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Birkhoff normal form for nonlinear wave equations

Many theorems on global existence of small amplitude solutions of nonlinear wave equations in ${\mathbb R}^n$ depend upon a competition between the time decay of solutions and the degree of the nonlinearity. Decay estimates are more effective when inessential nonlinear terms are able to be removed through a well-chosen transformation. Most wave equations that arise in a physical context can be considered as Hamiltonian PDEs, that is, partial differential equations that can be formulated as a Hamiltonian system. In this talk, we construct Birkhoff normal forms transformations for the class of wave equations which are Hamiltonian PDEs and null forms, giving a new proof via canonical transformations of the global existence theorems for null form wave equations of S. Klainerman, J. Shatah and other, in space dimensions $n \geq 3$. The critical case $n = 2$ is also under consideration.

These results are work-in-progress with A. French and C.-R. Yang.