

Modelling and Measuring Beyond-Vacuum-GR Effects

Current status of models

beyond Vacuum

Scalar clouds

Relativistic perturbative treatments exist; scalar fluxes, resonances, and conservative effects can be computed in controlled setups for rotating primaries.

DM & spikes

Two main tracks: effective dynamical-friction forces on Kerr geodesics; perturbation theory on modified spacetimes (very limited).

Disks

hydrodynamic drag, accretion, migration torques, Lindblad resonances.
Recent progress toward self-consistent relativistic disk response.

Tidal resonances

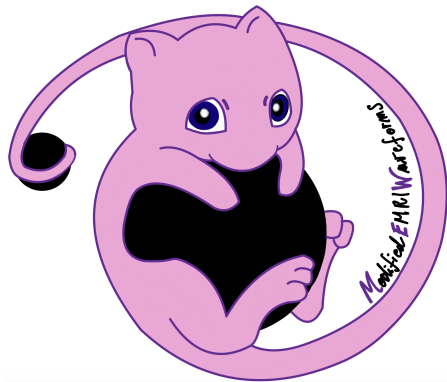
Perturbative modelling of resonant kicks from nearby stars/BHs.
Detectability and population studies.

beyond GR

EFT inspired

Waveforms with massless scalars already installed in FEW using MEW and exact at adiabatic order; grid for generic orbits on the way.

Secondary-spin effects under development way.



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Q1. How much modelling is enough?

Can we model new physics well enough to detect it?

- What waveform accuracy is required to distinguish departures from vacuum GR?
- How good are phenomenological/parametrised models?
- Do we need fully relativistic treatments?
- Do we need post-adiabatic corrections?
 - Seems that for Schwarzschild and EFT - beyond GR adiabatic corrections are enough up to (moderate) IMRIs
- Do we need extra input to calibrate models (e.g. agn & disks)

Q2. Is there anything limiting our measurements?

Is there any effect limiting our measurements?

- Are we afraid new physics can contaminate vacuum-GR parameters
- Are (vacuum-GR) waveform errors the dominant limitation?

Q3. Could we mistake one kind of new physics for another?

How do we build confidence in a detection?

- How degenerate are environmental and beyond-GR signatures?
- Can populations help break these degeneracies?
- What would constitute a convincing “smoking gun” for either scenario?