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The Hofstadter Butterfly and some physical consequences.

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Opening its beautiful wings for the first time four decades ago, the Hofstadter Butterfly emerged as a self-similar pattern of bands and gaps displaying the allowed energies for two dimensional crystalline electrons in a perpendicular magnetic field.[1] Within the Harper model, as the external field parameter is varied well defined gaps traverse the spectrum, some closing at a Dirac point where two approaching bands touch. Such band edges degeneracy is lifted in more realistic models.[2] Gaps have a unique label that determines the Hall conductivity of a noninteracting electron system, as observed in recent experiments.[3] When the 2D electron assembly is allowed to interact in the absence of an underlying periodic potential, the mean field approximation predicts a liquid at integer filling fractions and electron density fluctuations otherwise, which if periodic may be represented again by a Harper equation. The intriguing odd denominator rule observed in experiment in the fractional quantum Hall regime is then a natural prediction of the model.[4]

1. D. R. Hofstadter, Phys. Rev. B 14, 2239 (1976)

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3. C. R. Dean et al, Nature 497, 598 (2013)

4. F. Claro, Phys. Rev. B 35, 7980 (1987)

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