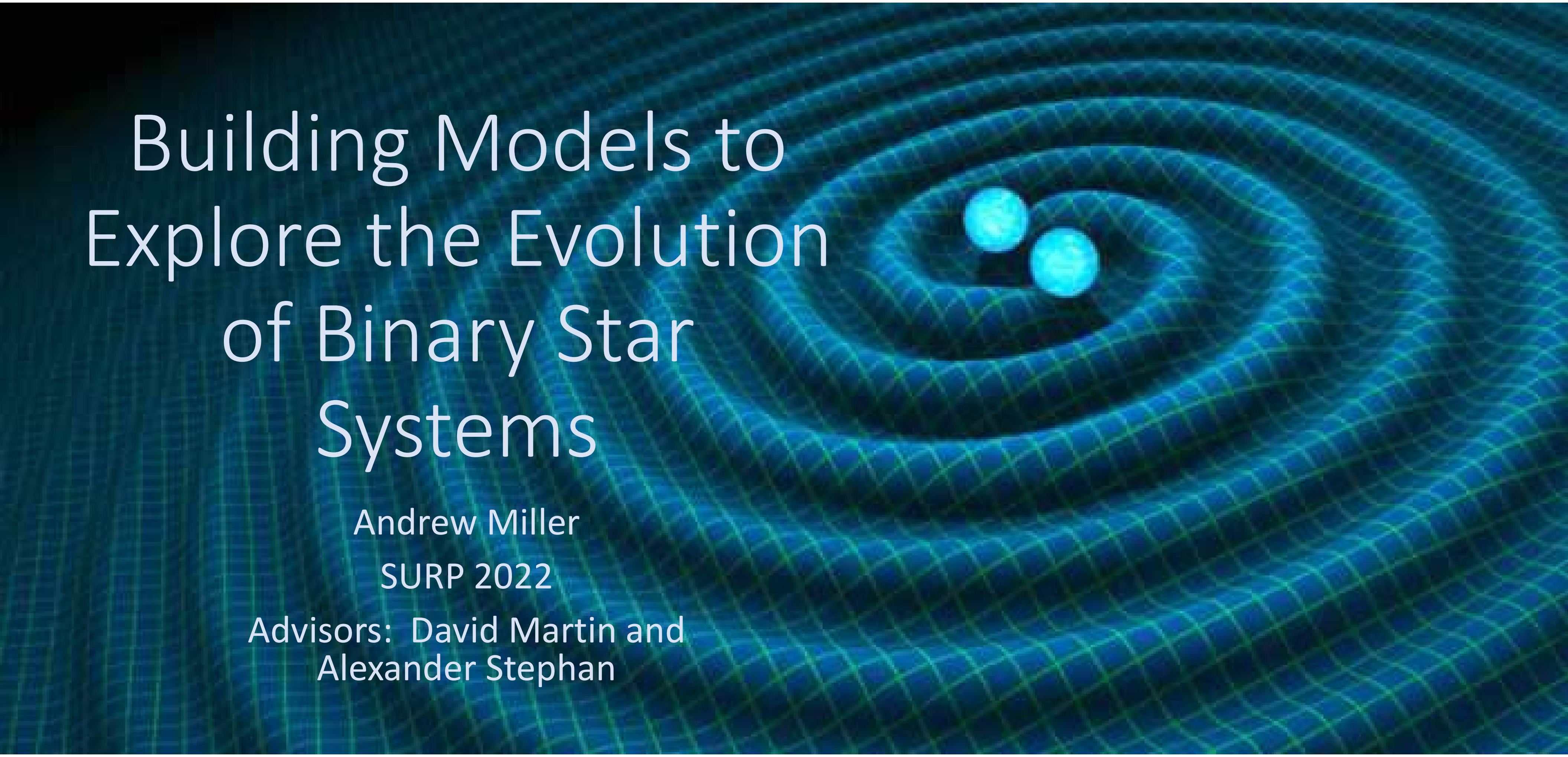

Building Models to Explore the Evolution of Binary Star Systems

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Image: R. Hurt/Caltech-JPL

The Science

- **Roche Lobe Overflow: Tight orbits (<10 au).** Gas accretes onto the smaller star
- **Common Envelope: Very tight orbits (<1 au).** Smaller star orbits inside atmosphere of the larger star
- **Two Outcomes:**
  1. **Merger** between smaller star and red giant core
  2. **Envelope ejected.** Two stellar remnants remain.

