The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.
The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

Research field: Laser and electromagnetic technologies

Development of a fast semiconductor-based short-pulse high-power source

High-power pulsed source technology currently experiences a dynamic development away from classical gas spark gap based towards semiconductor switch based solutions.

The advantages are spectacular, such as achievable pulse repetition rates up to the MHz range instead of a limitation to a maximum of several hundred hertz, an excellent pulse-to-pulse reproducibility and ultra-long lifetime thanks to the absence of electrode erosion, pulse-shaping capabilities, highest reliability and easy scalability.

The recent availability and continuous improvement of fast semiconductor switching devices, particularly also in the research area of wide-band-gap semiconductor technology, now opens the chance for the realization of fast semiconductor-based short-pulse high-power sources for applications in both the military and the civilian domains.

In past studies an IGBT-based, inductively-triggered high-voltage switching module was developed at ISL [1]. A series arrangement of fifteen switches allowed switching voltages up to 18 kV and 50 kV by stacking three of these modules. However, the switching current was limited to 450 A, and the rise time was no faster than about 550 ns. In order to overcome the switching speed limitations, current research focuses on fast SiC MOSFET and MOS-gated thyristor technology [2] as well as innovative gate boosting techniques for further improvement of the switching speed.

With respect to a planned replacement of the current classical gas discharge based pulse sources, a fast semiconductor-based short-pulse high-power source of about 350 kV output voltage is targeted. A ten-to-twelve stages semiconductor source with a charging voltage in the order of about 30 to 50 kV per stage, achieved by a serial arrangement of a sufficient number of semiconductor switches, could be a practicable compromise between total stage number and hold-off voltage per stage. Rise times faster than 10 ns will require a reliable fast synchronized turn-on and turn-off switching of the fast semiconductor switches used. Fast MOS-gated thyristor switching technology optionally opens doors to high power sources with multi-kilo-ampere current capabilities.

The task of the PhD student will be to investigate the different electrical (capacitive, inductive) and optical methods for fast synchronized triggering of the serial semiconductor switching modules for fast semiconductor-based short-pulse high-power sources in theory and experiment, to develop this semiconductor switching module and to design, realize and test a modular semiconductor-based source.

[1] V. Zorngiebel, M. Hecquard, E. Spahn, A. Welleman, S. Scharnholz,
Modular 50-kV IGBT switch for pulsed-power applications
IEEE Trans. Plasma Sci., Vol. 39, No. 1, pp. 364-367, 2011

[2] R. Bischoff, V. Brommer, M. Stoll, S. Scharnholz
Fast semiconductor switching modules for transformer coupled LC inversion generators
Proc. of the 6th Euro-Asian Pulsed Power Conference (EAPPC), Estoril, PT, 18-22 September, 2016

French-German Research Institute of Saint-Louis (ISL)

Rainer BISCHOFF – Pulsed power technologies
5 rue du Général Cassagnou – 68301 Saint-Louis – France
rainer.bischoff@isl.eu – tel : +33 (0)3 89 69 58 83

www.isl.eu