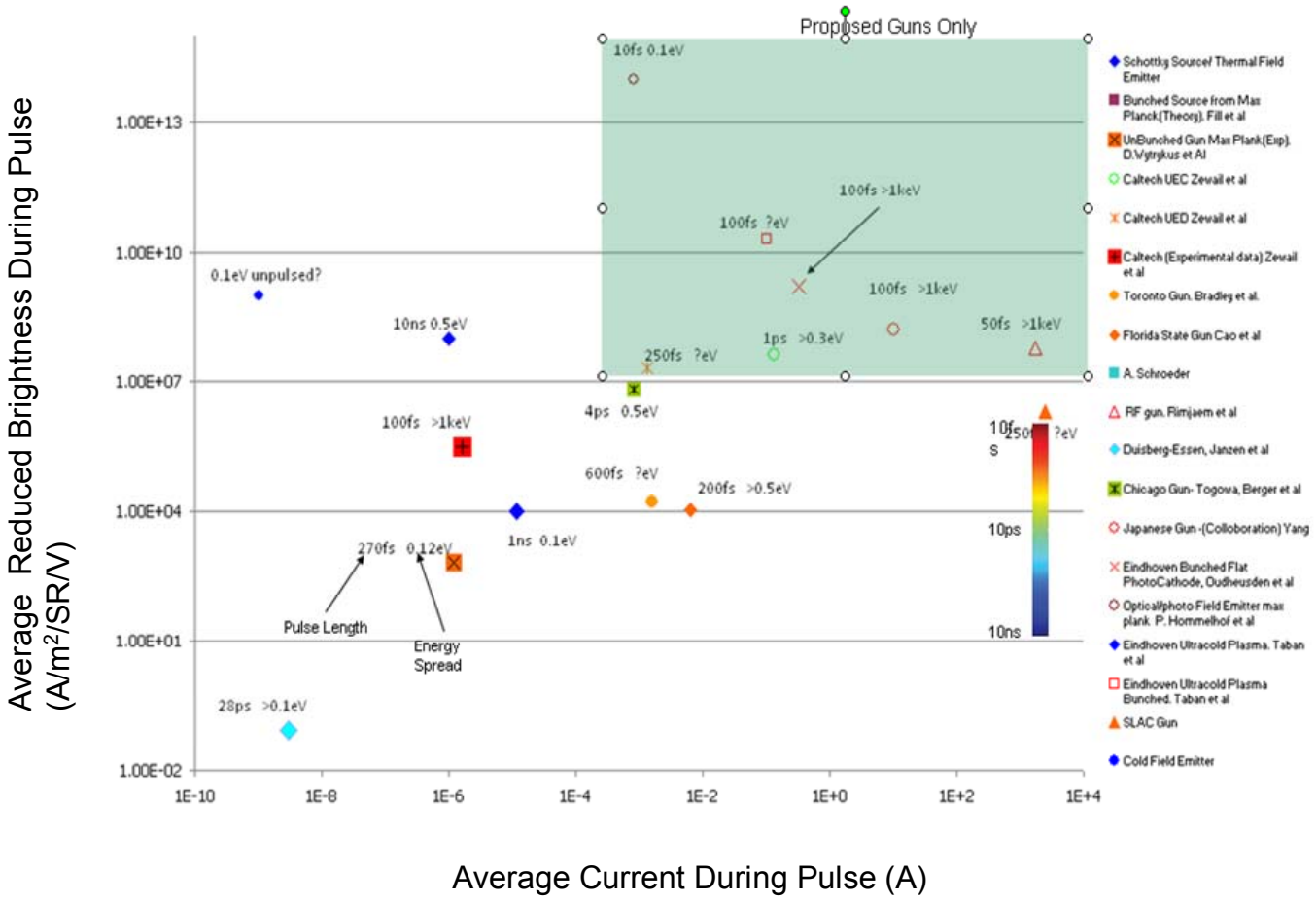
According to our research most Ultra Fast Electron Imaging Sources (UFEIS) waste much of the current they so painstakingly create, obtaining a brightness that does not match that of a continuous source.
A key parameters for any imaging source is reduced/normalised brightness Br (which scales as current over normalised emmittance) as it defines the current (I) an illuminated area A $I = A\pi\alpha^2 V B_r$, where α is the half opening angle and V the potential. We have examined existing and proposed sources making a table of Br, pulse length and energy spread (where possible at source and sample). This is summarised in fig(1) We concluded: (1) Accurate information about source design and performance is limited; (2) Surprisingly, despite modern mode-locked lasers, pulsed, experimentally proven, Br is much below continuous field and Schottky (thermal field) emitters. Photofield emission is very promising, both [1] and [2] have claimed Br of up to 10^{14}A/(m2srV) but no proper, experimental evidence is given. For a thermal field emitter we expect that the stochastic coulomb interactions decreases Br as early as 10^8A /(m^2srV) and the photofield emitter may do even worse.

We suggest chopping a high Br continuous source as an alternative for stroboscopic imaging. This could also allow for ultra fast ion microscopy, unleashing a whole new area of research.

References

[1] C. A. Brau. NUCL INSTRUM METH A, 407(1):1, 1998.
[2] P. Hommelhoff, C. Kealhofer, and M. A. Kasevich. PHYS REV LETT, 97(24):4, 2006.
[3] Refernces for graph available on request.



Figure(1) Filled symbols are experimentally proven, hollow are claims or simply theoretical possibilities. The shaded blue area is only occupied by theoretical guns. Fig(1) is compiled from literature, references are available on request. Some data is taken directly, other is calculated directly, and some is a best estimate. The label with each gun represents its pulse length and energy spread. We have tried to use the most favourable figures where possible (eg brightness at sample for bunched guns).