

Learning about Astrophysics through Sci-Fi!

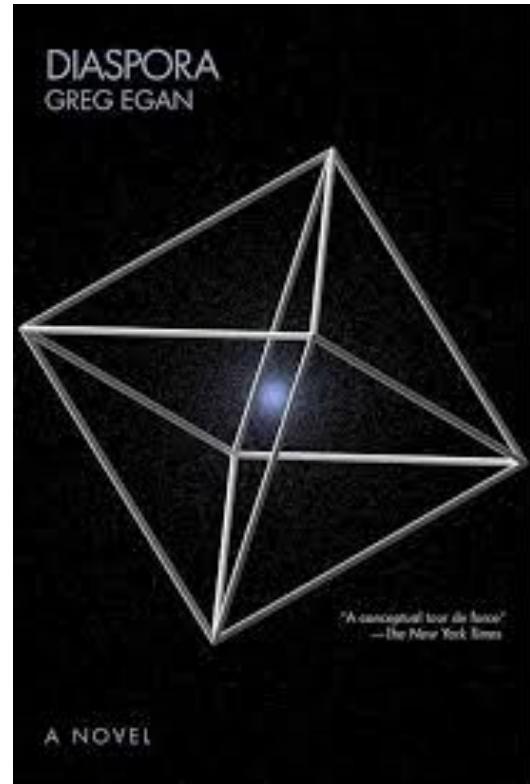
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Mellon
University

Diaspora - Greg Egan

- Hard Sci Novel, written in 1997 by Australian sci fi author
- Commonly touted as “hardest” sci-fi book ever
- Themes of
 - Transhumanism
 - Theories of everything
 - Ethics of *first contact*
 - Higher dimensional spaces and wormholes

Focusing on a scene in the beginning
of the book



Setting the stage

- April 2nd, 2996 AD, Gravitational wave (GW) observatory on the Moon, called TERAGO
- Laser interferometer

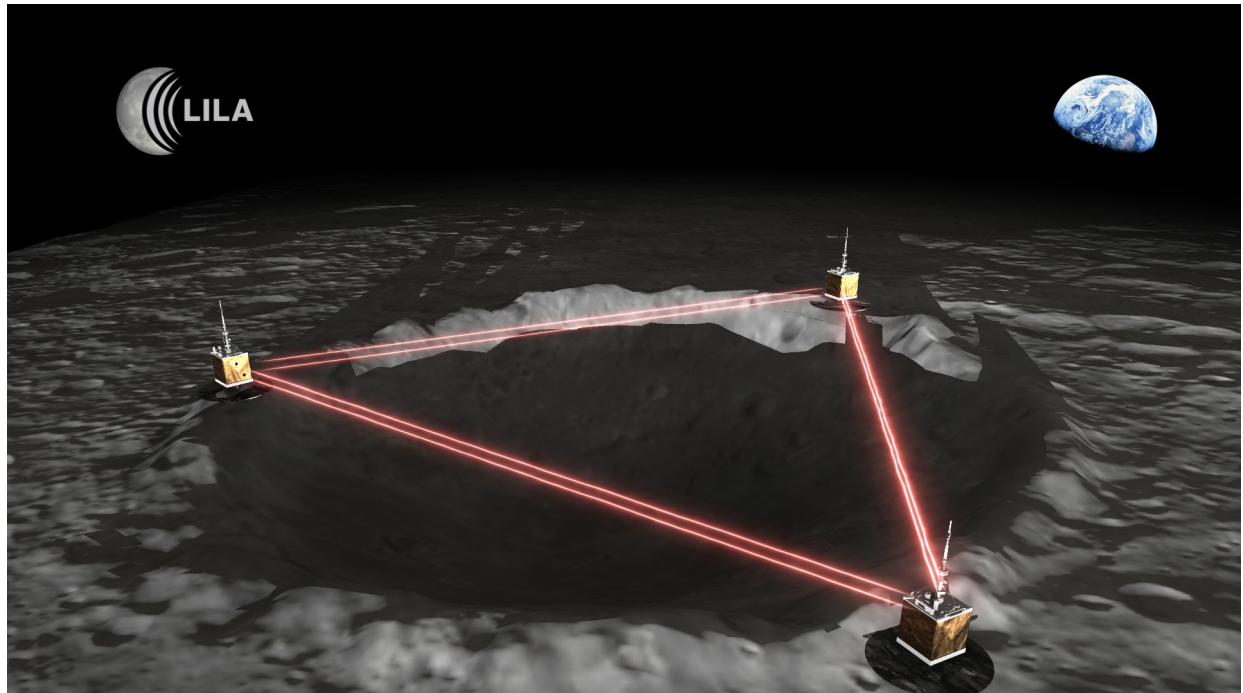


Image credit:

<https://www.vanderbilt.edu/lunarlabs/lila/>

How do Laser interferometers work?

