Landscape Functions And Agmon-Type Estimates For Magnetic Schrödinger Operators On Infinite Graphs

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We develop a theory of landscape functions to derive Agmon-type exponential decay estimates for magnetic Schrödinger operators on possibly infinite weighted graphs. Given a bounded, non-negative source ρ, the associated non-magnetic landscape function $u = (\Delta + V)^{-1}\rho$ defines an effective potential ρ/u that governs the spatial distribution of magnetic eigenfunctions. We prove that any eigenpair (E, ϕ) of the full magnetic operator $\Delta_\alpha + V$ decays exponentially away from the potential well with respect to a natural Agmon pseudometric. Crucially, our landscape function is defined using the non-magnetic operator, yet controls magnetic eigenfunctions via semigroup domination. Our framework extends existing finite-graph theories recently developed by Filoche-Mayboroda-Tao to infinite settings, incorporates magnetic fields, and significantly improves system-size dependence to provide uniform decay estimates. We present applications to Schrödinger operators with confining potentials and Anderson-type models on $\mathbb{Z}^d$. This is joint work with Liza Schonlau (Bonn) and Matthias Täufer (Valenciennes).