Strong Cosmic Censorship in charged black-hole spacetimes

Kyriakos Destounis

CENTRA, Instituto Superior Tecnico

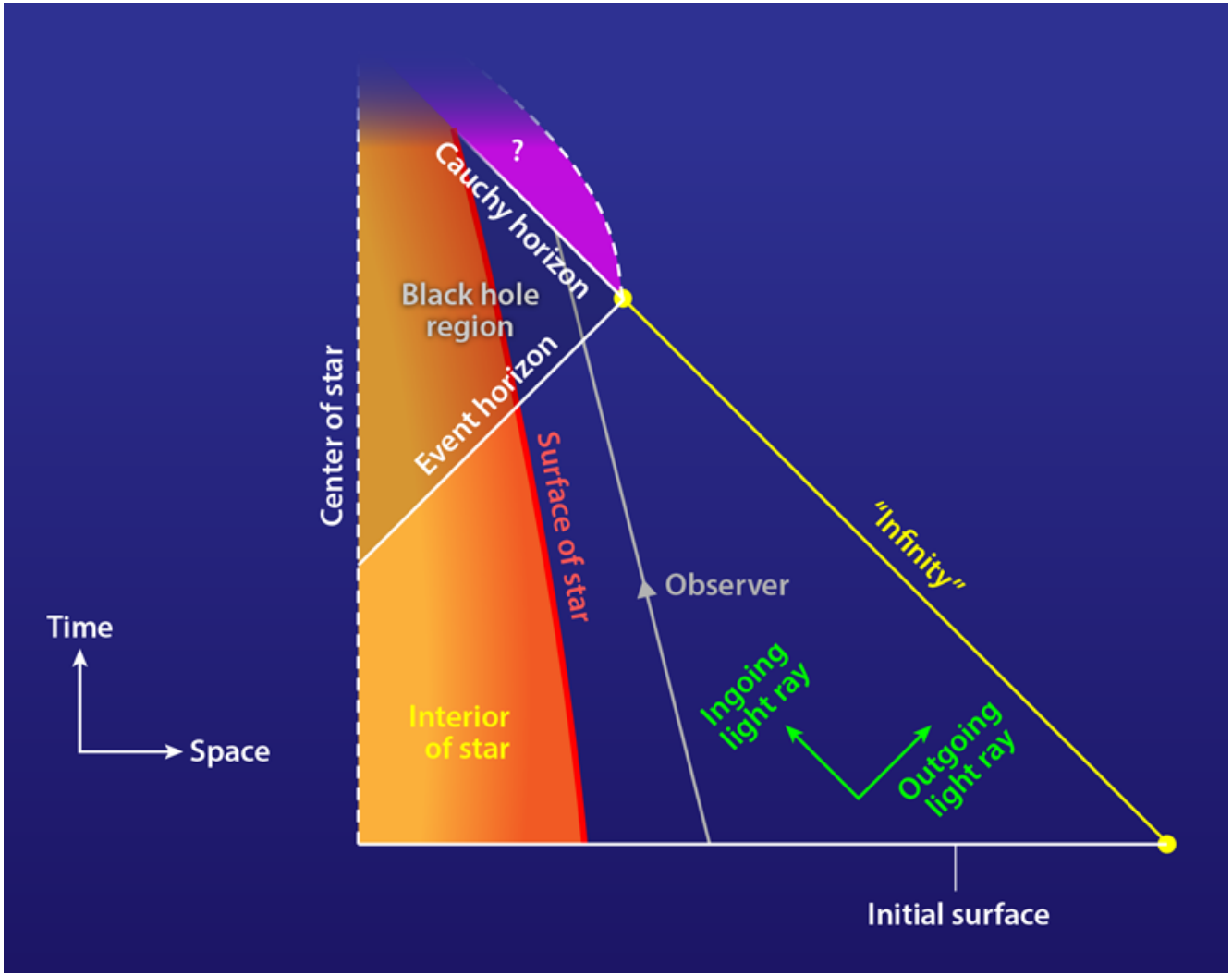
Athens 2019: Gravitational Waves, Black Holes and Fundamental Physics

January 24, 2019

centra
multidisciplinary centre for astrophysics

based on **Phys. Rev. Lett. 120, 031103**, **Phys. Rev. D 98, 104007** and **arXiv:1811.10629**

Cauchy horizons and Strong Cosmic Censorship



$$\beta \equiv \frac{-\mathrm{Im}(\omega)}{\kappa_-} < \frac{1}{2}$$

($\mathrm{Im}(\omega)$: decay rate)

