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The quasi-particle gap in a disordered boson Hubbard model in two dimensions JI-WOO LEE, School of Physics, Korea Institute for Advanced Study, Dongdaemun-gu, Seoul 130-722, Korea, MIN-CHUL CHA, Department of Applied Physics, Hanyang University, Ansan, Kyunggi-do 426-791, Korea — We investigate the behavior of the quasi-particle energy gap near quantum phase transitions in a two-dimensional disordered boson Hubbard model at a commensurate filling. Via Monte Carlo simulations of ensembles with fixed numbers of particles, we observe the behavior of the gap as a function of the tuning parameter for various strength of diagonal disorder. For weak disorder, we find that gapped Mott insulating phase is sustained up to the transition point and disappears only in a superfluid, strongly supporting a direct Mott-insulator-to-superfluid transition. Bose glass behavior, insulating with vanishing gap, appears only when the strength of disorder is bigger than a critical value.

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