Some cool things we can learn about gravity with HPC

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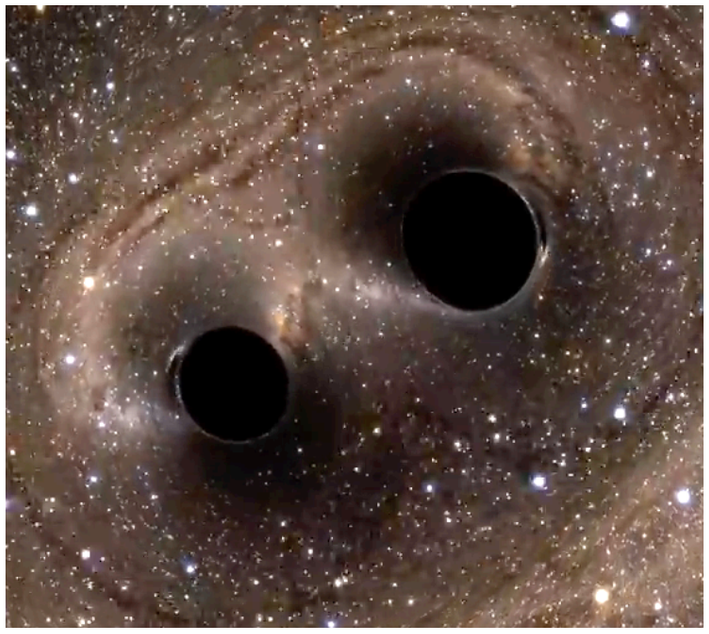
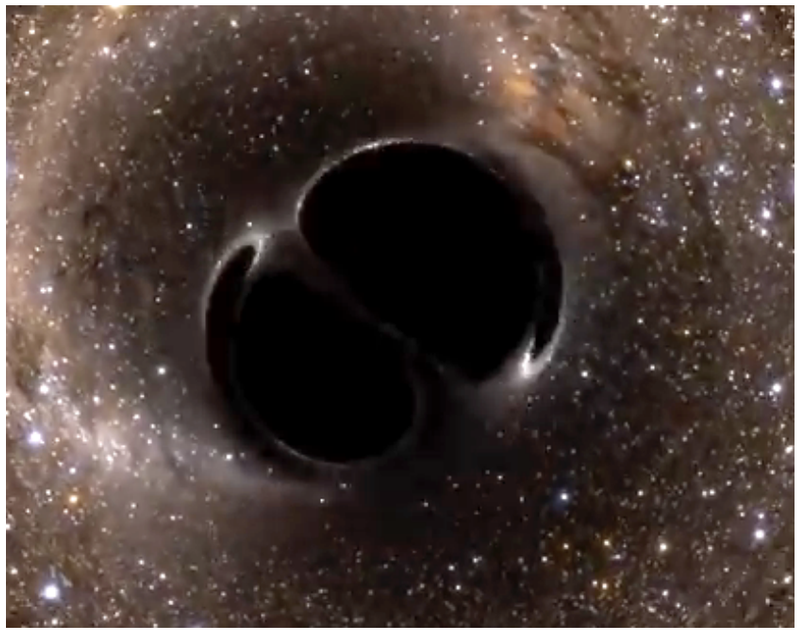
Caltech