(κ_-: blueshift amplification factor)

Setup

We consider a **Reissner-Nordström-de Sitter black hole (RNdS BH)**, where

$$f(r) = 1 - \frac{2M}{r} + \frac{Q^2}{r^2} - \frac{\Lambda r^2}{3},$$

with three horizons $r_- < r_+ < r_c$. The **master equation** reads

$$\frac{d^2\psi}{dr_*^2} + \left[\left(\omega - \frac{qQ}{r}\right)^2 - V(r)\right]\psi = 0,$$

where

$$V(r) = f(r)\left(\mu^2 + \frac{l(l+1)}{r^2} + \frac{f'(r)}{r}\right), \qquad l = 0,\ 1,\ 2\ldots$$

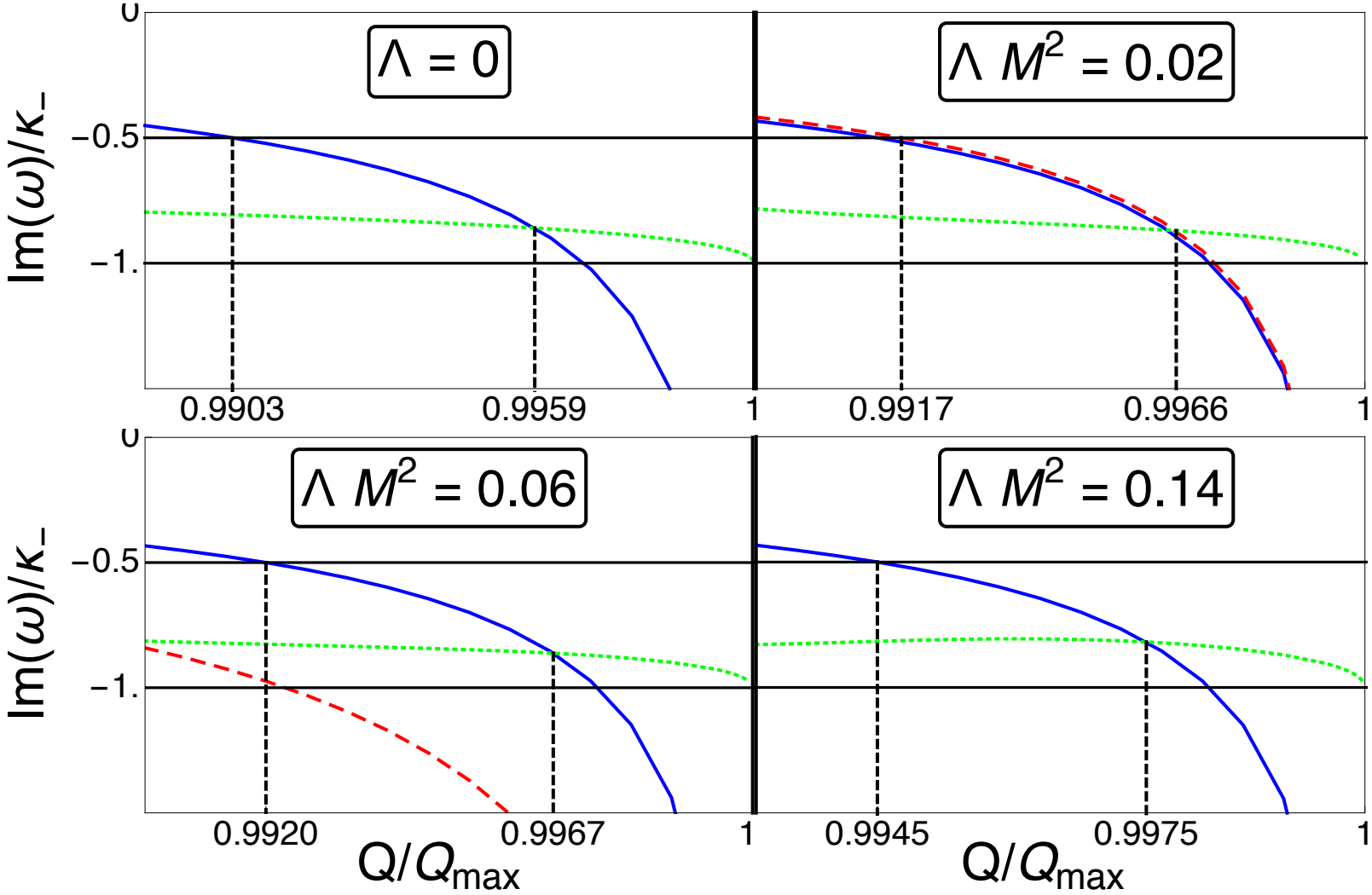
To obtain the **quasinormal modes (QNMs)** we impose the boundary conditions

$$\psi \to \begin{cases} e^{-i(\omega - qQ/r_+)r_*}, & r_* \to -\infty \quad (r \to r_+) \\ e^{i(\omega - qQ/r_c)r_*}, & r_* \to \infty \quad (r \to r_c) \end{cases}$$

