

The kerrgeodesic_gw SageMath package

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The kerrgeodesic_gw package

`kerrgeodesic_gw`: SageMath package implementing computations of gravitational waveforms, energy fluxes and inspiralling time for bodies on circular orbits¹ around a Kerr black hole, as well as SNR in LISA detector.

`kerrgeodesic_gw` is

- entirely open-source:
https://github.com/BlackHolePerturbationToolkit/kerrgeodesic_gw
- distributed via PyPi (Python Package Index):
<https://pypi.org/project/kerrgeodesic-gw/>
so that the installation in SageMath is very easy:
`sage -pip install kerrgeodesic_gw`
- part of the Black Hole Perturbation Toolkit:
<https://bhptoolkit.org/>
- using SageMath differential geometry tools developed through the SageManifolds project:
<https://sagemanifolds.obspm.fr/>

¹General orbits under development (Lazaros Souvatzis)

Example 1: computing generic geodesics in Kerr spacetime

A new feature in `kerrgeodesic_gw` 0.3

https://nbviewer.jupyter.org/github/BlackHolePerturbationToolkit/kerrgeodesic_gw/blob/master/Notebooks/Kerr_geodesics.ipynb

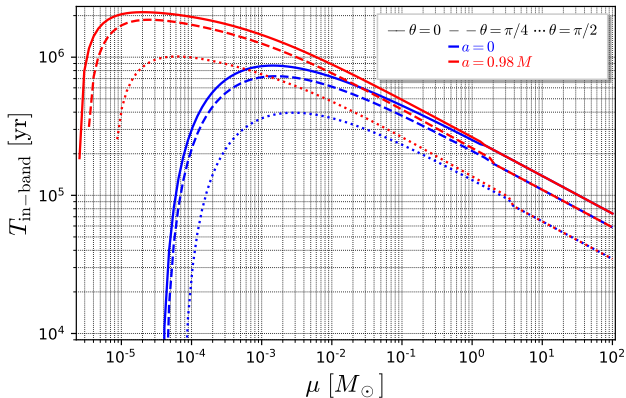
Example 2: gravitational waves from circular orbits around a Kerr black hole

https://nbviewer.jupyter.org/github/BlackHolePerturbationToolkit/kerrgeodesic_gw/blob/master/Notebooks/grav_waves_circular.ipynb

Application: Gravitational waves from bodies orbiting the Galactic Center black hole and their detectability by LISA

[Gourgoulhon, Le Tiec, Vincent & Warburton, *A&A* 627, A92 (2019)]

Time in LISA band with $\text{SNR}_{1\text{yr}} \geq 10$ for an inspiralling compact object



μ : mass of the inspiralling compact object

Primordial BHs with $1M_{\oplus} \leq \mu \leq 5M_{\text{Jup}}$ spend more than 10^6 yr in LISA band with $\text{SNR}_{1\text{yr}} \geq 10$

[Gourgoulhon, Le Tiec, Vincent & Warburton, A&A 627, A92 (2019)]

Example 3: some basic functionalities of kerrgeodesic_gw

Spin-weighted spheroidal harmonics and amplitude factors of gravitational waveforms

https://nbviewer.jupyter.org/github/BlackHolePerturbationToolkit/kerrgeodesic_gw/blob/master/Notebooks/basic_kerrgeodesic_gw.ipynb