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Mathematical Approach to Anderson Localization

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The study of conductivity properties of materials is one of the most important research areas in condensed matter physics. In 1958, a physicist P. W. Anderson discussed the phenomena which is now called "Anderson localization" where the materials such as alloys and amorphous media become an insulator if they have largely disordered atomic structure. This is in contrast with the behaviour of the ideal crystals which have ordered structure and are always conductors. Many convincing arguments and experiments on this topic have been done by physicists. However, we will explore how we can construct the mathematical proof of this phenomena. I will discuss the way to model the materials and the motion of electrons so that we can treat Anderson localization in mathematical languages. Then we will see that the phenomena corresponds to the fact that Hamiltonian of wave function of an electron has eigenvalues that are infinitely close to each other with exponentially localized eigenfunctions.