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BEC transistor JAMES STICKNEY, Dept. of Physics, WPI, DANA ANDERSON, University of Colorado and NIST, ALEX ZOZULYA, WPI — In the past decade, considerable efforts have been spent developing BEC based devices for applications such as fundamental research, precision measurements, and quantum information technology. These devices, capable of complex functionality, may be constructed from simple building blocks. New atom-optical components will enable researchers to build more elaborate integrated devices. One of the most important components of microelectronics is the transistor. We are proposing a device that shows behavior reminiscent of a transistor, which enables one to control a large number of atoms with a smaller number. This device utilizes three atom traps where the atoms in the left act as the source in a field effect transistor, the atoms in the middle act as the gate, and the right trap is the drain. When the middle trap is empty, atoms cannot tunnel from the left through the middle and in to the right, because the chemical potential in the middle trap is sufficiently smaller than that in the left or right to block tunneling. If a small number of atoms are placed in the middle, the device switches enabling tunneling from the left to the right. This tunneling is due to the fact that atom-atom interactions increase the chemical potential in the middle trap and remove the energy mismatch. We show that the number of atoms tunneling into the right can be much larger than the number of controlling atoms in the middle. Thus, the three trap structure demonstrates both absolute and differential gain, and that it can be used as an atomic transistor.

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