Observation of Quantized Flow of a BEC in a Toroidal Trap

CHANGHYUN RYU, KEVIN HENDERSON, MALCOLM BOSHIER, Los Alamos National Laboratory — Quantized circulation, one of the most important consequences of Bose-Einstein condensation, is fundamental to the understanding of superfluid phenomena. In a toroidal trap, Bose-condensed atoms should flow with a well-defined winding number, which makes it an ideal system to demonstrate the quantized nature of circulation. We used a scanning laser beam to create a toroidal trap [1]. To rotate the atoms, a small potential barrier within the toroidal trap was rotated at a certain frequency and then the barrier was lowered to create a quantized flow state. The winding number of the flow was determined by the diameter of the central hole seen in a time of flight image of the condensate. The measurement showed diameters increasing stepwise with the stirring frequency. We observed flows with winding number up to 5. This is a clear demonstration of the quantization of the flow of atoms in a toroidal trap. Further study of critical velocity and metastability of flow of atoms will be very important in understanding the nature of superfluidity of atoms in a toroidal trap, especially in a 1D limit.


1Supported by Los Alamos National Laboratory LDRD.