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Large-scale Bose-Einstein condensation in a vapor of sodium atoms at normal temperature (T=343K)

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Large-scale BEC at normal temperature (T=343K) has been observed. Our innovation lies in that we applied an electric field used for orientation polarization. In theory, 3s and 3p states of sodium are not degenerate, but Na may be polar atom, doesn't conflict with quantum mechanics because it is hydrogen-like atom. Na vapor was filled in a cylindrical capacitor. In order to determine its polarity, we measured the capacitance at different temperatures. Because its capacitance is related to temperature, sodium is polar atom. In order to achieve Na vapor phase transition, we measured the capacitance at different voltages. We found that the entropy S=Nk ln 2πe/a, when a=dV/kTH=2πe, S=0, the critical voltage V_c=68 volts. When V<V_c, S>0; when V>V_c, the atoms become aligned with the field, S<0, phase transition occurred. When V=390 volts >>Vc, the capacitance decreased from C=1.9C_0 to C≈C_0 (C_0 is the vacuum capacitance), this result implies almost all Na atoms are aligned with the field, Na vapor entered quasi-vacuum state. BEC is perfect alignment of bosons, so we create BEC with 2.506×10^{17} atoms, condensate fraction reached 98.9%, S=-1.747Nk<<0. This is BEC in momentum space. Ultra-low temperature (T_c) is in order to make Bose gas phase transition, we use V_c to achieve phase transition, so T_c is not necessary. The maximum induced dipole moment $d_{ind}\leq7.8\times10^{-15}$ e.cm can be neglected. Na material with purity 99.95% was supplied by Strem Chemicals Co., USA. Our experiments are easily repeated because low temperature is not necessary.

Biography

Pei Lin You is the Director of the Institute of Quantum Electronics. He has been engaged sixteen years in BEC experiment. The titles of his articles are: 1. "A large-scale BEC of sodium atoms at T=343K has been observed" Physica B 401(2016) 84-92). 2. "Large-scale Bose-Einstein condensation in a vapor of cesium atoms at normal temperature (T=353K)" J Material Sci Eng (2016) 5: 276).

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