

A Brief History of Our Creation

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Introduction

We are all **children of the stars**

composed of **stardust-**

The by-product of a **blast.**

But the process of our creation

left behind many **ghosts**

that **LIGO** wants to detect.

Let me tell you the story

Star Life

- Once formed, a star is powered by **nuclear** burning
- **Hydrogen** and then **Helium** fuse together-
producing energy (light and heat) and
forming heavier elements

Star Life

- As the star burns it becomes layered like an **onion**, with heavy elements fusing with heavier elements at the center.



Consuelo Gamboa

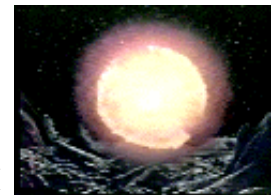
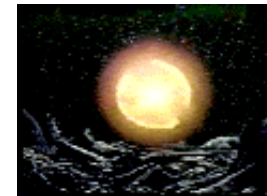
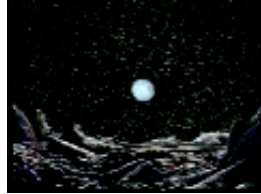
- This process continues up to **Iron**, with which fusion no longer occurs.

Star Life

- Once fuel is **burned up** (core is made of Iron), nuclear fusion ceases and the forces of gravity take over to initiate **collapse**
- Providing the star is large enough (>1.5 times the mass of the sun) the death will follow a **Supernovae** sequence

LIGO

Supernovae



time evolution



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Images from NASA High Energy
Astrophysics Research Archive-
Slide from Barry Barish LIGO-G030037-00-M

Remaining Debris

All the stuff (stardust) blown off in the explosion **slows down** in surrounding gas in space

This stardust eventually **coalesces into planets**- which, in some special cases, produce **life**

We are *made* of the **stardust** from the explosion!

What Remains

Explosion is only outward recoil of **collapse** into neutron star (which produces no light)

