PHD THESIS SUBJECT

TITLE	**Online particle detectors for experiments with high power, high repetition rate lasers**
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Ion beams that are laser-accelerated have attracted considerable interest over the last decade due to their unique characteristics, which have already enabled innovative applications, including ultrafast radiography, or prompt heating of dense matter etc. New large laser facilities which will deliver 10 PW pulses every minute such as Apollon (Saclay, France) and the ELI pillars in Europe, or 1 PW every second as CLPU (Salamanca, Spain) are being started while several hundred terawatt Lasers shooting at 10 Hz can now be bought from laser companies. These high repetition rates are mandatory to unlock other applications of laser accelerated particle beams (radioisotope production, medical imaging, etc.). They also open a way towards new types of nuclear physics experiments [1,2].

A major issue for high intensity laser operation at high repetition rates concerns the detectors. High background is generated during high power laser matter interactions: a strong electromagnetic pulse (EMP) able to damage electronic devices and an X-ray flash which saturates the detectors. This is why, passive detectors such as activation samples [3], CR39, RCF films and imaging plates [4] are commonly used in single shot operating mode. These detectors are extracted from the experimental chambers after each laser shot and analysed in a few minutes. They are obviously not suitable for high repetition rate operation.

Detectors that can be read online at each shot and which can survive to the EMP signal must therefore be developed which is one of the goals of the PhD thesis presented here. These detectors will allow not only to characterise laser accelerated ion beams produced at high repetition rates, but also to study the nuclear reactions induced by these latter. Several possibilities have been investigated in our group over the recent years such as semi conductors able to detect electrons or laser-accelerated ions within a few tens of nanoseconds and new scintillators capable to detect X-rays or gamma-rays in this highly noisy environment [2].

The candidates should have an interest in experimental physics and instrumentation in particular. He (she) will use simulations tools (GEANT4, SRIM, etc ...) and analysis (ROOT, Matlab, Python, etc ...) to design and perform experiments at national and international laser facilities and particle accelerators.

[1] **Laser driven de-excitation of 84mRb** ; D.Denis-Petit, M Tarisien ; Ch.21, Applications of Laser-Driven Particle Acceleration, Eds. Parodi, Bolton, Schreiber, CRC press, ISBN 9781498766418 (5th june 2018)

[2] **Scintillators in high-power laser-driven experiments** ; M.Tarisien, et al. ; IEEE Transactions on Nuclear Science, Vol 65, issue 8, p.2216-2219 (2018)

[3] **NATALIE : a 32 detector integrated acquisition system to characterize laser produced energetic particles with nuclear techniques** ; M.Tarisien, et al. ; Rev.Sci.Instr. 82, 023302 (2011)

[4] **Response functions of Imaging Plates to photons, electrons and 4He particles** ; T.Bonnet, et al. ; Rev. Sci. Instrum. 84, 103510 (2013).