Analytics of gravitational self-interactions of cosmic strings

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Based on work with Ken D. Olum and J. J. Blanco Pillado

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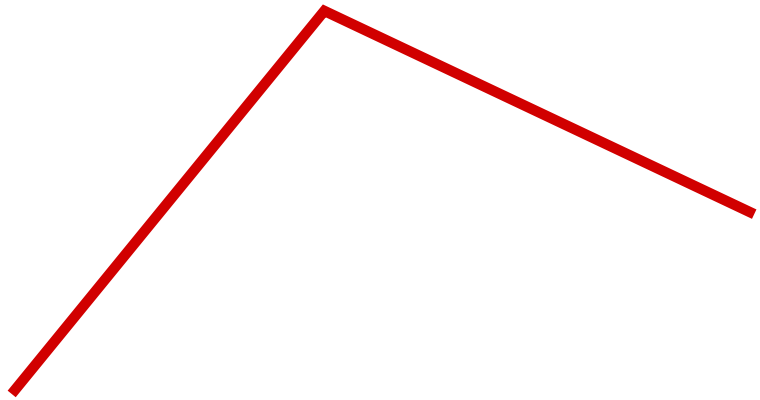
It is known that a point on a smooth worldsheet cannot have a divergent self-force.

The worldsheet near kinks is not smooth



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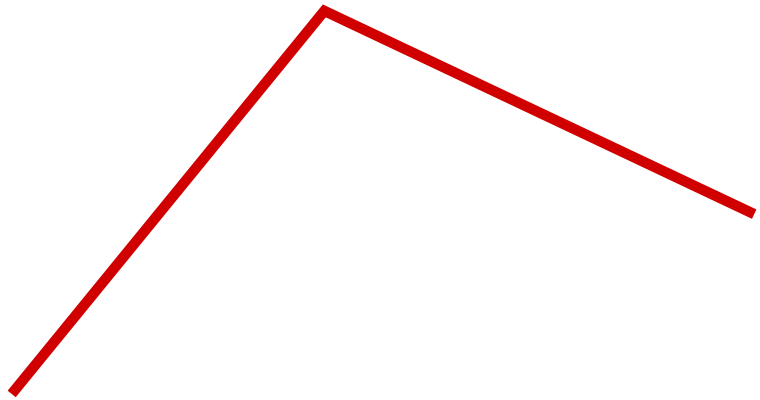

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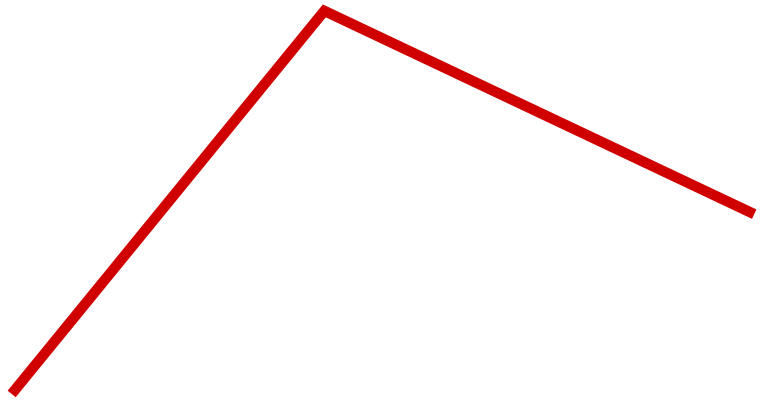

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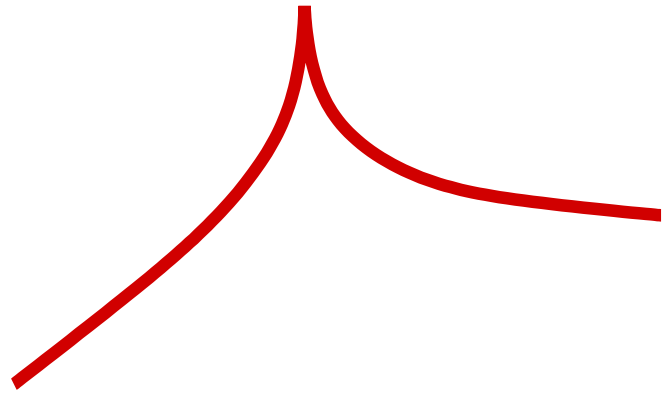
We have calculated that in the directions transverse to the worldsheet,

$$x_{,uv} \propto \frac{G\mu}{\epsilon^{1/3}}$$

for points nearby the kink on its past side.

