cillations, or of oscillations synchronized between two distant sites, build on the principles governing synchrony of local oscillations. In general, however, global/distant synchrony is more delicate than local synchrony. That is to say, global synchrony will prove more sensitive to parameter changes than local synchrony. If, in addition, global synchrony is required for higher brain functions, we can understand, in principle, specific means by which cognition can be disrupted, without necessarily losing the ability to generate gamma oscillations locally.

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Fast Oscillations in Cortical Circuits

1 Oscillations: What They Are, What They Might Be Good For

In mathematical physics, oscillations can be given a precise definition, for example, as a periodic solution of a set of differential equations. Oscillations of this sort arise in a number of contexts, including propagating electromagnetic and other kinds of waves. An example of a wave equation with periodic oscillations would be:

$$\nabla^2 E - \varepsilon\mu\partial^2 E/\partial t^2 - g\mu\partial E/\partial t = 0,$$

where the vector E is the electric field, ε is permittivity, μ is permeability, and g a constant relating current density to the electric field (Reitz and Milford 1960). In modeling biological oscillators, Kopell (1988) describes the properties of dynamical systems that can be used to represent the biological oscillator: the system should have a periodic orbit that is a limit cycle, that is, where certain stability criteria of the orbit are met. These criteria can, however, be defined precisely (Hirsch and Smale 1974).

How is one to define a biological oscillation itself, as distinct from the equations used to model the oscillation, especially given that phenomena in physiology that are called oscillatory are not precisely periodic? This issue is of practical importance in in vivo recordings, which tend to be noisy (see also below). Most investigators use an operational approach something like this: the recorded signal is fit with some standard function with free