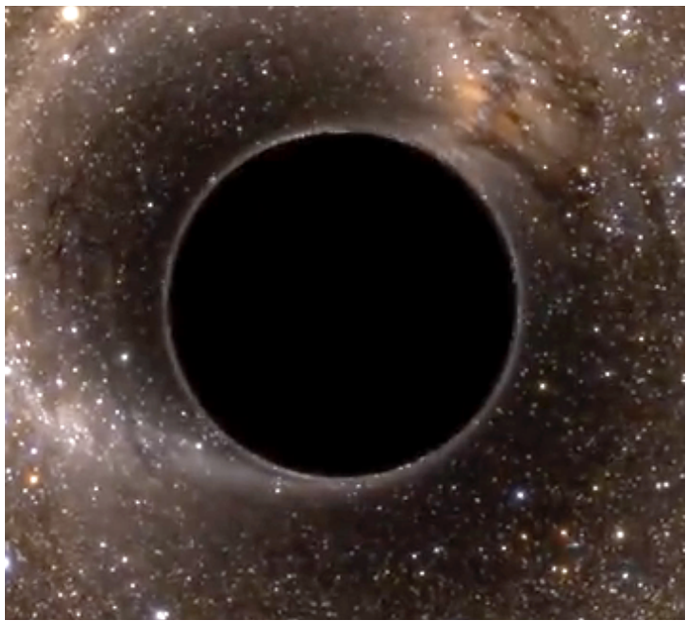
Cal State Fullerton | August 2018

Binary black holes

Gravitational Waves



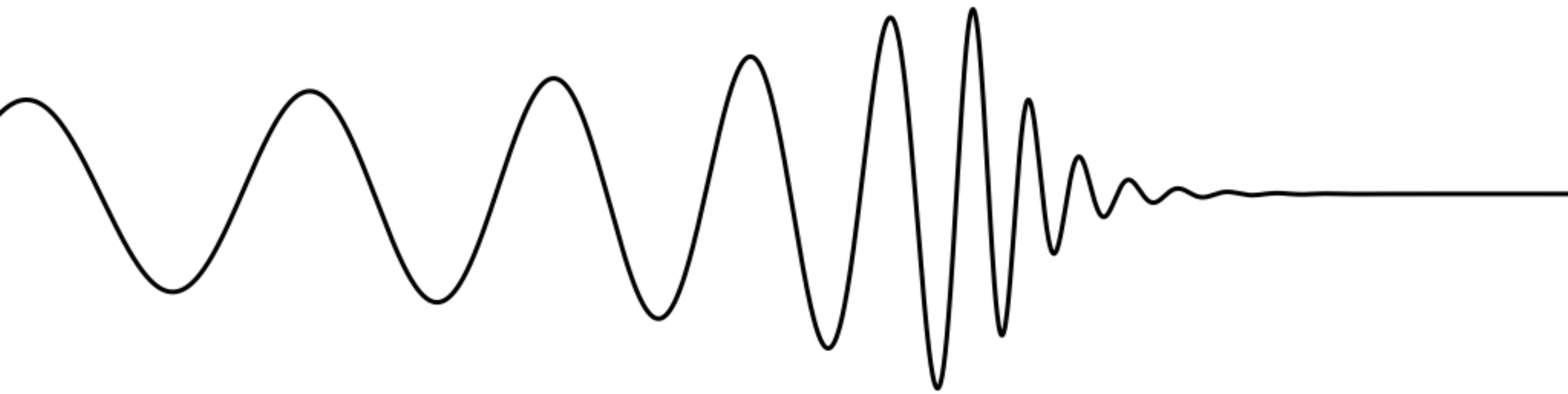




Inspiral

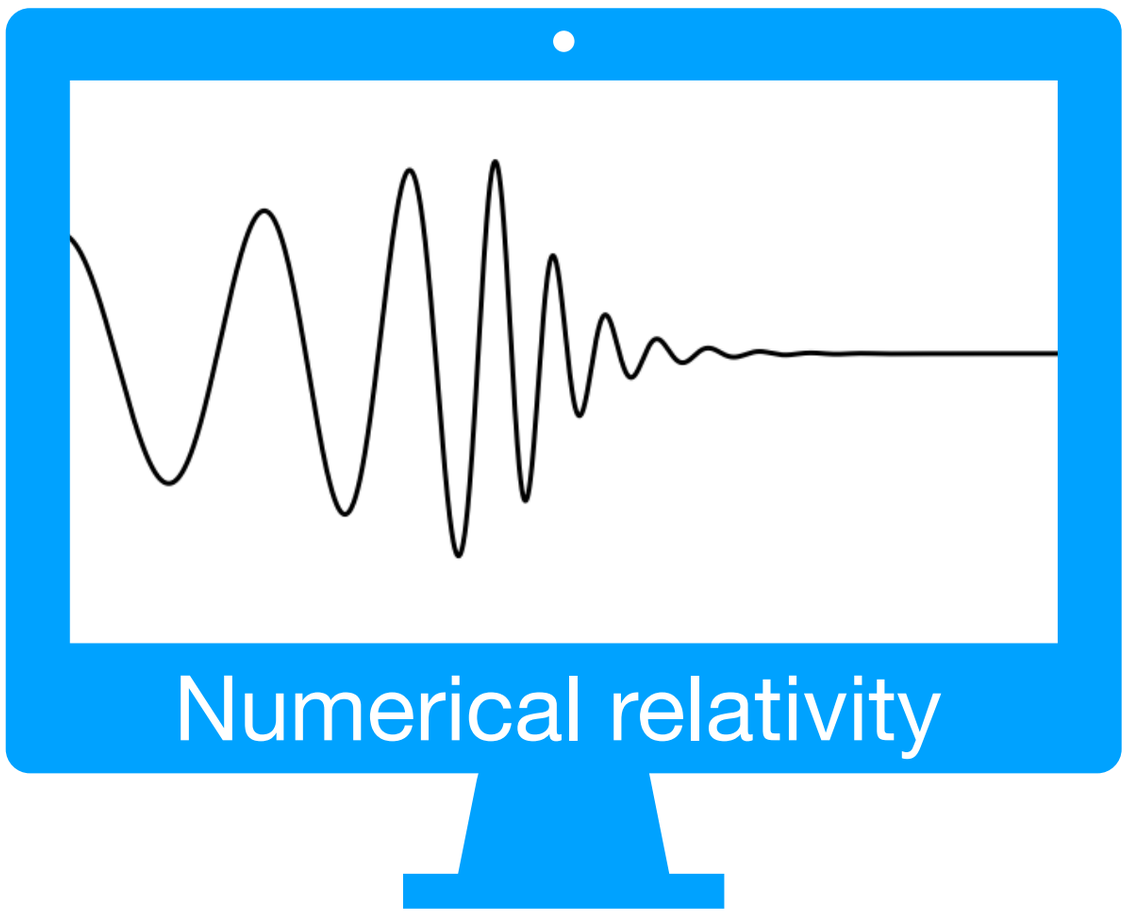
Merger

Ringdown

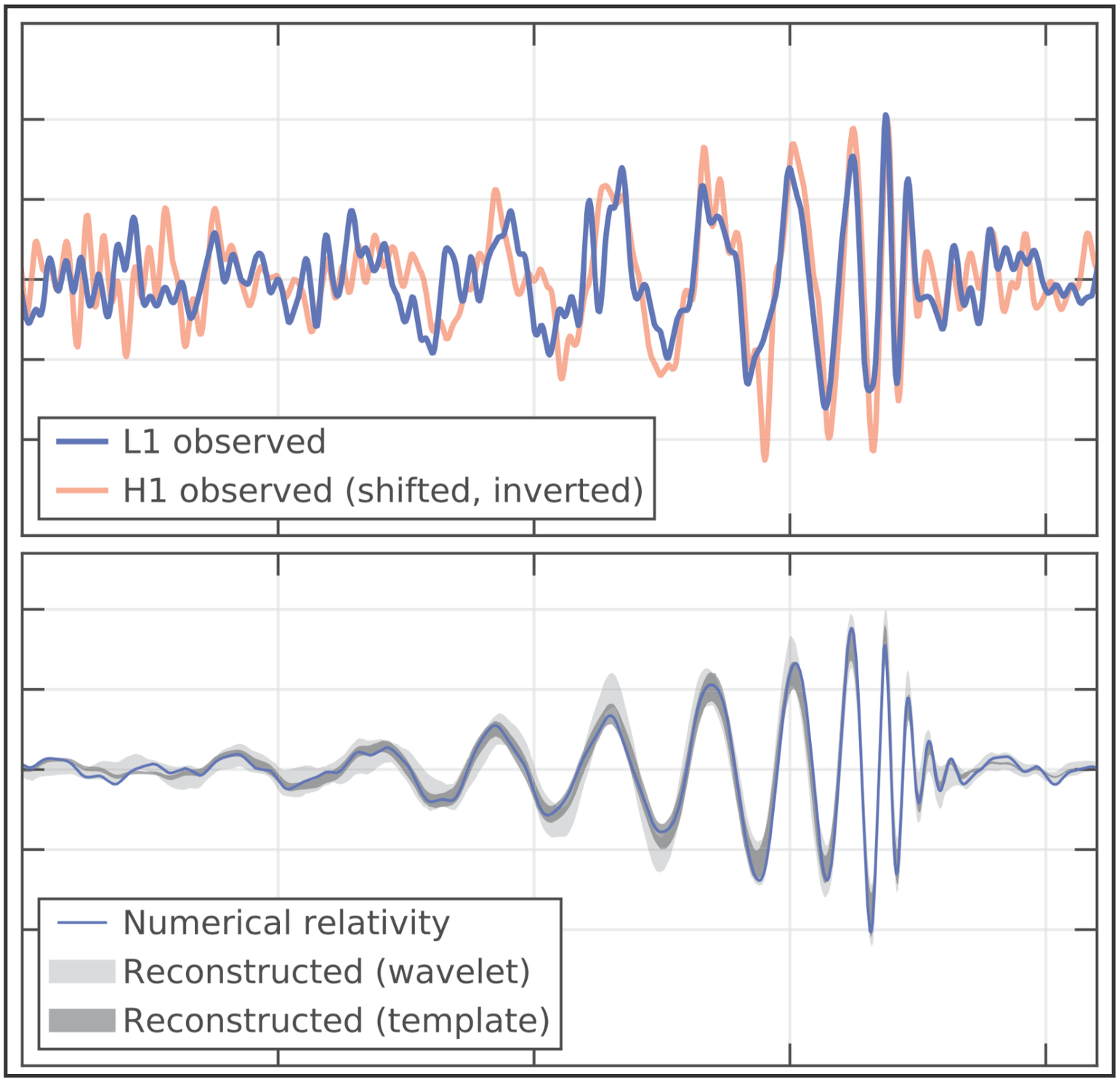


How do we know what these look like?