QNMs of RNdS BHs: the 3 families

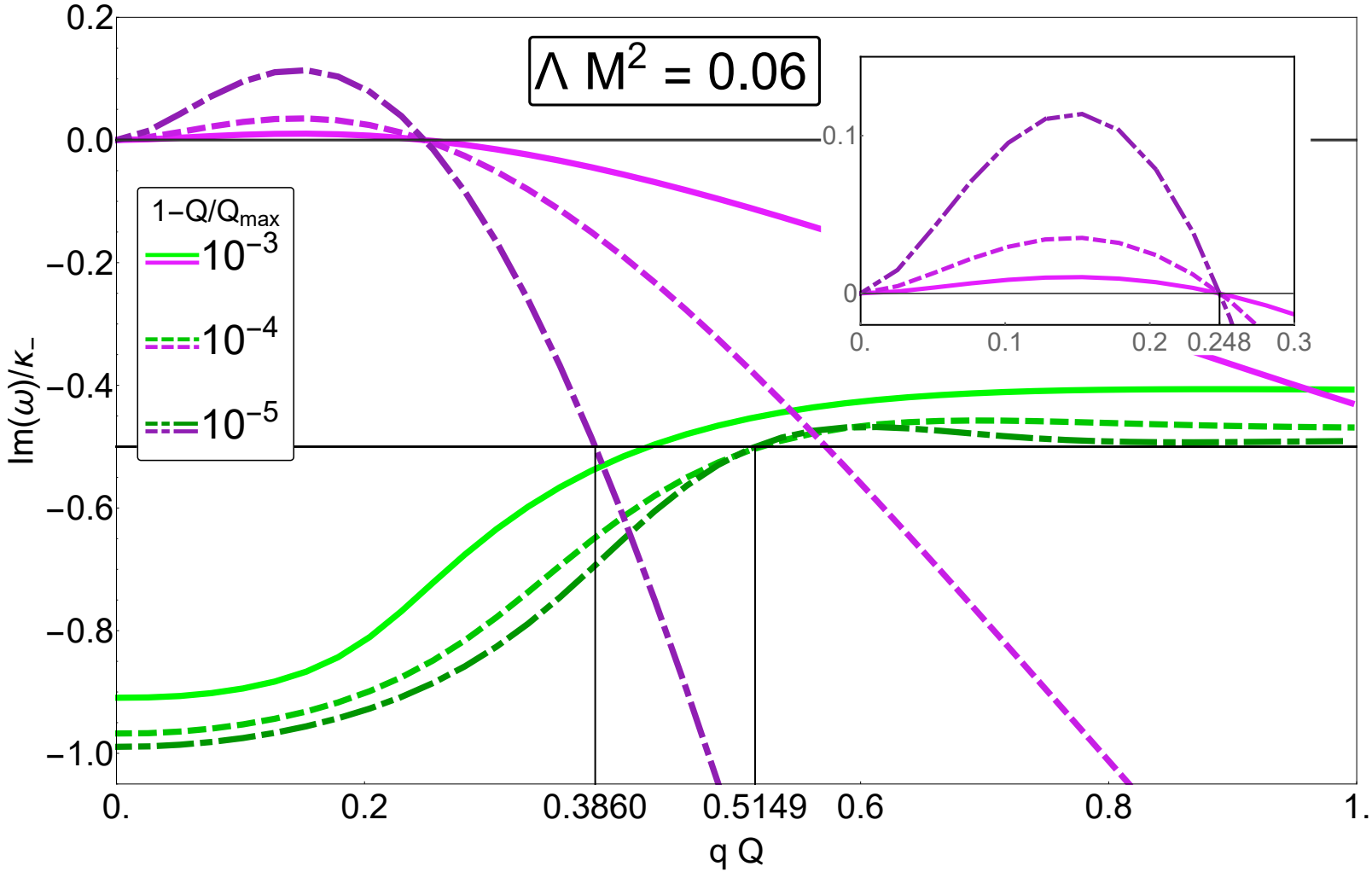
- **Photon Sphere Modes**
- **de Sitter Modes**
- **Near-Extremal Modes**

