# Theoretical Modeling of Massive Stars

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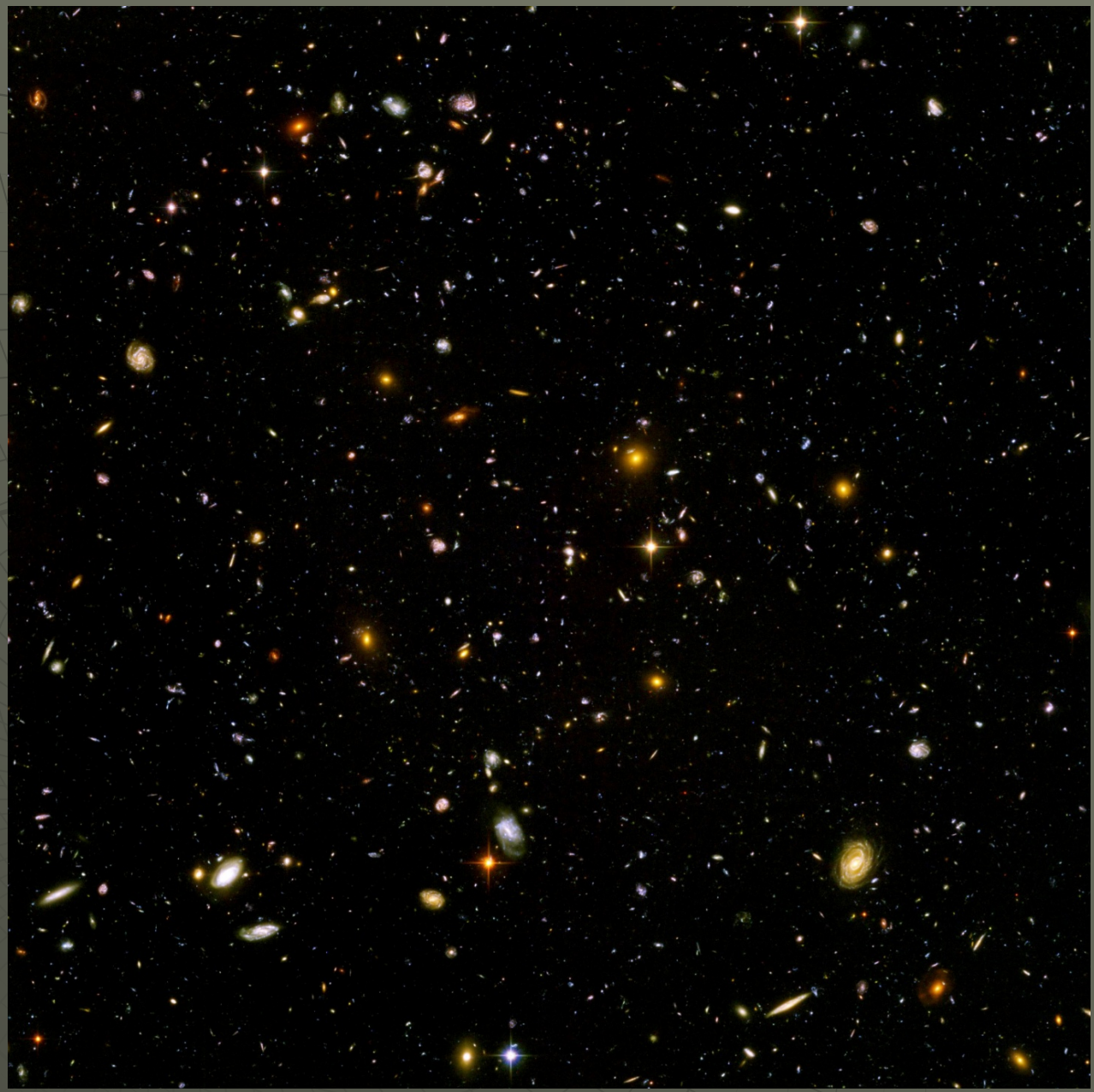
# Massive Stars

- 20-100 times the Sun's mass
  - Sun has 300,000 Earths in it
  - Massive star has 6,000,000-30,000,000 Earths: Absolutely Huge!
- Extremely Bright
  - Blinding if placed next to Sun
- Short Lifetime-millions of years
  - Sun lives 10 billion years
  - 10,000 Massive Stars live and die in Sun's lifetime
- Produce/distribute almost all elements past H and He in supernova

# Massive Stars

- Light from all galaxies is dominated by massive stars
- Can only resolve massive stars in close galaxies, not small stars
  - All individual stars seen in Whirlpool galaxy are massive stars
- Can only see light from massive stars in distant galaxies
  - All small stars are outshined so light from galaxies shown in Hubble Ultra-Deep Field is all from massive stars

Whirlpool Galaxy (NASA)



Hubble Ultra-Deep Field (NASA)

