# A Rubidium Cold Focussed Ion Beam

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We present our progress developing a laser-cooled rubidium focussed ion beam (FIB) for use in nanofabrication and imaging. Our ion source aims to achieve a higher beam brightness and a smaller focus spot size than current state of the art gallium FIB systems.

FIB systems have helped achieve major advances in nano-scale science. The most widely used conventional FIB source is the gallium liquid metal ion source (LMIS) which can provide high beam brightness and current [1]. However, the LMIS suffers from large beam energy spread and intrinsically high beam divergence [2] which prohibits forming very small spot sizes without sacrificing beam current. Also, it is not possible to use an ion species other than gallium in a LMIS [1], which can be restrictive in some applications. The cold-atom ion source we are developing aims to achieve brightness in excess of $10^7\,\mathrm{A\,m^{-2}\,sr^{-1}\,eV^{-1}}$ (which is greater than that of state of the art LMIS), with sufficient beam current for both milling and microscopy.

We present the design and preliminary results from our cold atom ion source. We generate a neutral cold atomic beam from a vapour loaded 2D magneto-optical trap (MOT) [3], [4]. The transversely cooled atoms are pushed out of the 2D MOT along the longitudinal dimension, are further cooled in a polarisation gradient cooling stage, and are then photoionised. We use a two-photon ionisation process, which allows for control over the ionisation volume and beam energy [5], maximising beam brightness. We will soon combine our rubidium ion source with conventional FIB optics to perform imaging and nanofabrication.

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