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Flat-band magnetism and spiral magnetic order in twisted bilayer graphene[1] LUIS GONZALEZ-ARRAGA, IMDEA Nanoscience, JOSE LADO, International Iberian Nanotechnology Lab, FRANCISCO GUINEA, IMDEA Nanoscience, PABLO SAN-JOSE, Instituto de Ciencia de Materiales de Madrid — The Fermi velocity in Moire superlattices of twisted bilayer graphene diminishes with decreasing twisting angle, so that below 1 degree, it is almost suppressed, and flat bands arise at the Fermi level. The flat bands correspond to quasi-localized states within the regions of AA-stacking. Electron confinement is enhanced by the application of an interlayer electrostatic bias. In this regime, AA regions behave at low energies as a triangular network of weakly connected quantum dots. We study the effects of electron-electron repulsions on these localized states within a Hubbard mean-field approach. Within the minimal supercell, we find that the magnetic moments of AA regions may become ferromagnetic above a critical Hubbard coupling, and may be efficiently controlled by an interlayer bias. The relative ordering of neighbouring AA regions is dominated by the inter-cell exchange, which has antiferromagnetic character. Due to the triangular symmetry of the moir pattern, the exchange results in a unique spiral magnetic order, despite the absence of spin-orbit coupling in the system. Such magnetic properties are rather unique amongst known 2D materials. Electrical spin-tuneability, and negligible stray fields from the spiral order make this system a promising platform for data storage.

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