Searching for chaos in dynamical Chern-Simons gravity

The illusion of the Ubiquity of Chaos
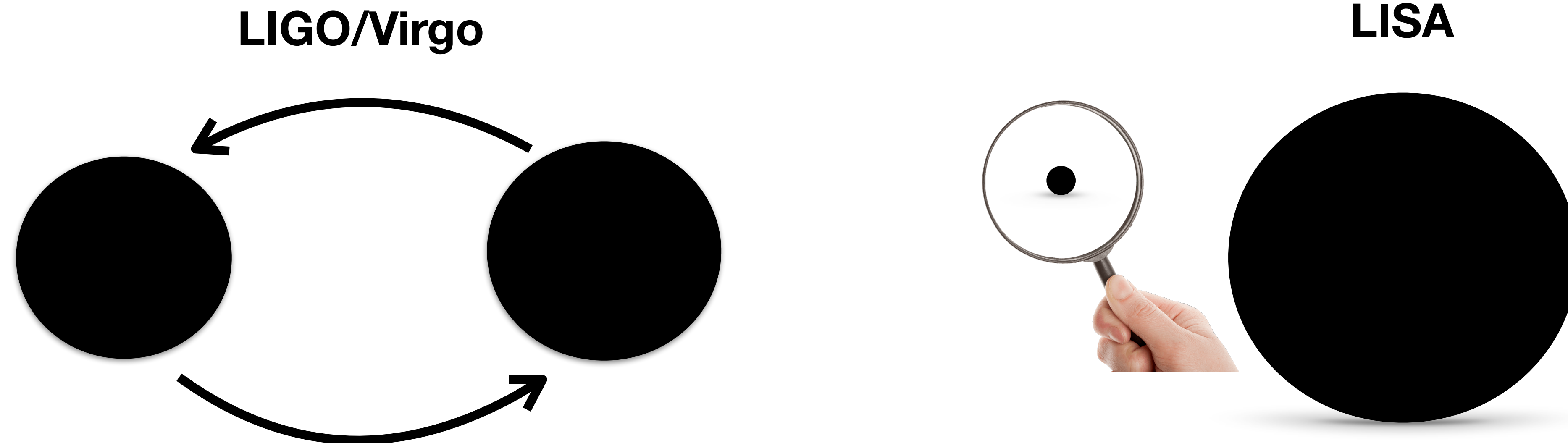
Alejandro **Cárdenas-Avendaño**

*Advised by Nicolás **Yunes** (XGI, USA) and in collaboration with Andrés F. **Gutiérrez** (UdeA, Colombia) & Leonardo A. **Pachón** (UdeA, Colombia)*

Testing General Relativity

Abbott et al., PRL 116 061102 **(2016)**
Abbott et al., PRL 119 161101 **(2017)**