The worldsheet near cusps is not smooth



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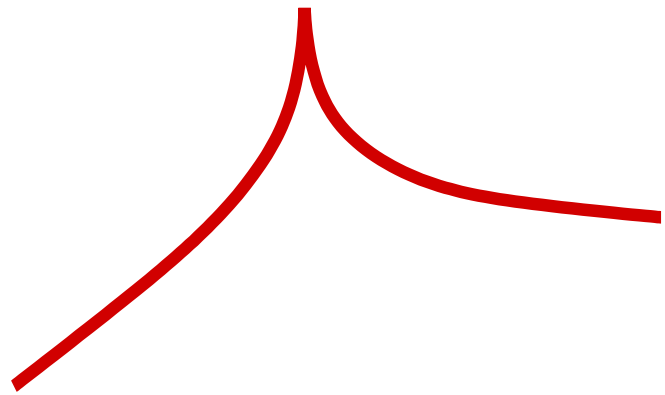

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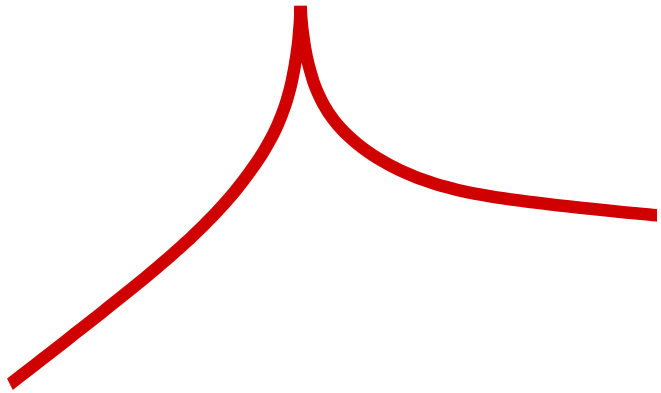

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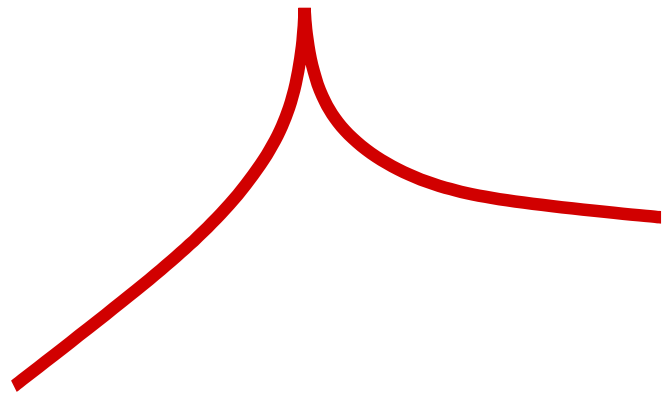