General Theory of Relativity



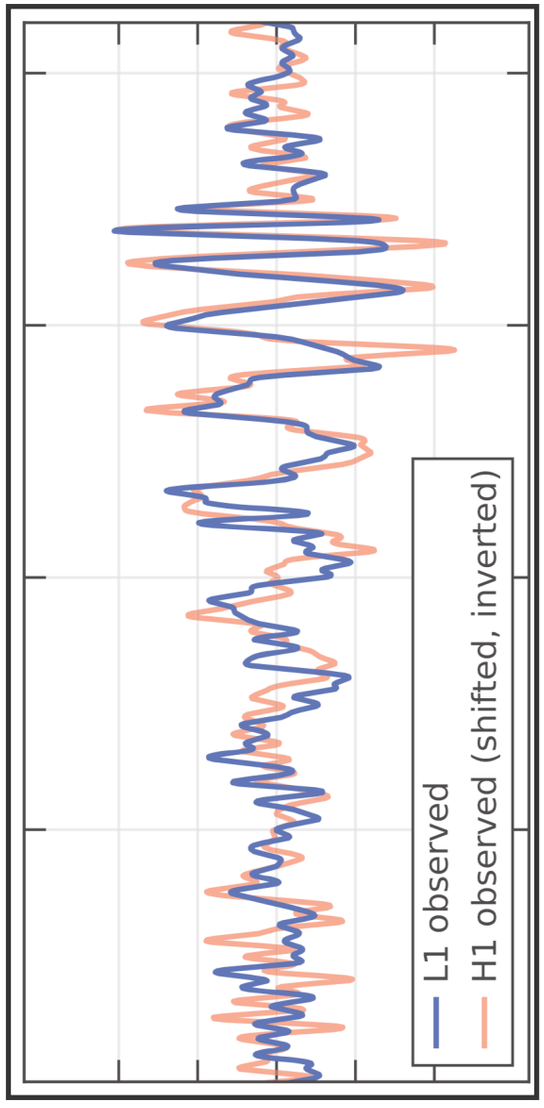
Data Analysis with Gravitational Waves



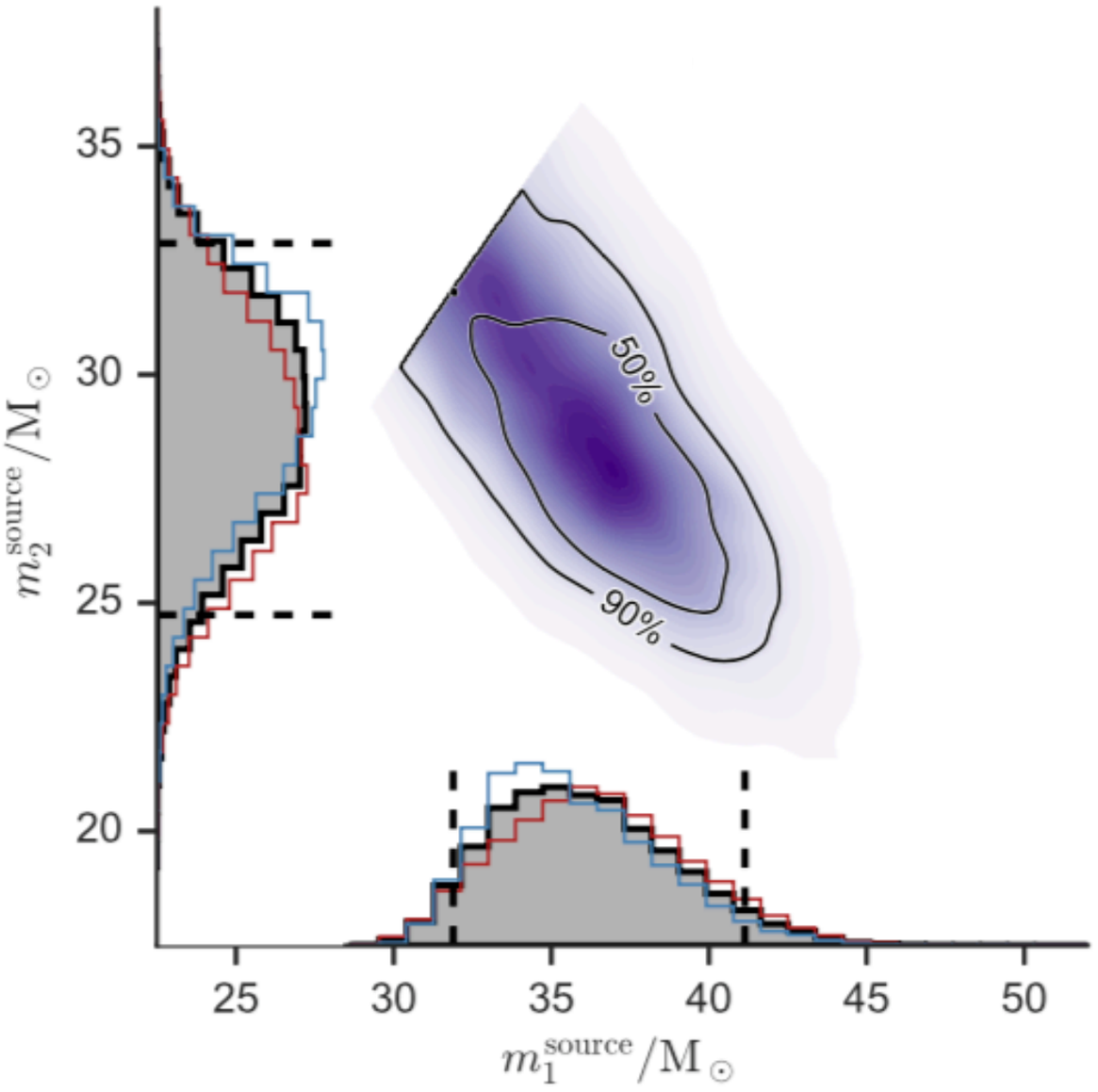
Detector data

Prediction from simulations

Data Analysis with Gravitational Waves



