Death from the Skies!

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Stanford Splash

Fall 2012

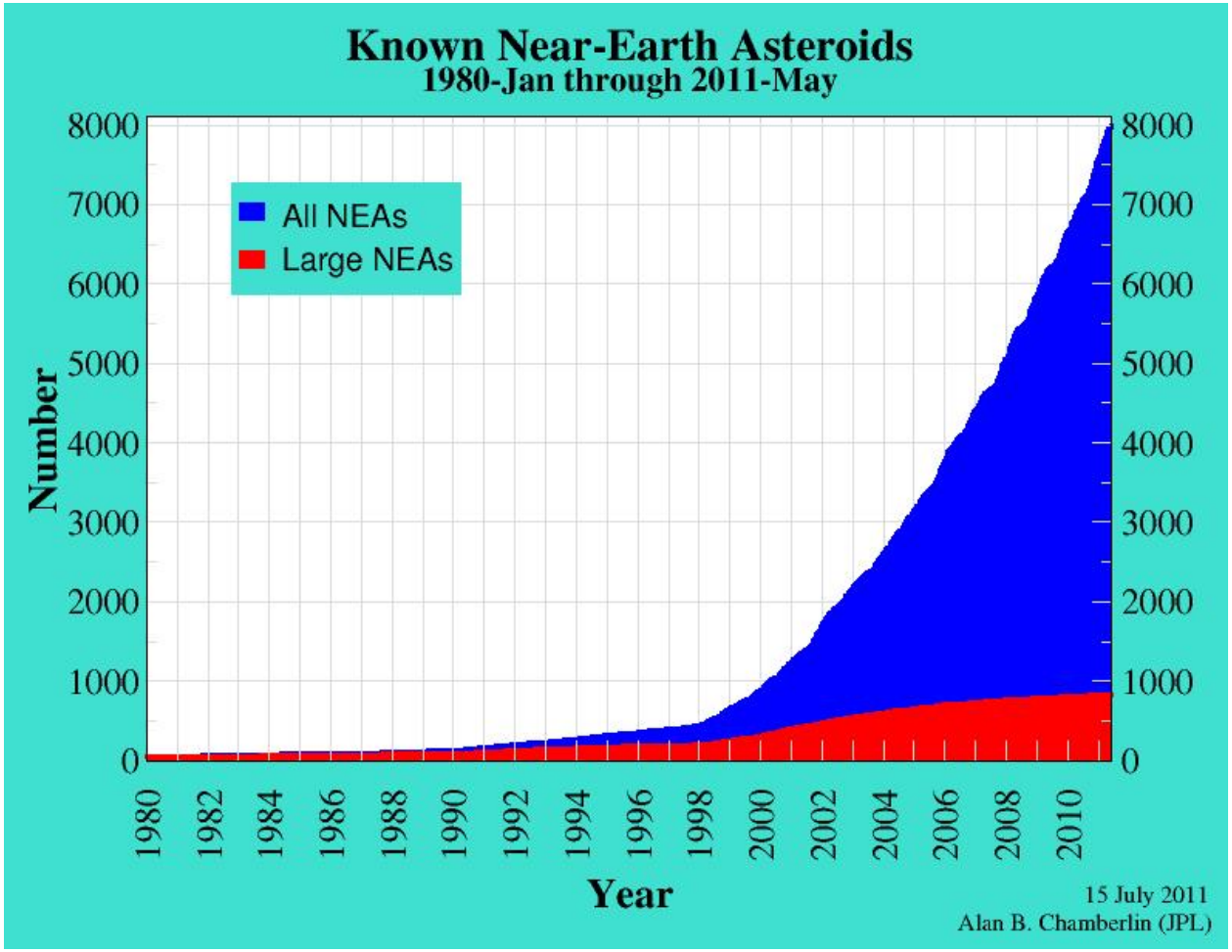
The universe is trying to kill us!

Well, not actively...

