Soliton configurations and ground states in maximal gauged supergravity

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Outline

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Solitons: special role in classical physics as well as in quantum and string theory, determining a richer structure of the full non-perturbative regime:

- originally used as “bounce solutions” to discuss the possible instability of the pure Kaluza-Klein vacuum ground state;
- generalizations of these soliton solutions have been also considered in the analysis of the semiclassical stability of non-susy AdS gravity;
- soliton configurations can turn out to be the lowest energy solution with chosen boundary conditions, leading to a new kind of positive energy conjecture;

- it is possible to consider configuration featuring Wilson loops:

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4. We consider an explicit solutions in the T^3 model, the latter resulting in a single dilaton truncations of the maximal $SO(8)$ gauged supergravity in $D = 4$.

We restrict to purely magnetic solutions. The action has the explicit form:

$$\mathscr{S} = \frac{1}{8\pi G} \int d^4x \sqrt{-g} \left(\frac{R}{2} - \frac{1}{2} (\partial\phi)^2 + \frac{3}{L^2} \cosh\left(\sqrt{\frac{2}{3}}\phi\right) - \frac{1}{4} e^{3\sqrt{\frac{2}{3}}\phi} \left(F^1\right)^2 - \frac{1}{4} e^{-\sqrt{\frac{2}{3}}\phi} \left(F^2\right)^2 \right).$$

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- in the model we consider there are two Wilson lines,

$$\Phi_M^1 = \int F^1, \qquad \Phi_M^2 = \int F^2,$$

and there is a one-parameter family of values of the Wilson lines which give supersymmetric solitons;

- the explicit solution has the schematic form

$$\phi = \pm \ell^{-1} \ln(x), \qquad F^{\Lambda}_{\mu\nu}(x, \Gamma^{\Lambda}),$$

$$ds^2 = \Upsilon(x) \left(L^2 \, dt^2 - \frac{\eta^2}{f(x)} \, dx^2 - f(x) \, d\psi^2 - L^2 \, dz^2 \right) ;$$

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$\Longrightarrow$ new kind of degeneracy of supersymmetric solutions;

$\Longrightarrow$ surprisingly, there is a family of non-susy solutions of lower energy and free energy than the susy ones.

The model Thermodynamics, boundary conditions

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- Regularity of the metric at $x = x_0$ requires $\varphi \in [0,\Delta]$ where

$$\Delta^{-1} = \left| \frac{1}{4\pi\eta} \frac{df}{dx} \right|_{x=x_0} ;$$

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- The scalar field induces a vev of an operator in the dual theory,

$$\langle \mathcal{O} \rangle = \phi_0 = \pm \frac{\sqrt{6}}{2} \frac{\pi x_0 \left|\psi_1^2 \left(1 + 2 x_0^2\right) - \psi_2^2\right|}{\Delta} \,.$$

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  - fixed charges, holding fixed $Q_1, Q_2 \;\Rightarrow\;$ 0 to 4 sols.