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In the cusp direction,

$$x_{,uv} \propto \frac{G\mu}{s} .$$

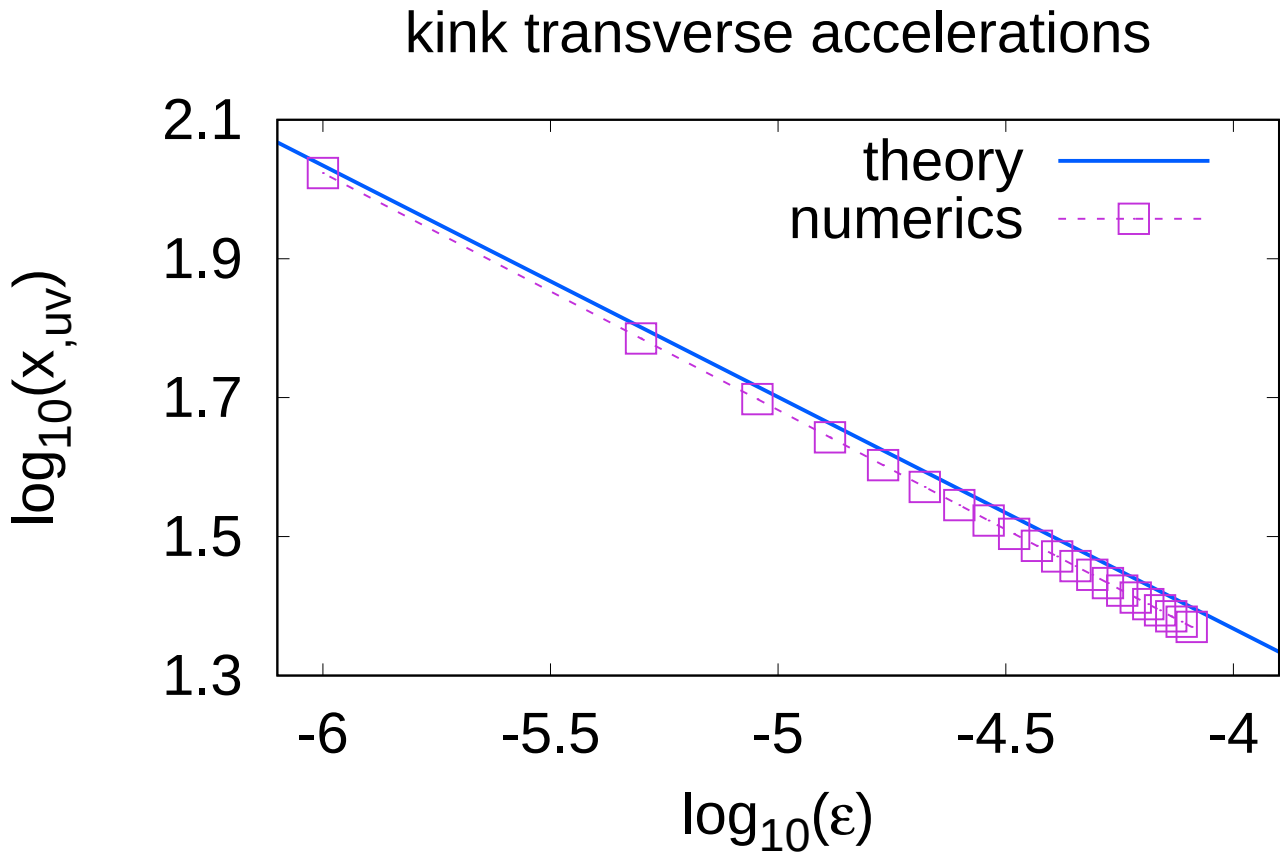
We have developed a code for gravitational self-interactions

Our approach:

1) Describe the loop as piecewise-linear
2) Find the linear metric perturbation due to a single segment
3) For every segment, integrate effects of all sources over one oscillation
4) Repeat until the loop evaporates

Current capability: can evolve a loop with 800 segments to $> 90\%$ evaporation in about a day.

Kinks are smoothed at small scales



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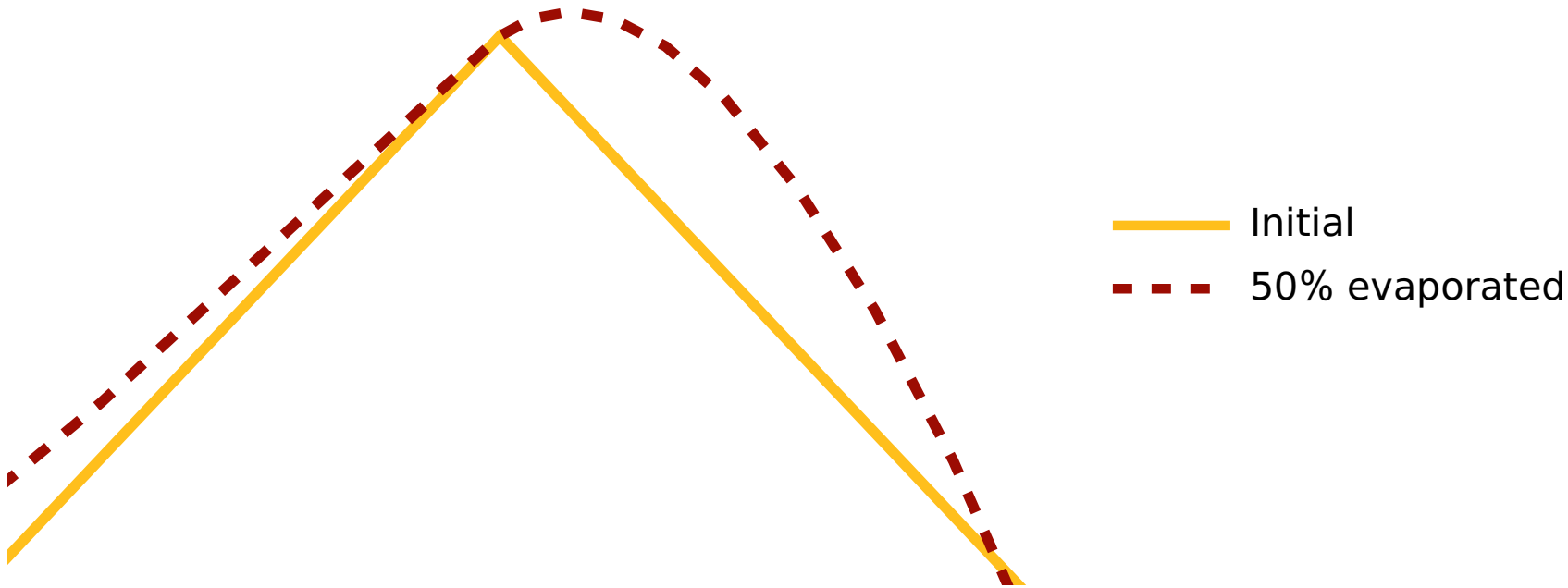

