**Influence of the ion mass on the non-linear Breit-Wheeler process with the next generation high power lasers**

R. Capdessus$^1$, M. Marklund$^2$ and P. McKenna$^1$

1. *Department of Physics SUPA, University of Strathclyde, Glasgow G4 0NG, United Kingdom*

2. *Department of Physics, Chalmers University of Technology, SE-41296 Gothenburg, Sweden*

Antimatter production is one of the most exciting phenomena encountered in physics. A new generation of laser facilities, such as the Extreme Light Infrastructure (ELI), are anticipated to produce field intensities on the order of $10^{23}$-$10^{24}$ W/cm$^2$, where the pair production will be copious. In such interaction regimes involving ultra-strong electromagnetic fields, the ions can no longer be considered as “background plasma particles” since the quiver electron energy can be comparable with the ion rest mass. It has been recently demonstrated that the ion mass affects the high energy synchrotron-like radiation and laser energy absorption [1]. Here, we highlight for the first time the influence of ion mass on the non-linear Breit-Wheeler process [2] with the next generation high power lasers. To confirm our predictions, we considered the interaction of an ultra-intense laser pulse ($10^{24}$ W/cm$^2$, 30 fs) with an overdense plasma. 2D numerical simulations have been performed using a QED-particle-in-cell code and considering hydrogen and deuterium plasmas with a range of densities. Semi-classical analytical estimates have been derived and compared with the numerical simulations results. In particular, it is shown that the ion mass affects significantly the angular distribution of positrons as well as the number of pairs, which can be dramatically higher in the case of a deuterium plasma compared to an hydrogen plasma. The upcoming new laser facilities will enable experimental exploration of this science for the first time [3] such as the highlight of the pair production via the Breit-Wheeler process. Our fundamental study advances the state-of-the-art of the pair production generation within complex plasmas, where the collective effects as well as the radiation back-reaction are of great importance [4] and could be useful for any future applications using positron beams.