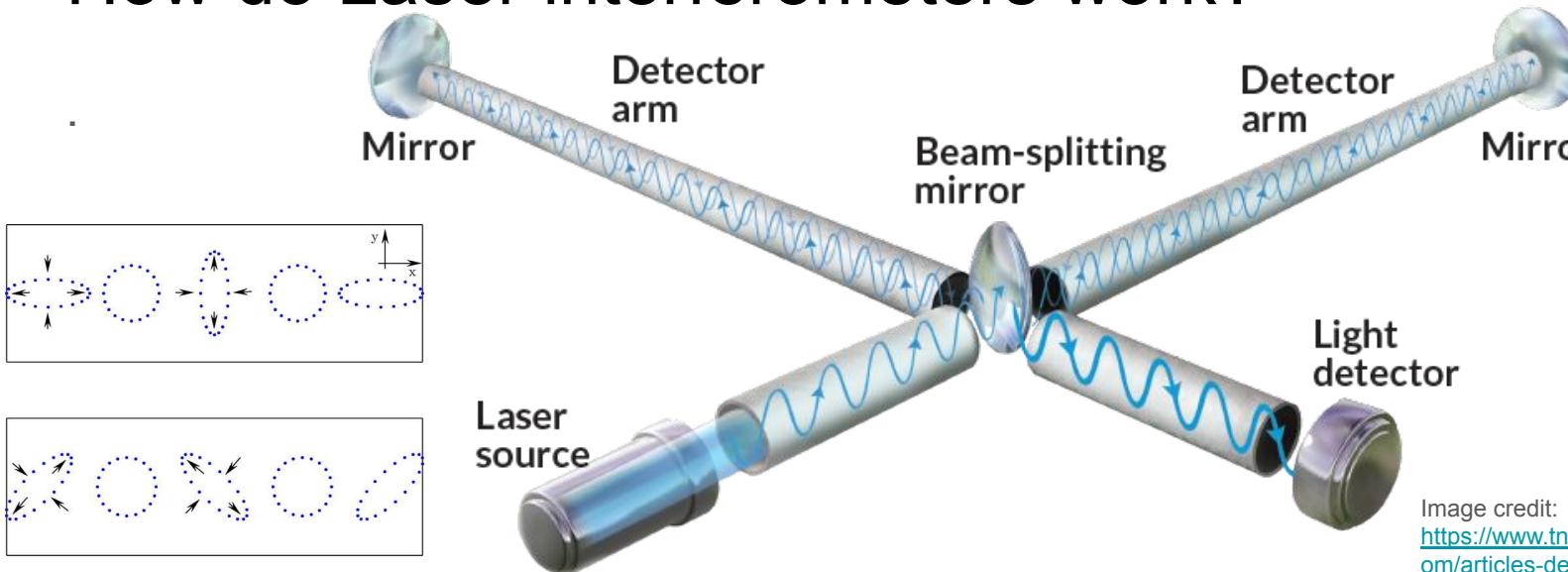
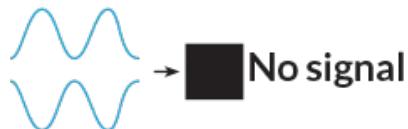
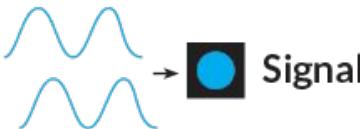


Image credit:
<https://www.tnpsc.gov.in/articles-detail/india%20%99s-contribution-to-ligo>

