Fifth-order superintegrable quantum systems separating in Cartesian coordinates: Doubly exotic potentials

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We consider a two-dimensional quantum Hamiltonian separable in Cartesian coordinates and allowing a fifth-order integral of motion. We impose the superintegrablity condition and find all doubly exotic superintegrable potentials (i.e., potentials $V(x; y) = V1(x) + V2(y)$, where neither $V1(x)$ nor $V2(y)$ satisfy a linear ordinary differential equation), allowing the existence of such an integral. All of these potentials are found to have the Painleve property. Most of them are expressed in terms of known Painleve transcendents or elliptic functions but some may represent new higher order Painleve transcendents.

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