

Title: Three thoughts about black holes and cosmology

Date: Mar 16, 2009 11:00 AM

URL: <http://pirsa.org/09030034>

Abstract: I will present three ideas about black holes and cosmology. First, I will discuss a way of understanding the simple patterns which emerge from the notoriously thorny numerical simulations of binary black hole merger, and some of the directions where this understanding may lead. Second, I will suggest a sequence of practical bootstrap tests designed to give sharp observational confirmation of the essential idea underlying the inflationary paradigm: that the universe underwent a period of accelerated expansion followed by a long period of decelerated expansion. Third, I will investigate a way that one might try to detect the strong bending of light rays in the vicinity of a black hole.

Latham Boyle (CITA)

Three Thoughts
About Black Holes and Cosmology

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1. Binary Black Hole Merger: Symmetry and the Spin Expansion

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1. Binary Black Hole Merger: Symmetry and the Spin Expansion
2. Light Loop Echoes and Blinking Black Holes

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2. Light Loop Echoes and Blinking Black Holes
3. Testing Inflation: A Bootstrap Approach

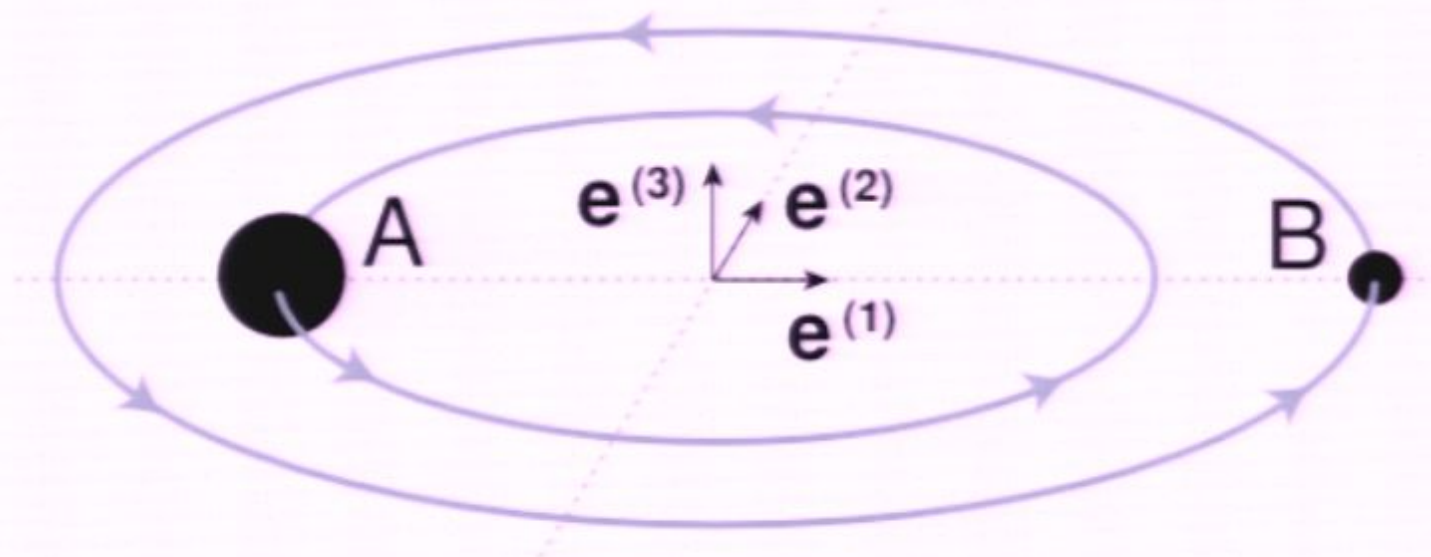
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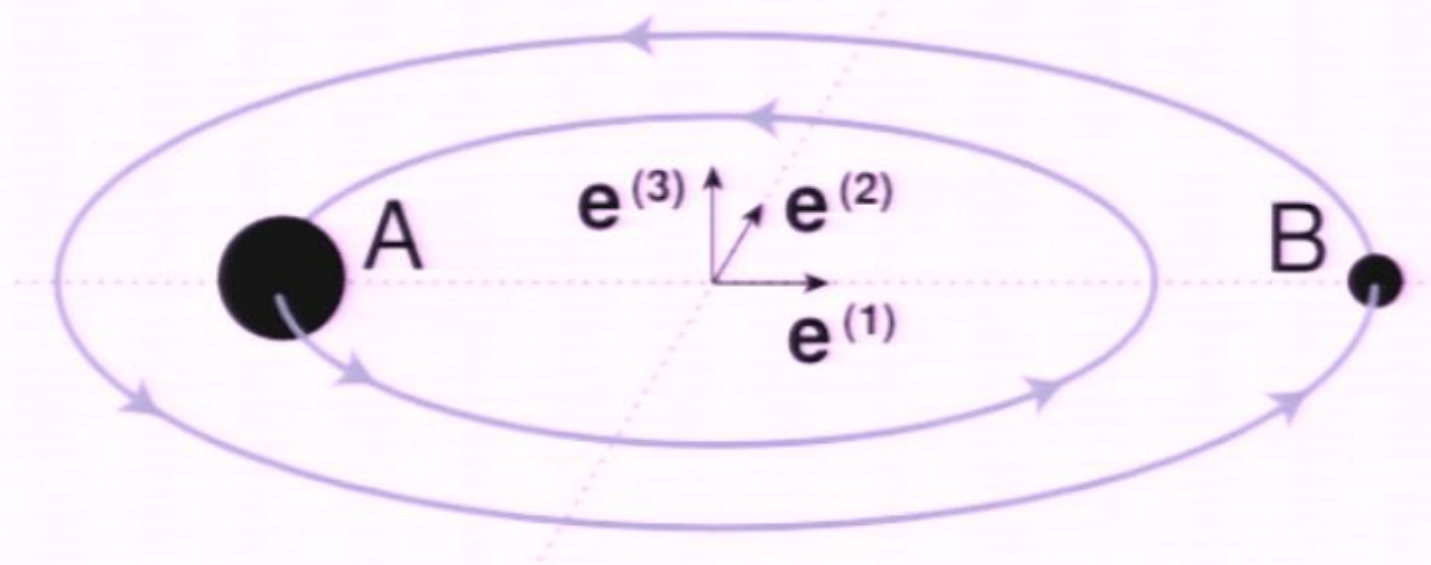
Part 1:

Binary Black Hole Merger: Symmetry and the Spin Expansion



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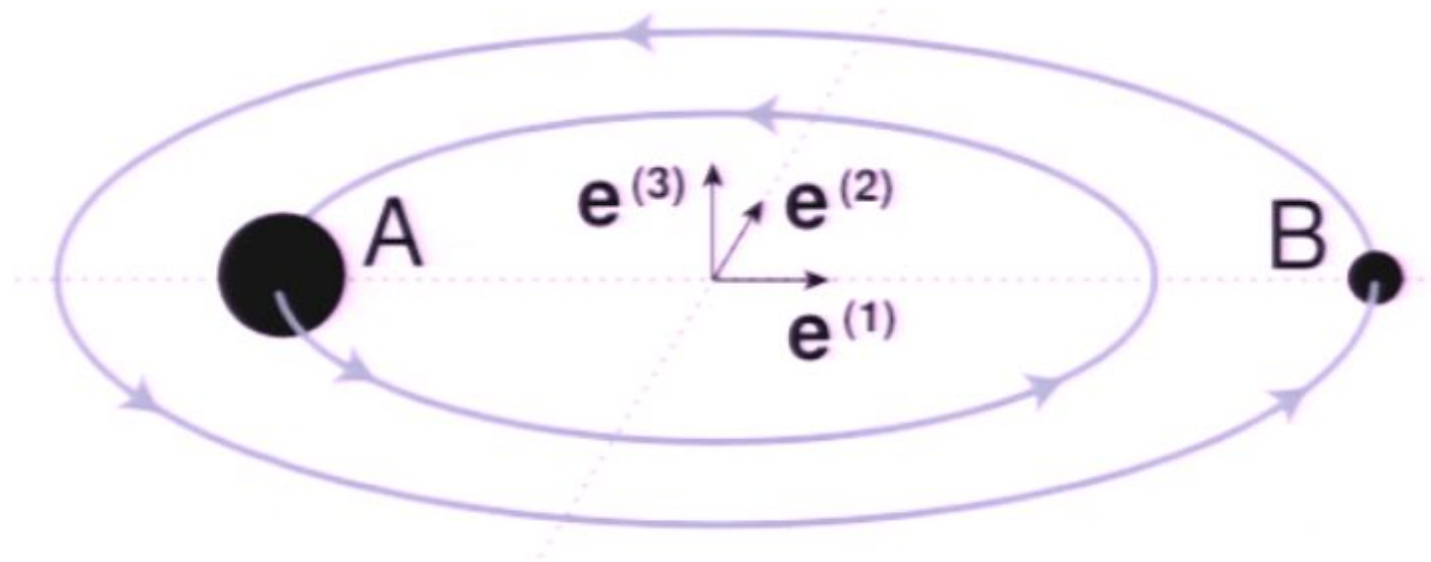
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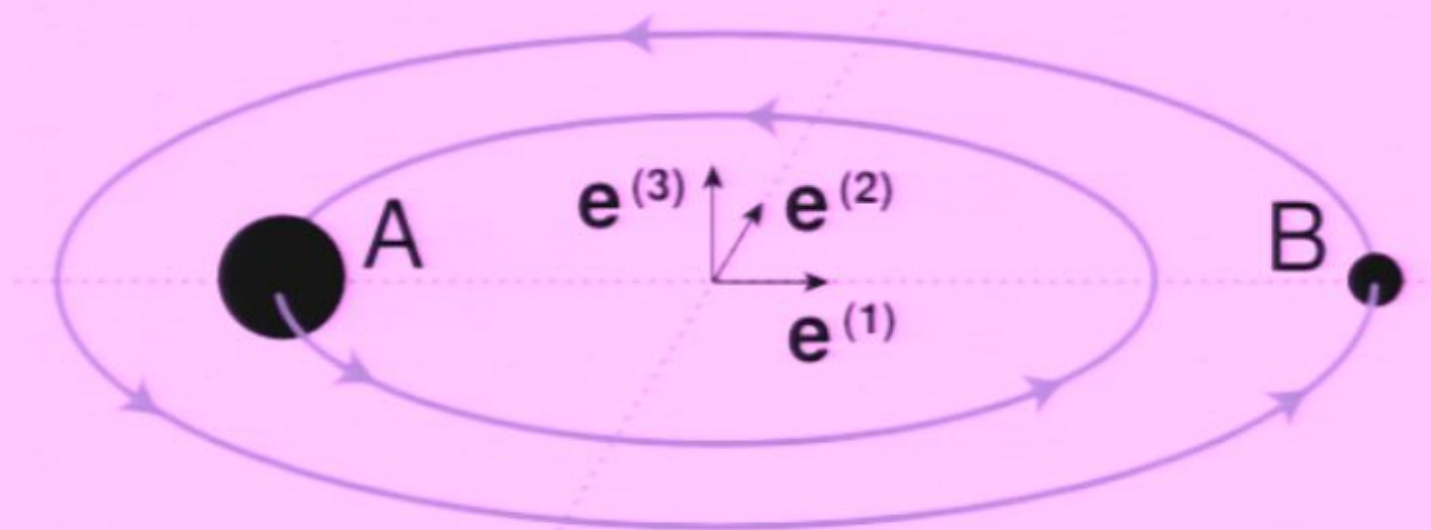
- 1) L. Boyle, M. Kesden, S. Nissanke, Phys. Rev. Lett. 151101 (2008)
- 2) L. Boyle, M. Kesden, Phys. Rev. D78, 024017 (2008)