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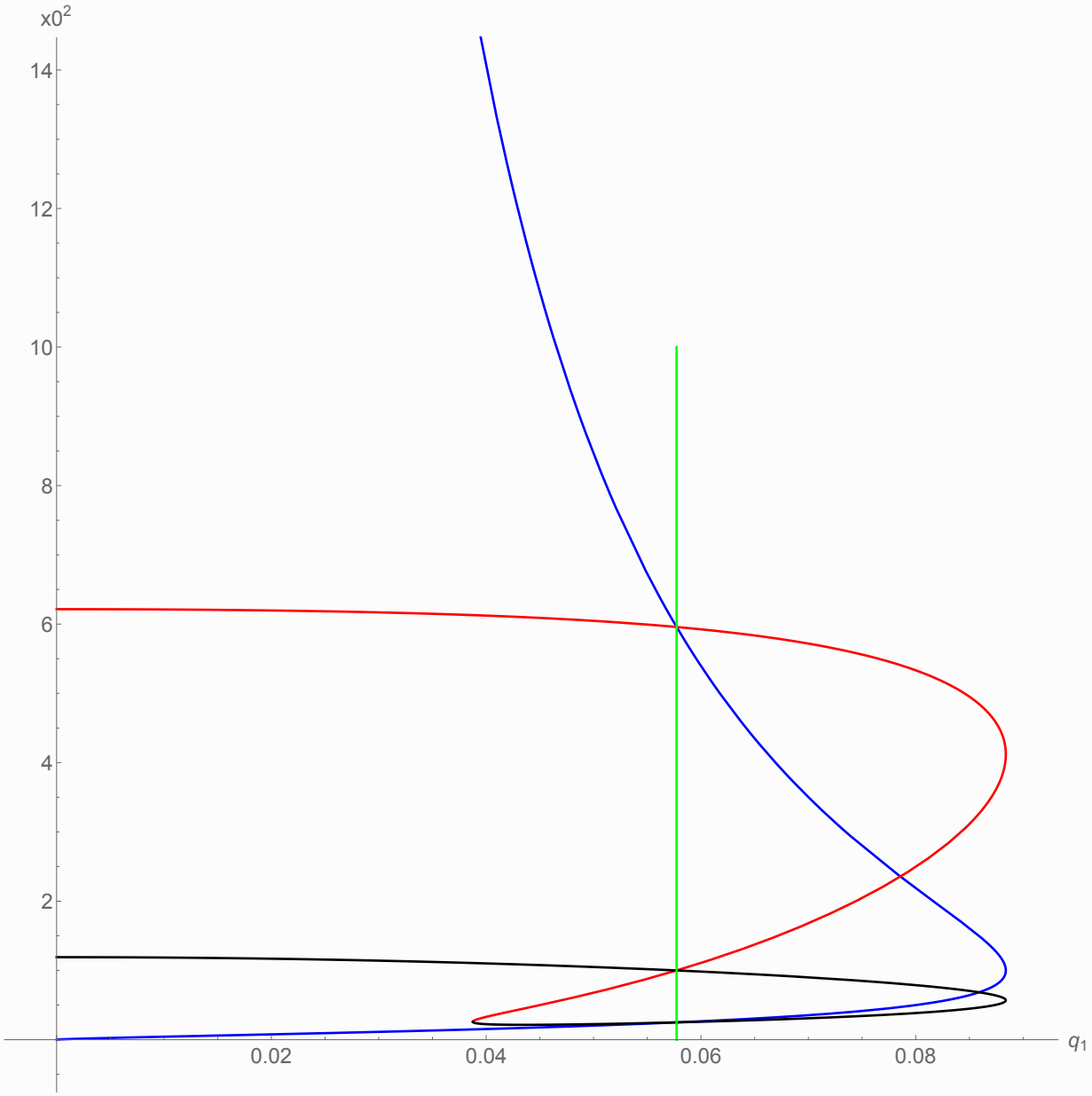
- for fixed charge boundary conditions there are 2 distinct susy soliton configurations (degeneracy of supersymmetric solutions);
- for the same fixed charge boundary conditions, surprisingly a family of non-susy solutions of lower energy and free energy than the supersymmetric ones can be found.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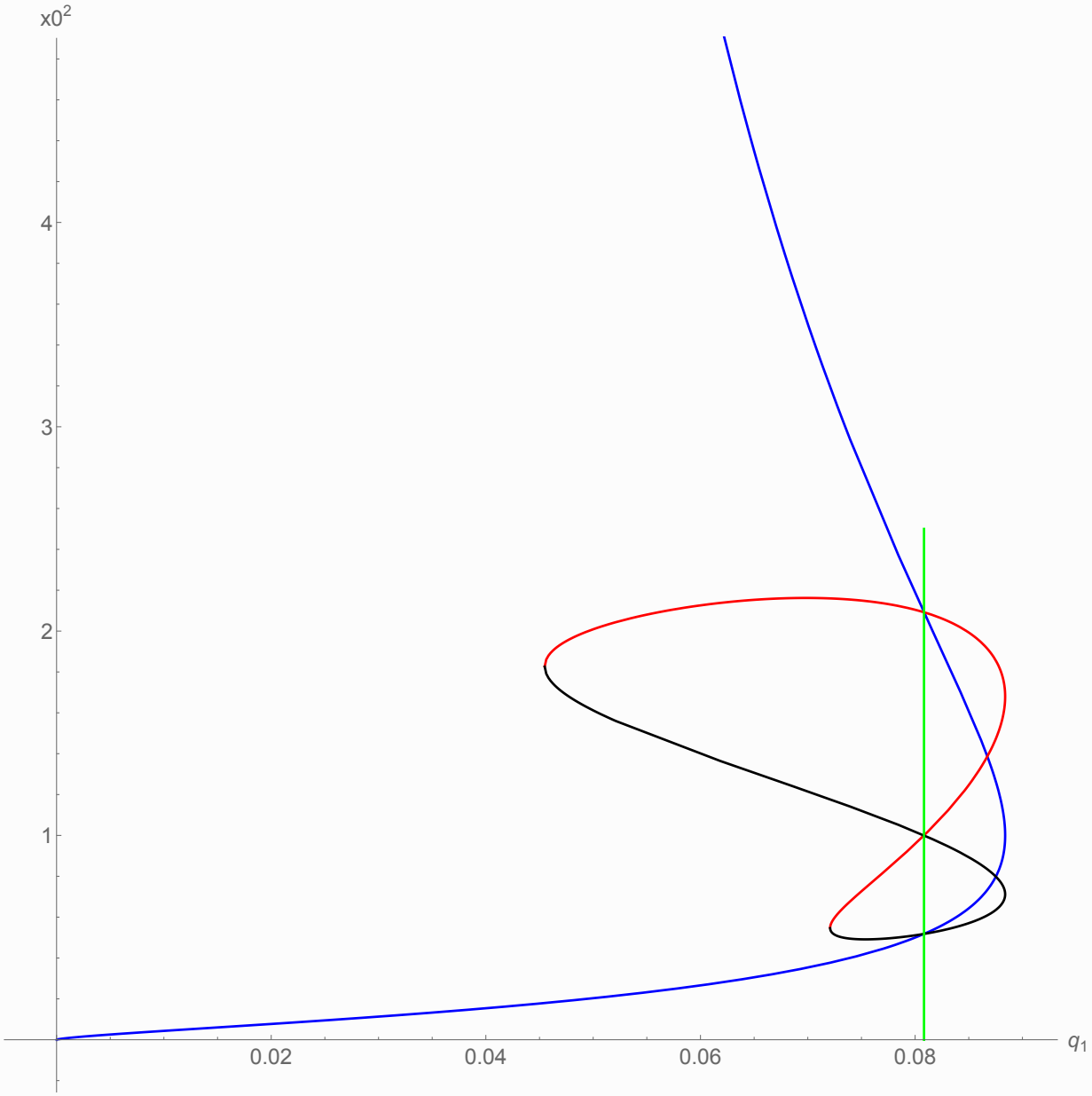