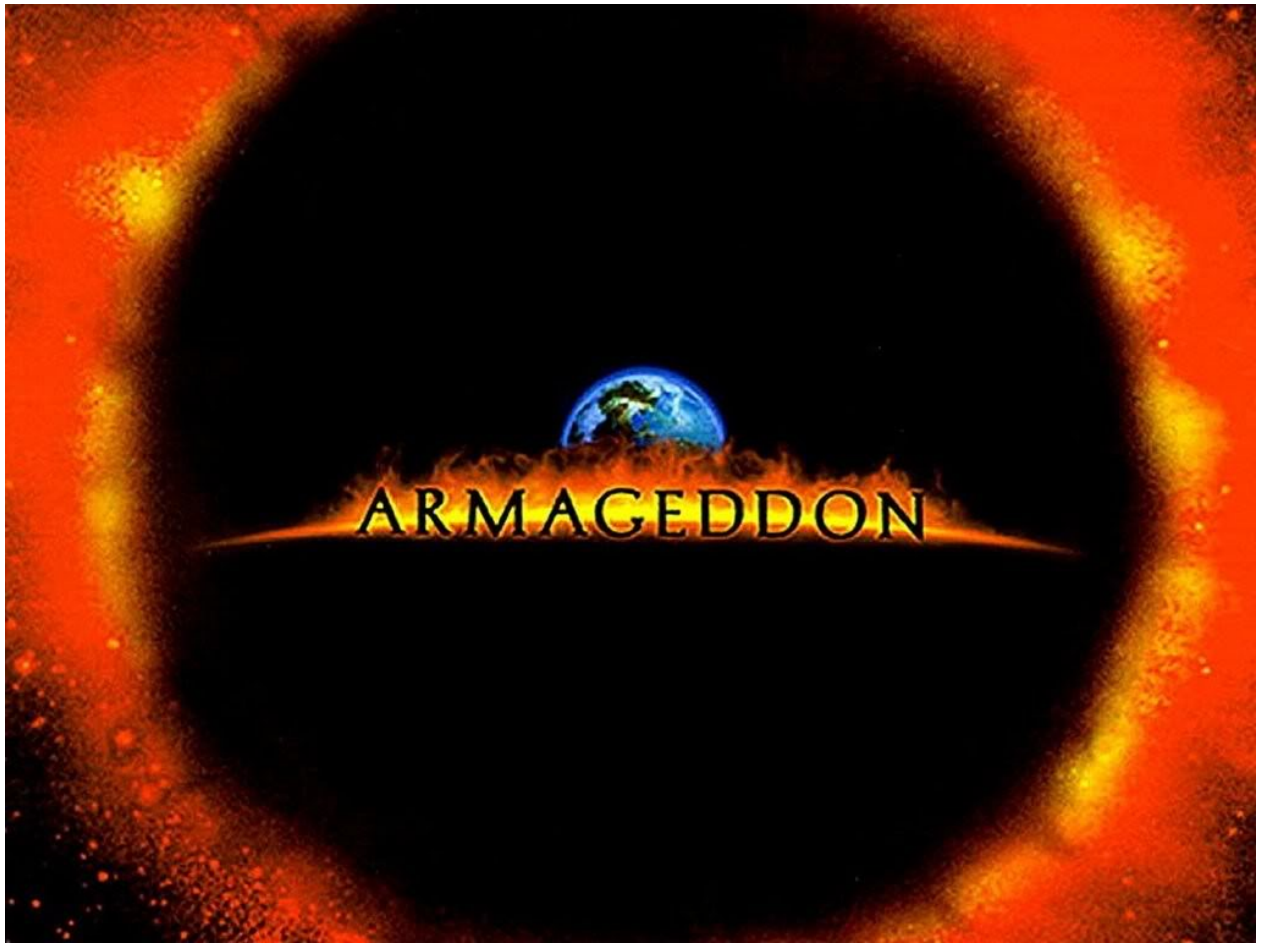
BUT

- Near-Earth Asteroids
- Solar Flares and Coronal Mass Ejections
- Supernovae
- Gamma Ray Bursts
- Black Holes

