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Crystalline Order in Two Dimensions*

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If N classical particles in two dimensions interacting through a pair potential $\Phi(\vec{r})$ are in equilibrium in a parallelogram box, it is proved that every $\vec{k}\neq 0$ Fourier component of the density must vanish in the thermodynamic limit, provided that $\Phi(\vec{r}) - \lambda r^2 | \nabla^2 \Phi(\vec{r})|$ is integrable at $r=\infty$ and positive and nonintegrable at $r=0$, both for $\lambda=0$ and for some positive λ. This result excludes conventional crystalline long-range order in two dimensions for power-law potentials of the Lennard-Jones type, but is inconclusive for hard-core potentials. The corresponding analysis for the quantum case is outlined. Similar results hold in one dimension.

- The existence of 2D materials was not believed to be possible.

- Nowadays there is a whole branch of science sploiting their applications.