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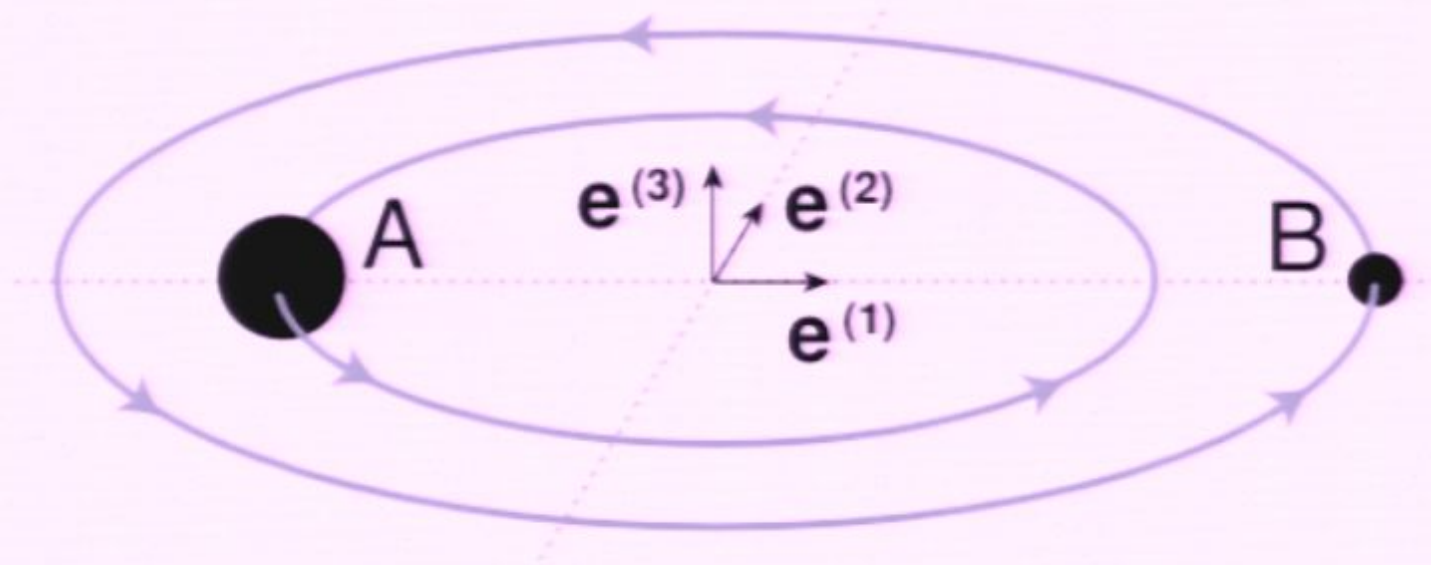
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$$k_1 = k_1(q, a_1, a_2, a_3, b_1, b_2, b_3)$$

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$$k_1 = k_1^{m_1 m_2 m_3 | n_1 n_2 n_3} a_1^{m_1} a_2^{m_2} a_3^{m_3} b_1^{n_1} b_2^{n_2} b_3^{n_3}$$

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$$k_1 = k_1^{001|000} (a_3 - b_3)$$

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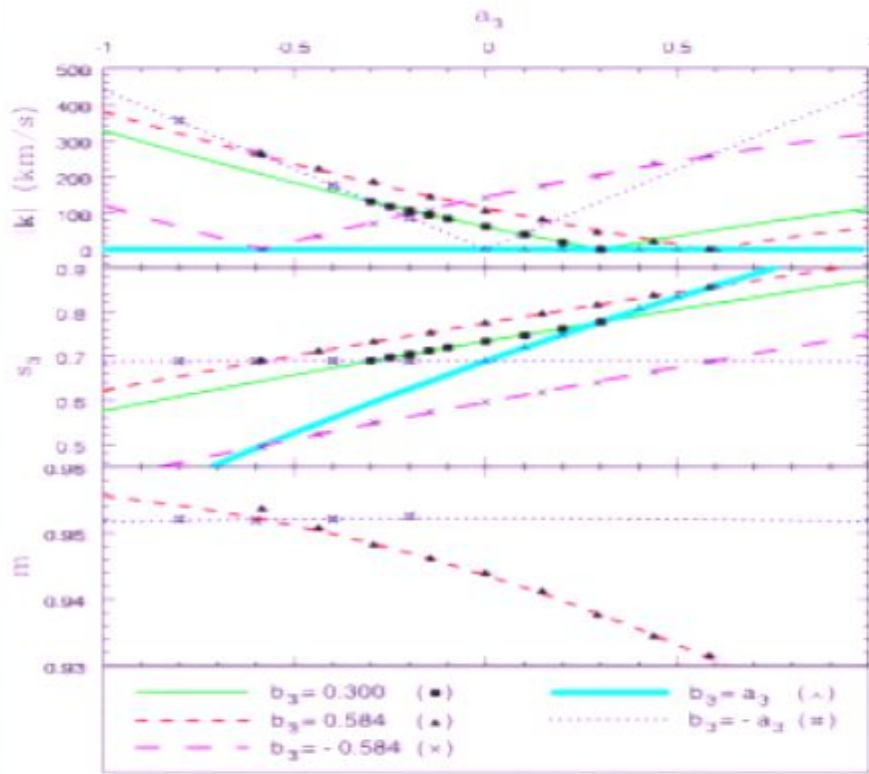
$$k_1 = k_1^{m_1 m_2 m_3 | n_1 n_2 n_3} a_1^{m_1} a_2^{m_2} a_3^{m_3} b_1^{n_1} b_2^{n_2} b_3^{n_3}$$

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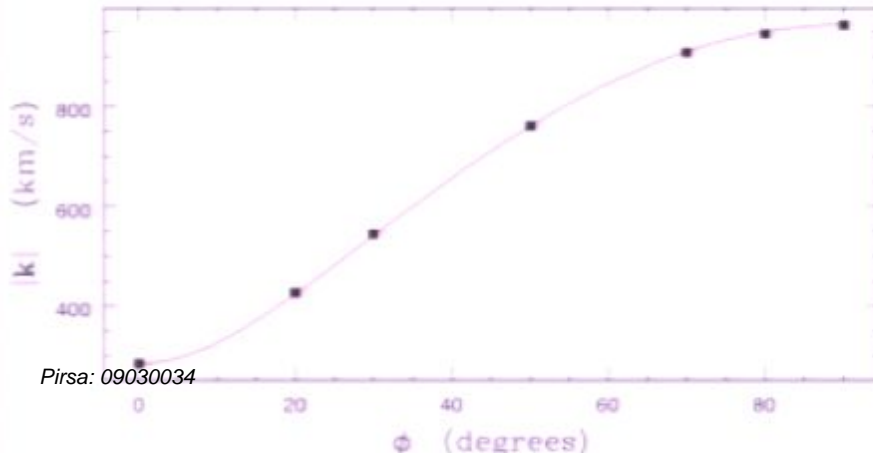
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$$\begin{aligned} k_1 &= k_1^{001|000} (a_3 - b_3) \\ &+ k_1^{200|000} (a_1^2 - b_1^2) + k_1^{020|000} (a_2^2 - b_2^2) + k_1^{002|000} (a_3^2 - b_3^2) \\ &+ k_1^{110|000} (a_1 a_2 - b_1 b_2) + k_1^{100|010} (a_1 b_2 - b_1 a_2) \end{aligned}$$

