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Is there a stable commensurate solid phase in the second ^{4}He layer on graphite? – path integral Monte Carlo study JEONGHWAN AHN, HOONKYUNG LEE, YONGKYUNG KWON, KonKuk Univ — Existence of a stable commensurate structure in the second ^{4}He layer on graphite has been a subject of intensive experimental and theoretical studies because of its implication in the possible realization of two-dimensional supersolidity. Earlier path-integral Monte Carlo (PIMC) calculations of Pierce and Manousakis predicted a stable $C_{4/7}$ commensurate structure above the first-layer ^{4}He atoms fixed at triangular lattice sites [1], but Corboz *et al.* later showed that no commensurate phase was stable when quantum dynamics of the first-layer ^{4}He atoms was incorporated in the PIMC calculations [2]. On the other hand, recent heat capacity measurements of Nakamura *et al.* provided a strong evidence for a commensurate solid in the second ^{4}He layer over an extended density range [3]. Motivated by this, we have performed new PIMC calculations for the second helium layer on graphite. Unlike previous PIMC calculations where a laterally-averaged one-dimensional substrate potential was used, we here employ an anisotropic ^{4}He-graphite potential described by a sum of the ^{4}He-C pair potentials. With this fully-corrugated substrate potential we make more accurate description of quantum dynamics of the first-layer ^{4}He atoms and analyze its effects on the phase diagram of the second layer.

[1] M. Pierce and E. Manousakis, *Phys. Rev. Lett.* **81**, 156 (1998).
[2] P. Corboz *et al.*, *Phys. Rev. B* **78**, 245414 (2008).
[3] S. Nakamura *et al.*, arxiv:1406.4388 (2014).

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