Normal situation

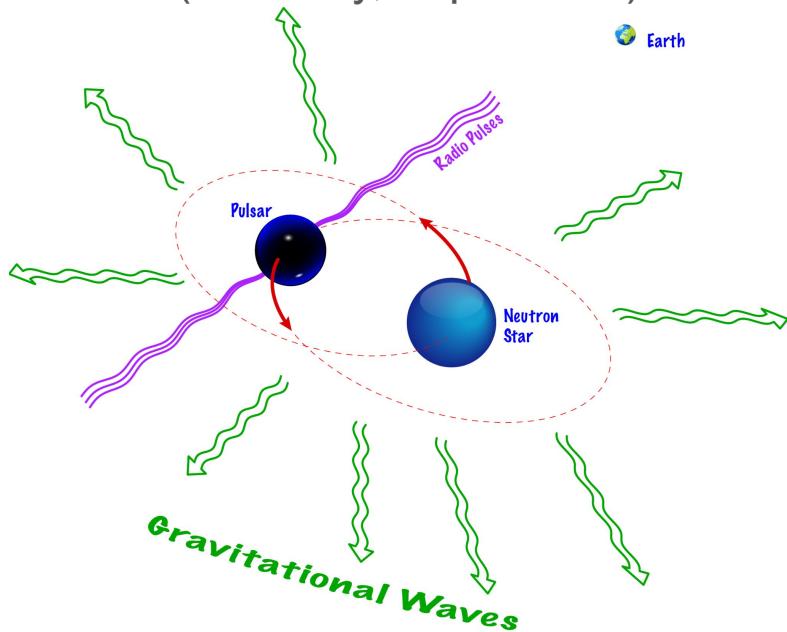
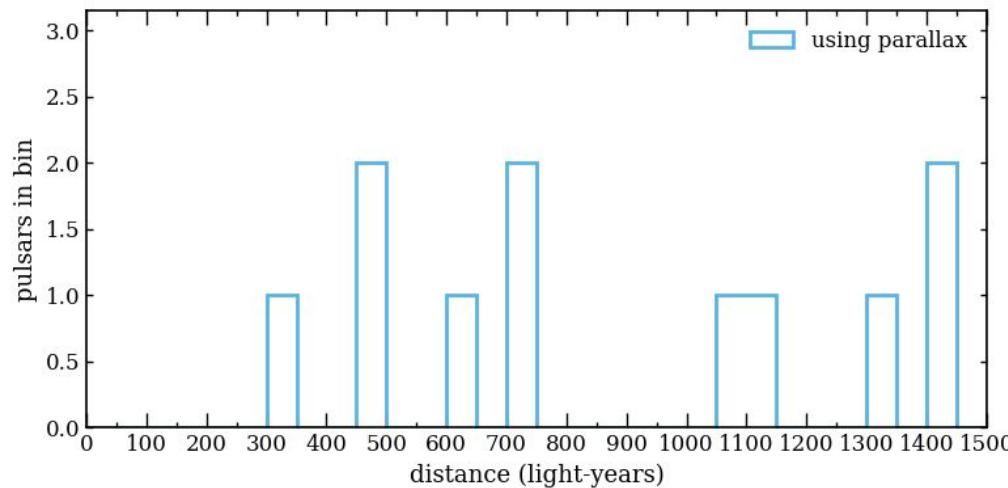


Gravitational wave detection



Observing a neutron star binary

- Binary neutron star, Lacerta G-1, 100 light years away
- Not pulsars! Detected through the GW detector (currently, impossible)