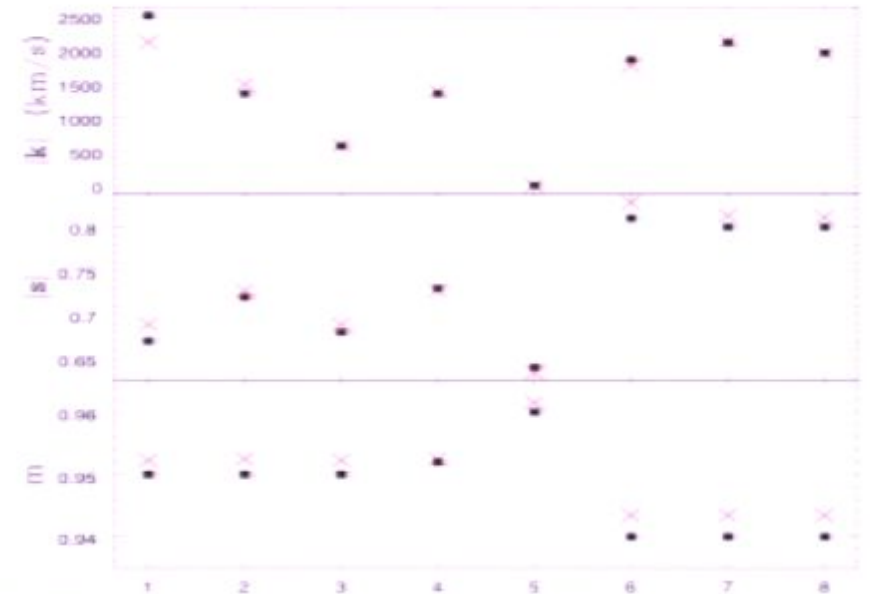


L. Rezzolla et al, arXiv:0708.3999

F. Herrmann et al, arXiv:0706.2541



Pirsa: 09030034



W. Tichy et al, gr-qc/0703075

M. Campanelli et al, PRL 98, 231102 (2007)

B. Bruggmann et al, arXiv:0707.0135



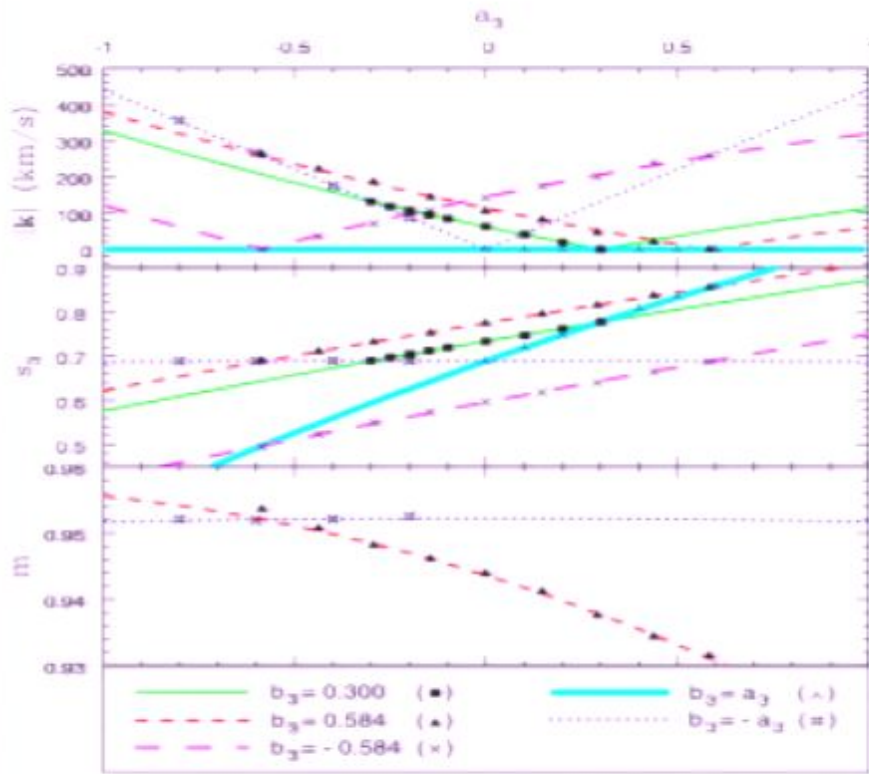
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$$\lambda = \frac{1}{\frac{1}{6} + \frac{1}{6}}$$

$$\lambda = 3$$

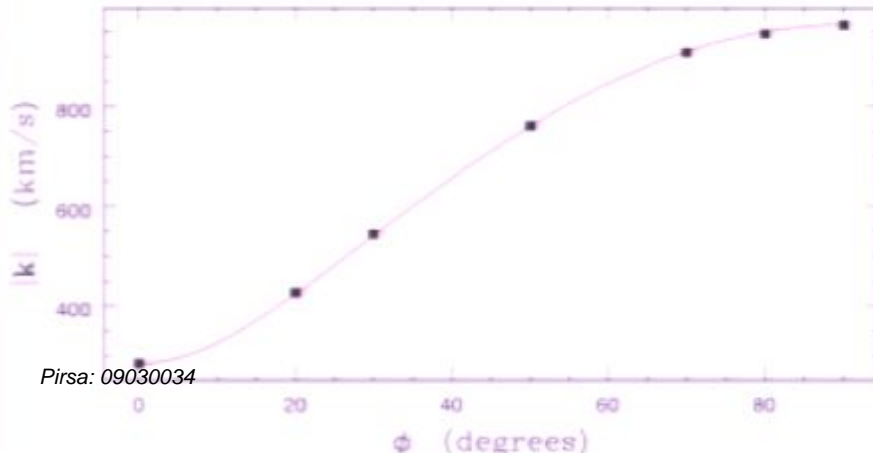
$$| \lambda > 1 |$$

OS / AKI

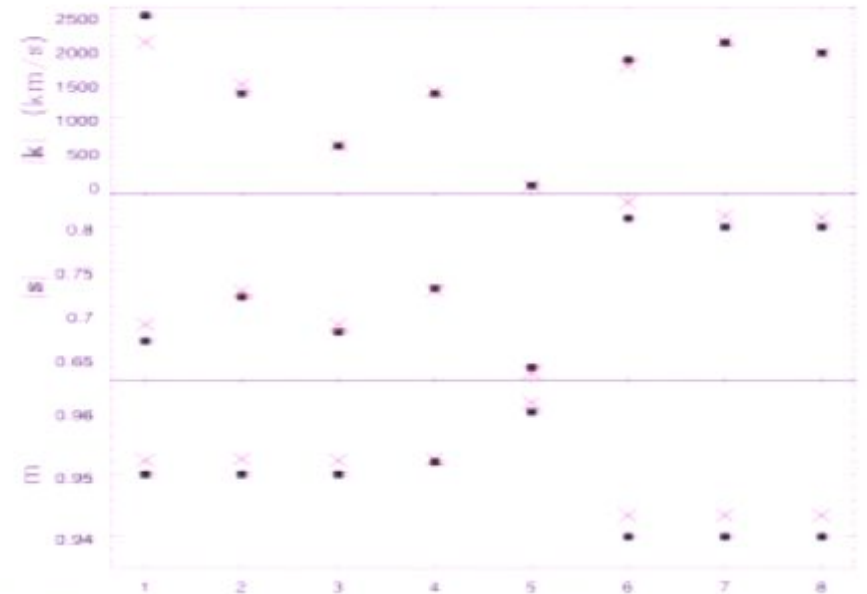


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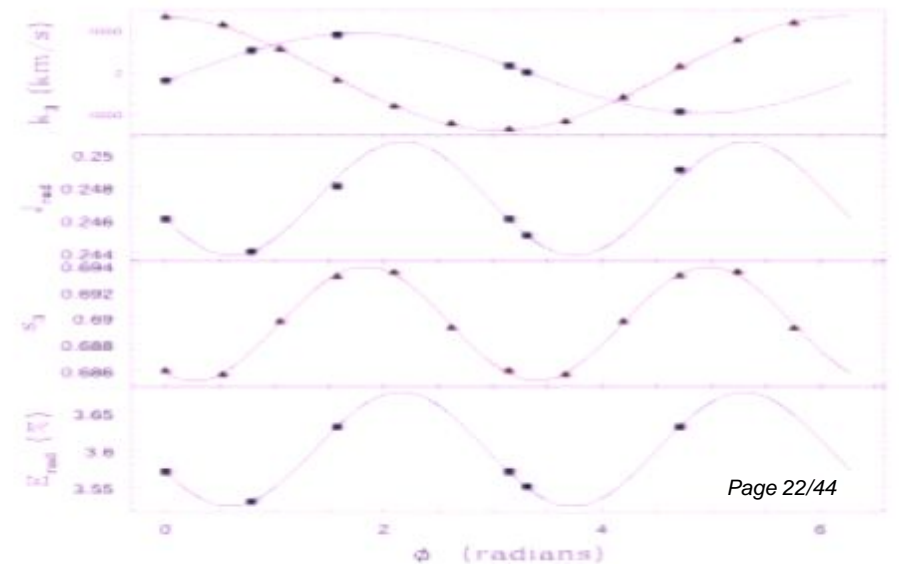
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$$\alpha = \frac{q-1}{q+1}$$