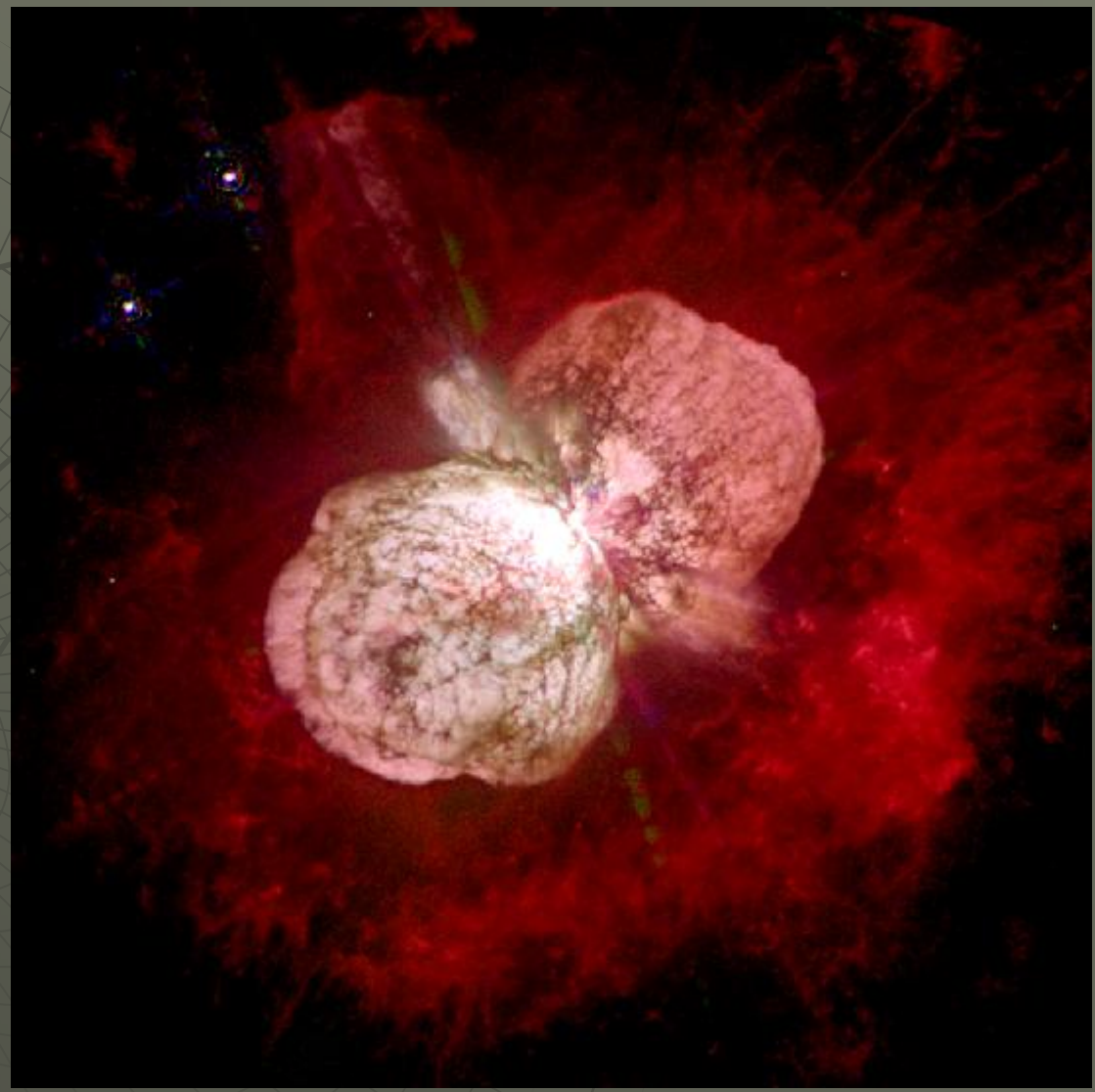
# Why Make Models?

- Can’t make a star in the laboratory
- Can’t travel to them

- Can observe light from stars
- Can apply physical laws and concepts to learn about stars
  - use computer models to simulate properties of stars
  - match model results to observational data

# Eta Carinae

- Thought to be most massive star(s) in our Milky Way Galaxy
- 10 M_sun Bipolar Nebula enshrouds star(s) from 1840's "Giant Eruption"
- Very close so lots of data
- Data predicts system is actually a binary system with one star ~90 M_sun and the other ~30 M_sun
- Think it is in last stages of life before big star undergoes a supernova



# X-Rays of Eta Carinae

- High energy X-rays penetrate nebula allowing light directly from star(s) to be detected
- Colleague made a model to simulate the two stars
- I analyzed the results to see how the X-ray brightness of the star(s) changed over time
- Excellent comparison between model and observation: suggests Eta Carinae is indeed a binary system