2026 PhD Proposal in FRANCE: Pulsefront and wavefront shaping of ultrafast laser pulses for micro-nanostructuring

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Background and Objectives

Microstructuring of materials can drastically change the local physical properties, yielding, e.g., self-cleaning surfaces, anti-bacterial functions, cell differentiation, friction reduction, bulk optical guiding, and many other possibilities [1, 2, 3]. Ultrafast laser pulses offer high precision, low thermal side effects, and greater sustainability (no chemicals involved).

Several developments have enhanced the capabilities of ultrafast lasers, like spatial beam shaping and temporal pulse shaping, increasing machining throughput and precision (see Fig. 1).

The aim of this PhD proposal is to develop and manipulate the **next generation of ultrafast light shaping tools** and monitor their effect on material microstructuring. Pulse front modulation has recently been shown to yield flying foci traveling at superluminal speeds, overcoming plasma formation in gas [4, 5]. This PhD will explore advanced light manipulation tools (wave and/or pulse front modulation) for material structuring, aiming to reveal **new and efficient light coupling phenomena** and material responses.

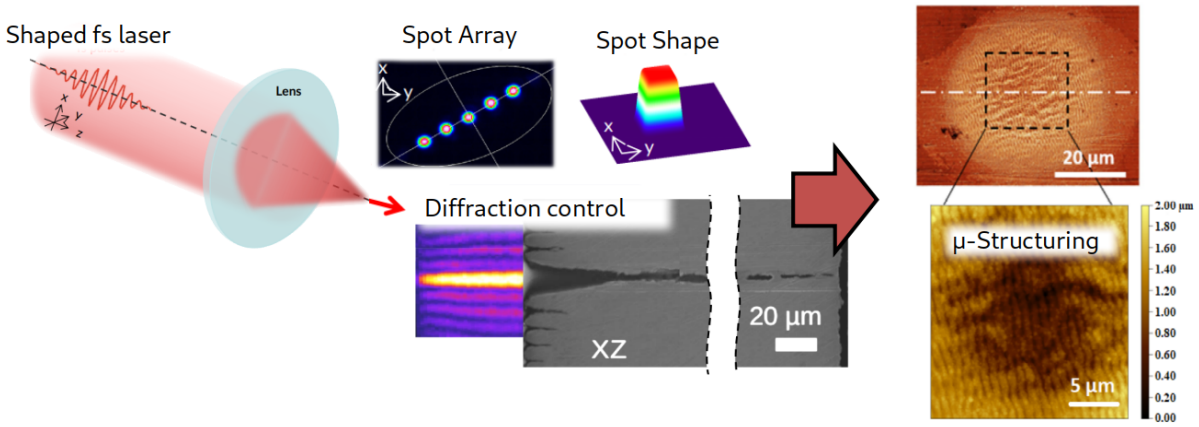

Figure 1: Background of the PhD proposal, advanced beam shaping of femtosecond laser pulses for material structuring at the micrometric level and below using non-diffracting beams [6] and dynamic pulse energy control [7]

Candidate Profile

The successful candidate must possess a Master's degree in Physics/Photonics with a strong background and motivation in light-matter interaction. Prior projects or studies involving ultrafast laser pulses and/or light wavefront modulation would be highly valued, as would strong teamwork skills, communication abilities, and the capacity to conduct experiments and bibliographic searches independently. The PhD work will lead to several dissemination opportunities, both orally at international conferences and through scientific publications.

Team Expertise

The PhD will take place at LPhiA (Laboratoire de Photonique d'Angers, Université d'Angers, FRANCE). The team possesses extensive expertise in femtosecond laser control, including beam shaping and wavelength manipulation across the visible to infrared spectrum. We have successfully developed techniques for precise laser interactions with various materials, providing a solid foundation for this project. The project leader has conducted pioneering research in surface structuring down to the submicrometric level, drilling, and cutting of various materials using advanced beam shaping techniques (full bibliography available via the QR code below).

Scholarship Details and Environment

France Excellence Eiffel scholarship holders receive a monthly stipend of €1,800, along with benefits such as international transportation, national transportation, health insurance, housing assistance, cultural activities, and more. To undertake the PhD, the Eiffel scholarship **must be** obtained, with Campus France's application deadline set for January 10, 2024.[1]

Angers, located in the scenic Loire Valley, is just 90 minutes from Paris by high-speed train and near the Atlantic Ocean. Known for its rich heritage and high quality of life, the city combines historic charm with a vibrant university environment, offering top-tier research facilities and a supportive academic community. Studying in Angers provides an ideal blend of French culture and a dynamic research setting for international PhD candidates.

[1] Full details can be found at `https://www.campusfrance.org/en/the-france-excellence-eiffel-scholarship-program` or using the QR code below

Contact

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Bibliography

Campus France Website

FRANCE EXCELLENCE EIFFEL

FACULTÉ DES SCIENCES UNIVERSITÉ D'ANGERS

Laboratoire de Photonique d'Angers