Amaro-Seoane **(2012)**
Danzmann K et al. **(2016)**
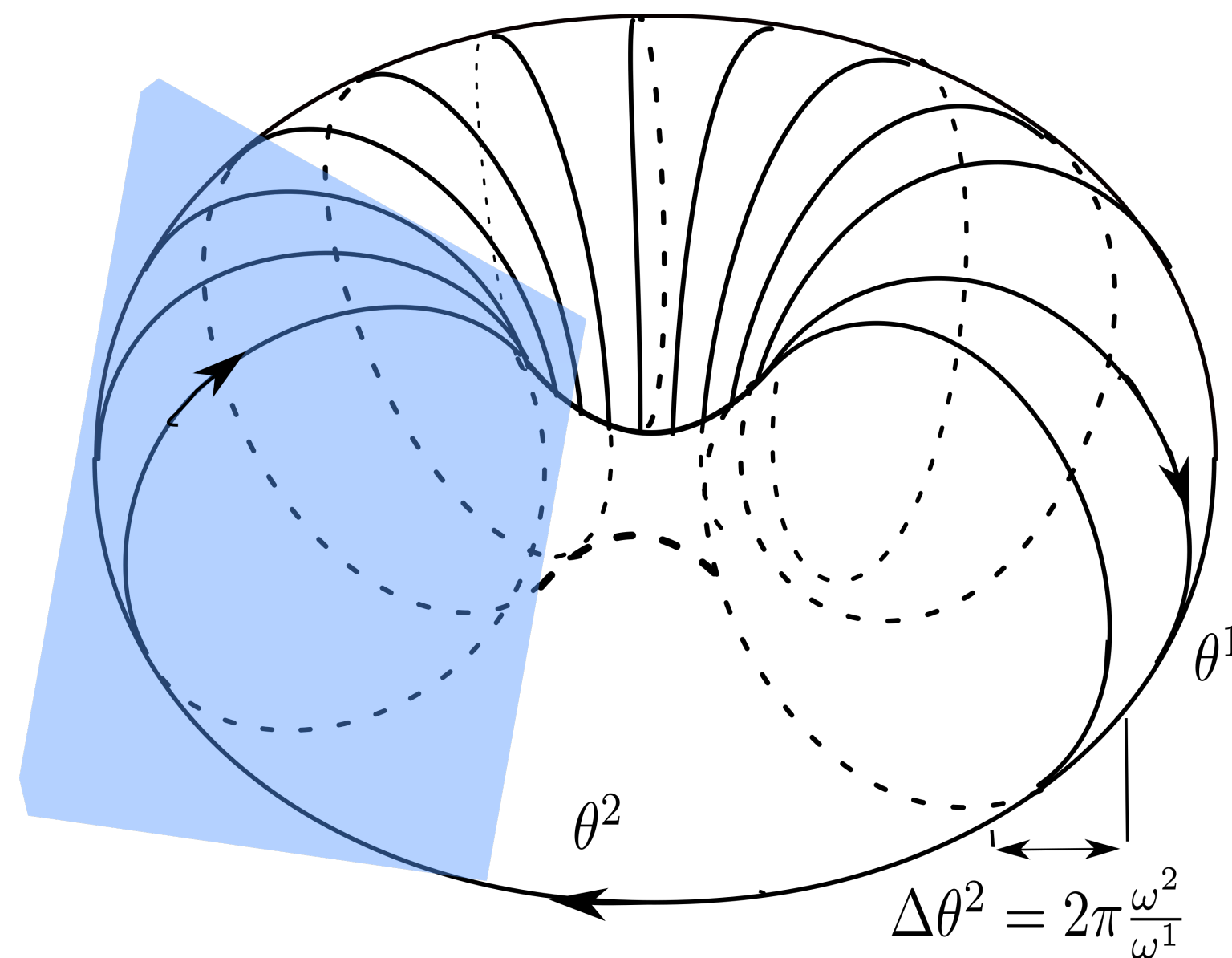
LIGO/Virgo

LISA

Gair, Li,& Mandel **(2008)**
Apostolatos, Lukes-Gerakopoulos & Contopoulos **(2009)**

The presence of **chaotic features** in the GWs emitted by **EMRIs** would then signal either a departure from the:

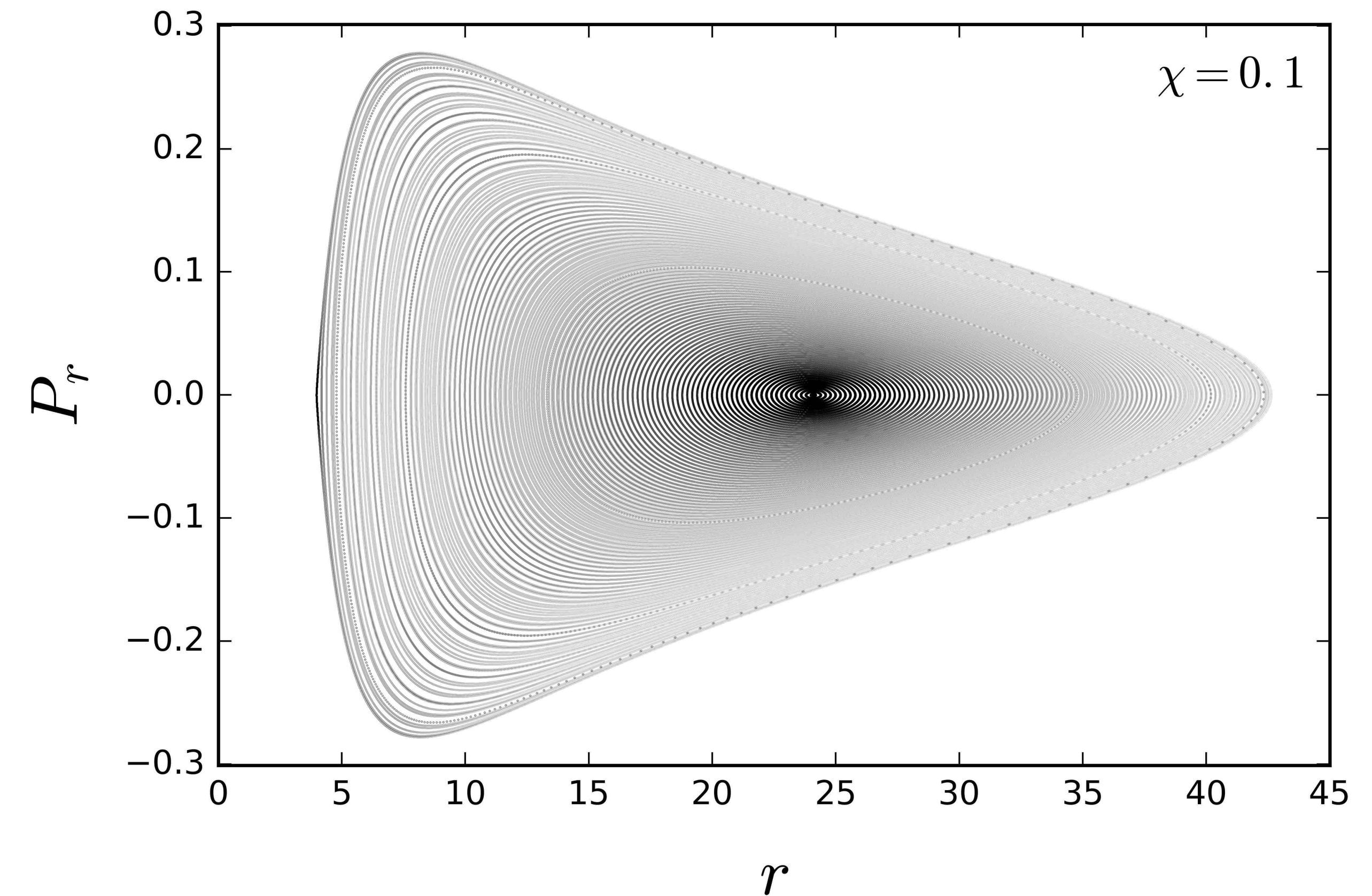**strong-equivalence principle** or a **violation