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We prove regularity and properties of minimizers for Landau-de Gennes energies whose bulk energy term is singular and defined via Maier-Saupe type probability density functionals. In particular, we show that for a general class of these energies describing liquid crystals, minimizers (which are H^1 functions from a two-dimensional domain into a subclass of 3×3 symmetric, trace-free matrices) are Holder continuous, and their eigenvalues are strictly within the physically realistic interval $(-1/3, 2/3)$, even though the admissible functions have eigenvalues in the closure of this interval. (Received July 30, 2015)