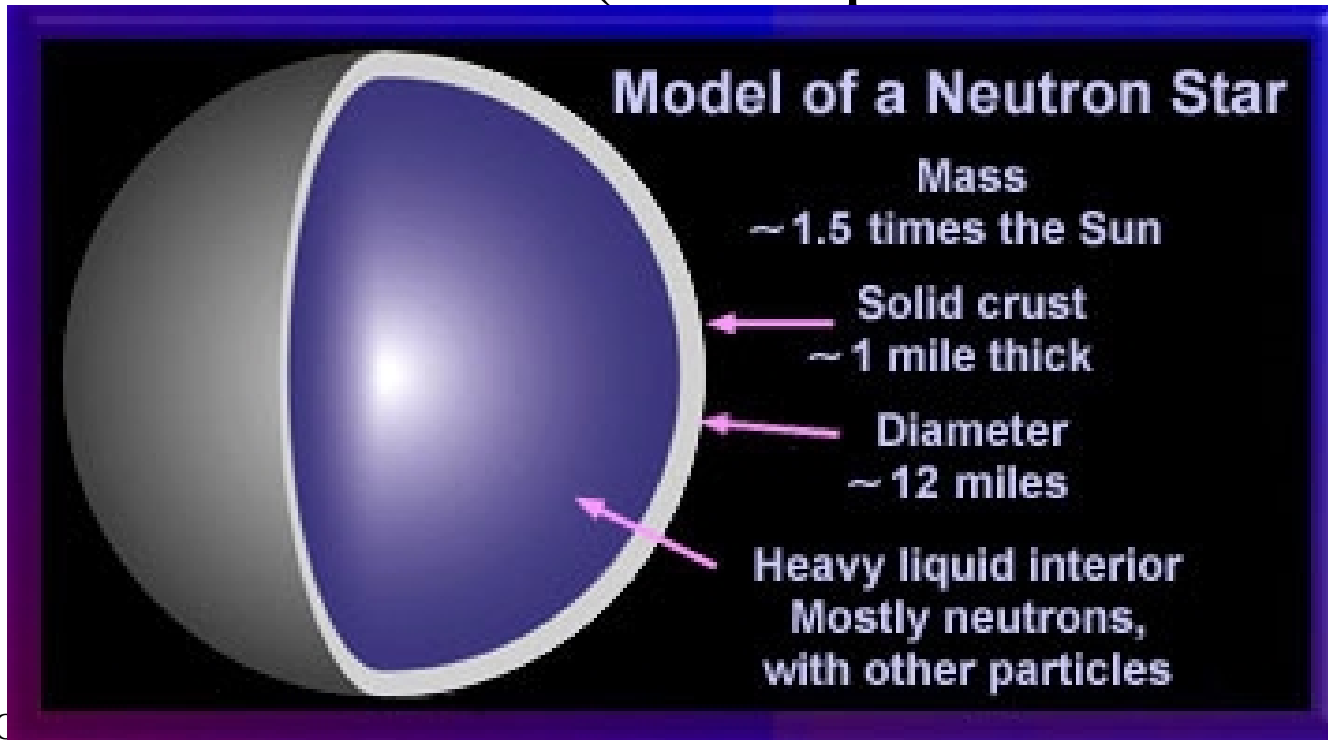
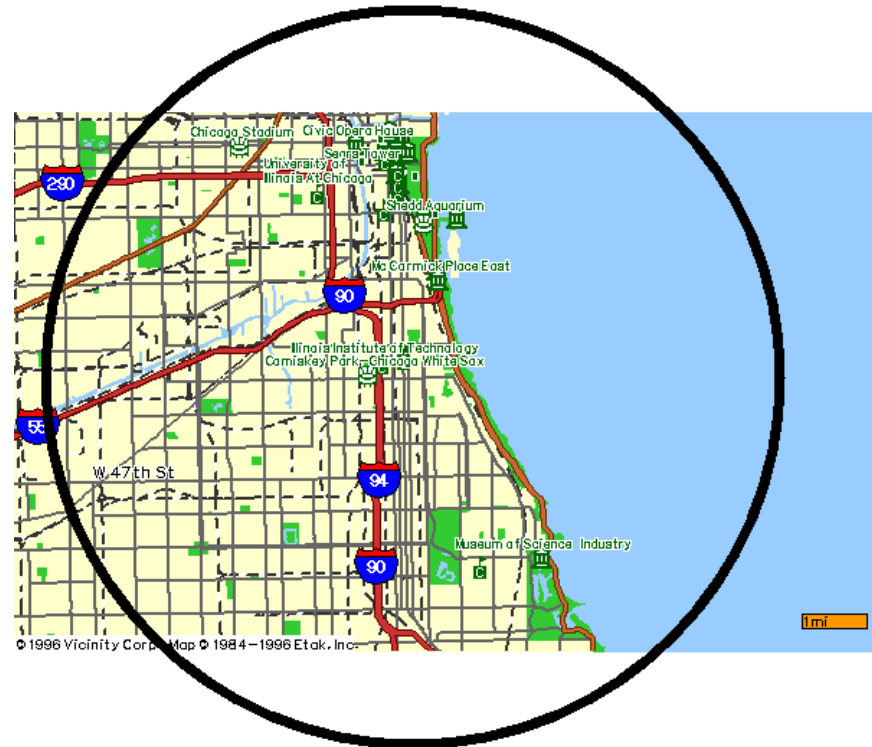


Photo from
Barry Barish
LIGO-G030037-00-M

Neutron Star (Ghost)

Neutron star vs. Chicago

Density is
equivalent to all
of humanity
crammed into a
volume the size
of a **sugar cube!**



Mass = $1.4 M_{\text{sun}}$, Radius = 10 km
Spin rate up to 38,000 rpm
Density $\sim 10^{14}$ g/cc, Magnetic field $\sim 10^{12}$ Gauss