of the Kerr hypothesis**
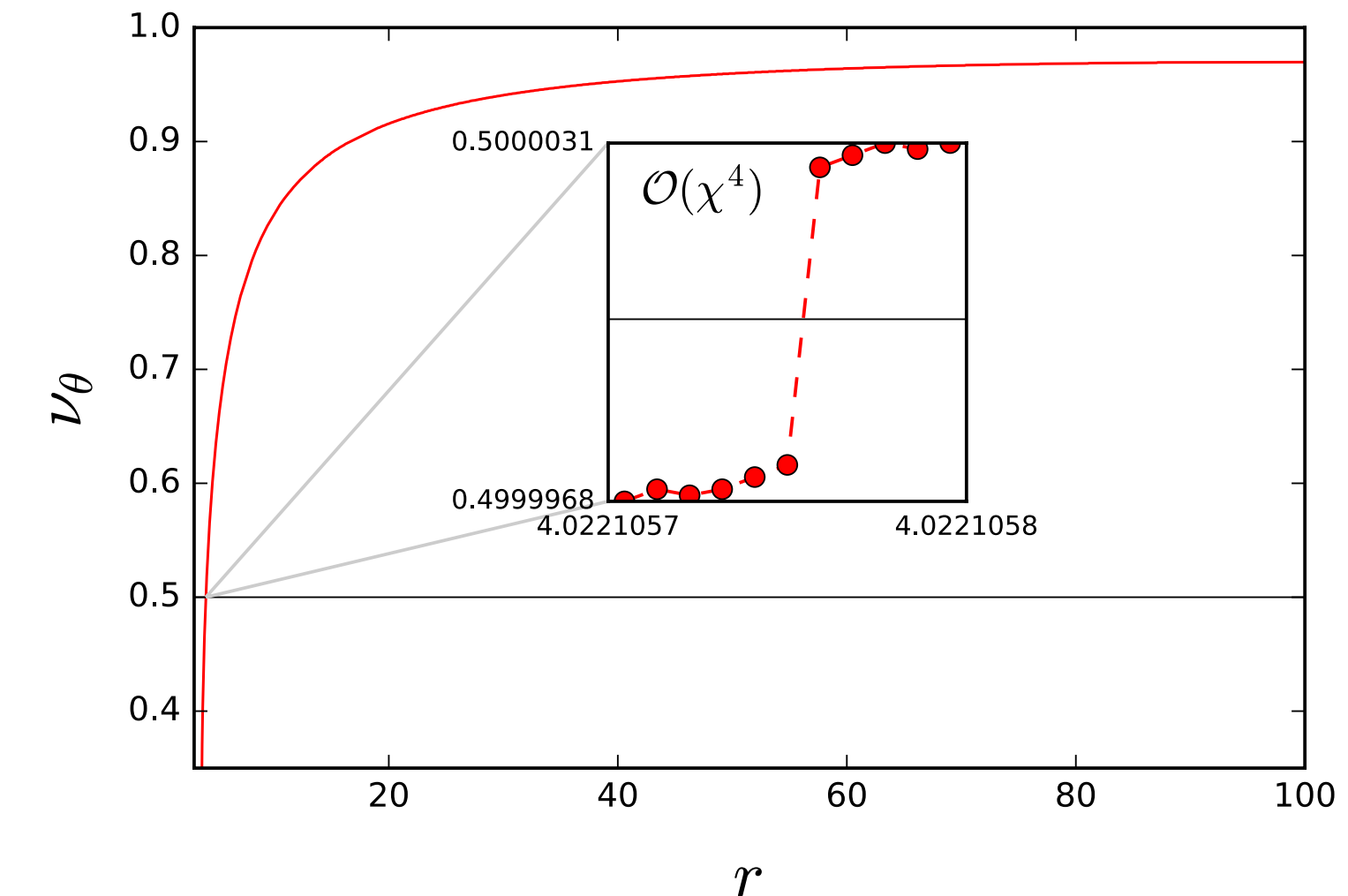