Multiferroicity with improper ferroelectricity and uniaxial ferromagnetism in $EuAl_{12}O_{19}$

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We report the discovery of a multiferroic phase in $EuAl_{12}O_{19}$ with ferroelectric ordering at T_e=50 K and a ferromagnetic ordering at T_C=1.3 K. $EuAl_{12}O_{19}$ is a quasi-two dimensional ferromagnet with magnetic ions Eu^{2+} building a planar triangular lattice. The magnetic ground state is ferromagnetic with a strong magnetic anisotropy, which may results from allowed Dzyaloshinskii–Moriya interactions. At the center of every second triangle of magnetic ions sits an electric dipoles AlO_5. The electric dipoles form also a triangular lattice, which may realize ferroelectric frustration, an analog of the famous problem of frustrated magnetism on a triangular lattice. These electric dipoles order via an improper ferroelectric phase transition at T_e=50 K leading to an unusual case of type I multiferroicity in $EuAl_{12}O_{19}$.