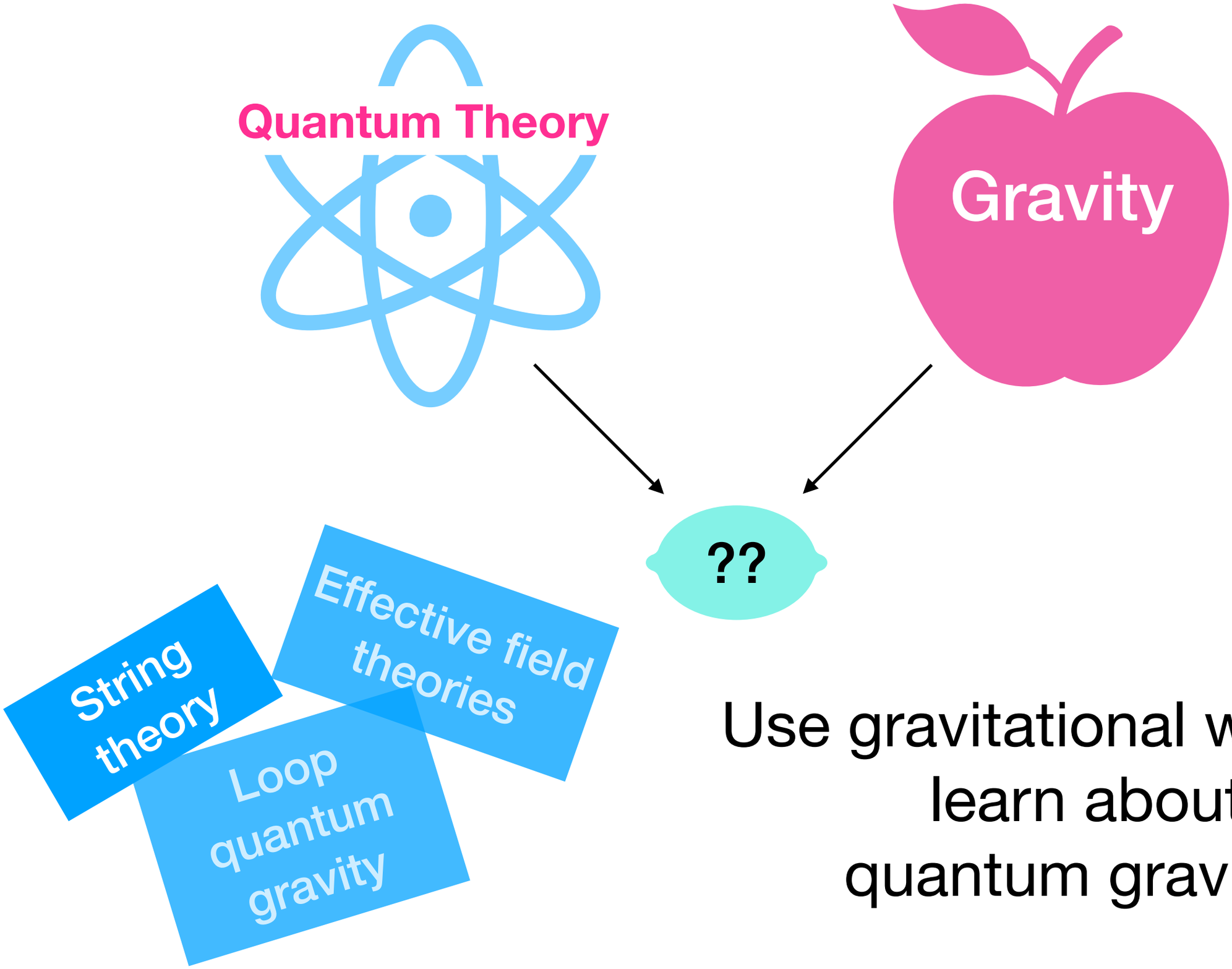
Compare to simulations



Data

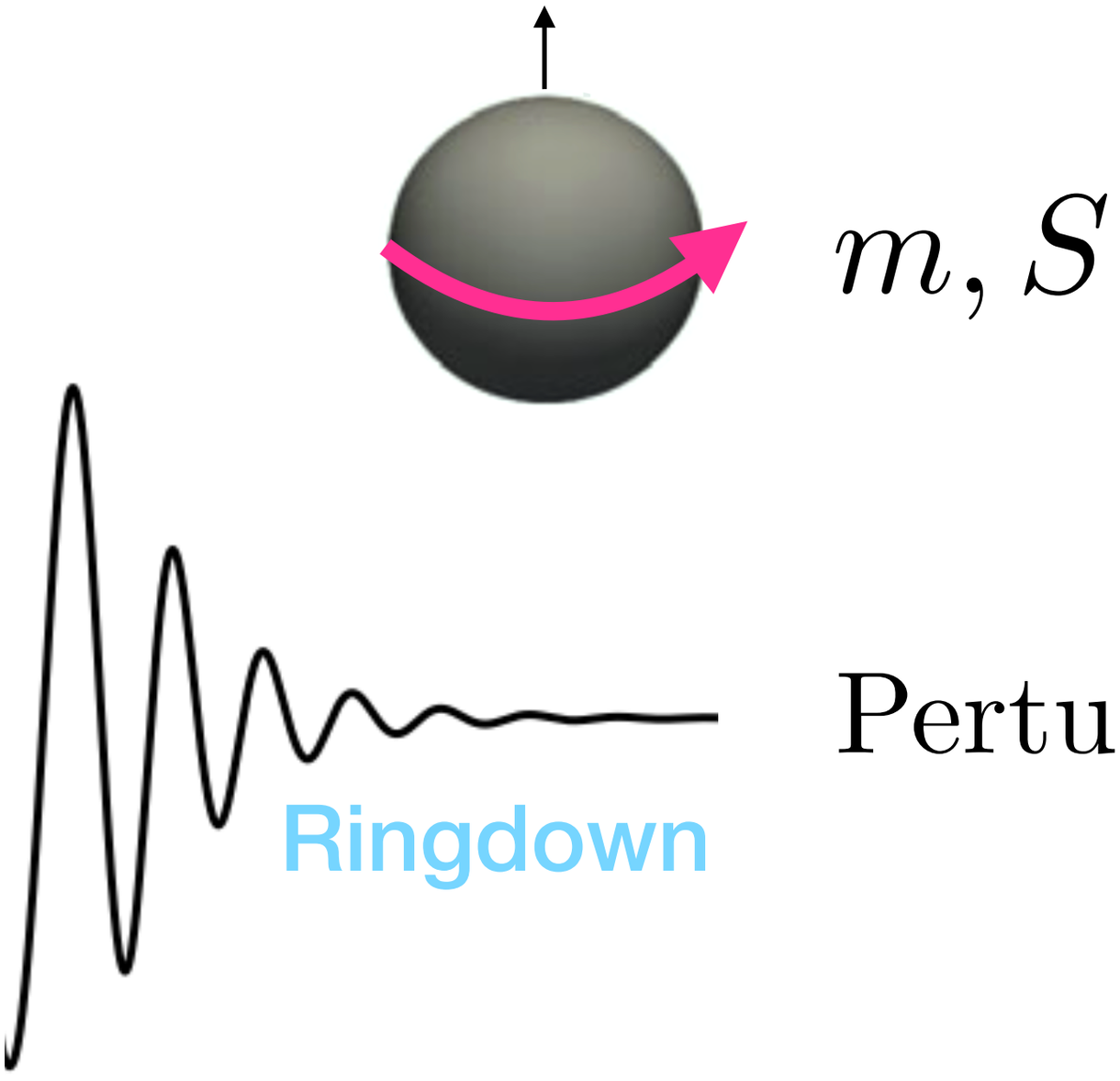
One project in Numerical Relativity + gravitational wave physics

General Relativity isn't the full story!



Use gravitational waves to learn about quantum gravity?

