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A kHz length scalable plasma for the ALiVE proton driven plasma accelerators

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The ALiVE concept for a Higgs factory using single stage proton driven plasma acceleration of lepton bunches requires a plasma with electron density matching the driver bunch size and length matching the driver depletion length. This results in a plasma with an electron density of up to 10^15 cm^-3 and a length of hundreds of meters. An energy and cost efficient way to create long plasmas use a double pulse (ignition+heating) direct current electric discharge. This generated plasmas in noble gases with lengths up to 20m.

The ALIVE concept brings new constrains to the plasma due to the possibility of field ionisation and ion motion caused by the intense lepton bunch being accelerated. These lead to the choice of plasmas generated from alkali vapours of medium ion mass which combine a low/high first/second ionisation potentials with a sufficient ion mass to reduce ion motion. Alkalis also reduce the required electric power. The high repetition rate (∼15 kHz) requires a new electric circuit topology to mitigate the resulting plasma ion drift. Further power reduction may be achieved by partial plasma axial confinement using a solenoid magnetic field.

The plasma source development plan will be presented.

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