Dominant neutral modes and SCC



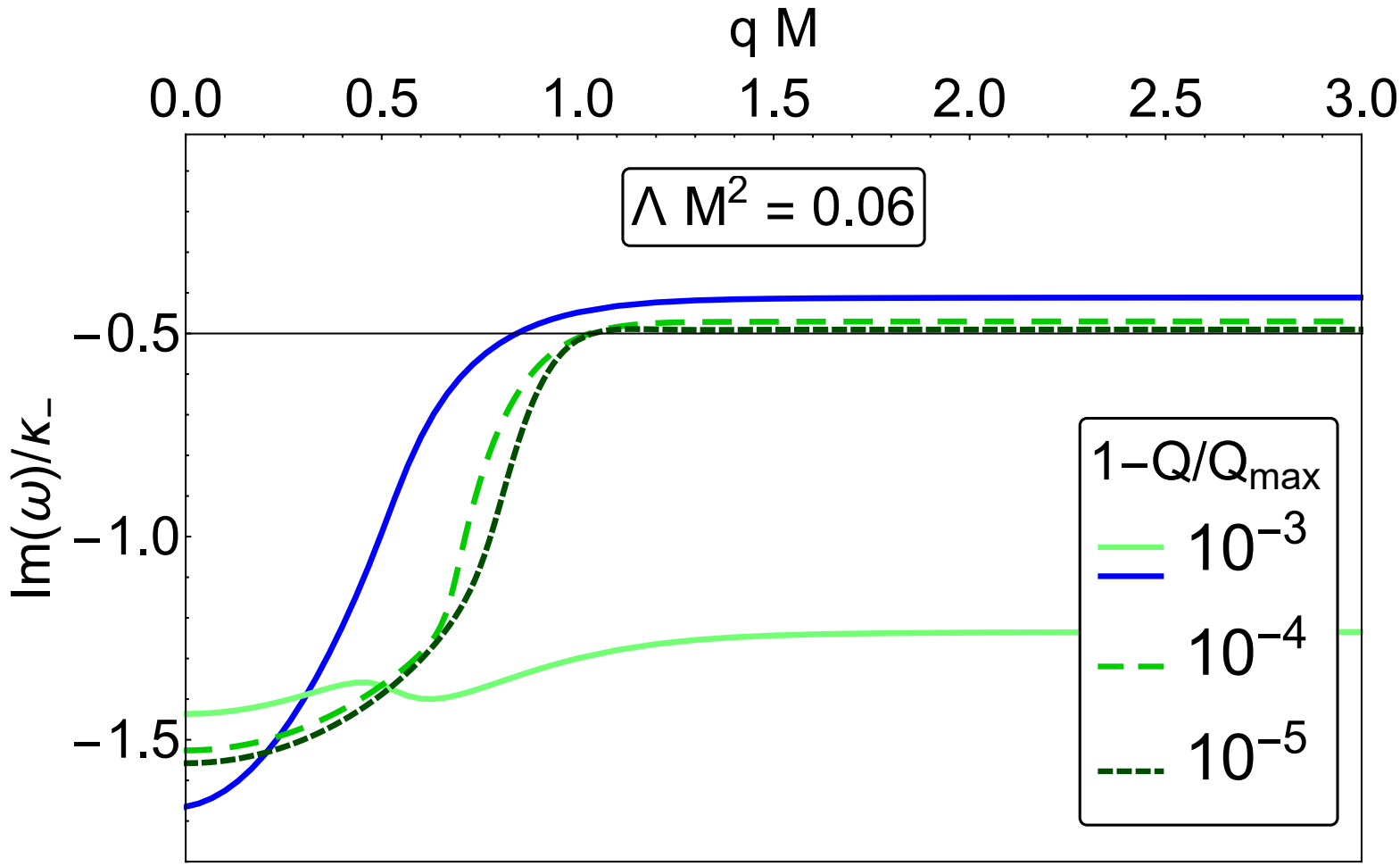
V. Cardoso, J. L. Costa, KD, P. Hintz, A. Jansen (Phys. Rev. Lett. 120, 031103)

