Moiré-driven multiferroic order in twisted CrCl3 , CrBr3 and CrI3 bilayers

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Van der Waals heterostructures
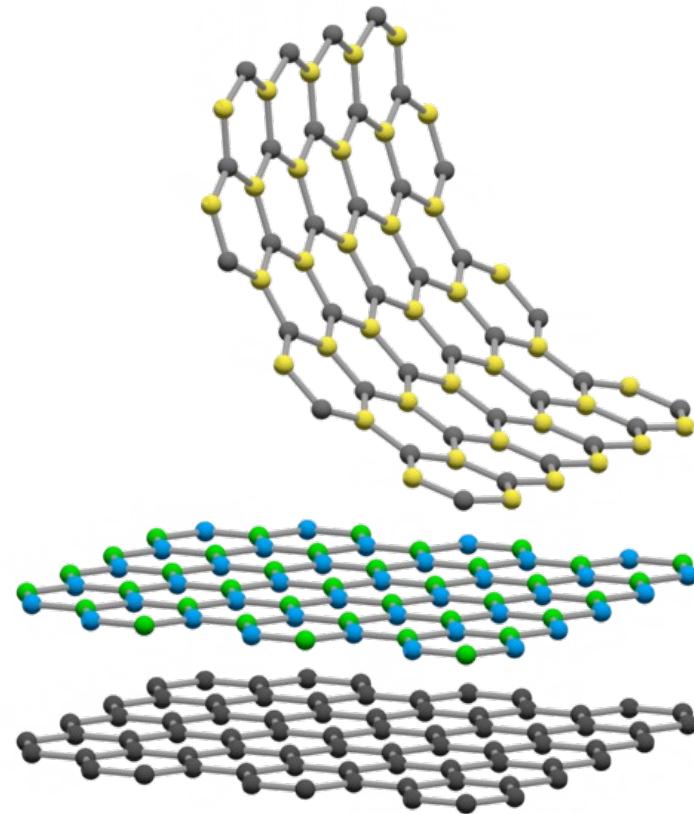
Moire pattern
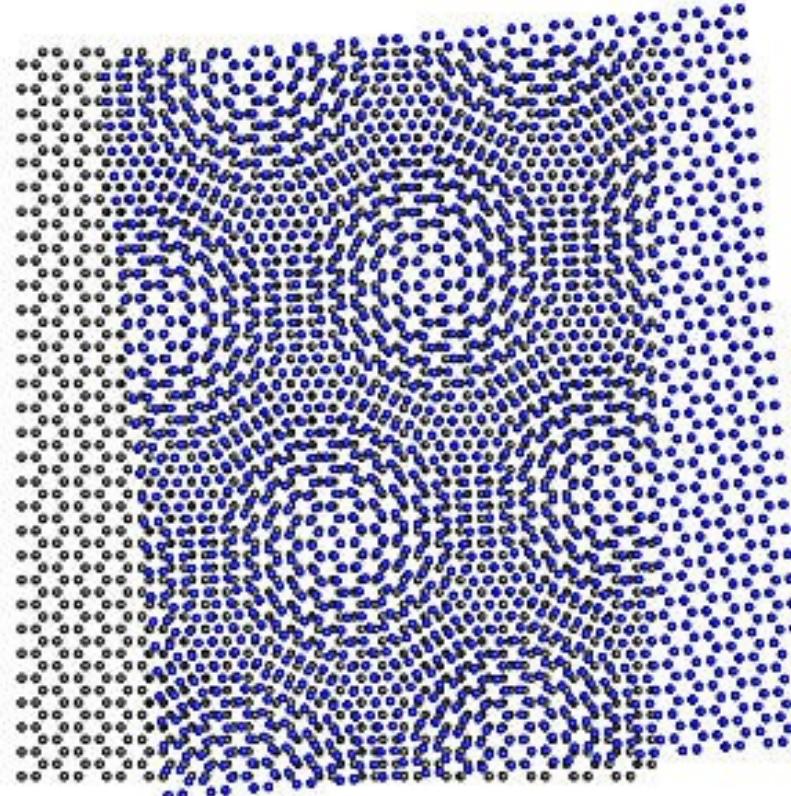
Twisted bilayer graphene

Lu, X., Stepanov, P., Yang, W. et al. Superconductors, orbital magnets and correlated states in magic-angle bilayer graphene. Nature 574, 653–657 (2019).