Asteroids and Near-Earth Objects



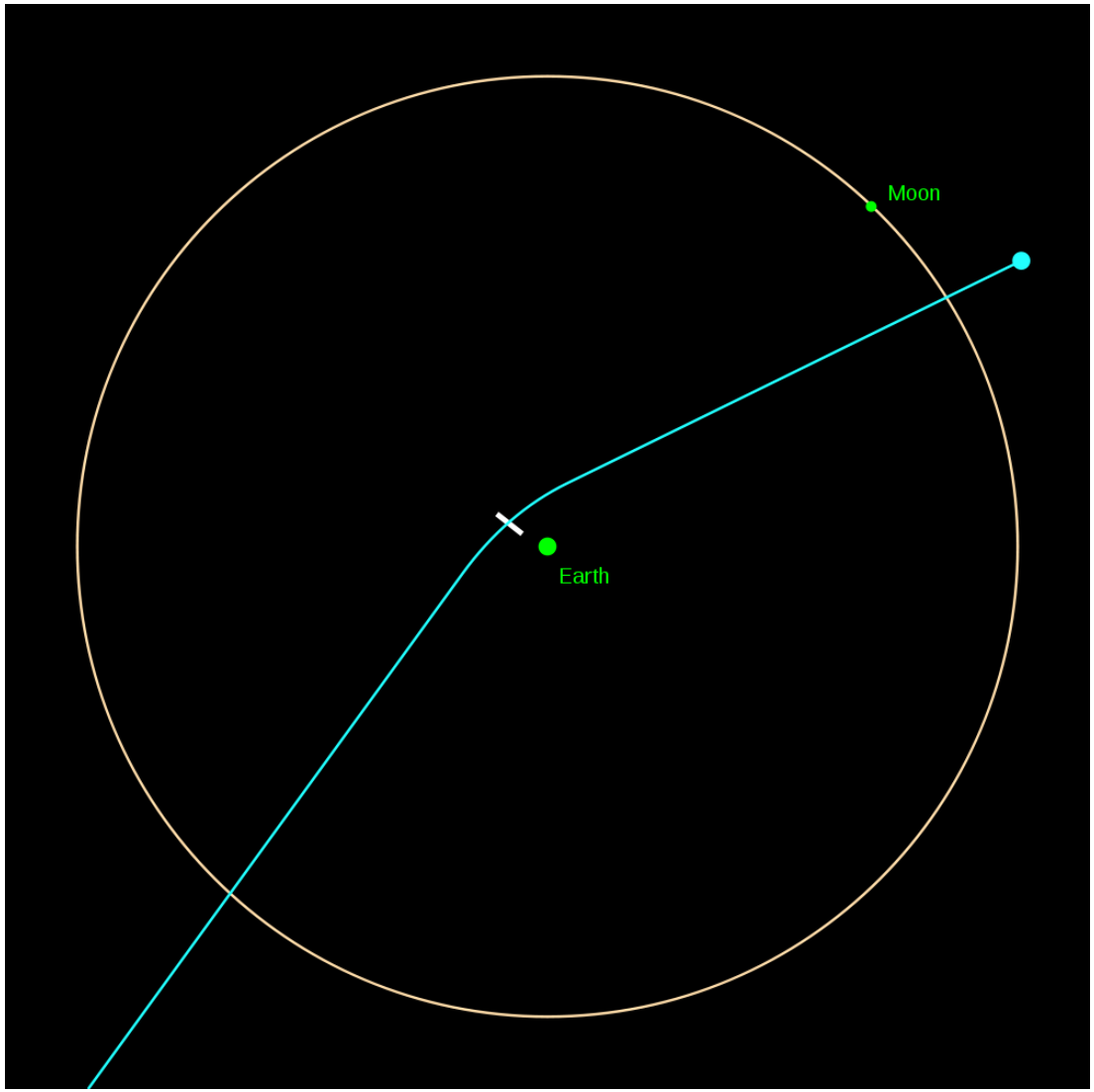
Hollywood—Armageddon



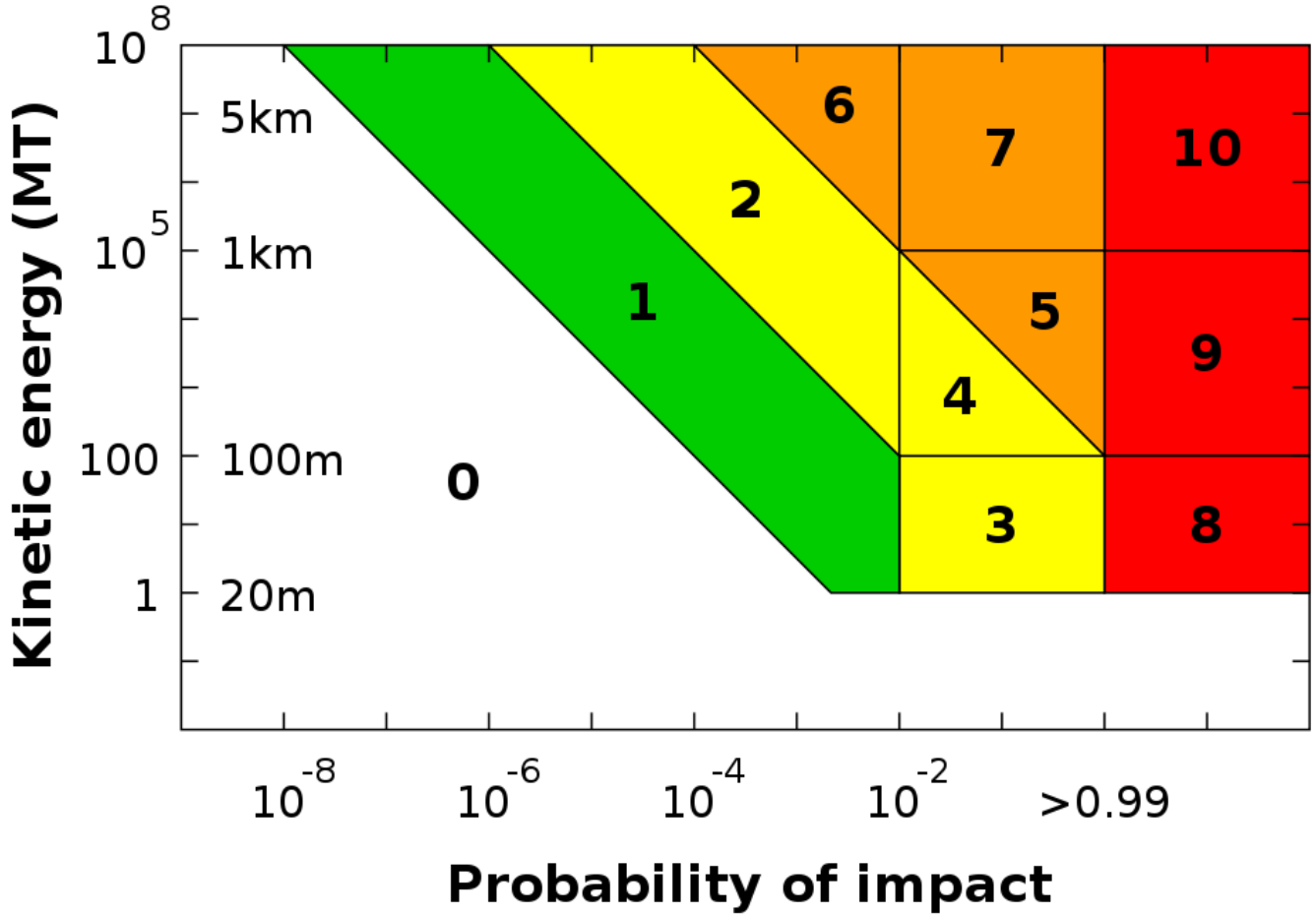
Reality

- The earth is pummeled by 20-40 tons of material every day