No-Hair Theorem [General Relativity]

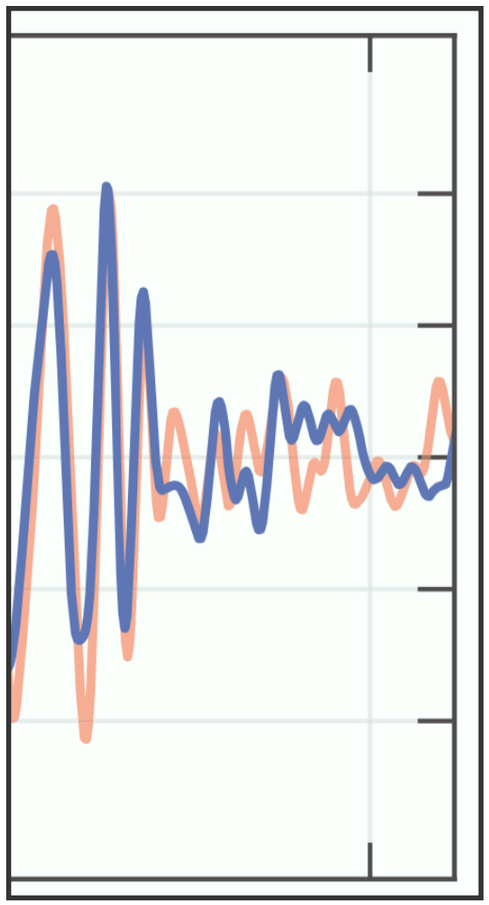


[Some other theory…]

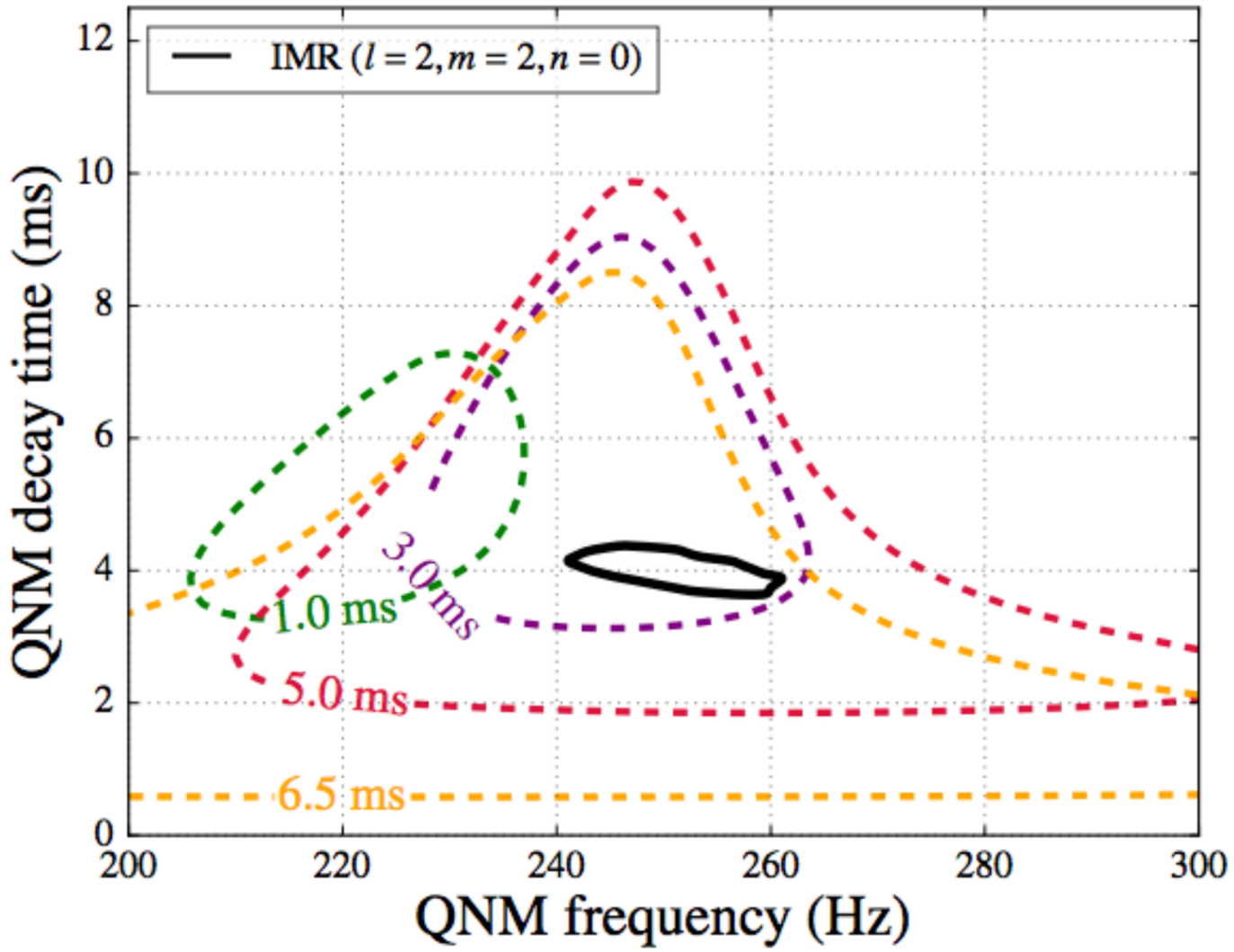
$m, S, A, B, C \ldots$

$\mathrm{Perturbation}(m, S, A, B, C \ldots)$

Does the No-Hair Theorem Hold?

