Scientific importance of the discrete electronic structure of f- and d-electron systems

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We will point out the scientific importance of the increasing evidence for the existence of the discrete energetical states in compounds containing atoms with incomplete $4f$, $5f$ and $3d$ shells. As the existence of such states has been rather accepted in conventional rare-earth compounds, both ionic and intermetallic, there is growing evidence for their existence also in heavy-fermion compounds and $3d$ oxides. As far as the heavy-fermion compounds are concerned we will concentrate on analysis of the low-energy electronic structure, below 1 meV, of such hall-mark heavy-fermion compounds like $YbRh_2Si_2$ and UPd_2Al_3 establishing the valency, the charge distribution and the width of the discrete states. For the $3d$ compounds we recall the experimental evidence for the discrete electronic structure of $FeBr_2$ and $LaCoO_3$ with analysis of their macroscopic properties. Finally we would like to point out that the present *ab initio* calculations offer the description of the electronic structure of $3d$ compounds in the eV energy scale only, i. e. with 1000 times less accuracy than our theoretical atomistic-based approach.