- Chicxulub impact–extinction of dinosaurs
- 1908 Tunguska event (air burst of $\sim$100 m asteroid above Siberia)

Reality—99942 Apophis



The Torino Scale



What can we do about this?

- Blow it up (this might create more problems...)
- Redirect it with rockets, large masses, or lasers

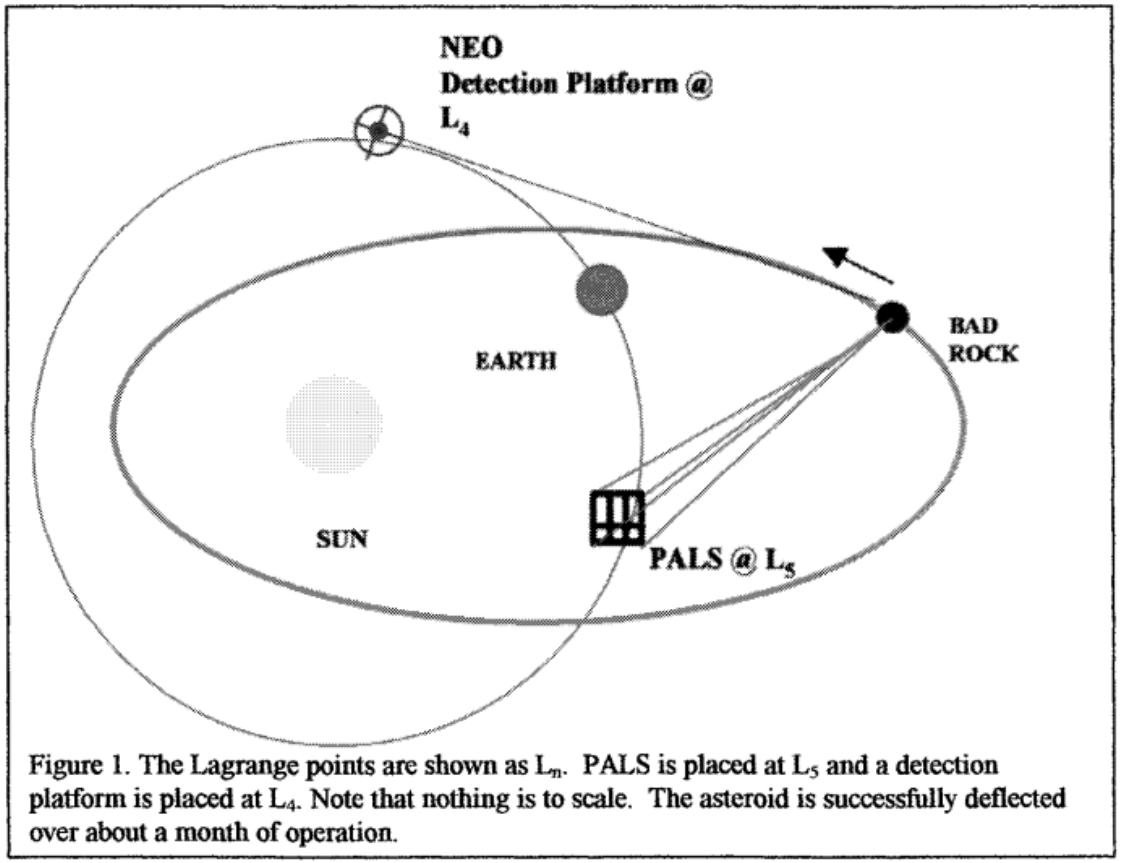
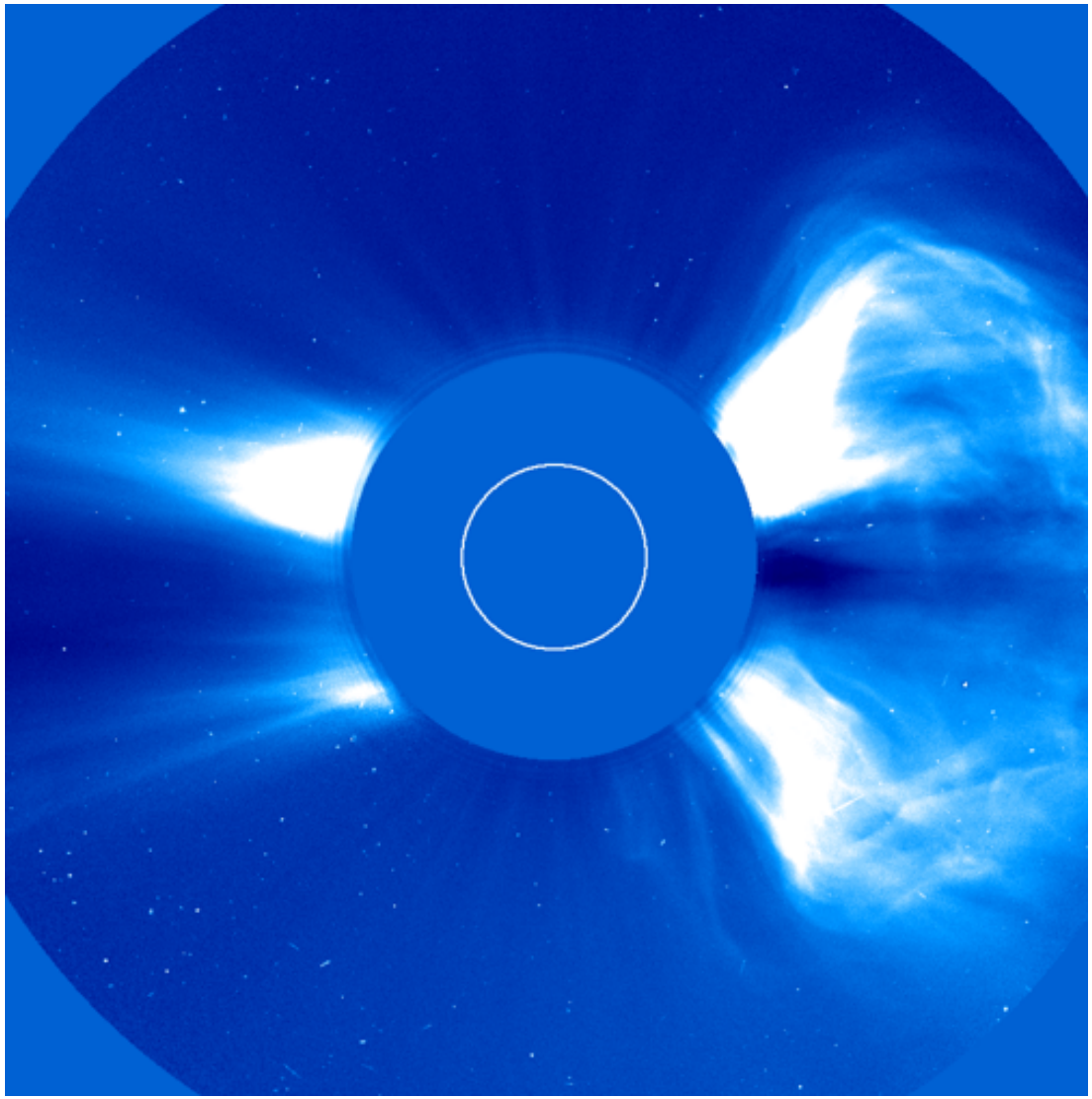