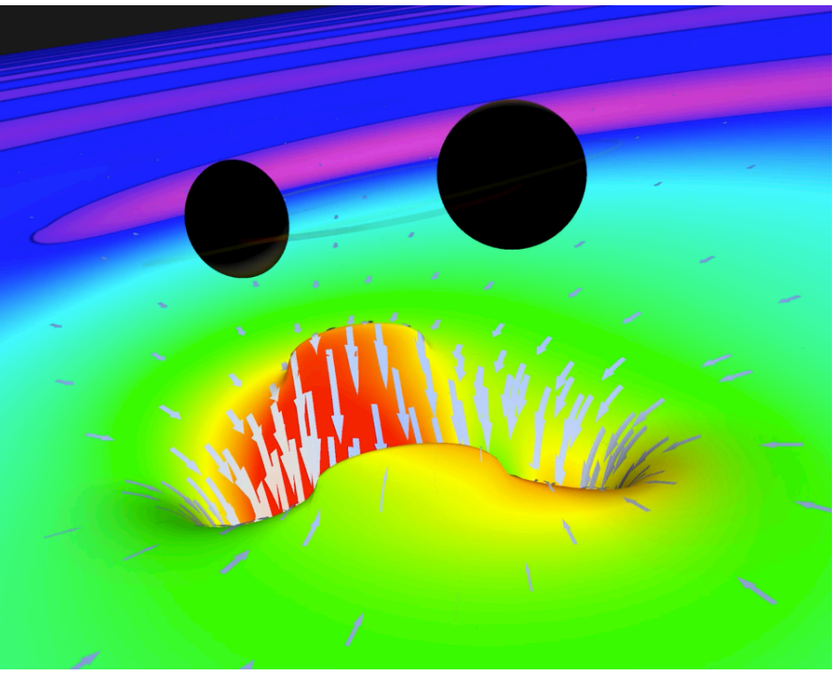


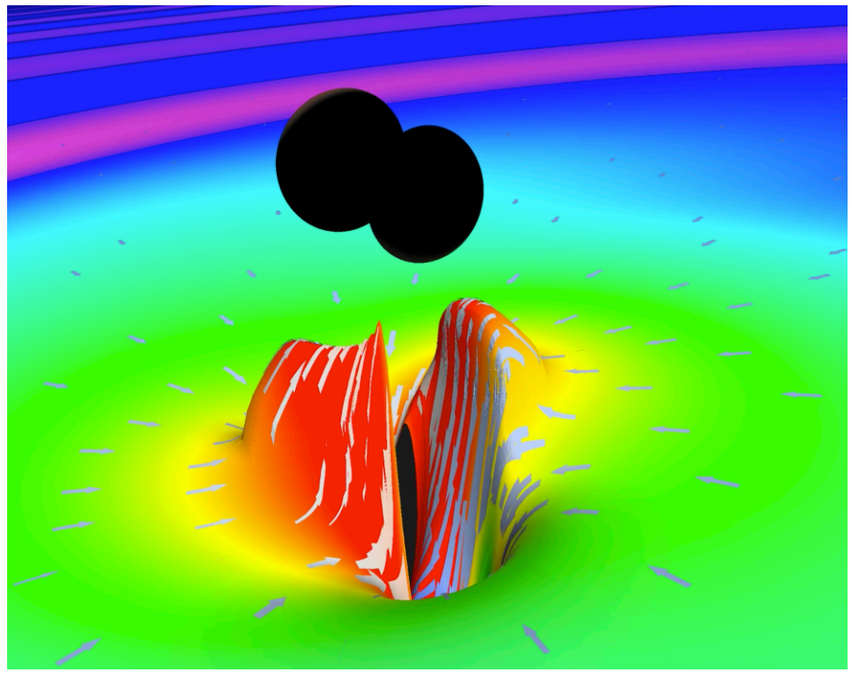
Data

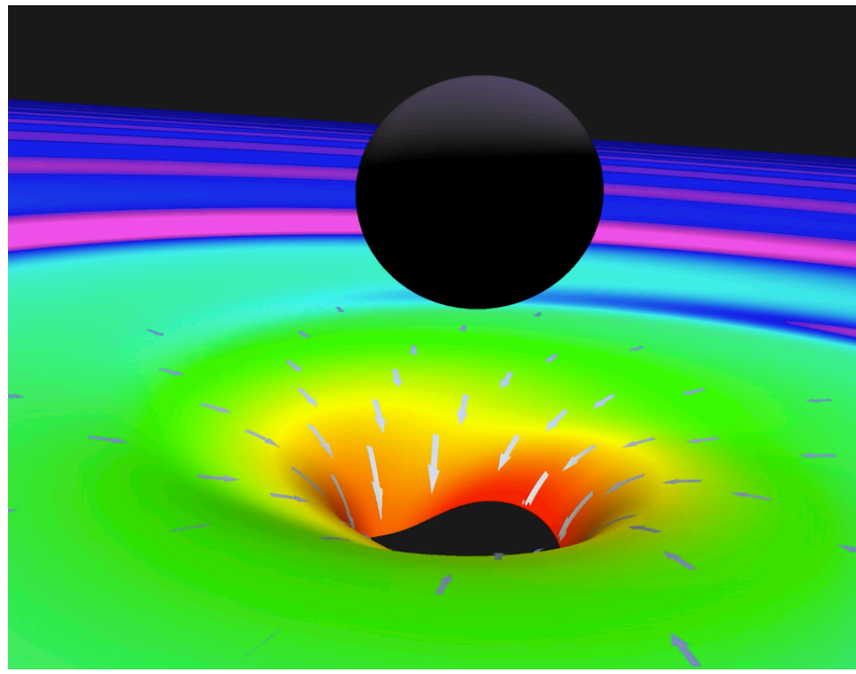


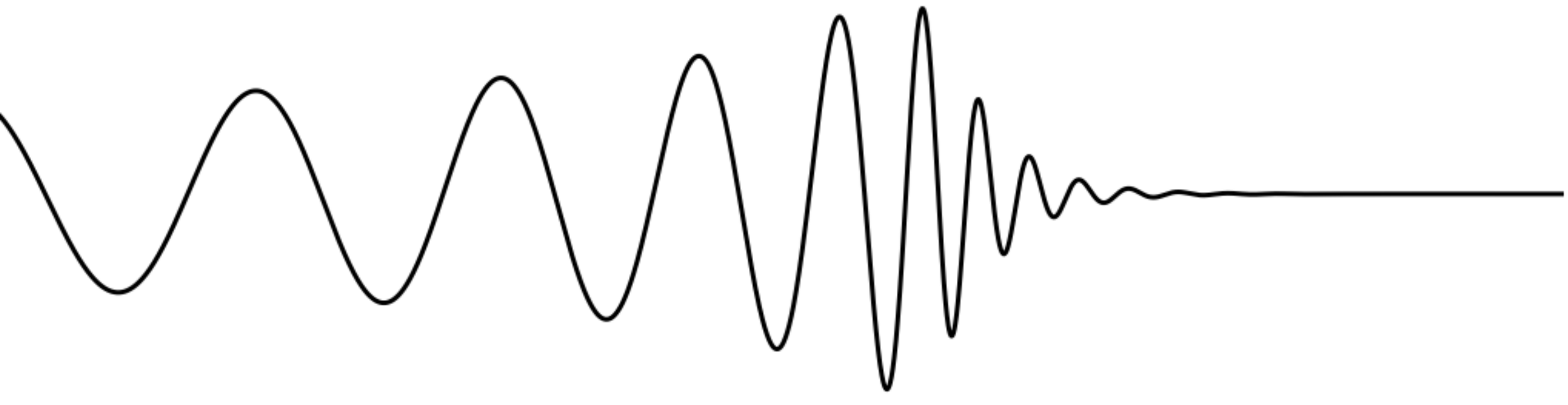
Posterior on m, S

When can we apply this analysis?