$$0 \leq \alpha < 1$$

$$0 < q < \infty$$

$$-1 < \alpha < 1$$

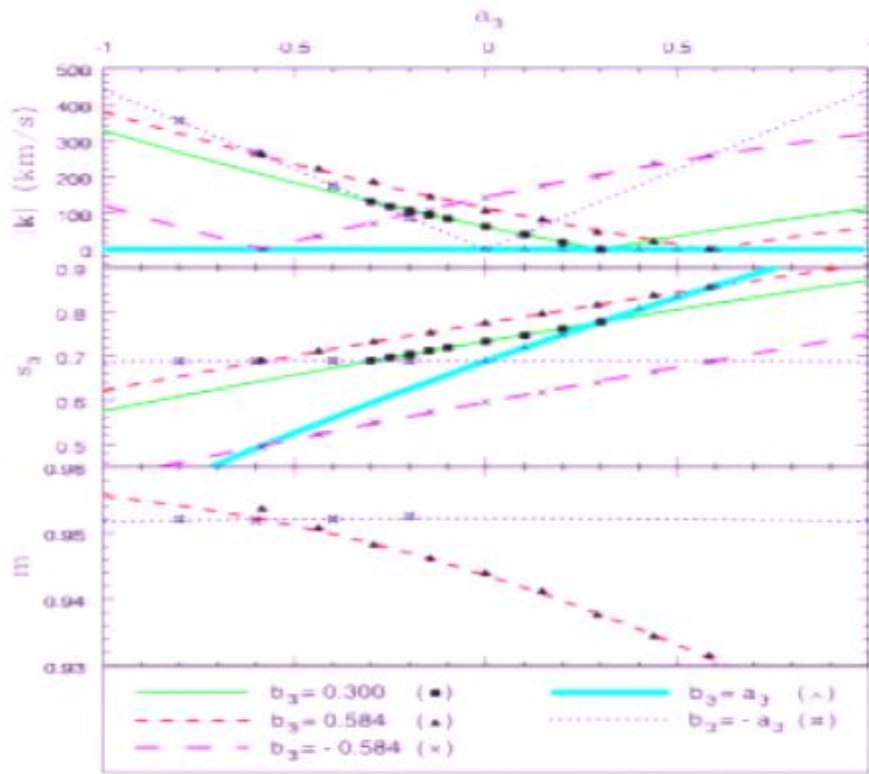
$$q = \frac{1}{1-\alpha}$$

$$\alpha \rightarrow -\alpha$$

$$q = 1$$

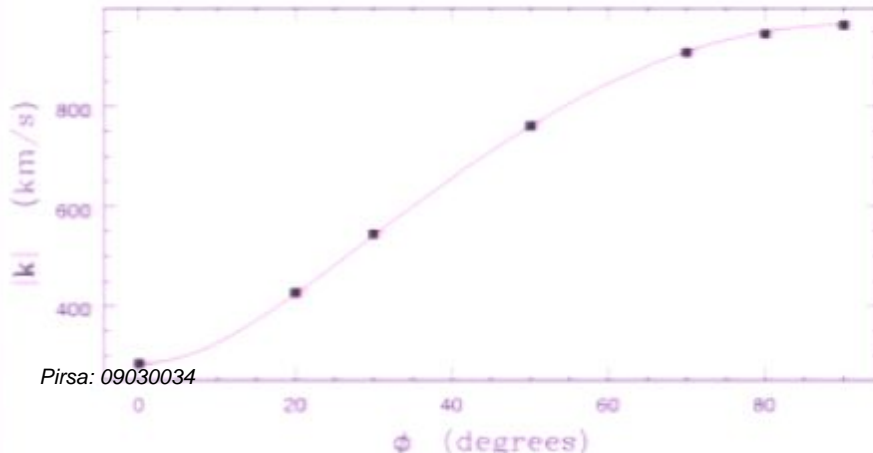
$$\alpha = 0$$

λ

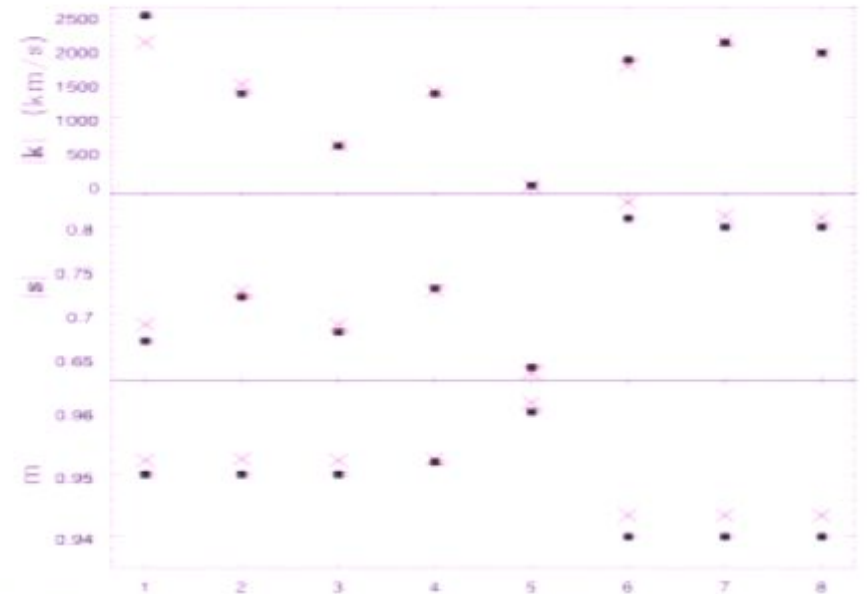


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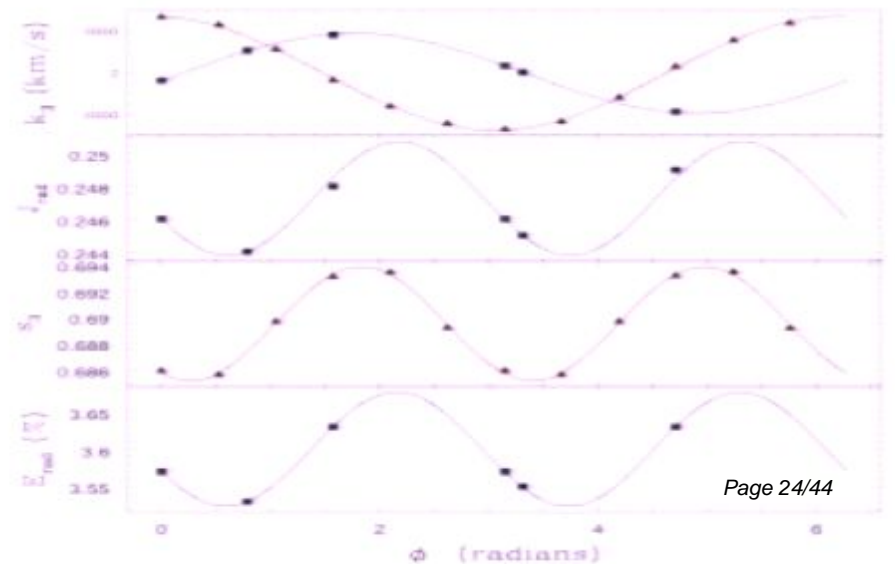
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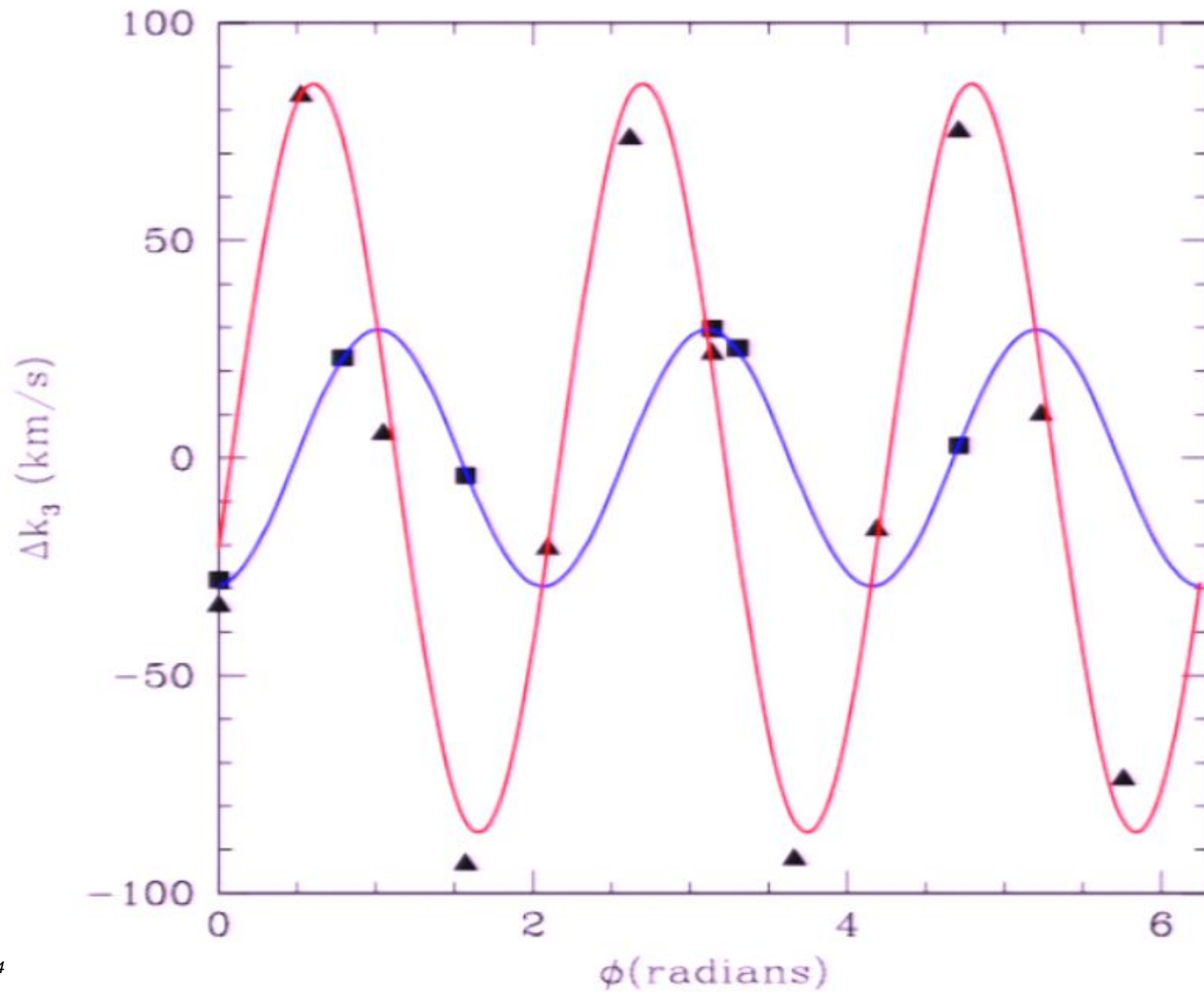
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- Efficient (see W. Tichy & P. Marronetti: arXiv:0807.2985)