Figure 1. The Lagrange points are shown as L_n. PALS is placed at L_5 and a detection platform is placed at L_4. Note that nothing is to scale. The asteroid is successfully deflected over about a month of operation.

The B612 foundation

http://www.b612foundation.org/

Death by Sun



Hollywood—Knowing

Hollywood (again)—2012

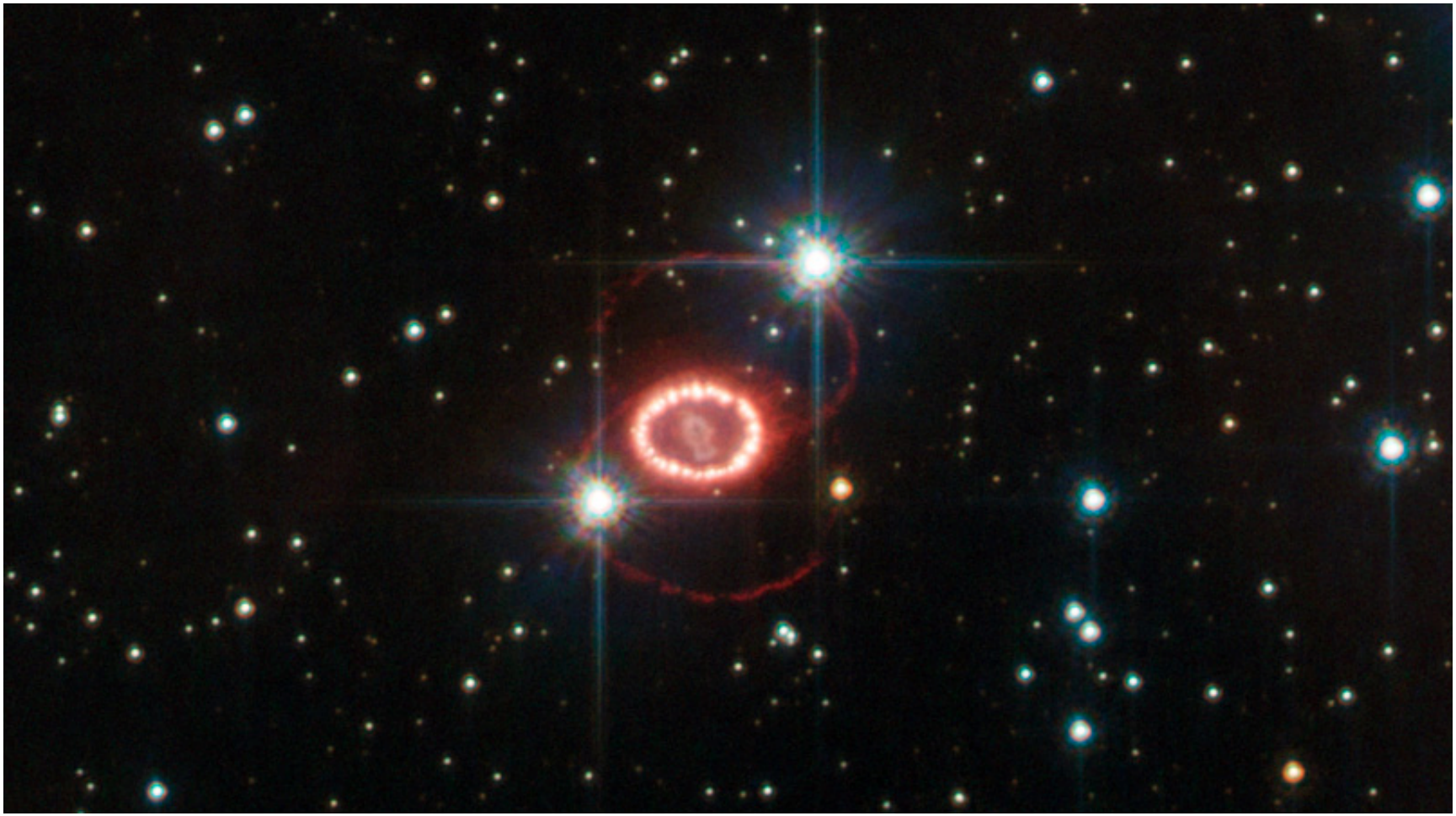
The neutrinos have mutated!

http://www.youtube.com/watch?v=uXqUcuE8fNo

Reality

- Charged particles from CMEs mess with satellites and power grid
  - March 1989—major power outages in NJ and Canada
  - Damage only increases as we use more power
- Depletion of ozone and production of NO_2 in atmosphere
- "Little Ice Age" in Europe (17th Century) correlated with very low sunspot activity

Supernovae–the death of a star



Death by supernova?

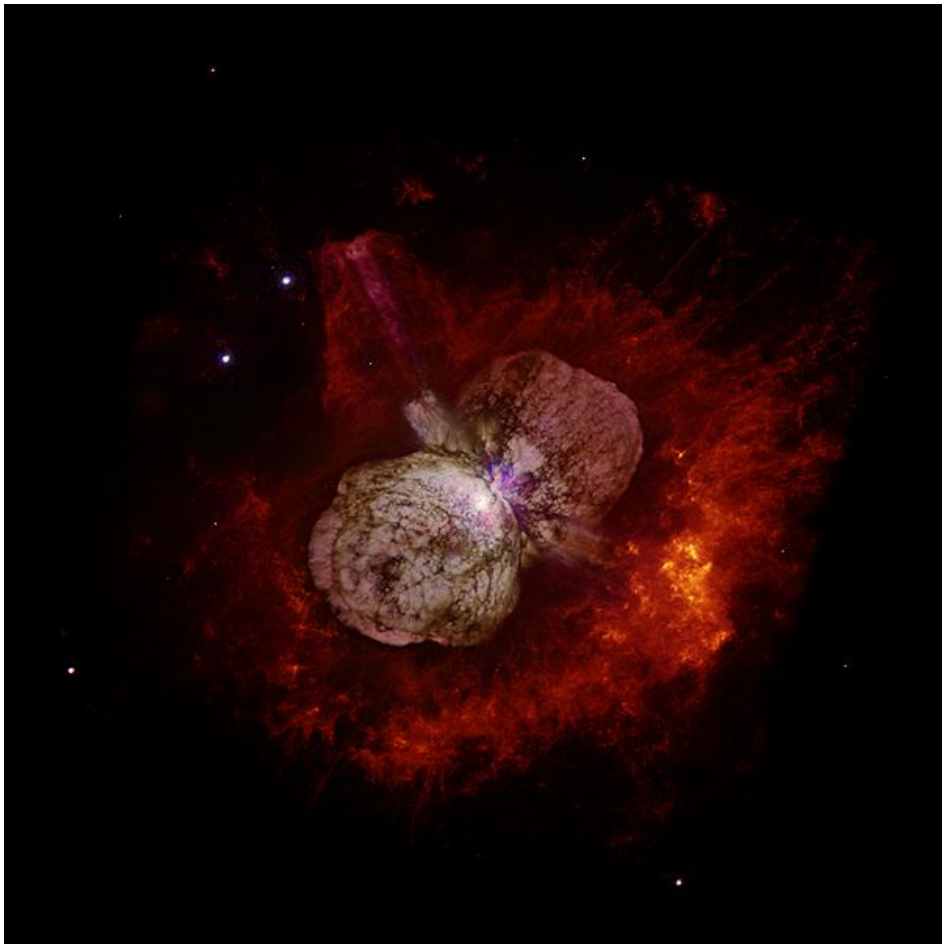
- $\sim$20 stars within 1000 ly could potentially become supernovae
- For 20 $M_\odot$ star 10 ly away, 40 million tons of material would hit us
  - $<$ One ounce per square foot over Earth's surface
- Other stuff: neutrinos, X-rays, gammas
  - Earth-bound people are pretty safe safe, but astronauts?

