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Height Fluctuations in Interacting Dimers

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Perfect matchings of Z^2 (also known as non-interacting dimers on the square lattice) are an exactly solvable 2D statistical mechanics model. It is known that the associated height function behaves at large distances like a massless gaussian field, with the variance of height gradients growing logarithmically with the distance. As soon as dimers mutually interact, via e.g. a local energy function favoring the alignment among neighboring dimers, the model is not solvable anymore and the dimer-dimer correlation functions decay polynomially at infinity with a non-universal (interaction-dependent) critical exponent. We prove that, nevertheless, the height fluctuations remain gaussian even in the presence of interactions, in the sense that all their moments converge to the gaussian ones at large distances. The proof is based on extension of the Interacting Fermions Picture method, proposed and employed by P. Falco in the study of the universality of critical exponents in the interacting dimer model. An important novelty of our approach is the combination of multiscale methods with the path-independence properties of the height function.
Joint work with V. Mastropietro and F. Toninelli.

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