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Singularities of the susceptibility of an SRB measure in the presence of stable-unstable tangencies

David Ruelle

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Let ρ be an SRB (or "physical"), measure for the discrete time evolution given by a map f, and let $\rho(A)$ denote the expectation value of a smooth function A. If f depends on a parameter, the derivative $\delta\rho(A)$ of $\rho(A)$ with respect to the parameter is formally given by the value of the so-called susceptibility function $\Psi(z)$ at $z=1$. When f is a uniformly hyperbolic diffeomorphism, it has been proved that the power series $\Psi(z)$ has a radius of convergence $r(\Psi)>1$, and that $\delta\rho(A)=\Psi(1)$, but it is known that $r(\Psi)<1$ in some other cases. One reason why f may fail to be uniformly hyperbolic is if there are tangencies between the stable and unstable manifolds for (f,ρ). The present paper gives a crude, nonrigorous, analysis of this situation in terms of the Hausdorff dimension d of ρ in the stable direction. We find that the tangencies produce singularities of $\Psi(z)$ for $|z|<1$ if $d<1/2$, but only for $|z|>1$ if $d>1/2$. In particular, if $d>1/2$ we may hope that $\Psi(1)$ makes sense, and the derivative $\delta\rho(A)=\Psi(1)$ has thus a chance to be defined

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