Cometary motion on hyperbolic orbit

Determine a parametric representation \( x(\xi), y(\xi), t(\xi), \vartheta(\xi) \) for the hyperbolic motion in time of a comet with mass \( m \) in the central force potential \( V(r) = -\kappa/r \). Start from the orbital equation \( r(\vartheta) \) from [msl23] and the general integral expression for \( t(r) \) from [mln18]. Then use the parametrization \( \tilde{a} + r = \tilde{a} e \cosh \xi \) with \( \tilde{a} = \kappa/2E \) and \( e^2 = 1 + 2E\ell^2/m\kappa^2 \) with \( E > 0 \), as well as \( p = \tilde{a}(e^2 - 1) \).

Solution: