Rich patterns are observed in self-propelled particles systems with Morse like interaction potential \( U(x) = C_a e^{-|x|/l_a} - C_r e^{-|x|/l_r} \). However, the explicit forms of the observed patterns like flocks and mills are not available in higher dimension.

In this talk, the potential is replaced by a quasi-Morse potentail [Carrillo et.al, 2013 Physca D], which consists the difference of two rescaled Bessel potentials. A few observed patterns can be obtained by solved some algebraic equations, leading to an extensive parametric study of the underlying particle system. The stability of certain patterns are also discussed.