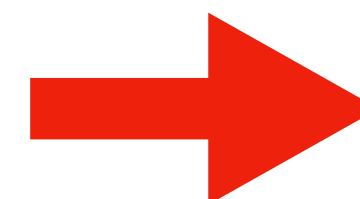
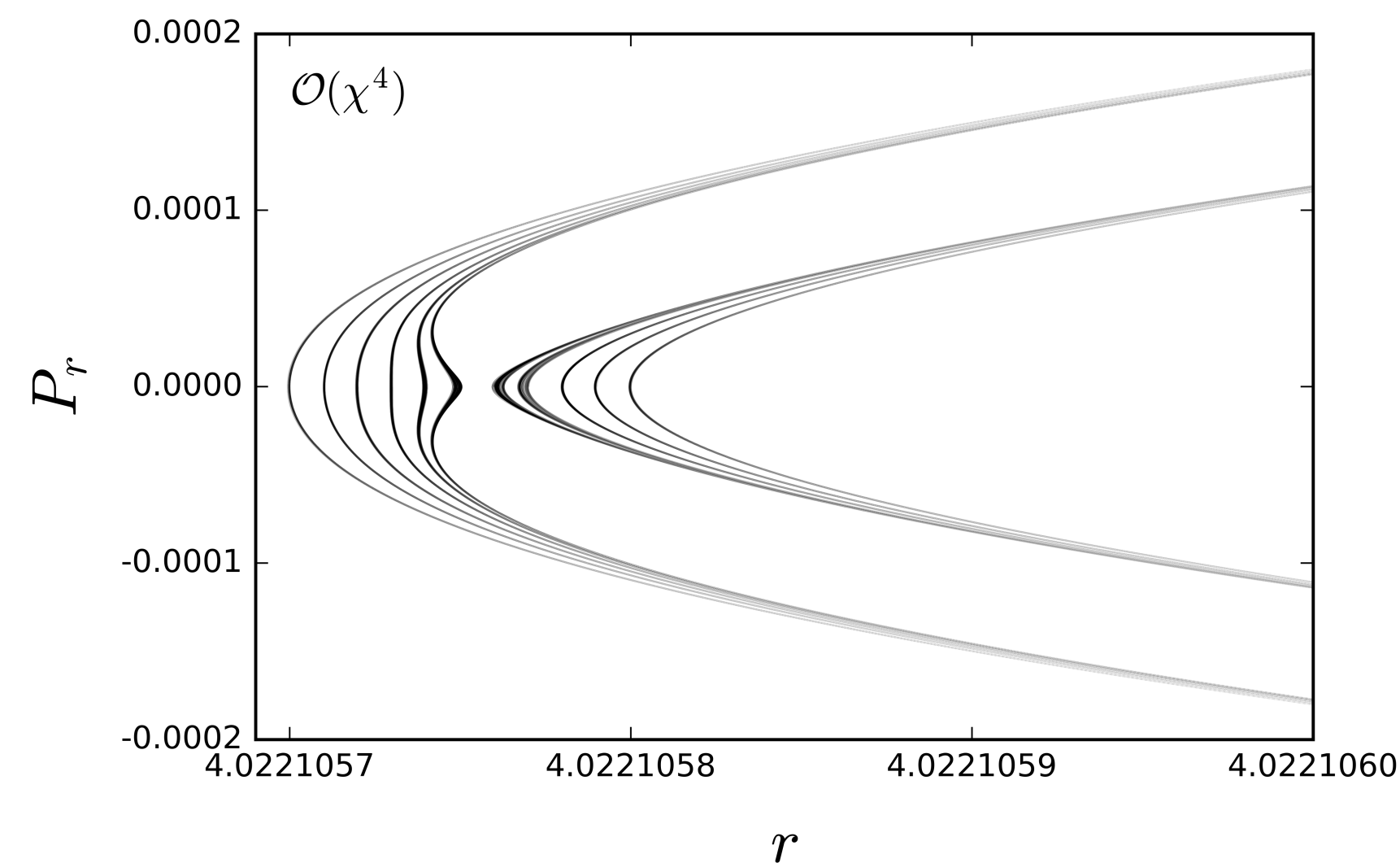# 2 DoF Systems