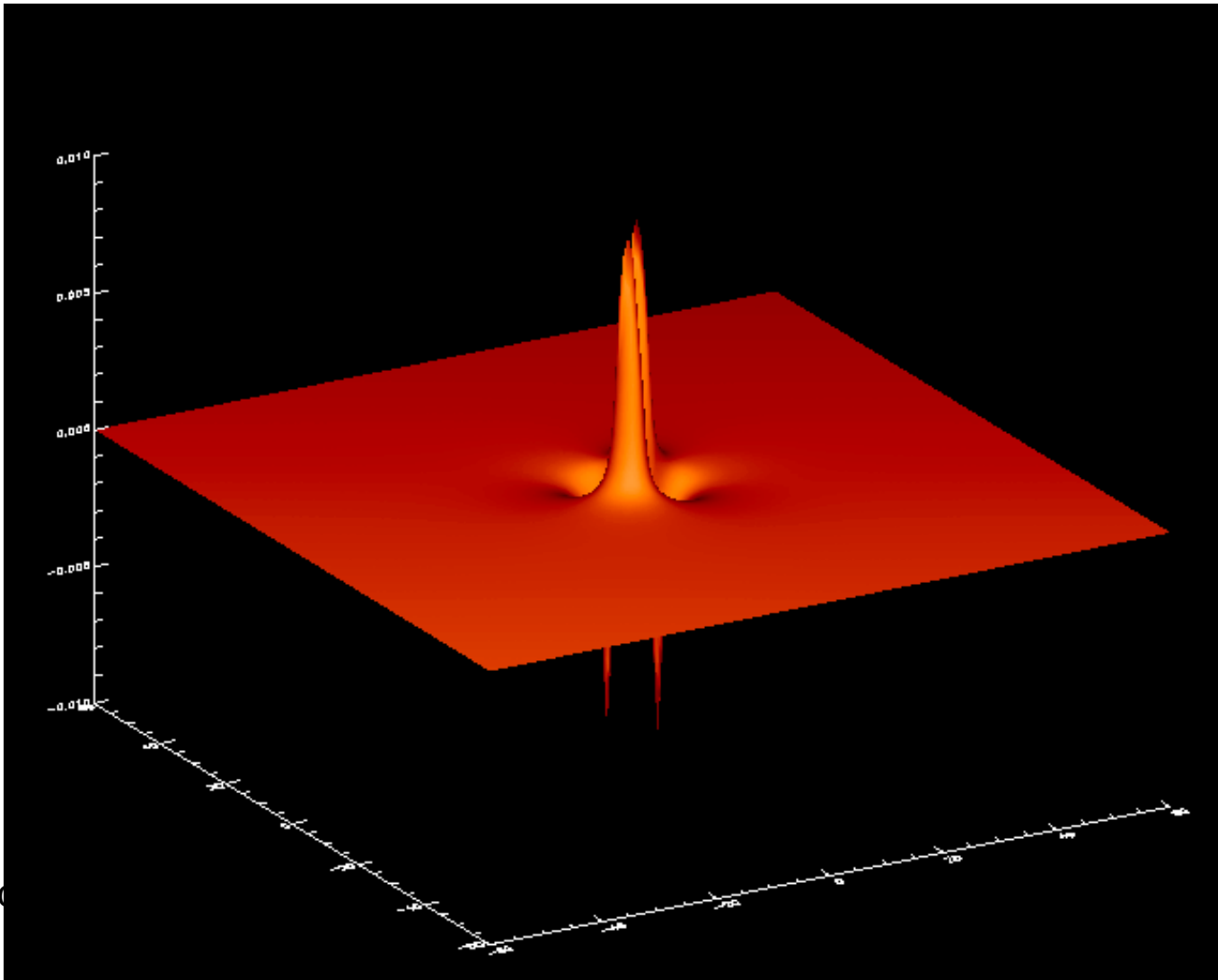


LIGO's interest

LIGO will study the **early history** of
our creation by **detecting** the
remnant ghosts,
neutron stars
and black holes