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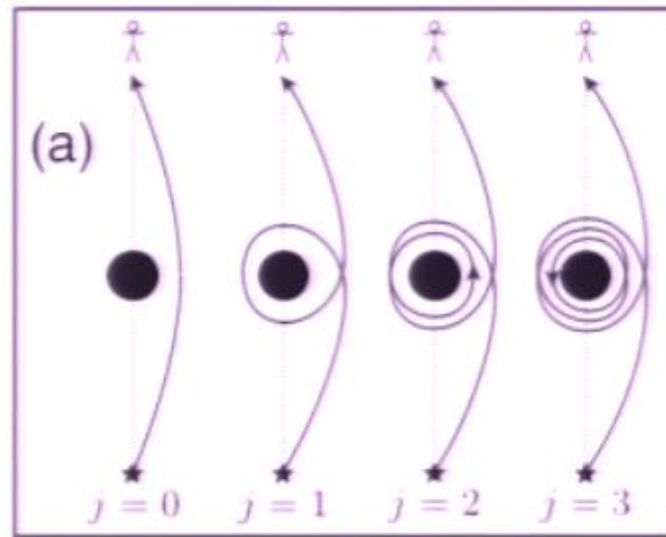
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- Useful for astrophysics and cosmology
(N-body simulations, BH distributions, waveforms...)

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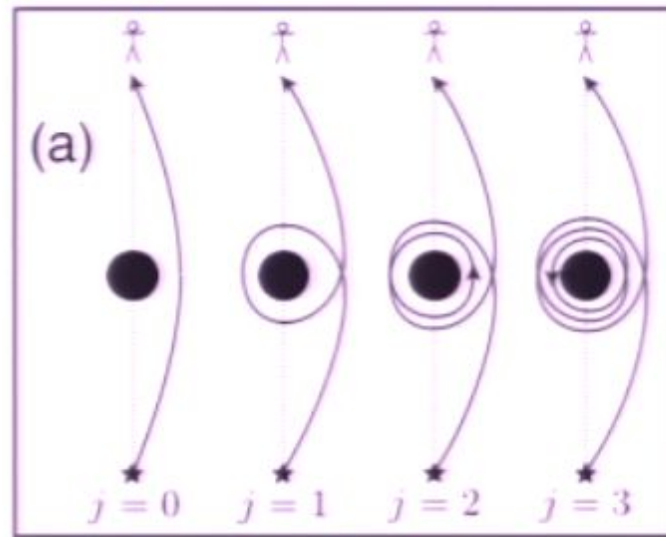
- Efficient (see W. Tichy & P. Marronetti: arXiv:0807.2985)
- Useful for astrophysics and cosmology
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- Theoretically interesting.

Part 2. Light-Loop Echoes and Blinking Black Holes

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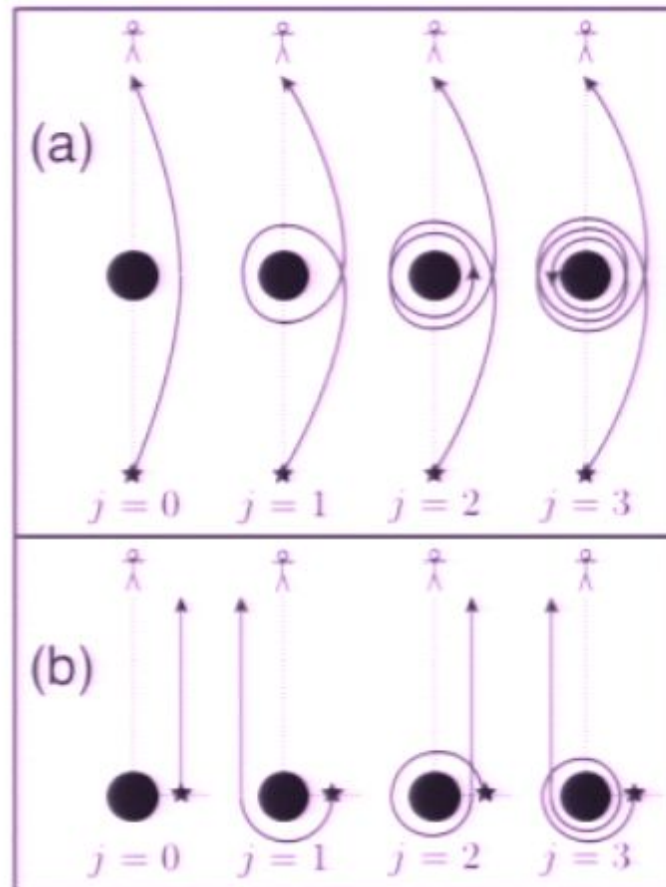


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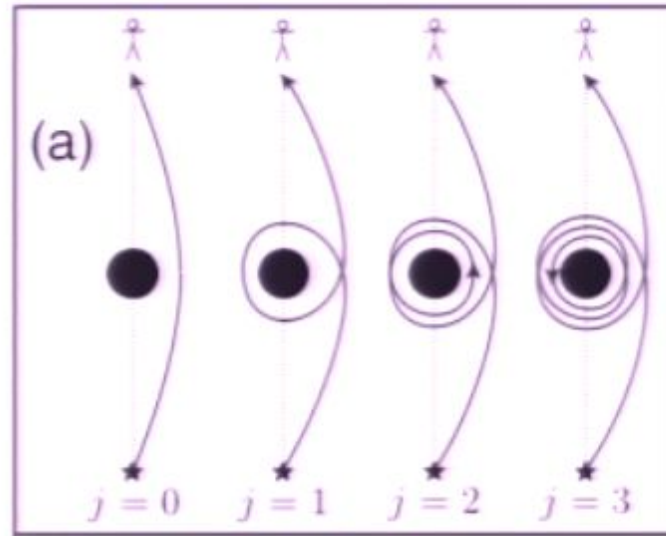


$$\mu_j / \mu_0 \approx 4(9 - 3\sqrt{3})^4 (MD_S / D_L D_{LS})^{3/2} e^{-(2j+1)\pi}$$

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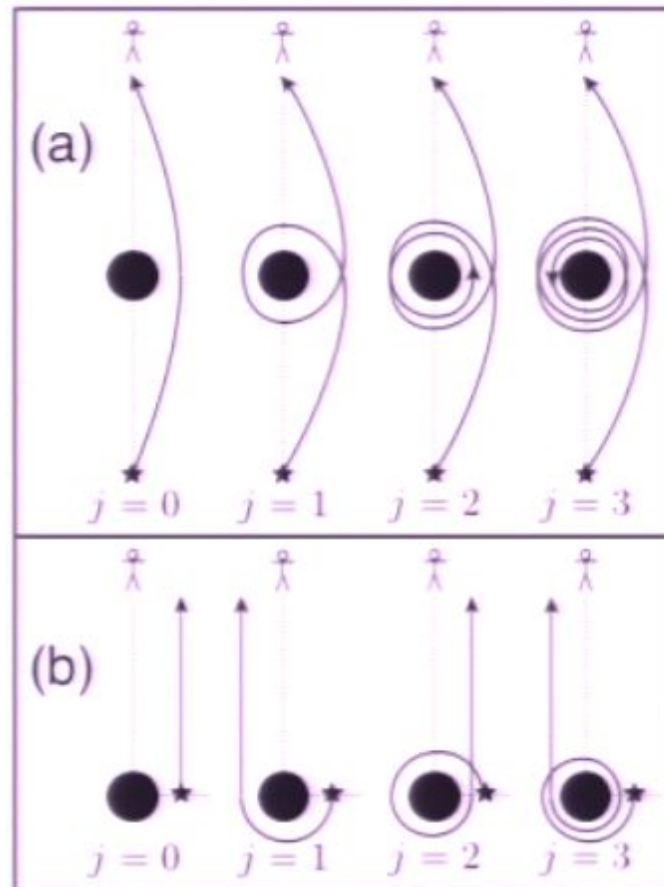


