Novel topological phases in strongly correlated electron systems

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The role of topology in electronic systems is an active subject of research. Within a non-interacting quasi-particle picture, describing both weakly correlated insulators and superconductors, a rather complete classification of possible topological phases has been achieved, and of course topological insulators have been found and studied intensively experimentally. The problem of correlated electrons is much richer, and requires updating the quasi-particle classification. New topological phases and phenomena can occur only when electronic interactions are present. I will discuss some of the possible novel states that might be achieved in this way. I will describe how gapped states may exhibit two distinct classes of topology: symmetry protected topological order, and intrinsic topological order. I will also touch upon gapless states with topologically protected bulk gapless excitations. Finally, I will spend some time describing applications of these ideas to the iridates.