BEC and dimensional crossover in a boson gas within multi-slabs

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For an ideal Bose-gas within a multi-slabs periodic structure, we report a dimensional crossover and discuss whether a BEC transition at $T_c \neq 0$ disappears or not.
The multi-slabs structure is generated via a Kronig-Penney potential perpendicular to the slabs of width b and separated by a distance a. The ability of the particles to jump between adjacent slabs is determined by the hight of the potential barrier and the separation a between them. Contrary to what happens in the boson gas inside a zero-width multilayers case [1], where the critical temperature diminishes and goes up again as a function of the wall separation, here the T_c decreases continuously as the potential barrier height and the cell size $a + b$ increase. We plot the surface $T_c = 10^{-6}$ showing two prominent regions in the parameters space, which suggest a phase transition BEC-NOBEC at $T \neq 0$. The specific heat shows a crossover from 3D to 2D when the height of the potential or the barrier width increase, in addition to the well known peak related to the Bose-Einstein condensation.

1. P. Salas, F.J. Sevilla, M. Fortes, M. de Llano, A. Camacho and M.A. Solis, (2010). "Dimensional crossover of a boson gas in multilayers". Phys. Rev. A **82**, 033632.

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