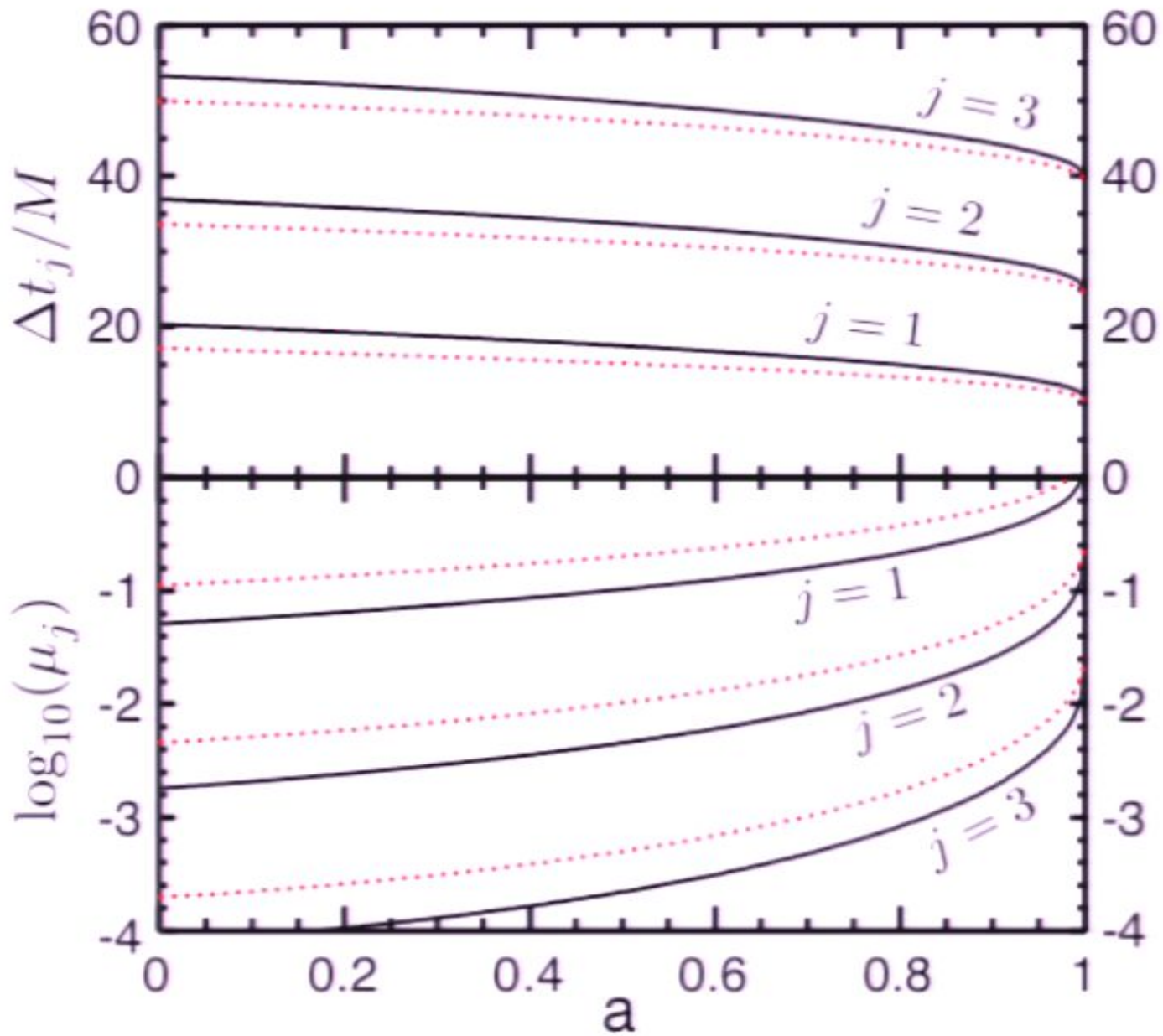
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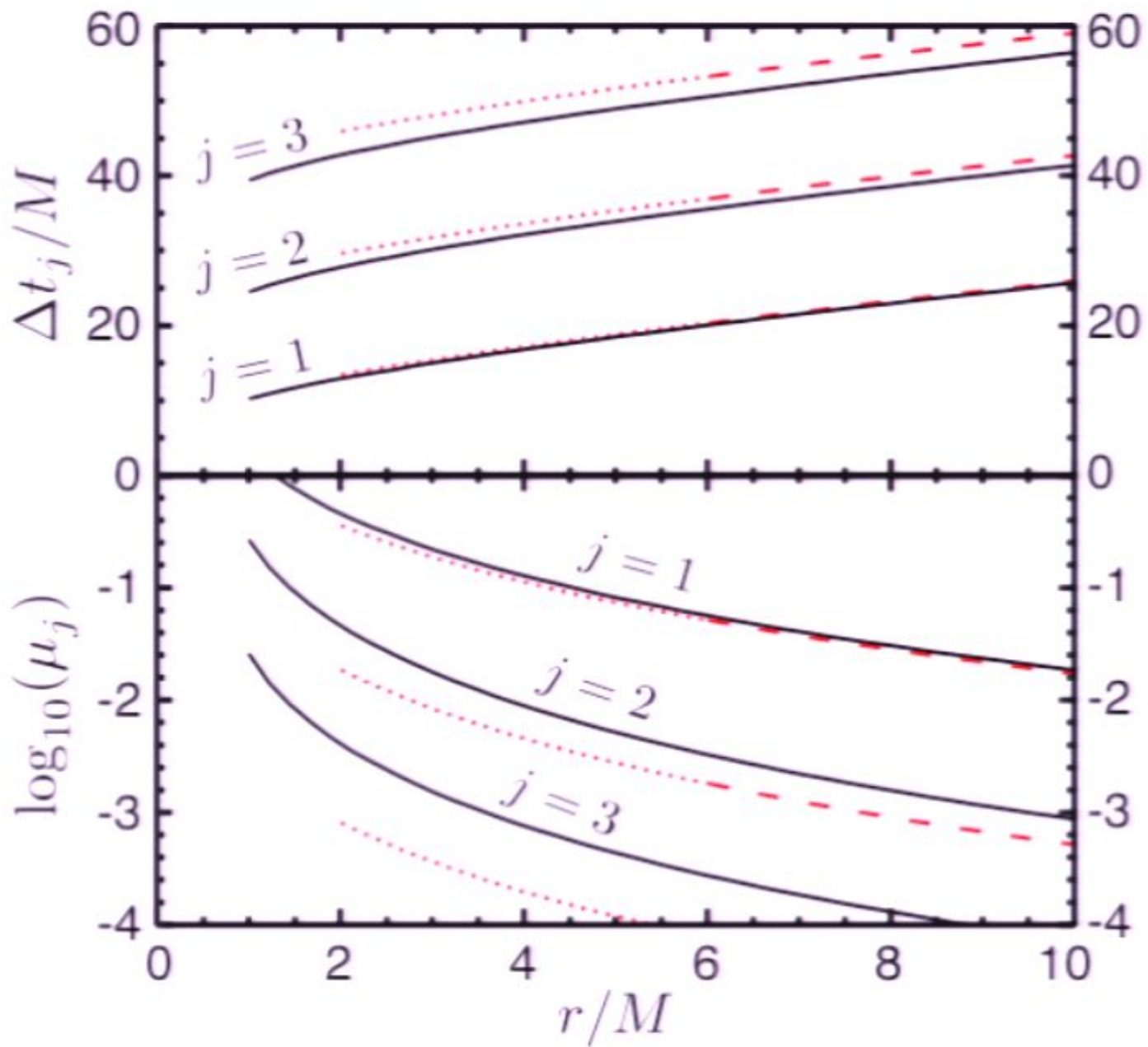


