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Photon sphere for a dyonic black hole corresponding to A_2 Toda chain

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We consider a dilatonic dyon black hole solution with a gravitational radius of 2μ and two charges, Q_1 (electric) and Q_2 (magnetic), within the framework of a four-dimensional gravitational model comprising one scalar field and one 2-form. The dilaton coupling constant λ is fixed by $\lambda^2 = \frac{3}{2}$. This solution is related to the A_2 Toda chain. The circular orbits of null geodesics are explored, and the fifth-order polynomial master equation governing the photon sphere radius R_0 is analyzed. It is shown to admit a unique solution satisfying $R_0 > 2\mu$. The circular null geodesics are proven to be unstable. Finally, the black hole shadow is examined, yielding relations for the shadow angle and the critical impact parameter.

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