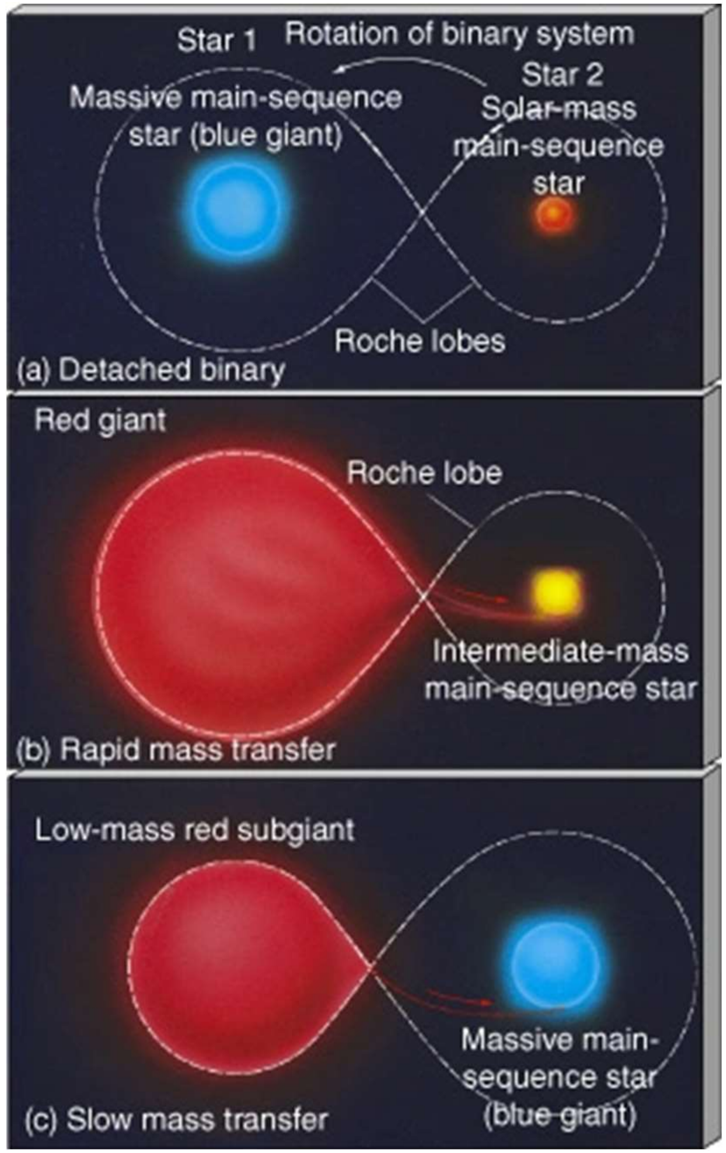
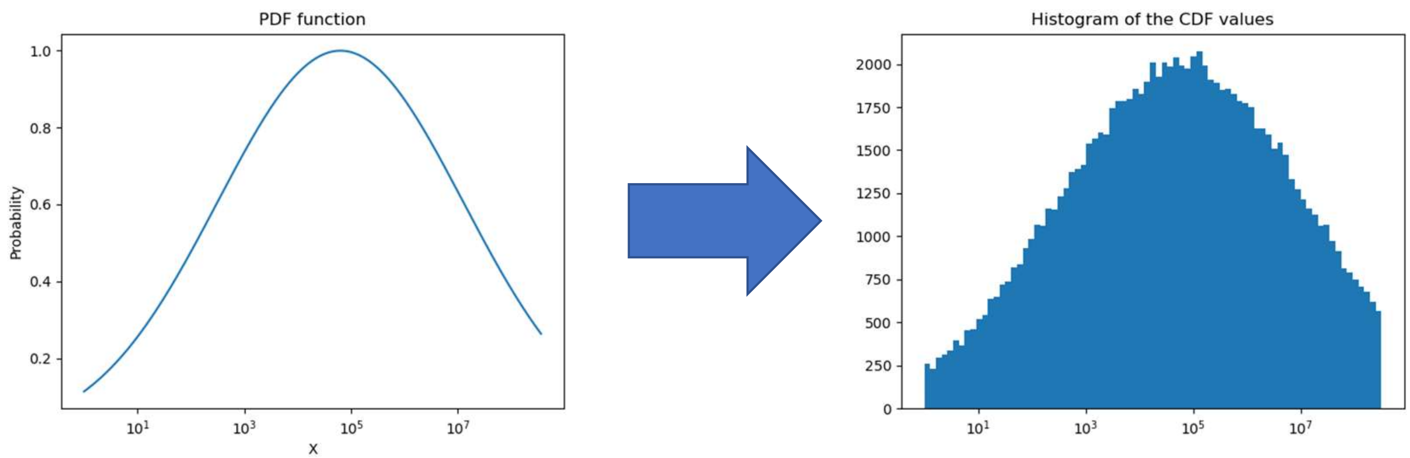


Image: https://scienceatyourdoorstep.files.wordpress.com/2020/12/image-37.jpeg?w=277