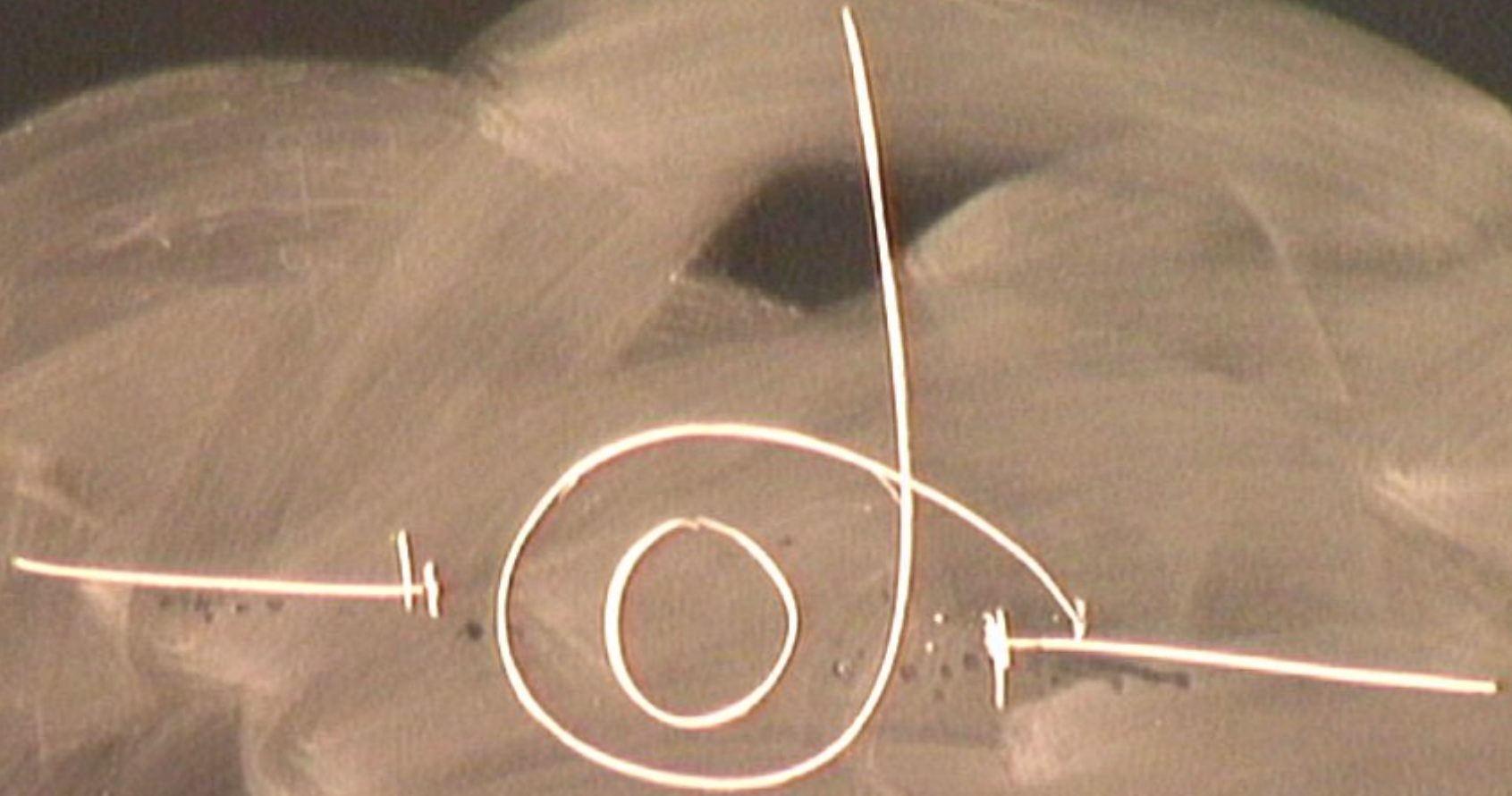
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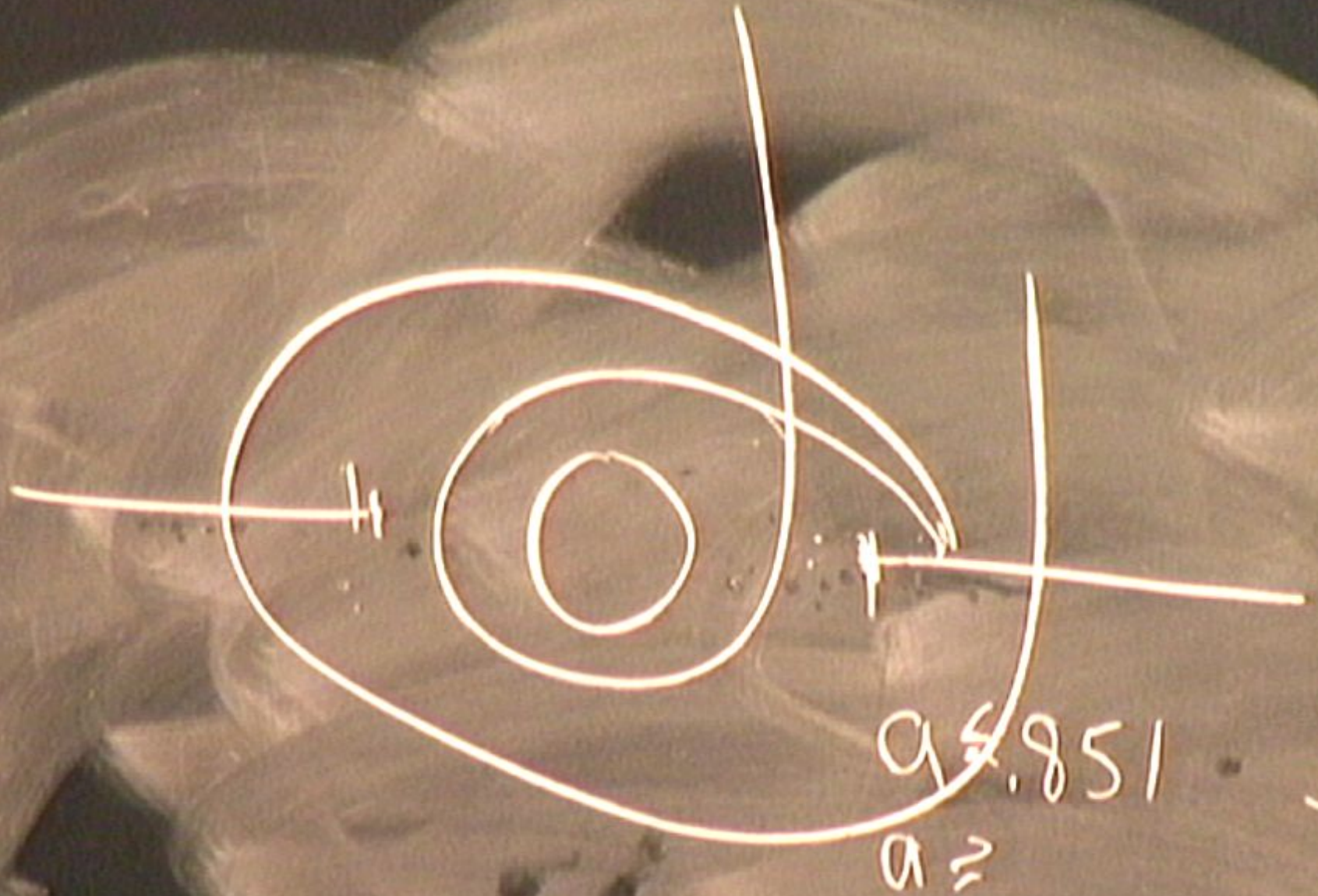