Dominant charged modes and SCC



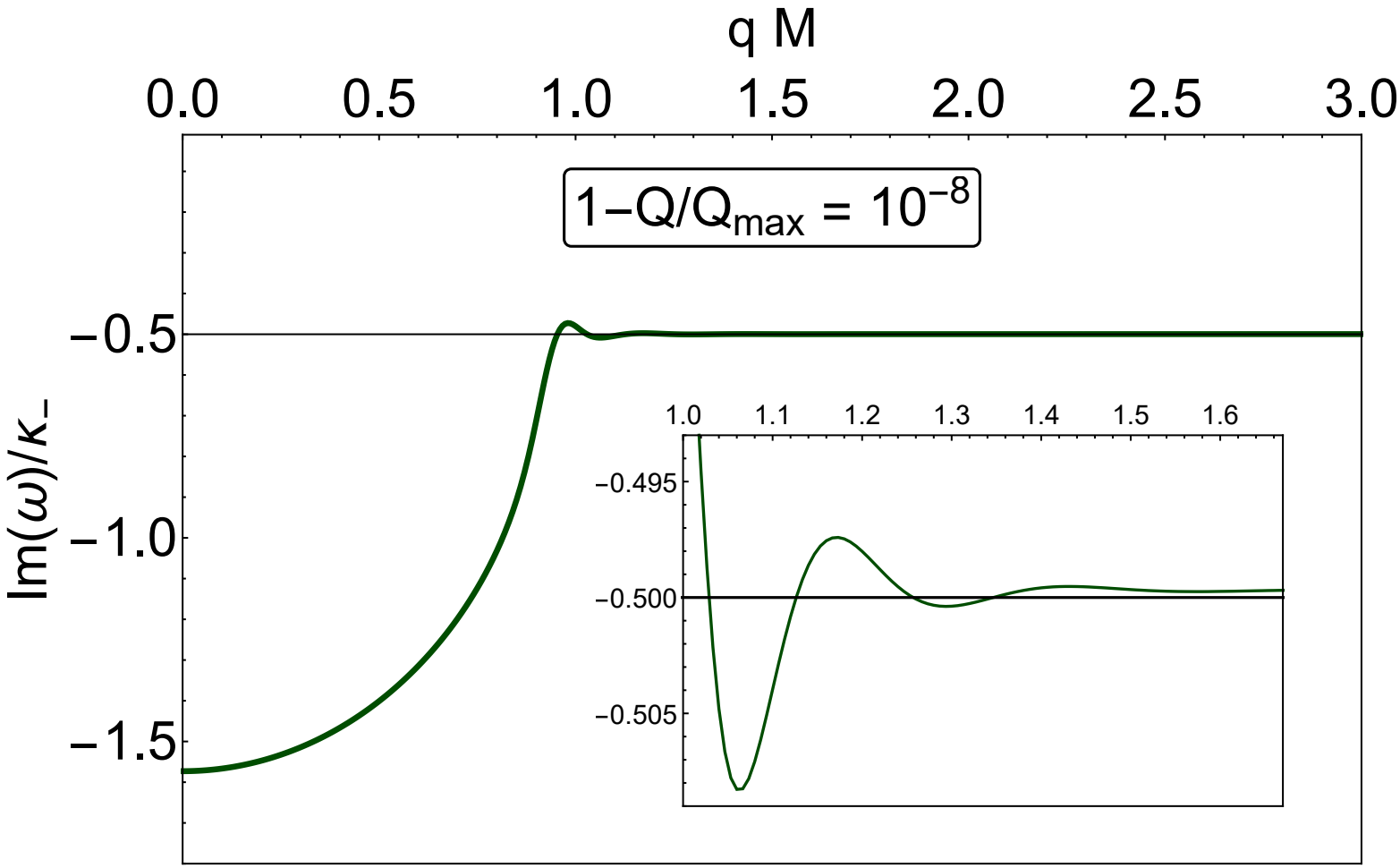
V. Cardoso, J. L. Costa, KD, P. Hintz, A. Jansen (Phys. Rev. D 98, 104007)

Dominant charged fermionic modes and SCC



KD (arXiv:1811.10629)

Dominant charged fermionic modes and SCC



KD (arXiv:1811.10629)

Summary & Conclusions

β **controls** the stability of Cauchy horizons and **the fate of Strong Cosmic Censorship**.

If $\beta > \mathbf{1/2}$ the Cauchy horizon can be stabilized and **Strong Cosmic Censorship may be violated**

By studying **charged scalars and fermions** in Reissner-Nordström-de Sitter we find regions of the parameter space for which $\beta > \mathbf{1/2}$.

Our results indicate a potential **failure of determinism in General Relativity**.