Stationary and **Axisymmetric**
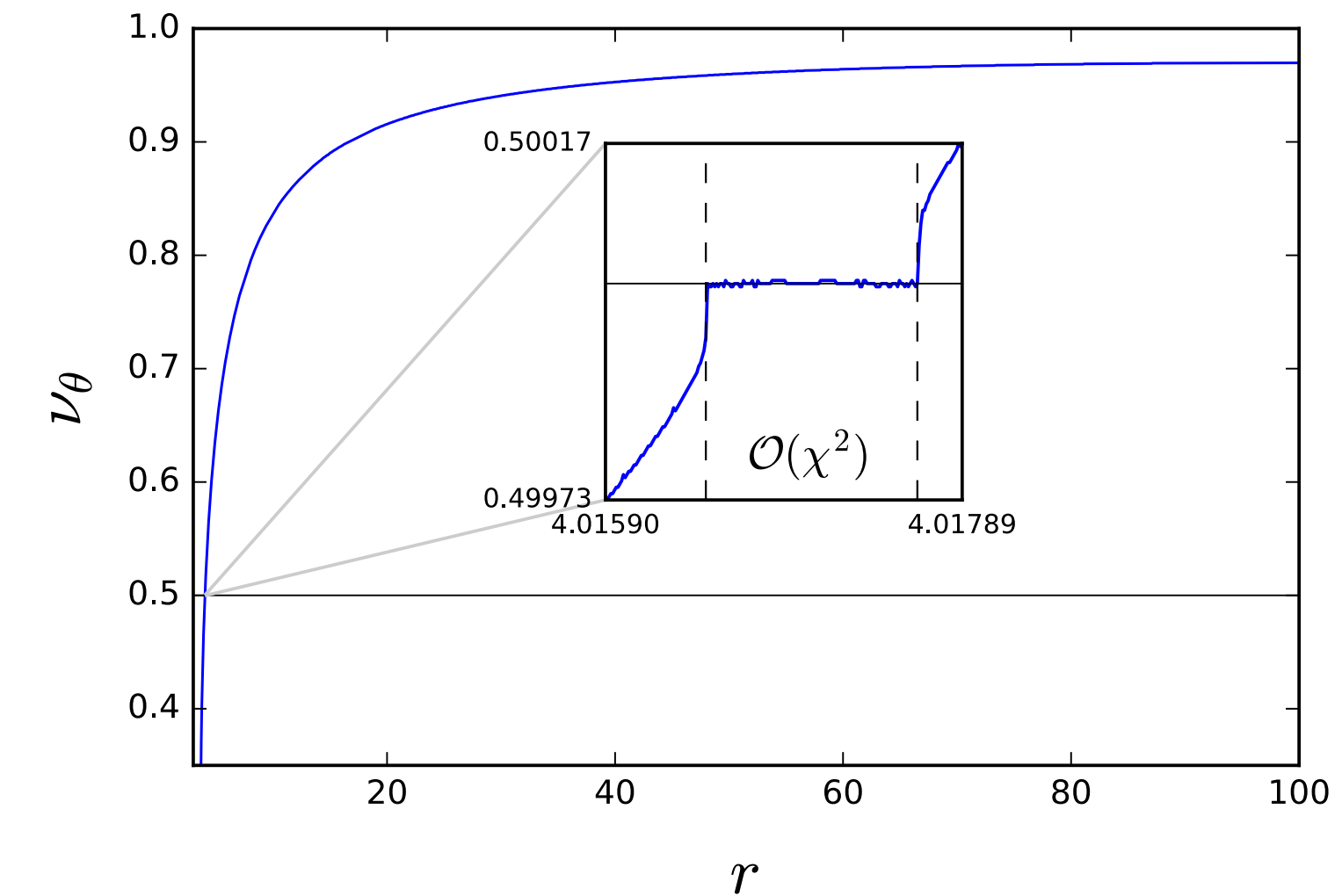

$$\Delta\theta^2 = 2\pi\frac{\omega^2}{\omega^1}$$