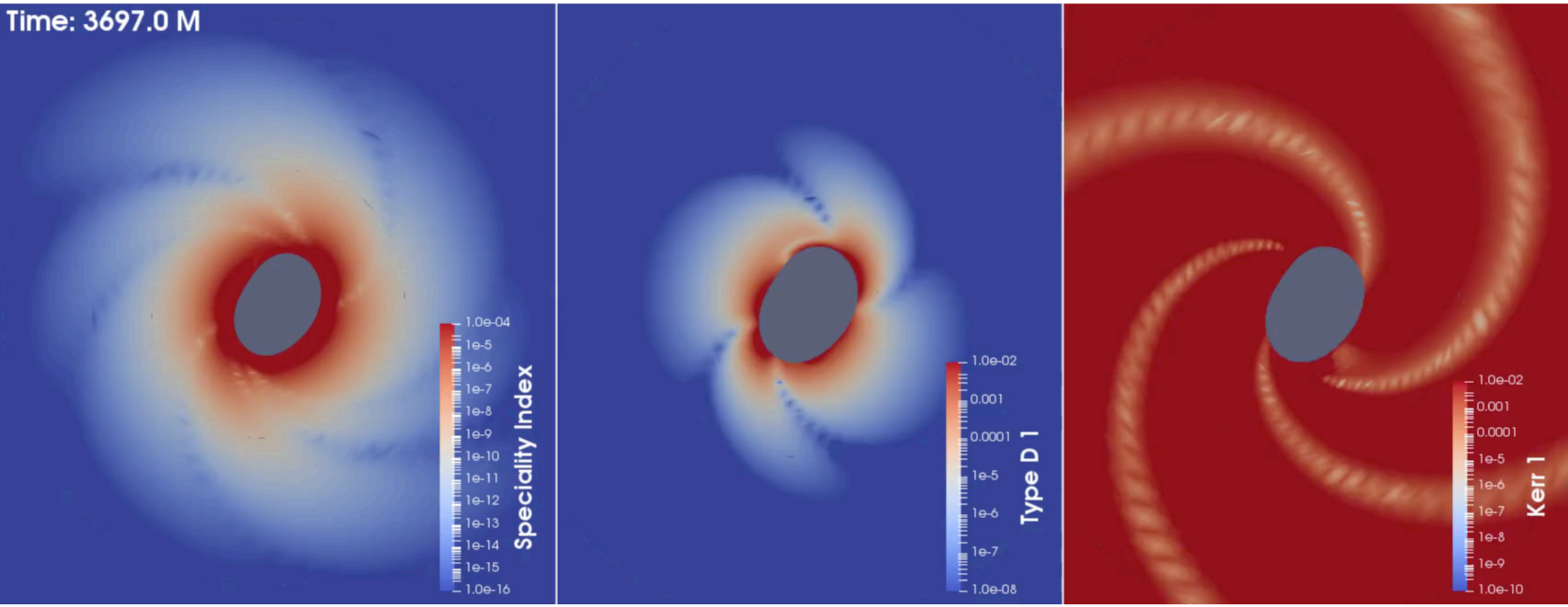


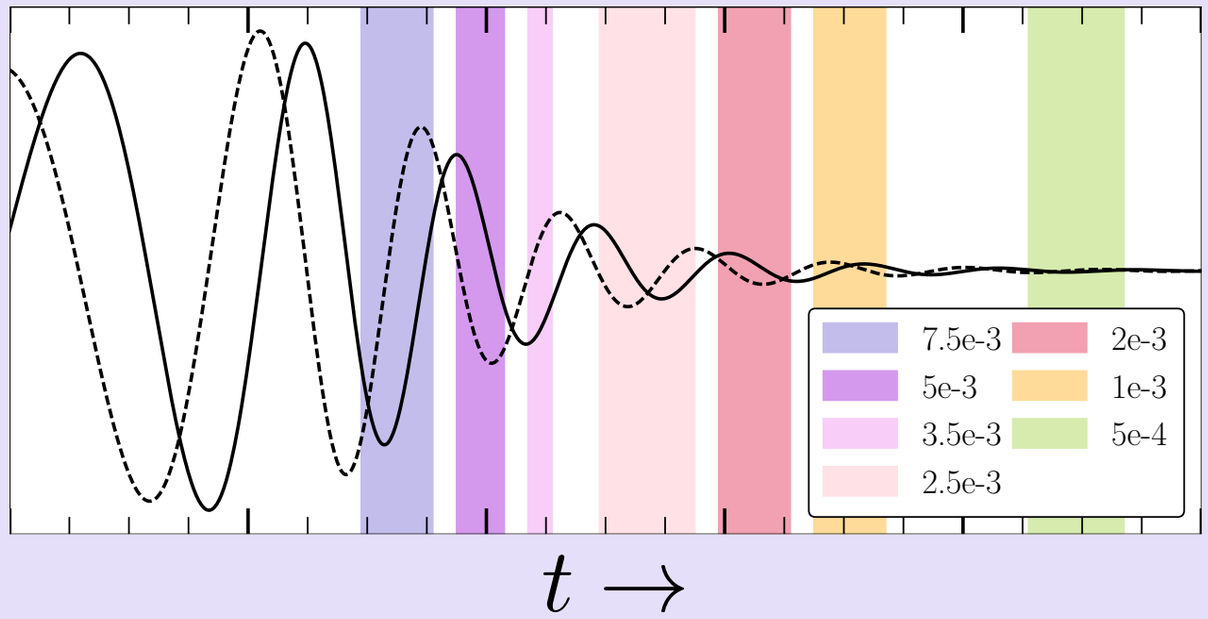


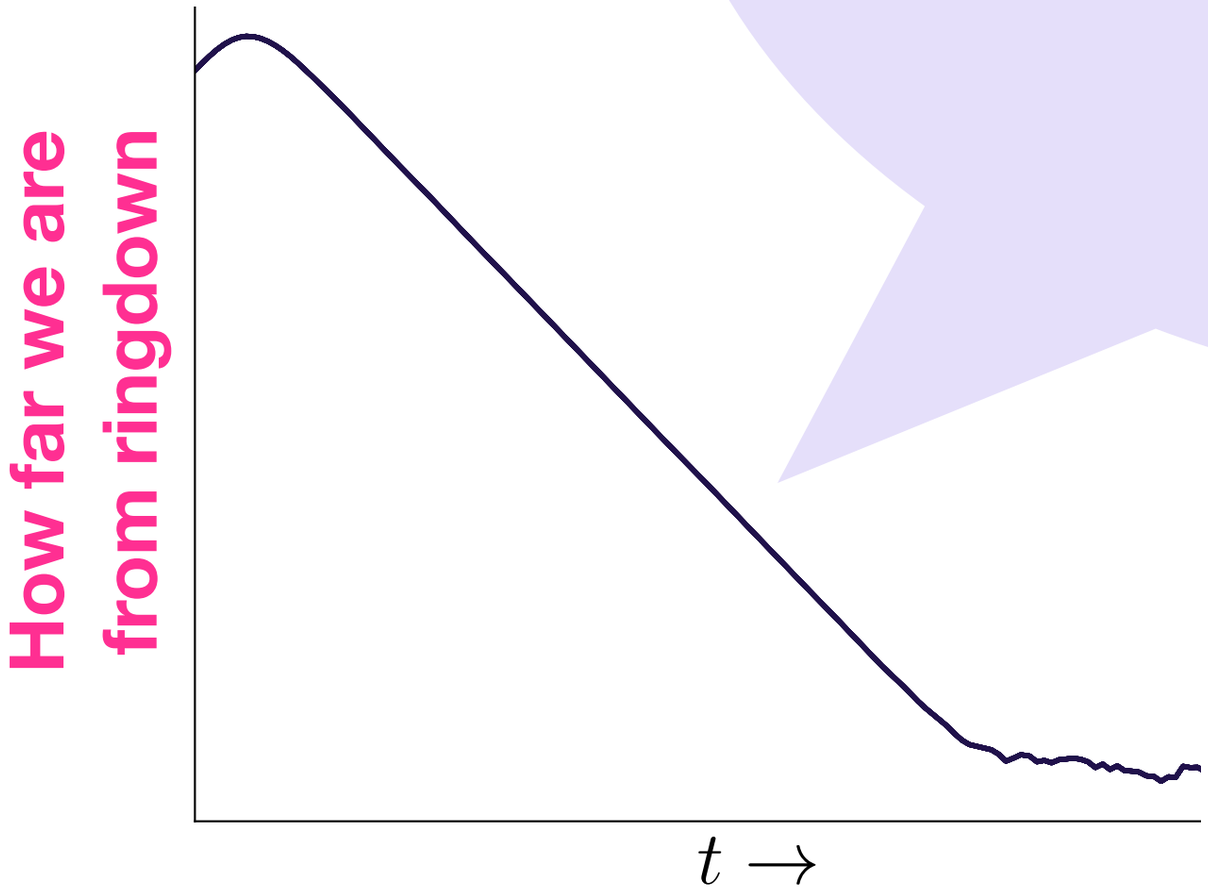




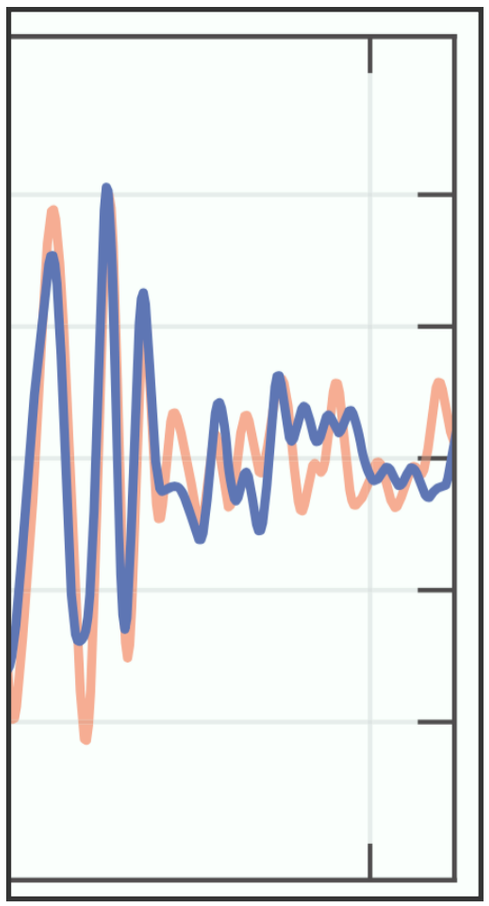
Use simulations to see when we're in ringdown




7.5e-3
5e-3
3.5e-3
2.5e-3
2e-3
1e-3
5e-4
$t \rightarrow$


