Buckling of Scroll Waves

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Scroll wave turbulence occurs in excitable media with negative filament tension [1]. This phenomenon has been observed in numerical simulations with a number of excitable media models, including e.g. cardiac excitation models [2]. For chemical systems it still remains a prediction to be confirmed by experiment, although there are "suspicious" experimental observations [3]. The present talk is concerned with expected behaviour of scroll waves with a negative filament tension, if they are initiated in a thin layer of the excitable medium. Apparently, in a sufficiently thin layer, a scroll can be stabilized by "filament rigidity". Above a critical thickness, scroll wave can deform into a buckled, precessing state. On the surface this would be seen as spiral wave meandering, the amplitude of which grows with the layer thickness, until a break-up to the scroll turbulence happens. We present a simplified theory for this phenomenon and illustrate it with numerical examples. The knowledge about the buckling transition and its properties is important for the planning and interpretation of experiments where the medium thickness is comparable to the typical length scale of the spiral wave.

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