Carter's constant

Carter (1968)
Walker & Penrose (1970)
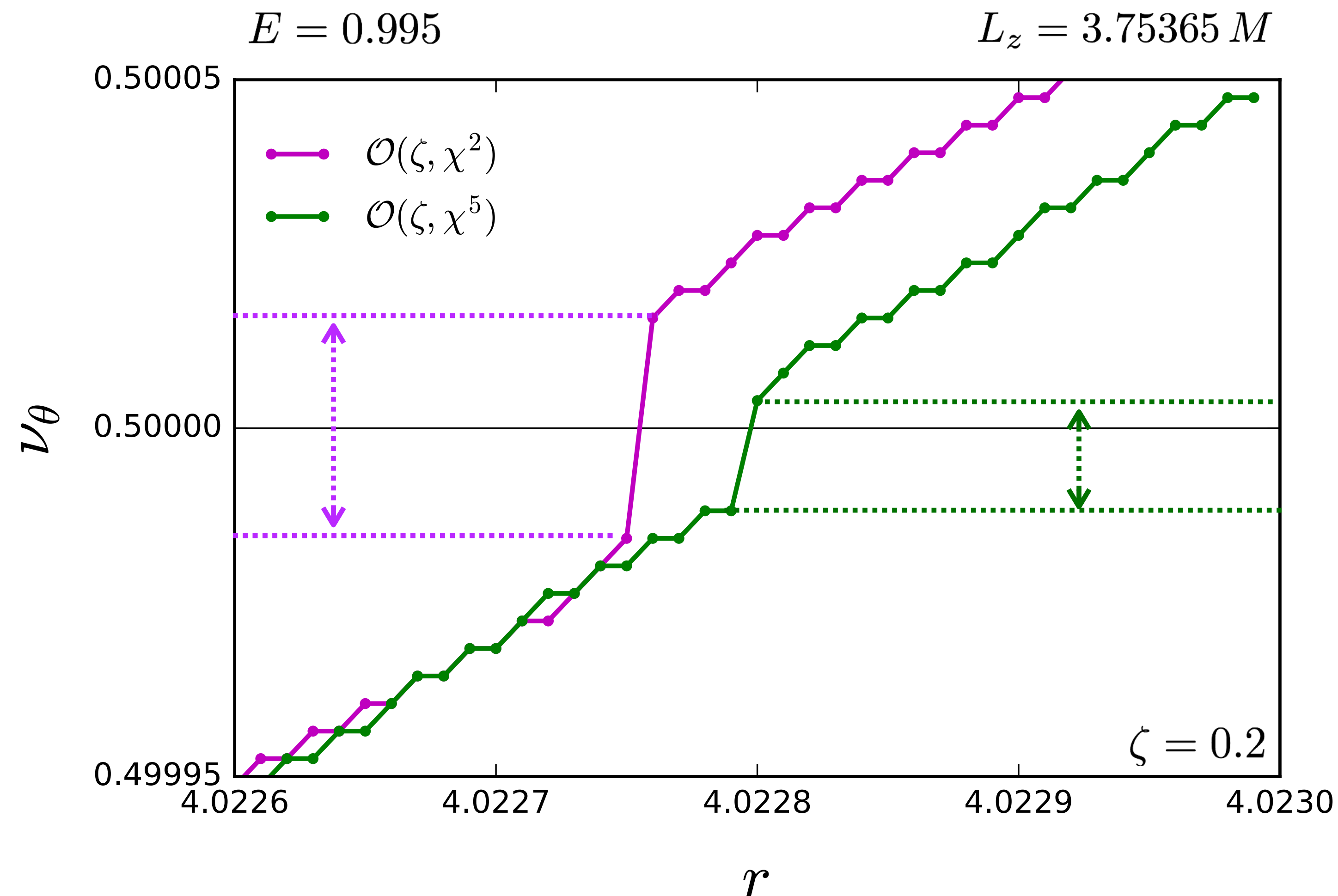
Poincaré Surface of Section