2D magnets: CrX3

(a)   (b)

CrX3 Moire structure

(a)

L_M

Bilayer Stacking
- (M) Monoclinic
- (R) Rhombohedral

(b)

L_M

AFM   Interlayer exchange J_M FM

$-J_M^{Max}$ 0 J_M^{Max}

(c)

L_M

Electric Polarization

0   P^{Max}
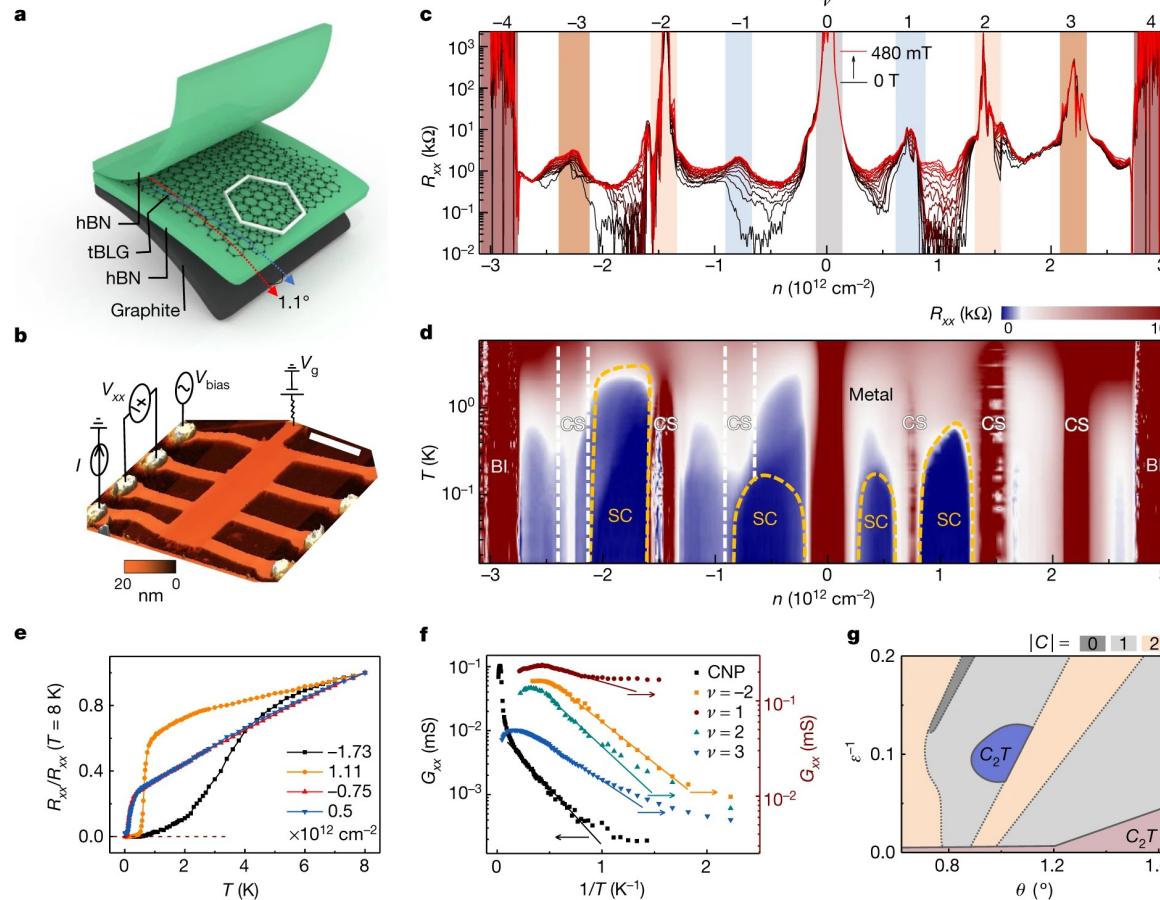