Gamma Ray Bursts

- Discovered while looking for a different kind of destruction—Soviet nuclear tests on the moon
- Many of the same effects as SN, but more extreme
- At 100 ly, like one-megaton nuclear bomb per square mile of Earth

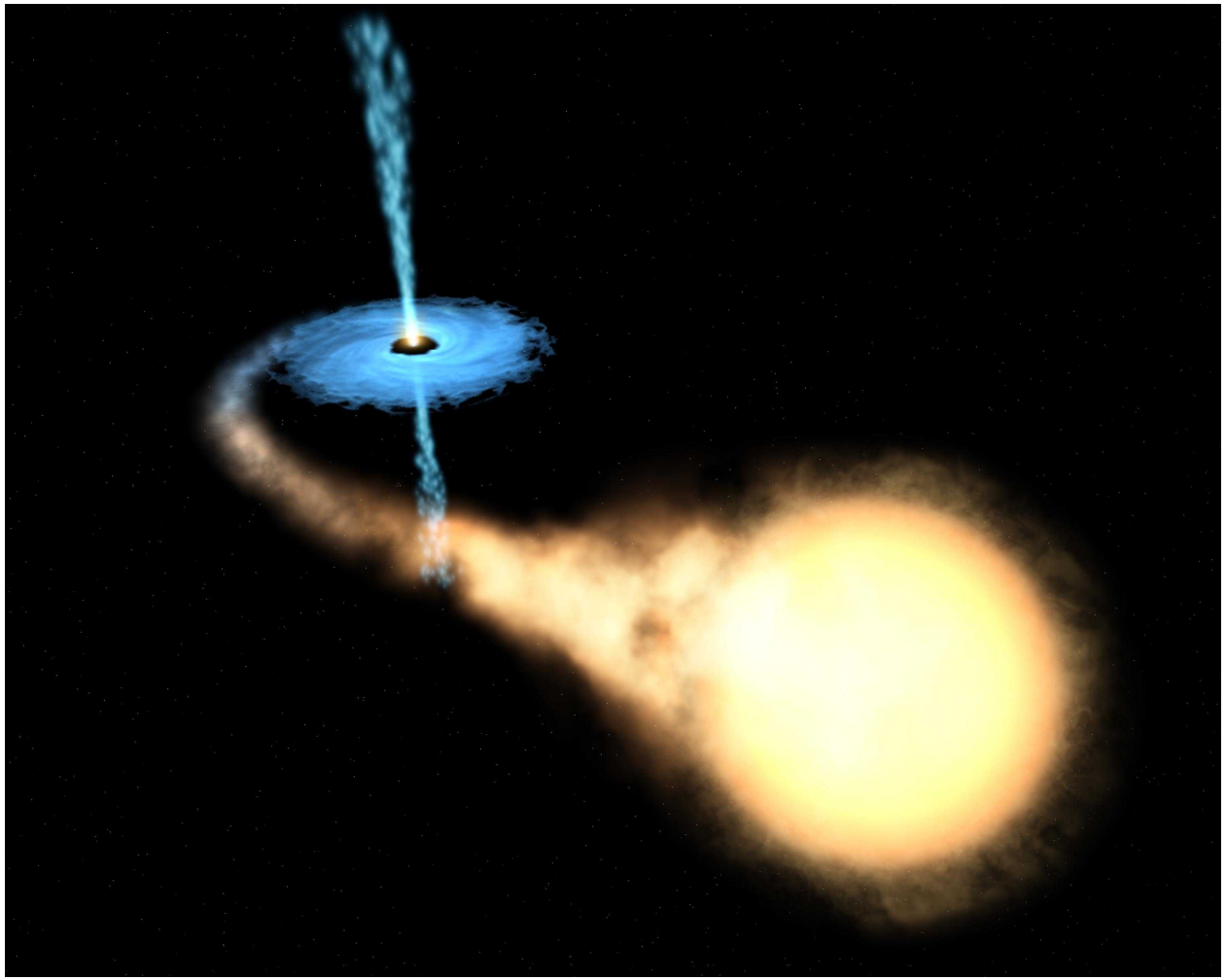
No possible GRB sources are anywhere near that close to us!

