Periodic solutions to a forced Kepler problem in the plane

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We investigate the following forced Kepler problem in the plane:

$$\ddot{x} = -\frac{x}{|x|^3} + \nabla_x U(t,x), \qquad x \in \mathbb{R}^2 \setminus \{(0,0)\},$$

where $U(t,x)$ is T-periodic in the first variable and satisfies $U(t,x) = \mathcal{O}(|x|^\alpha)$ for some $\alpha \in (0,2)$ as $|x| \to \infty$. We look for a T-periodic solution which minimimizes the corresponding action functional on a space of loops which are not null-homotopic in the punctured plane.

On one hand, we do not impose further symmetry conditions on the perturbation's potential U. On the other, the solution we find is generalised, according to the definition given in the paper [Boscaggin, Ortega, Zhao, *Periodic solutions and regularization of a Kepler problem with time-dependent perturbation*, Trans. Amer. Math. Soc. **372** (2018), 677–703]. In particular, such solution may have a finite number of collisions with the origin in each period, while its energy and bouncing directions behave in a regular way at each collision time.