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Interplay of Hofstadter and quantum Hall states in bilayer graphene ERIC M. SPANTON, ALEXANDER A. ZIBROV, HAOXIN ZHOU, University of California - Santa Barbara, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, ANDREA YOUNG, University of California - Santa Barbara — Electron interactions in ultraclean systems such as graphene lead to the fractional quantum Hall effect in an applied magnetic field. Long wavelength periodic potentials from a moir pattern in aligned boron nitride-graphene heterostructures may compete with such interactions and favor spatially ordered states (e.g. Wigner crystals orcharge density waves). To investigate this competition, we studied the bulk phase diagram of asymmetrically moir-coupled bilayer graphene via multi-terminal magnetocapacitance measurements at ultra-high magnetic fields. Two quantum numbers characterize energy gaps in this regime: t, which indexes the Bloch bands, and s, which indexes the Landau level. Similar to past experiments, we observe the conventional integer and fractional quantum Hall gaps ($t = 0$), integer Hofstadter gaps (integer s and integer $t \neq 0$), and fractional Bloch states associated with an expanded superlattice unit cell (fractional s and integer t). Additionally, we find states with fractional values for both s and t. Measurement of the capacitance matrix shows that these states occur on the layer exposed to the strong periodic potential. We discuss the results in terms of possible fractional quantum hall states unique to periodically modulated systems.

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