Shadowing in the parabolic equations

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This talk is devoted to the numerical analysis of abstract semilinear parabolic problem $u'(t) = Au(t) + f(u(t)), u(0) = u^0$, in some general Banach space E. We are developing a general approach to establish the discrete dichotomy in a very general setting and prove shadowing Theorems that compare solutions of the continuous problem with those of discrete approximation in time. It is well-known fact that the phase space in the neighborhood of the hyperbolic equilibrium can be split in a such way that the original initial value problem is reduced to initial value problems with exponential decaying solutions in opposite time direction. We use the theory of compact approximation principle and collectively condensing approximation to show that such a decomposition of the flow persists under rather general approximation schemes. The main assumption of our results are naturally satisfied, in particular, for operators with compact resolvents and condensing semigroups and can be verified for finite element as well as finite difference methods.