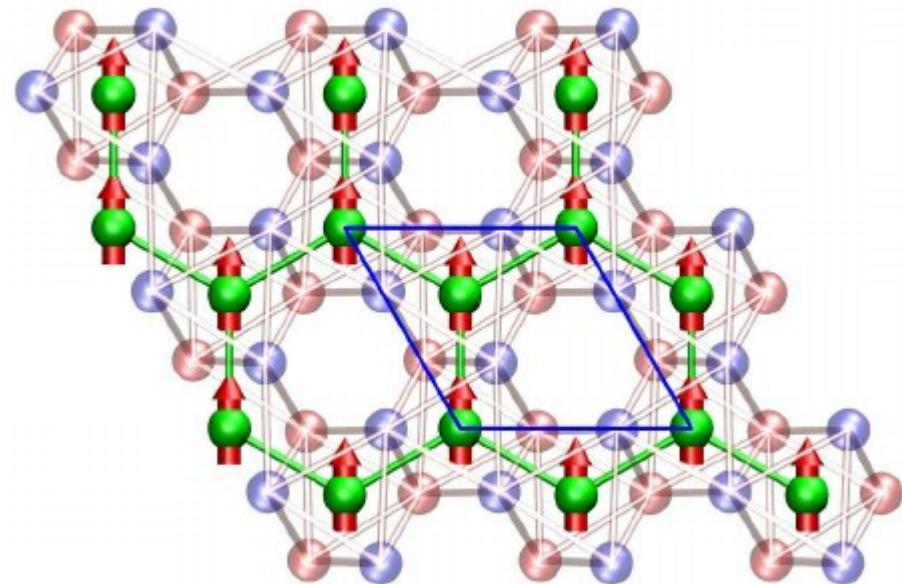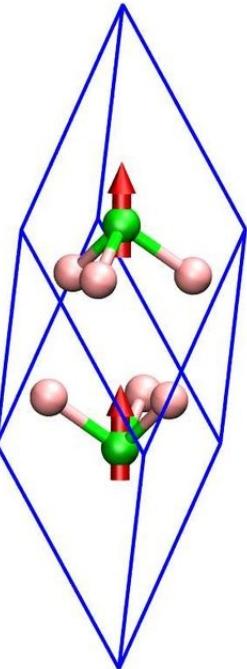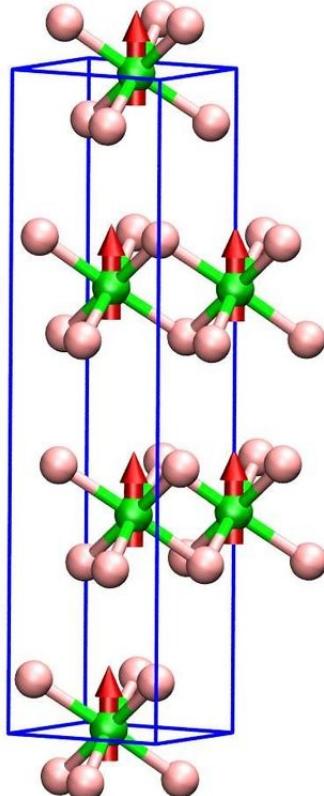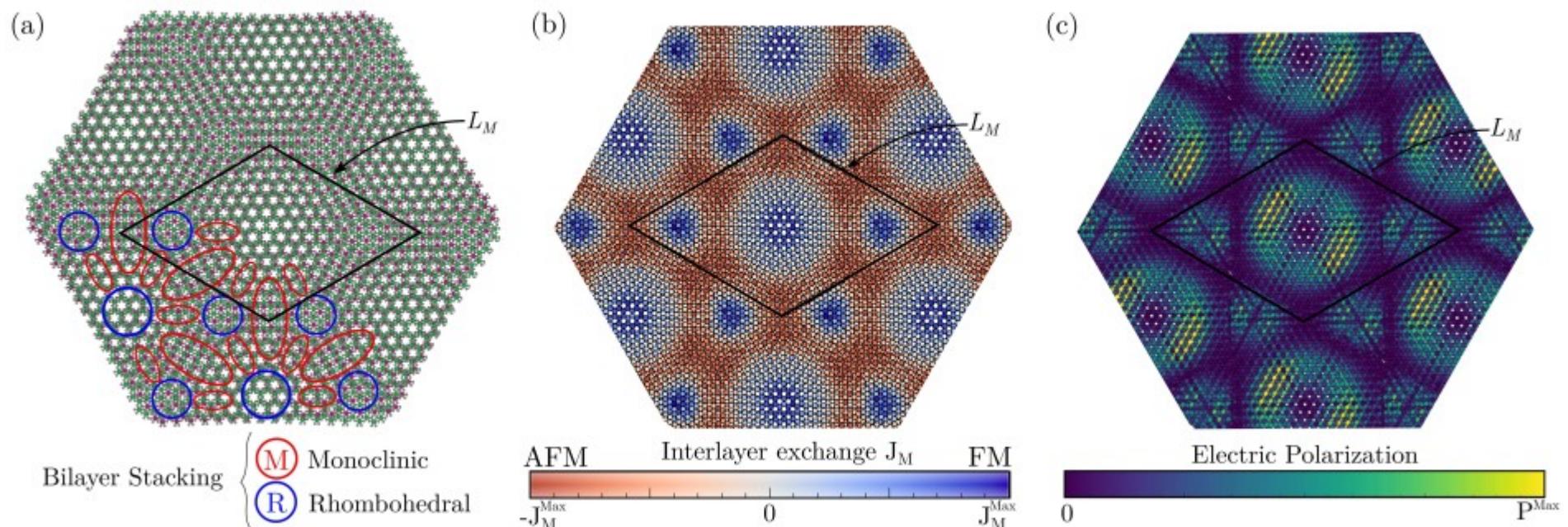
$$\mathbf{P}_{ij} = \lambda_{\text{SOC}} \left(\mathbf{r}_{ij} \times \left(\mathbf{S}_i \times \mathbf{S}_j \right) \right)$$

