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Observation of the Hofstadter butterfly in graphene on boron nitride PATRICK MAHER, CORY DEAN, CARLOS FORSYTHE, LEI WANG, FERESHTE GHAHARI, Columbia University, PILKYUNG MOON, MIKITO KOSHINO, Tohoku University, KENJI WATANABE, TAKASHI TANIGUCHI, National Institute for Materials Science, KEN SHEPARD, JAMES HONE, PHILIP KIM, Columbia University — In 1976, Douglas Hofstadter considered the general problem of 2D electrons subject to both a magnetic field and a periodic potential. His solution predicted a remarkably complex energy spectrum exhibiting self-similar fractal structure, termed the Hofstadter Butterfly. Experimental exploration of this problem has been limited by the difficulty of fabricating a system with a lattice constant on the order of the magnetic length. It has recently been shown that single layer graphene on hexagonal-BN develops a Moiré pattern with a length of up to 15 nm when the rotational angle between the two lattices approaches zero. We present data demonstrating that for bilayer graphene on hexagonal boron nitride, the effect of the modulation potential associated with the Moiré pattern is large enough to be observable by standard transport. Under large magnetic fields, additional gaps appear within the usual bilayer quantum Hall spectrum, consistent with calculations of the Hofstadter spectrum. We present the first direct experimental evidence of the longstanding theoretical prediction that the gaps arising from the superlattice are characterized by two integer quantum numbers.

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