Orbital decay anomaly

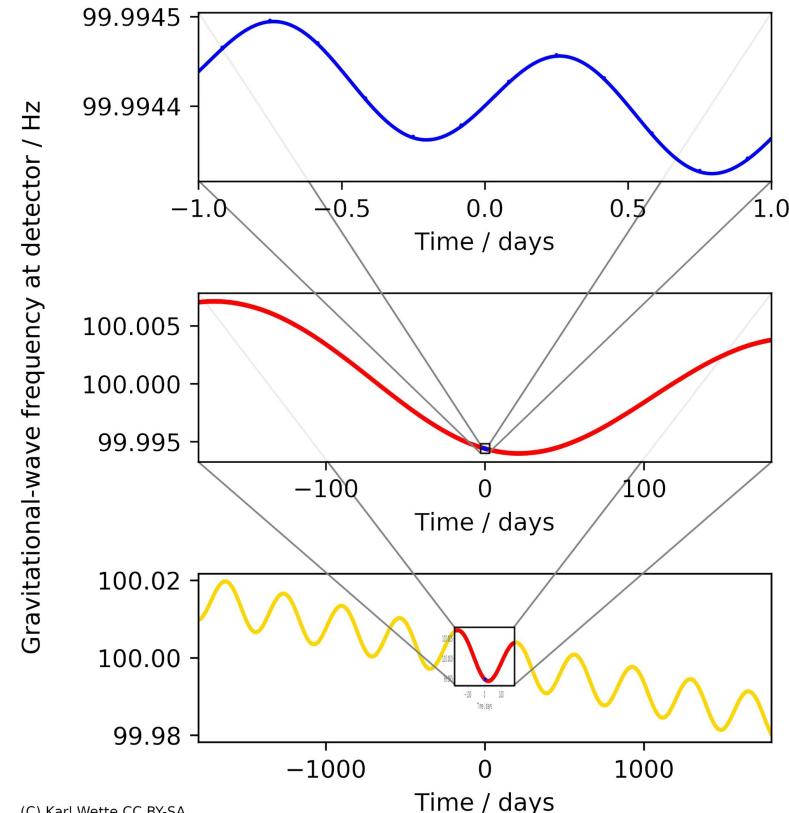
- Due to gravitational radiation, every second, 6×10^{17} Joules being emitted
- Expected to merge in 7 million years
- Period should decay about 0.5 nanosecond every day

Physicist at the lab notices something strange:

*Over the past month,
orbital decay ~ 520 ns / day*

Very strange!

Image credit: [Continuous gravitational waves from neutron stars | Centre for Gravitational Astrophysics](#)



How strange is this?

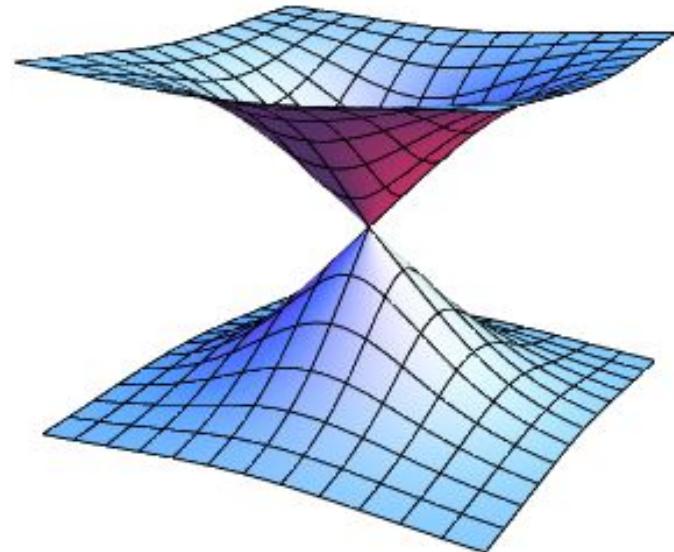
- Rate of decay was accelerating much faster than expected
- Neutron stars lost as much energy in a month as they had in the last 1 million years, aka the equivalent of the moon made of antimatter annihilating itself
- No detection of any X-rays, UV radiation, or neutrinos to explain the missing energy. Where did it all go?
- All fits to the data points to the neutron stars colliding in

4 days!



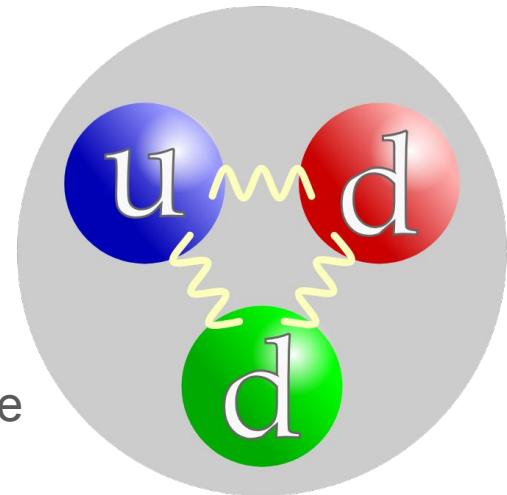
How plausible is this?

