On the convergence of splitting methods for linear evolutionary Schrödinger equations involving an unbounded potential

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In this talk, we study the convergence behaviour of high-order exponential operator splitting methods for the time integration of linear Schrödinger equations

$$\mathrm{i}\,\hbar\,\partial_t\psi(x,t) = -\,\tfrac{\hbar^2}{2m}\,\Delta\,\psi(x,t) + U(x)\,\psi(x,t)\,, \qquad x\in\mathbb{R}^d\,, \quad t\geq 0\,,$$

involving an unbounded potential; in particular, our analysis applies to potentials U defined by a polynomial. We deduce a global error estimate which implies that any time-splitting method retains its classical convergence order for linear Schrödinger equations, provided that the exact solution fulfills suitable regularity requirements. Numerical examples illustrate the theoretical result.