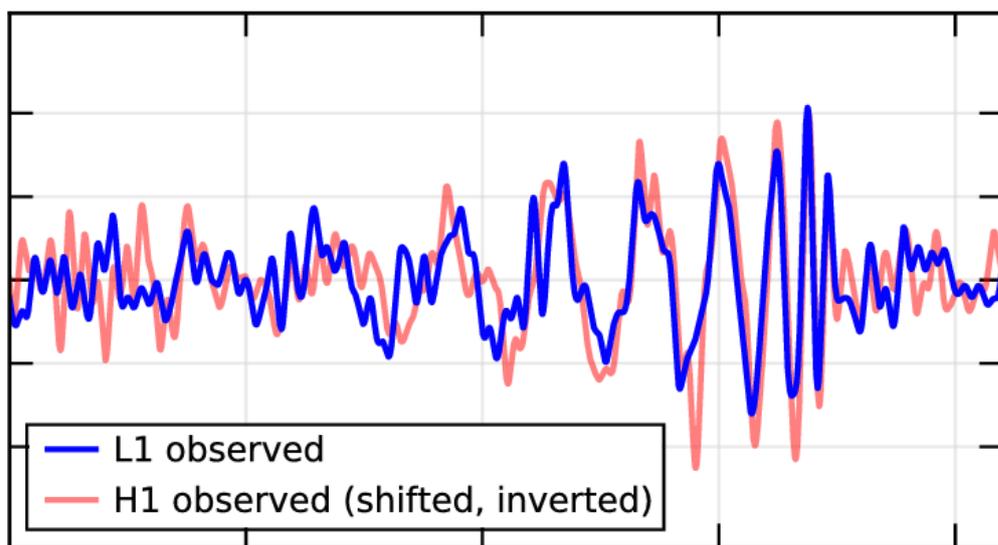


General Relativity Just Works

How in one fell swoop (or one fell chirp), a myriad of plausible alternates describing strong gravity were flushed away with the ether...

Livingston, Louisiana (L1)



... and what Rai *really* wanted to teach me when he decided to share the news about LIGO's 1st event.

Strong gravity before 2015

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1. Luminous and rapidly variable: need efficiency $\epsilon > 0.01$.
2. Lifetimes consistent with accretion efficiency.
3. Jets imply relativistic potential well.
4. Line features imply orbits with speeds $v \sim 0.5 c$ or more.
5. Source amplitude variability implies size $R \sim (\text{several}) GM/c^2$.
6. Thermal part of spectrum implies an inner disk radius $R \sim (\text{several}) GM/c^2$.
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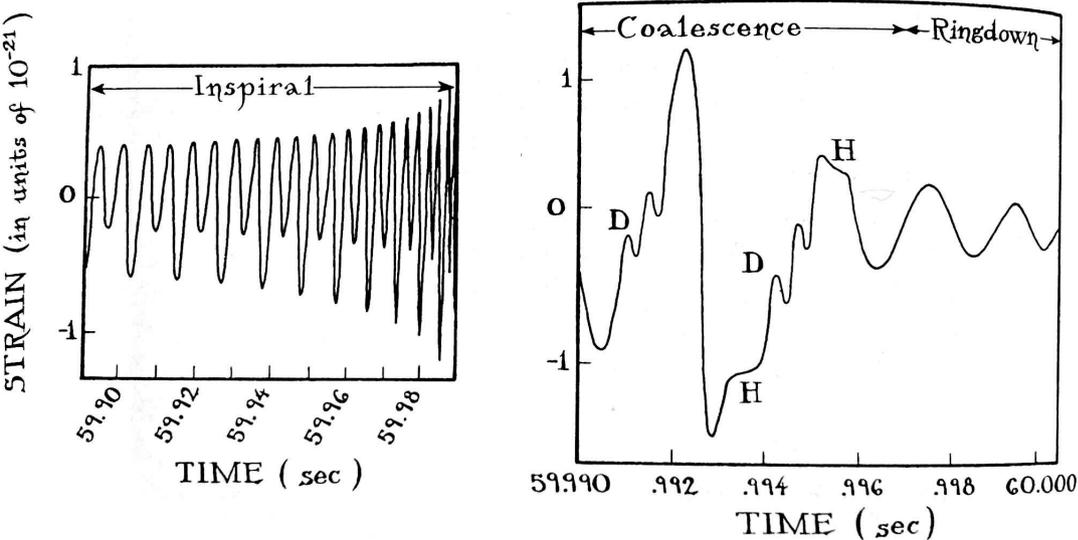
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If you had one *good* reason you wouldn't need 7.

Binary black holes

Though many astronomers were skeptical, relativists *loved* the binary black hole: nothing but gravity needed to describe them! Don't have to worry about fields and matter, cleanest binary source possible.



From “Black Holes and Time Warps: Einstein’s Outrageous Legacy,” K. S. Thorne, 1994, Chapter 10

“Inspiral, merger, ringdown” structure of waves depends on (and encodes...) source properties in a way that is totally determined by the Einstein field equation.