Polarization as function of parameters
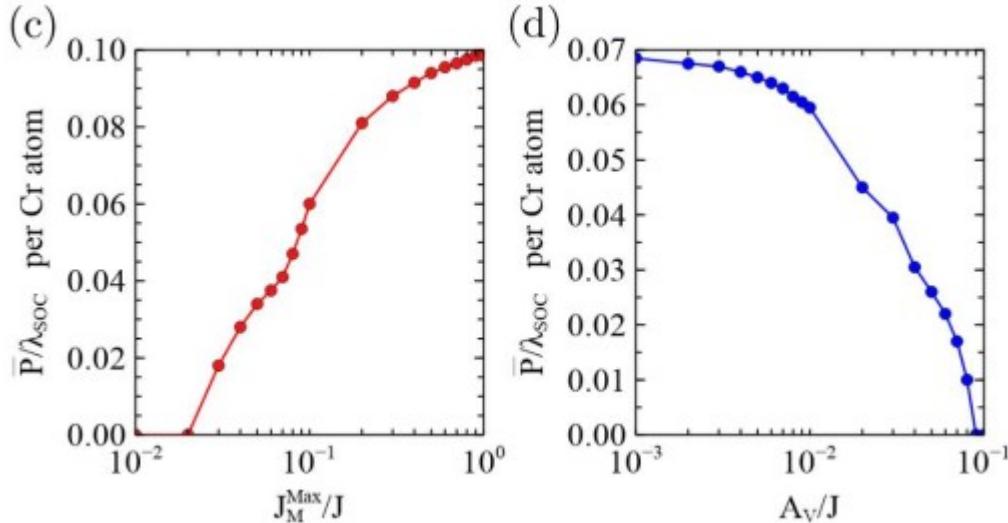
$$\mathcal{H} = -\frac{J}{2} \sum_{<i,j>} \mathbf{S}_i \mathbf{S}_j - \frac{A_v}{2} \sum_{<i,j>} S_i^z S_j^z - A_u \sum_i (S_i^z)^2$$

Polarization as function of halogen