Integrability in the *broad* sense

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Abstract: The current notion of integrability of Hamiltonian systems was fixed by Liouville in a famous 1855 paper. It describes systems in a $2k$-dimensional phase space whose trajectories are dense on tori T^q or wind on toroidal cylinders $T^m \times R^{q-m}$. Within Liouville's construction the dimension q cannot exceed k and is the main invariant of the system. In the talk, I will present a generalization of Liouville integrability so that trajectories can be dense on tori T^q of arbitrary dimensions $q = 1, \cdots, 2k-1, 2k$ and an additional invariant $v : 2(q-k) \leq v \leq 2[q/2]$ can be recovered. The main theorem classifies all $k(k+1)/2$ canonical forms of Hamiltonian systems that are integrable in a newly defined *broad* sense. An integrable in the broad sense physical problem having engineering origin will be presented.