- Caveat: In this story, the humans have come up with a theory of everything
- Every particle is the mouth of a wormhole
- The physicist who observed this proposed a theory to explain the orbital decay problem



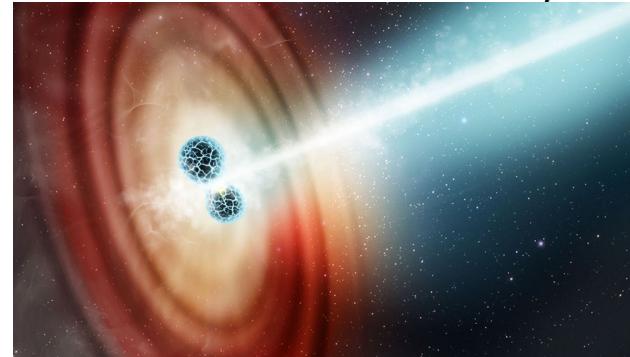
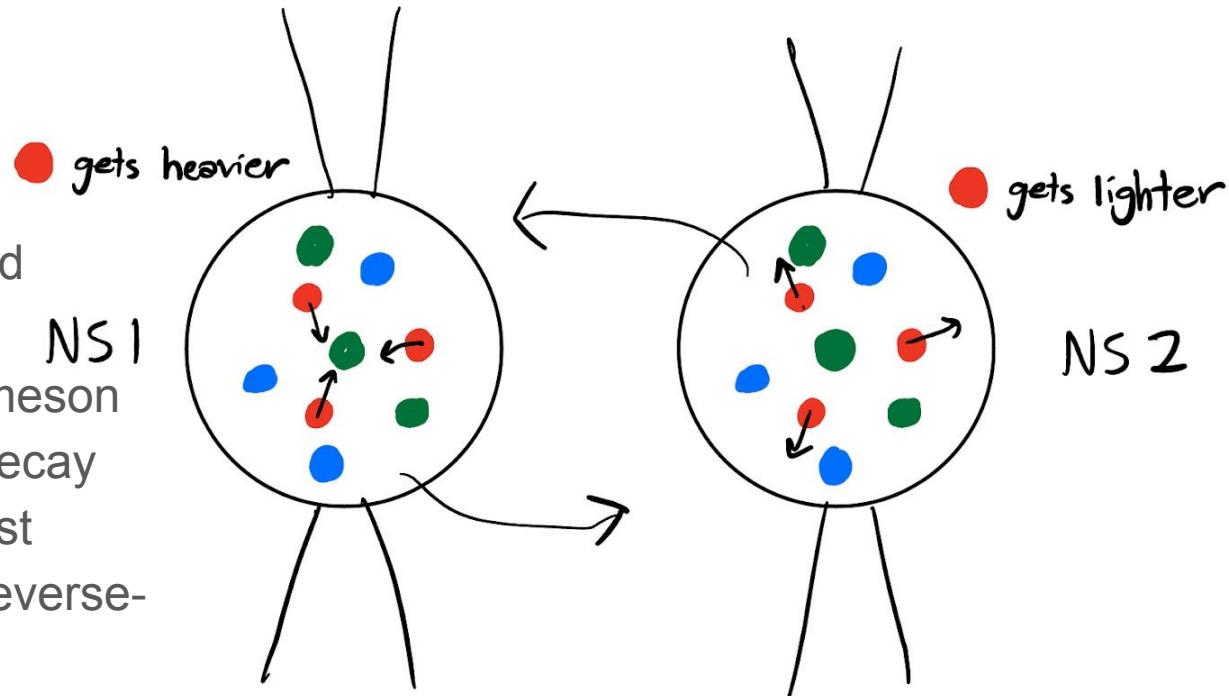
Potential Solution

- Neutrons are color neutral
- Both neutron star cores are “pools” of differently colored quarks
- Locally, the color isn’t necessarily neutral everywhere
- In their theory of everything: red, blue, and green don’t necessarily behave the same way (symmetry breaking)
 - This happens extremely rarely, but the special conditions of the neutron star cores could allow this process to be stable



Meson Jets

- Cores become polarized
- In theory, we would be able to observe these meson jets because mesons decay and would slam into dust
- Behaves as a sort of “reverse-Catherine wheel”



Conclusion

- No meson jets ever detected in the story, so fate of Lacerta G-1 still mystery
- Rest of the book is the tale of humanity trying to figure out
 - What is the true theory of everything?
 - Where did all of the angular momentum go in Lacerta G-1?