$\chi = 0.1$

Poincaré Surface of Section in **Slowly-Rotating Kerr**
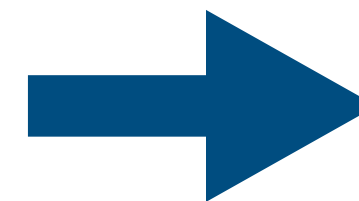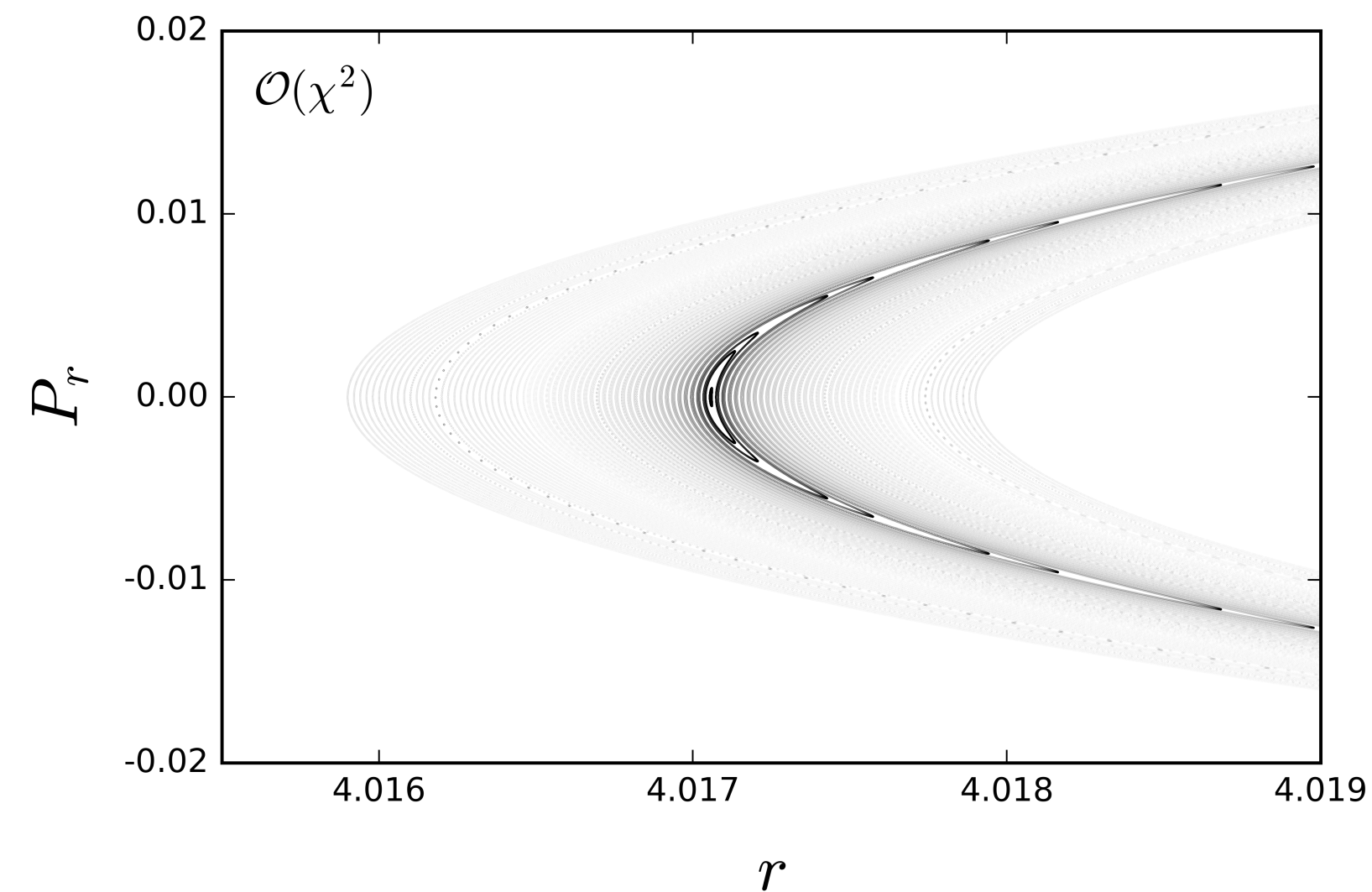
$$\chi = 0.2 \quad E = 0.995 \quad L_z = 3.75365\,M$$

The rotation number/Curve in **dCS**

$$ds^2 = ds^2_{Kerr} + ds^2_{dCS}$$

$E = 0.995$ $L_z = 3.75365\,M$

Conclusions

Conjecture: The *yet-to-be-known* ***exact*** dCS metric for a spinning BH posses a **fourth constant** of motion.

- Geodesics in the resummed dCS spacetime are **slightly non-integrable**

- **Future Work: Compute observables** that included dissipative effects in the orbits to estimate the accuracy to which dCS gravity could be constrained by future **GWs observations with LISA**.

Thank you!

More details:
arXiv:1804.04002