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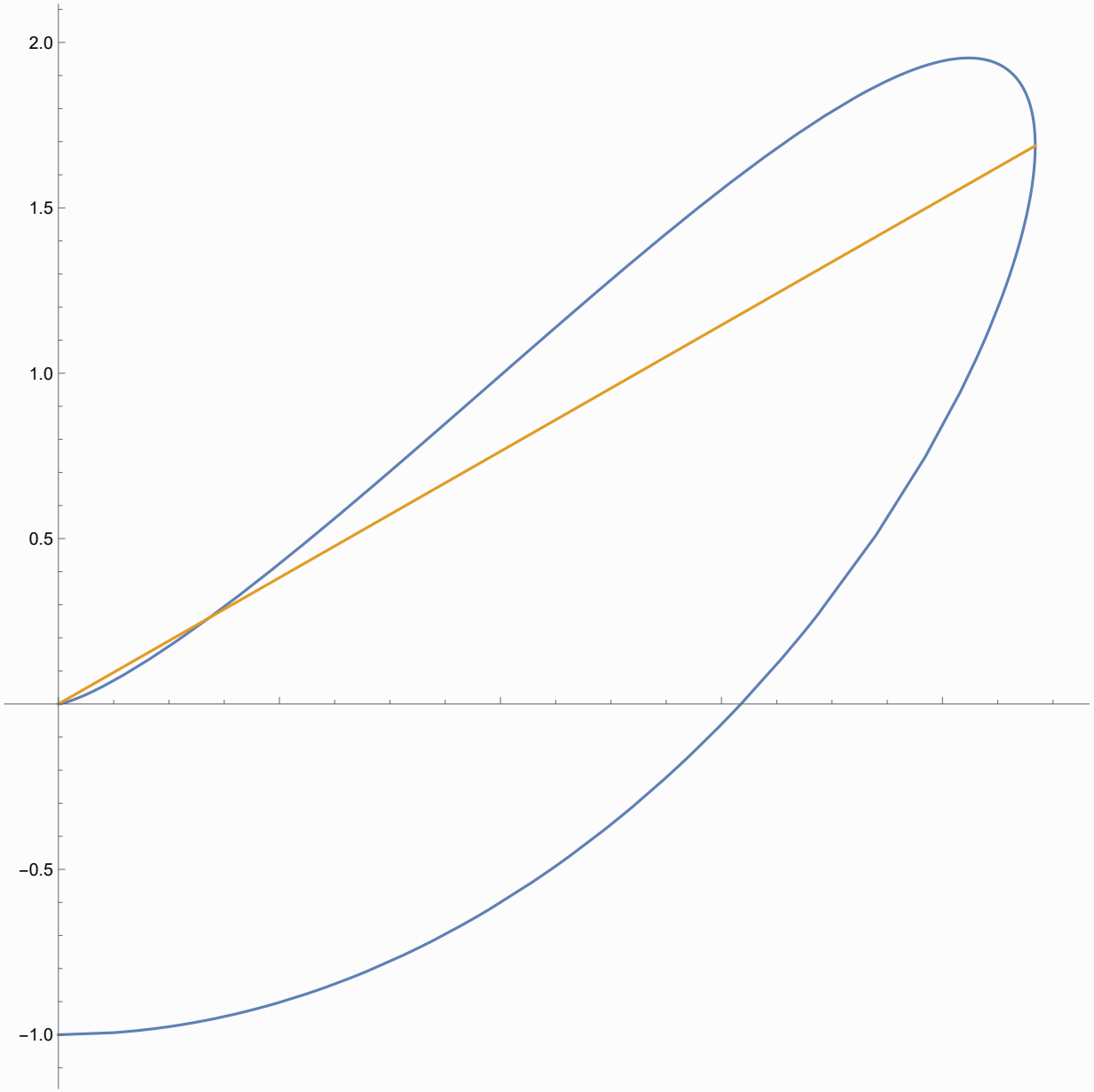
The model Canonical



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4. The new solutions require a more in-depth study of the degeneracy of the susy configurations in the presence of generic boundary conditions.

Conclusions Distinctive features

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3. For supersymmetry-preserving fixed charge boundary conditions there are two distinct soliton solutions.

4. The new solutions require a more in-depth study of the degeneracy of the susy configurations in the presence of generic boundary conditions.

5. One branch of susy solutions has higher energy than a non-susy one with the same boundary conditions.

Thank you for listening!