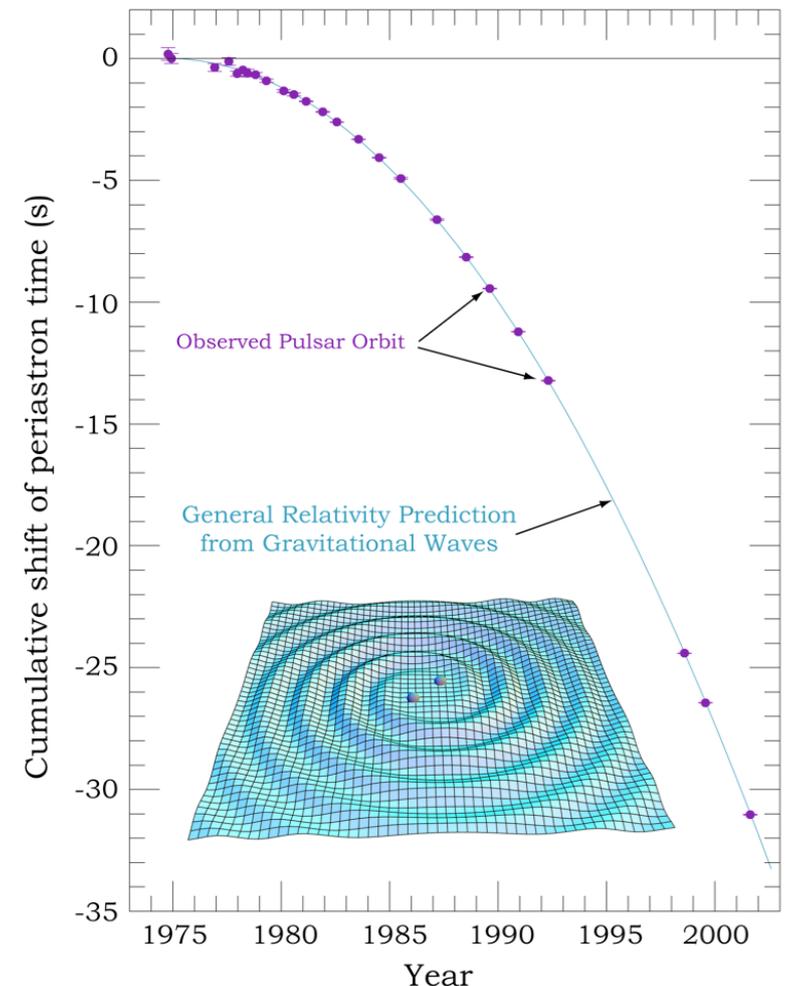
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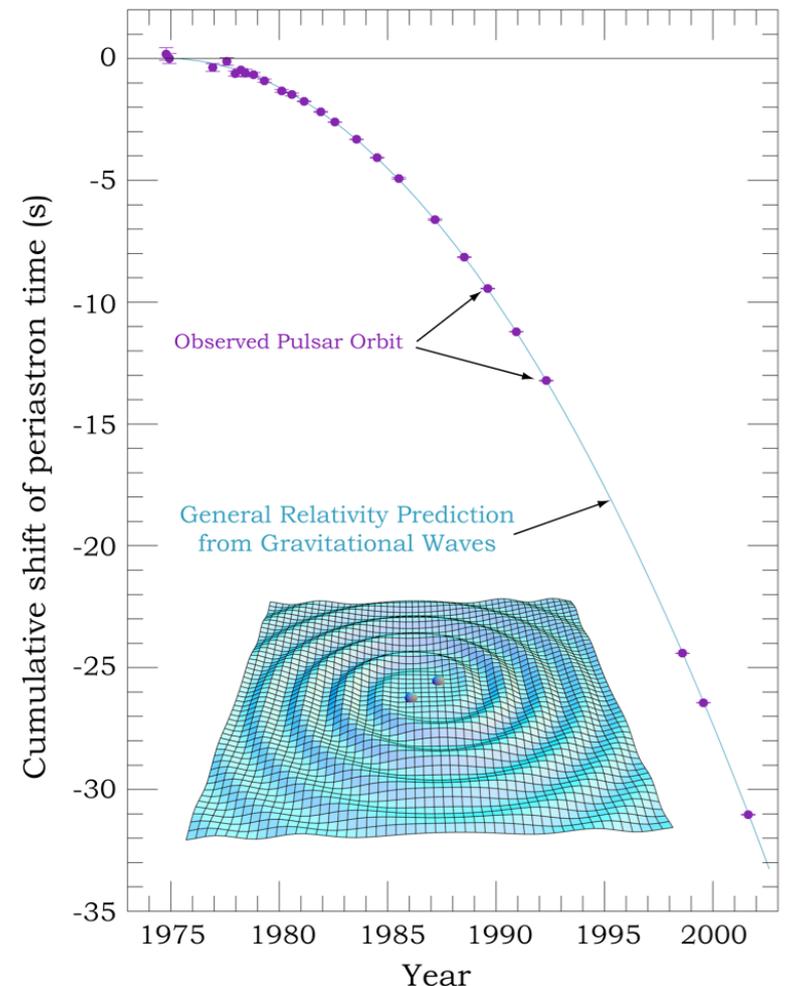
Important empirical constraint:
Binary neutron star inspiral measured with pulsar timing.
Any non-GR alternative *must* have GW backreaction that duplicates this result.