$\sim 0.5\% - 1\%$ of total length shown

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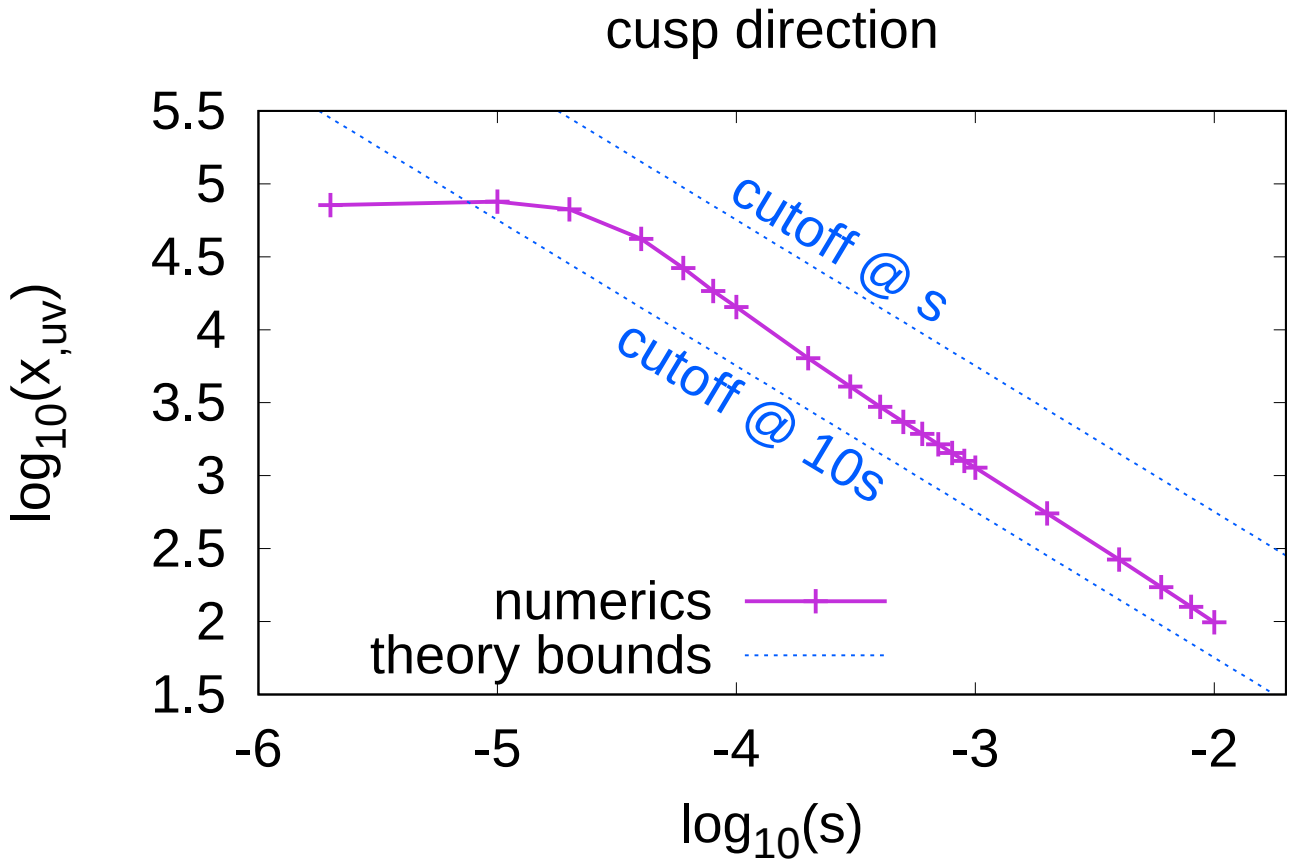

