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Calculations of the Photonic Properties of Two Dimensional QuasiCrystals WEINING MAN, ORION CRISAFULLI, PAUL STEINHARDT, Princeton University, PAUL CHAIKIN, New York University, PRINCETON UNIV. TEAM, NYU COLLABORATION — Quasicrystals have higher point group symmetry than ordinary crystals, and hence are good candidates for complete photonic bandgaps. Our model system consists of infinite long cylinder dielectric (or air) rods at each Penrose lattice point We took three different approaches in using periodic approximants for these calculations. Our first approach uses a rectangular section of a Penrose tiling of different sizes and at different positions. In the second set of calculations, we generate a series of periodic approximants of the Penrose lattice via an inflation method. Our third approach, a rational number approximation, has the fewest number of defects. The rational number approximant is the best since there are no modes localized along the defects and no artificial modes appear in the gap frequency region. In each case we increased the approximant size until the results converged. Our calculations on 2-D Penrose quasicrystals show very isotropic sizeable complete photonic bandgaps which can be identified with known Bragg scattering peaks. We predict the best Bragg scattering spot and optimize the cylinder size for the widest over all band gap for a given dielectric contrast. We also discuss experimental results on 3D icosahedral quasicrystals in the microwave regime and show that 3D icosahedral quasicrystals are better photonic bandgap candidates than crystalline structures.

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