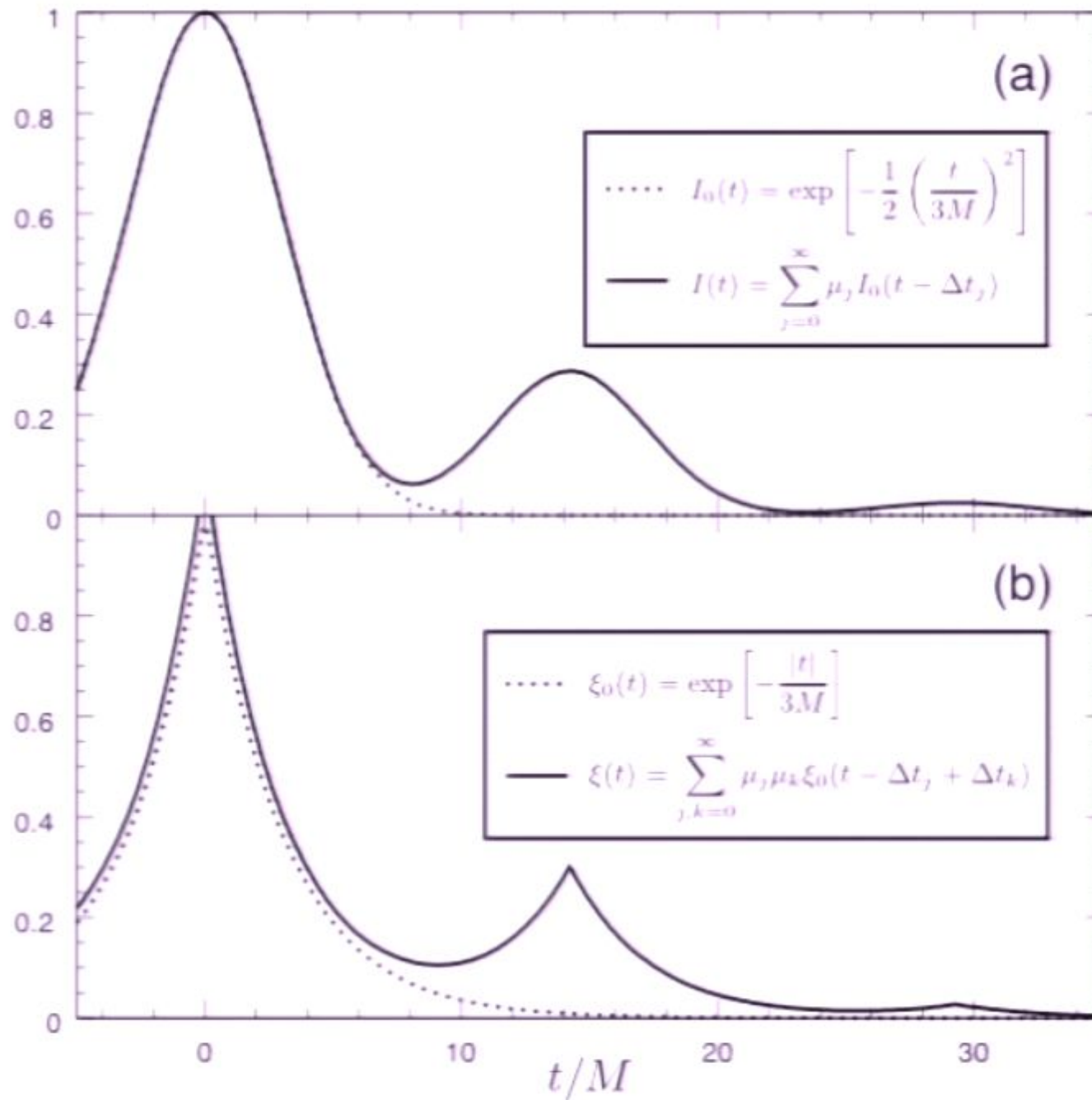


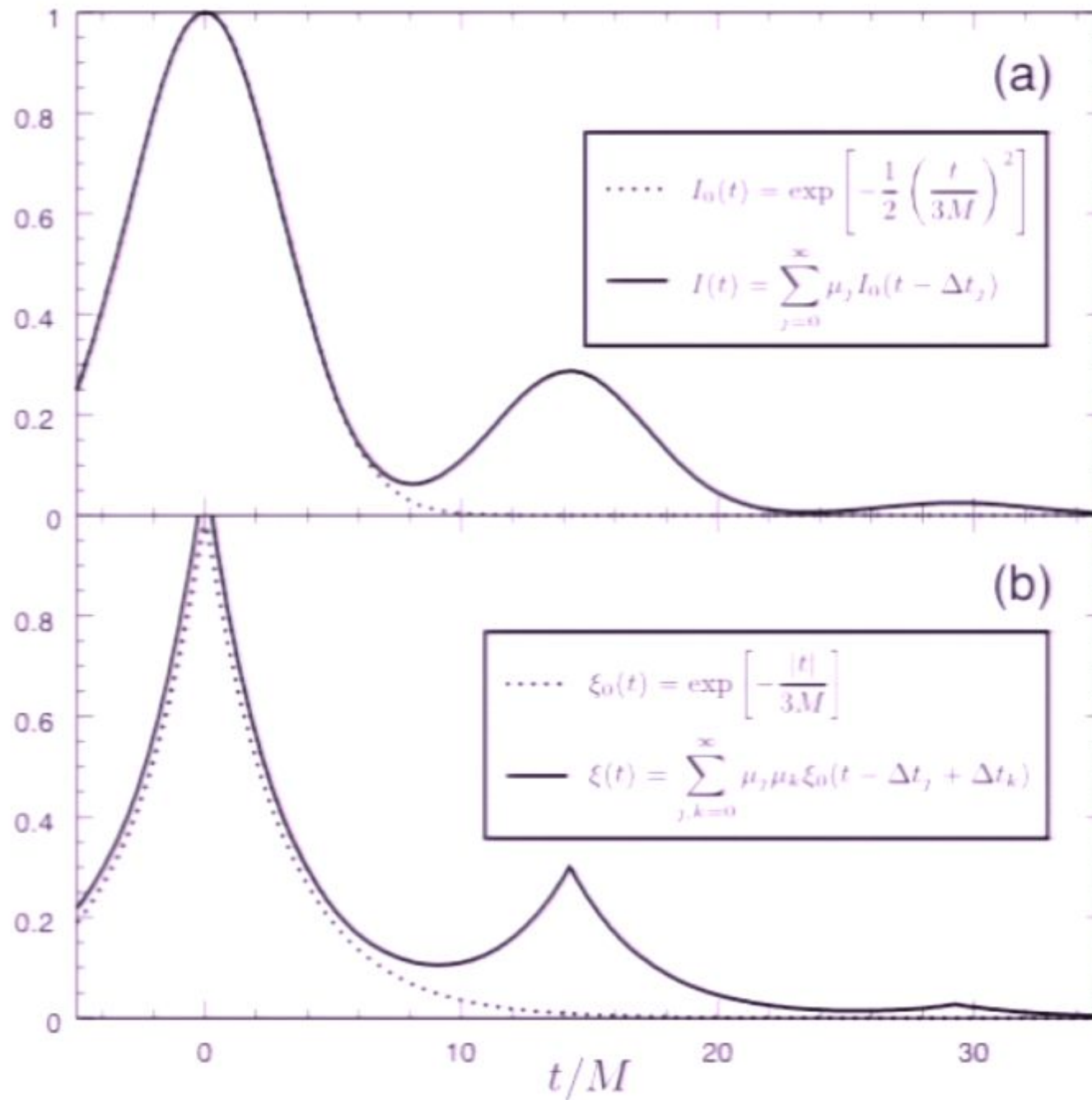


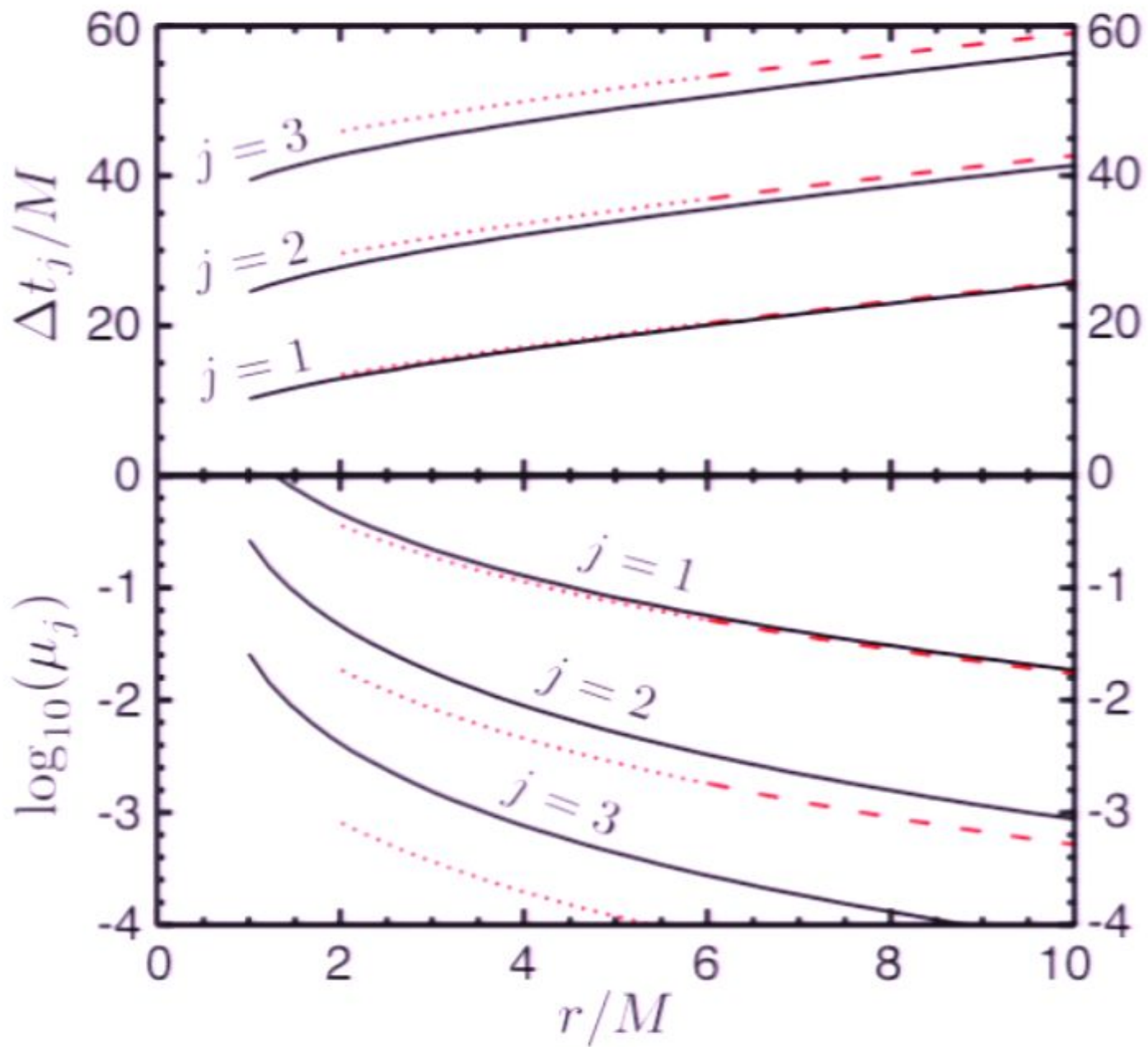


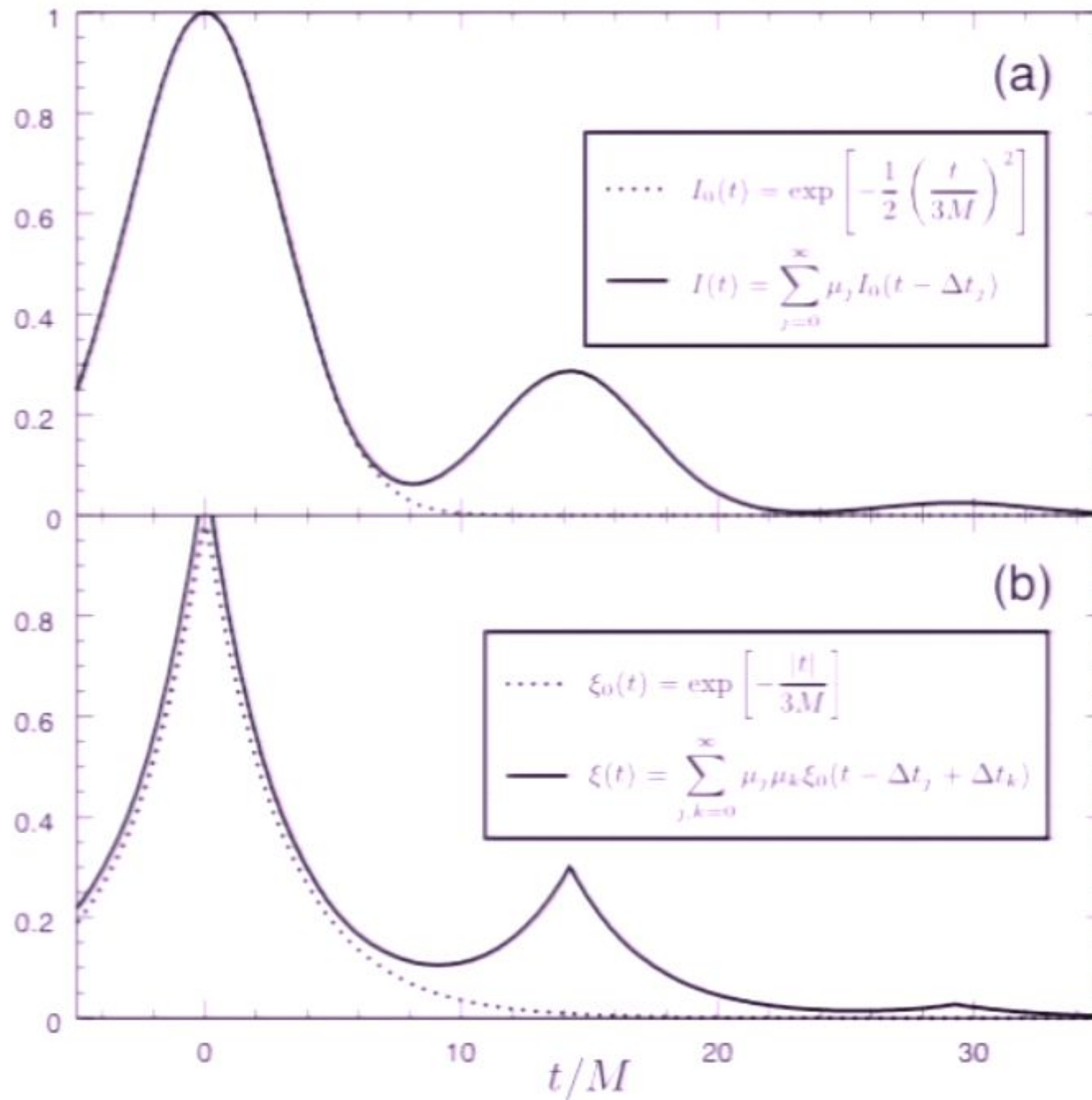
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Part 3:

Testing Inflation: A Bootstrap Approach

w/ Paul Steinhardt, arXiv:0810.2787