Eta Carinae



- Nearest GRB candidate—7500 ly away
- Jets are pointed away from us
- But say it was a threat–what would happen?
  - Fried electronics
  - $>$35% depletion of ozone
  - NO_2 production dims sun

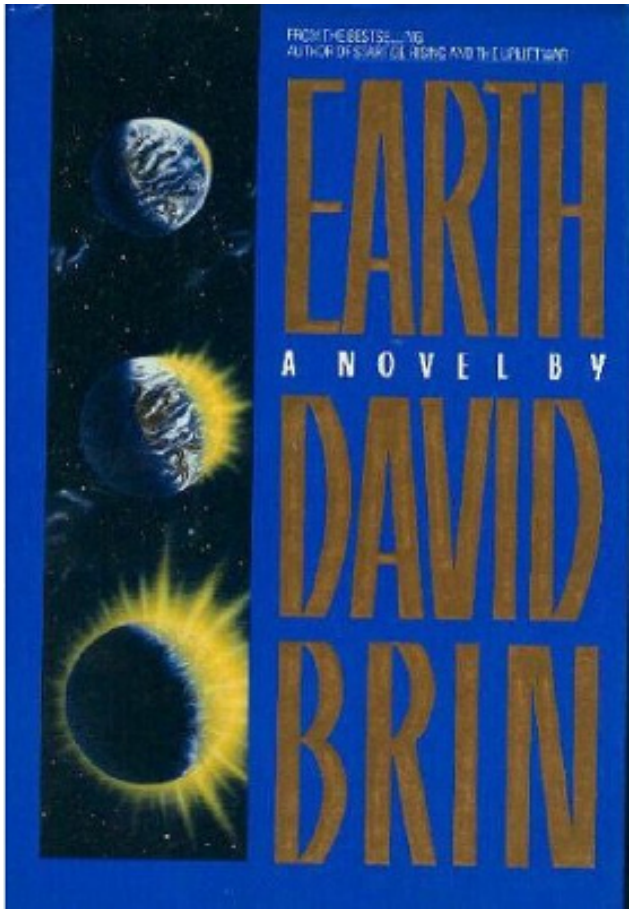
The destructive power of black holes



Death by black hole

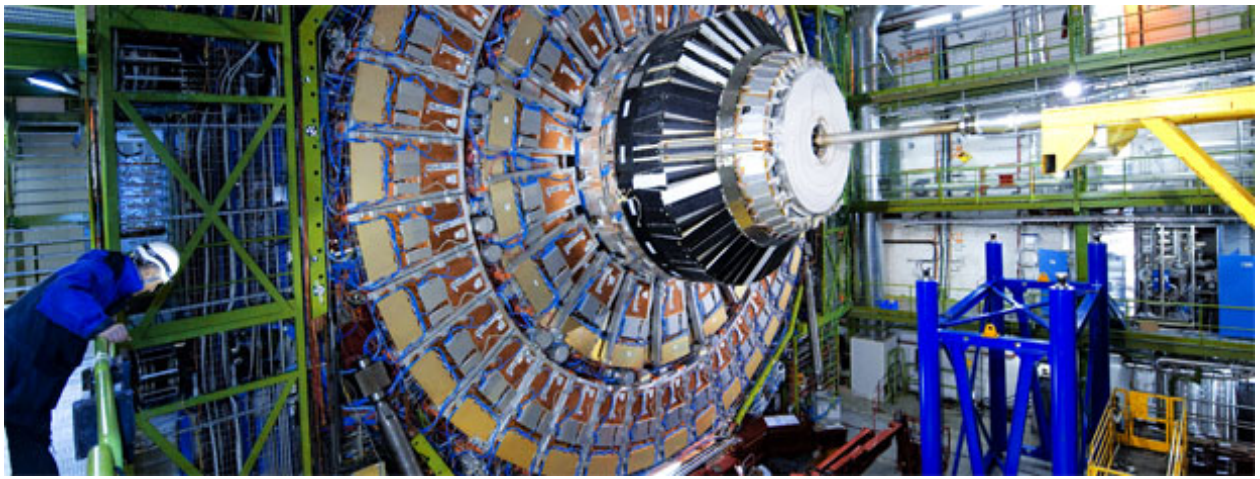
Death by black hole

Black holes, LHC and otherwise



- LHC (microscopic) black holes:
  - Could collisions in accelerators produce microscopic black holes?
- Astrophysical black holes:
  - Alter orbits of planets
  - Could eat Earth if it got close enough
  - Radiation if black hole is active

Why LHC black holes will not destroy the universe



- The ultra-high energy cosmic ray argument:
  - Cosmic rays have been colliding with the atmosphere for billions of years
  - If it hasn't happened yet, it's probably not going to!
- The Hawking radiation argument:
  - According to theory black holes evaporate through Hawking radiation
  - The smaller the mass, the shorter the lifetime!

Inevitabilities we won't be around for

- Death of the sun
- Milky Way merging with Andromeda
- End of the universe (Big Crunch, Big Rip, Big Chill)

Don't worry—something else will get us first!

For more information