How far we are from ringdown
$t \rightarrow$

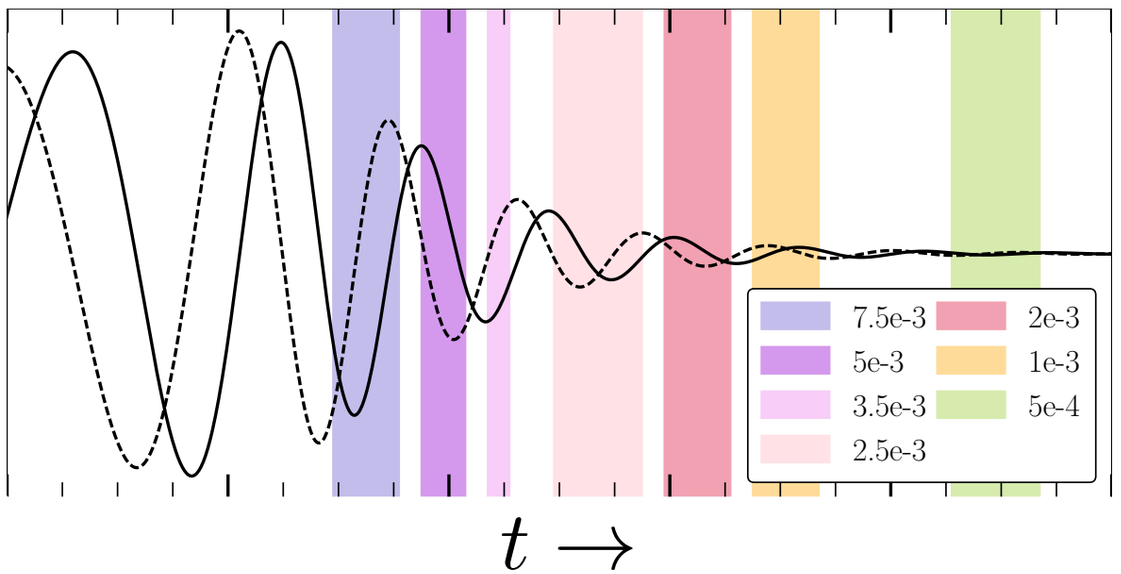
Does the No-Hair Theorem Hold?



Data

Posterior on m, χ

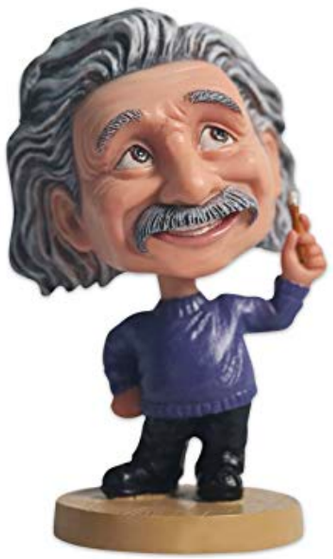
Analysis start time

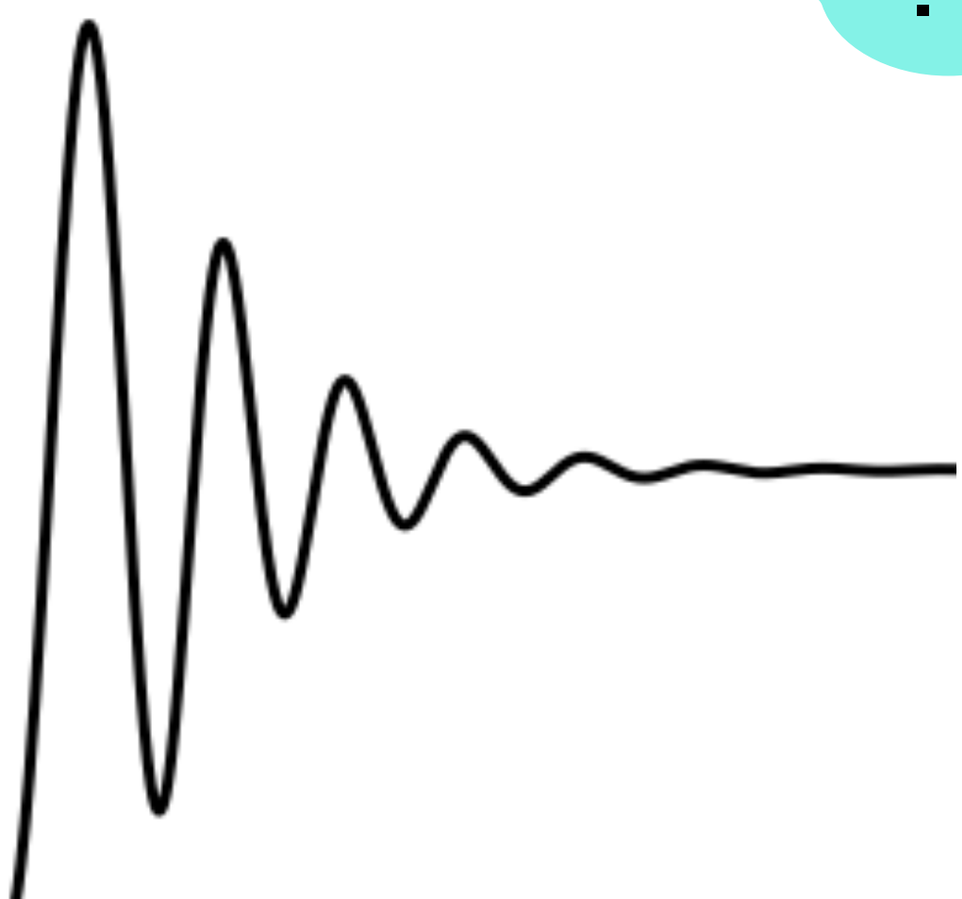


Quantum Theory

Gravity

??





Thank you!