Type II vanishing asymptotics of maximal Solutions to the Ricci flow in $R^2$

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We consider the initial value problem

$$u_t = \Delta \log u,$$

$$u(x,0) = u_0(x) \geq 0 \text{ in } R^2,$$

corresponding to the Ricci flow, namely conformal evolution of the metric $u(dx_1^2 + dx_2^2)$ by Ricci curvature. It is well known that the maximal (complete) solution $u$ vanishes identically after time $T = \frac{1}{4\pi} \int_{R^2} u_0$. Assuming that $u_0$ is compactly supported we describe precisely the Type II vanishing behavior of $u$ at time $T$: we show the existence of an inner region with exponentially fast vanishing profile, up to proper scaling, a soliton cigar solution, and the existence of an outer region of persistence of a logarithmic cusp. It recovers rigorously formal asymptotics derived by J.R. King.
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