LIGO

The ghosts are invisible unless
and until they meet another ghost

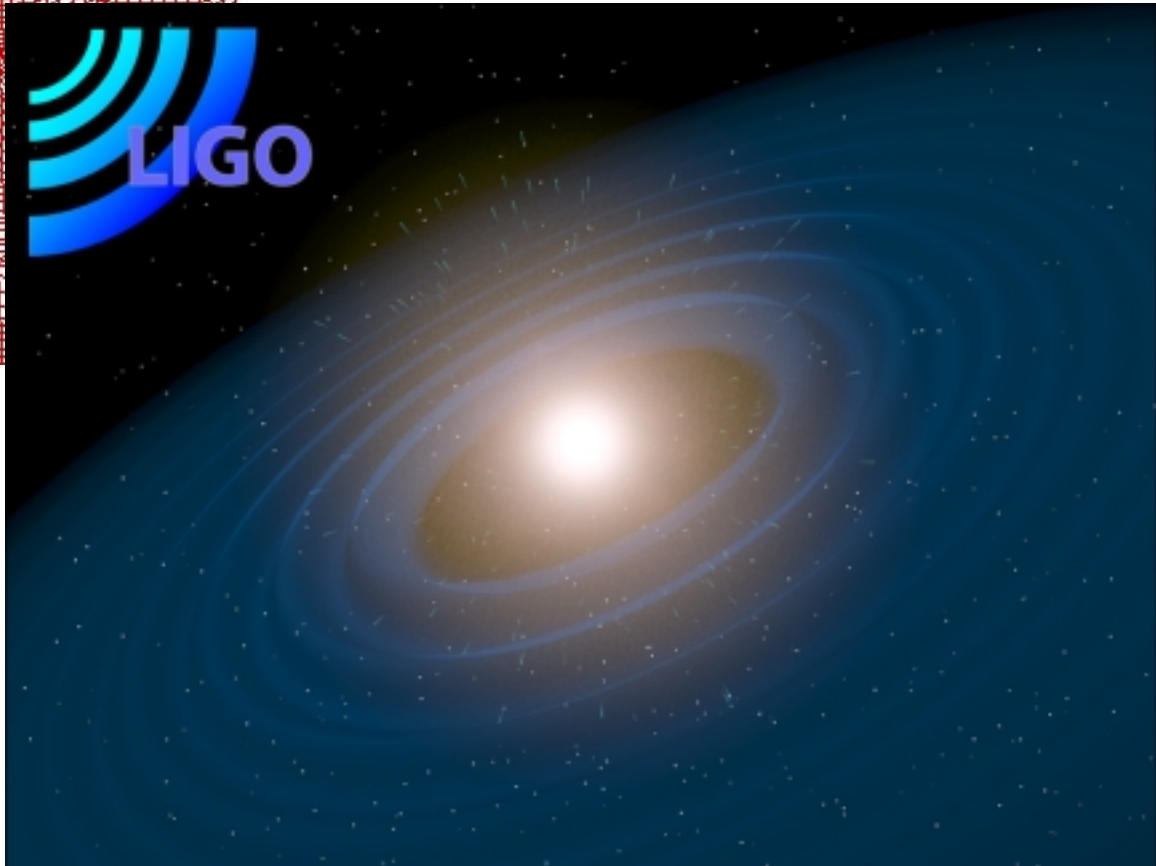
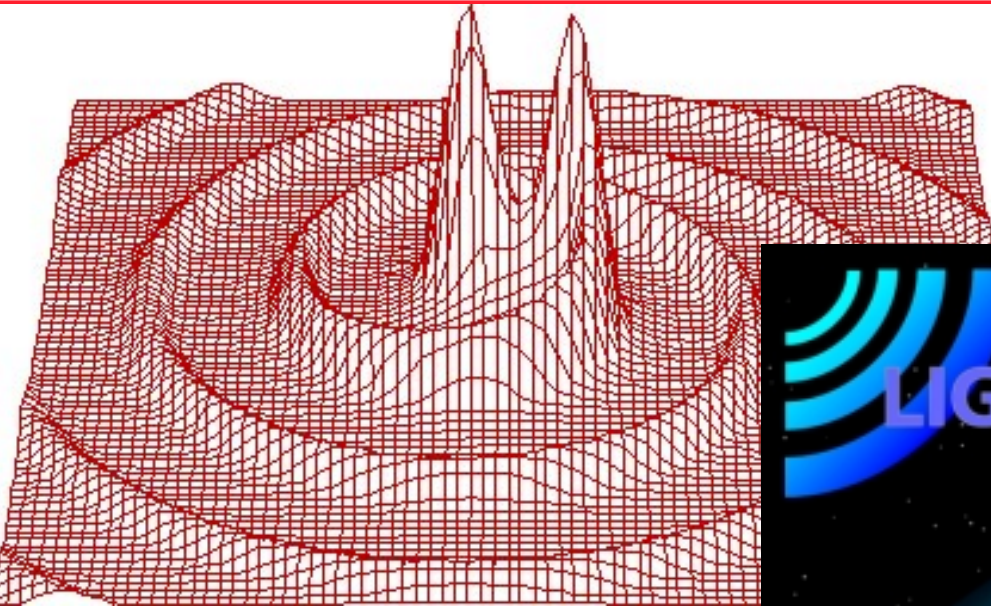


LIGO-C

The LIGO logo consists of the word "LIGO" in a bold, black, sans-serif font. To the left of the text are several concentric, curved lines that resemble ripples or a stylized spiral, rendered in a light gray color.

LIGO

And in the final spiral emit gravitational waves



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