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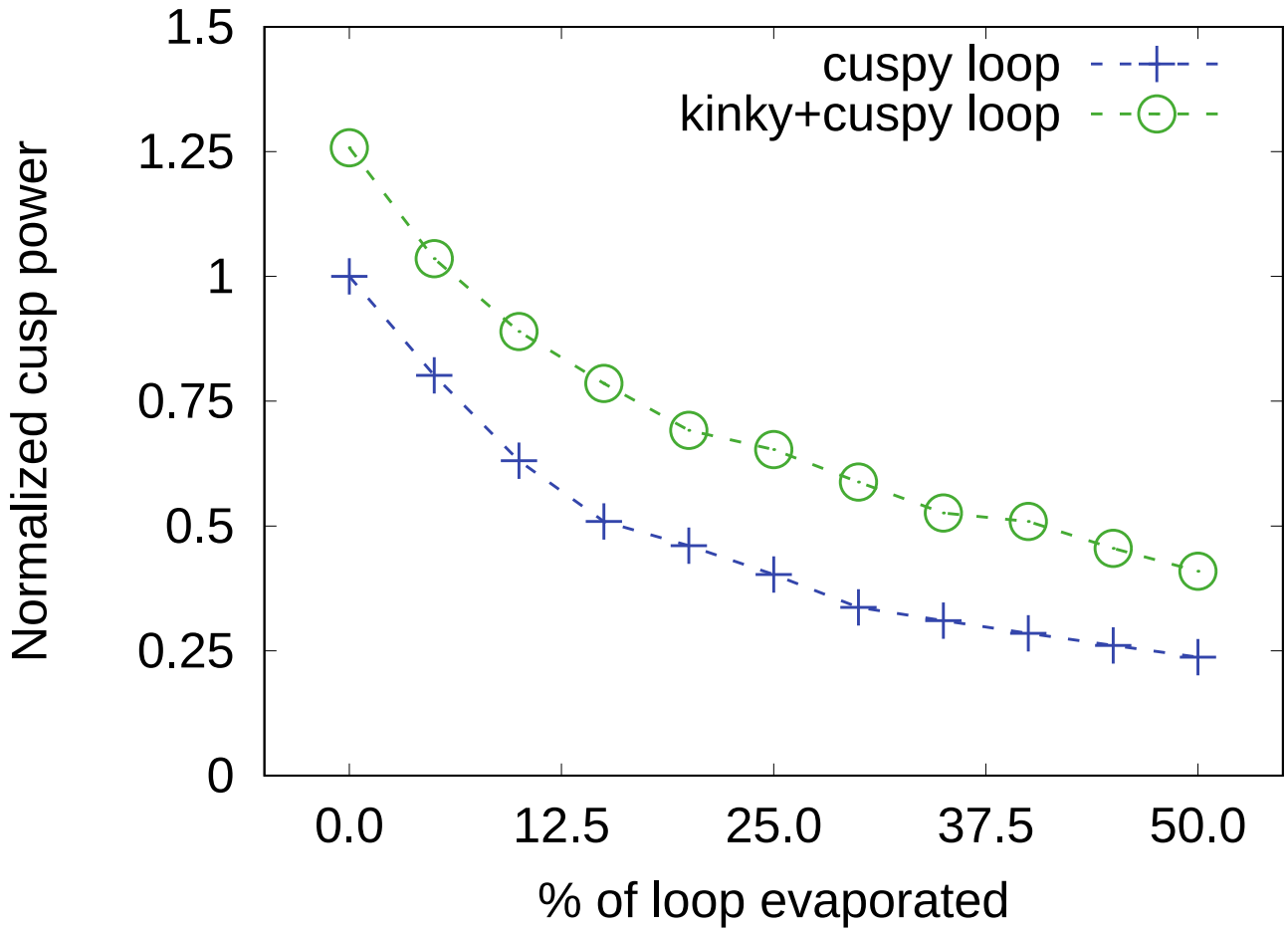

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2) Apply code to realistic loops.
    - Evolve a representative sample and study how the GW spectrum changes.
    - We suspect the stochastic background will only change a little.

Questions?