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Laser-assisted negative ion production in caesium sputter ion source

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The negative ion formation in the caesium sputter ion sources occurs on the surface of a cathode containing the ionized material. The cathode is covered by a thin layer of caesium (Cs), which lowers the work function of the surface enhancing the negative ion formation. Vogel [1] recently introduced a hypothesis that the negative ion current can be enhanced by exposing the cathode to a laser beam. According to [1] this should resonantly excite neutral caesium atoms to electronic states, acting as a catalyst for negative ion production via so-called ion pair production. Recently JYFL-ACCLAB have revealed that the photo-assisted production of negative ions can be provoked by lasers at various wavelengths with the photon energy exceeding a certain threshold, which questioned the resonant ion pair production hypothesis [2]. Furthermore, the laser-assisted production of negative ions of oxygen (O-) as well as aluminium (Al-) was observed with the off-resonance diode lasers [3]. This observation opens the door for practical applications of photo-assisted negative ion production also for other negative ion species, not just those with their electron affinity states in resonance with the excited states of neutral Cs. In this presentation we present that the beam current enhancement does not depend on the resonant ion pair production, it depends on the applied laser power, ion source conditions, and the extracted beam current can be enhanced by a factor >2 [4].

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