Binary black holes

What would we get if GR didn't hold into the strong field? Would we have black holes? Would the inspiral differ? Would the system produce GWs?

Proposed counterexample (from someone who argued to me that LIGO would measure nothing): GWs are generated and backreact on system exactly as in GR. **However, they propagate “off brane” and cannot interact with any distant detector.**



The binary black hole

Instant change
on morning of
14 Sept 2015!



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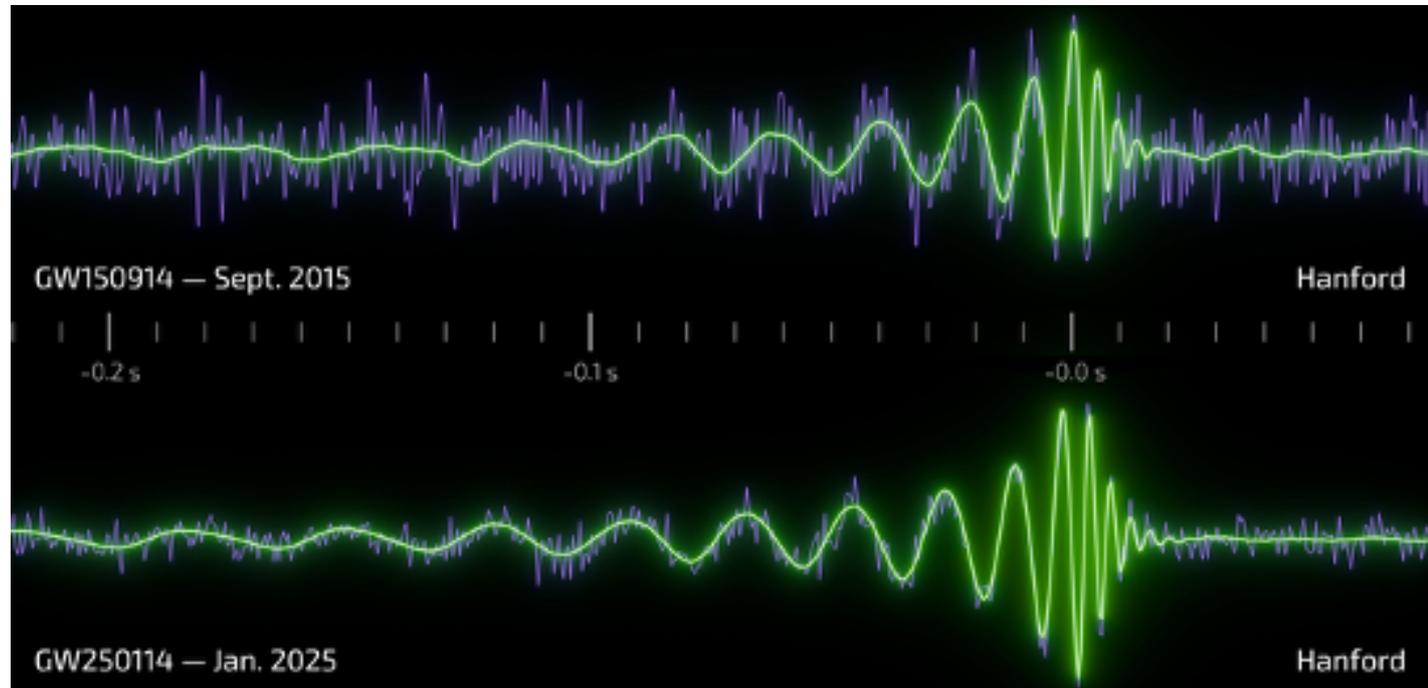


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Like the near-twin event measured 14 Jan 2025.

My “briefing” with Rai

I am not an official member of LIGO or LVK ... but have been “LIGO-adjacent” since 1993 or so.

Following the first event, news was in lockdown. I saw the same rumors as everyone else ... when people asked, I could (truthfully) say “I have no idea what’s going on.”

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Fall 2015: Rai decided I needed to know some stuff ... and that I needed to understand how and why news about ongoing activities was in lockdown.

His #1 message to me: my friendships with folks in LIGO were more important than this discovery.

Thank you, Rai

Rai deserves every accolade for all that he did to move the boundaries of what we can measure and learn about our universe.



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What will live in my memory is his deep and sincere concern that all of us remember the friendship and love that our work enabled.