Fermi and Bose gases within Multitubes

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We report the thermodynamic properties of Boson and Fermi ideal gases immersed in periodic structures such as penetrable multilayers [1] or multitubes [2] simulated by one (planes) or two perpendicular (tubes) external Dirac comb potentials, while the particles are allowed to move freely in the remaining directions. Although the bosonic chemical potential is a constant for $T < T_c$, a non decreasing with temperature anomalous behavior of the fermionic chemical potential is confirmed [3] and monitored as the structure goes from 2D to 1D when the wall impenetrability overcomes a critical value. In the specific heat curves dimensional crossovers are very noticeable at high temperatures for both gases, where the system behavior goes from 3D to 2D and latter to 1D as the wall impenetrability is increased.

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