**A hybrid channel for fast six-dimensional beam cooling using gas-filled microwave cavities**

**Abstract:**

A fast cooling technique is described that simultaneously reduces all six phase-space dimensions of a charged particle beam. In this process, cooling is accomplished by reducing the beam momentum through ionization energy loss in absorbers and replenishing the momentum loss only in the longitudinal direction through gas-filled rf cavities. We show that our channel is capable to achieve a notable decrease of the 6-dimensional phase-space volume by three orders of magnitude while potentially avoiding cavity breakdown. This work elucidates the key parameters that are needed for successful beam cooling, such as the required absorber material, focusing field, gas density and rf cavity frequency.

**Summary:**