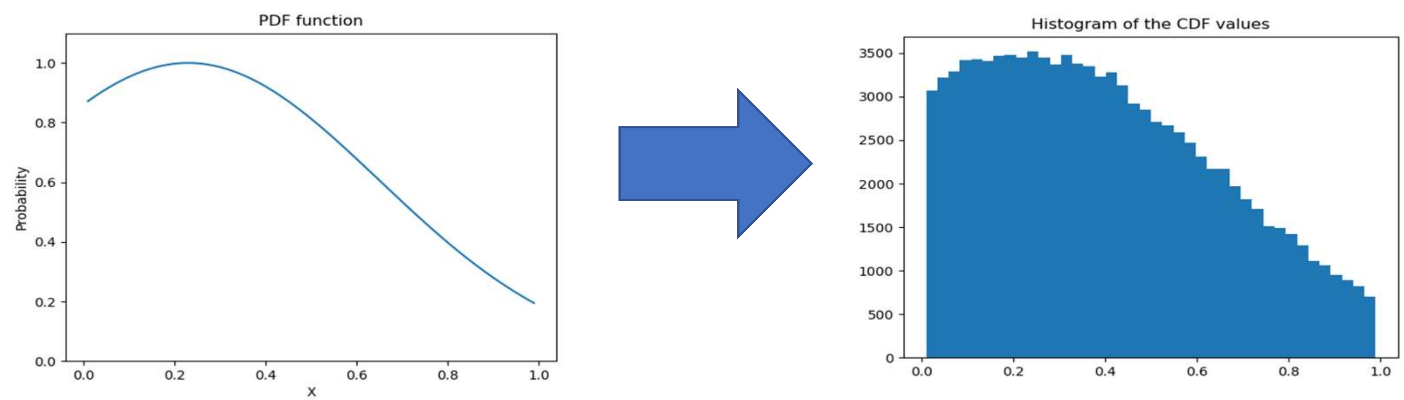
The Model

1. **Model Probability Density Functions** for primary mass, mass ratio, period, and eccentricity (Duquennoy & Mayor, 1991; Hurley et al. 2002)
2. **Draw random samples** to create a population
3. **Evolve the population** with COSMIC

Orbital periods:



Mass ratio (secondary /primary):



The Target

The Arches Cluster has a “top-heavy” initial mass function (Hosek et al. 2019)

Can compare to standard Kroupa IMF

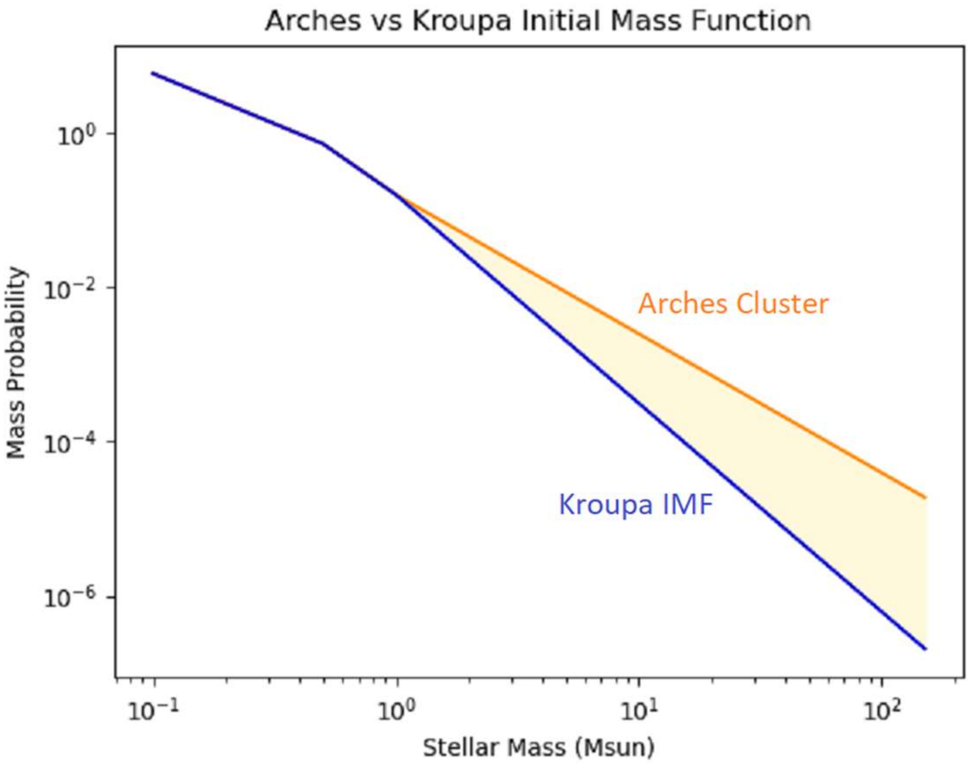


Image: NASA/ESA HST

- **Quenching:** Stellar winds drive away gas around high-mass stars (Wang et al. 2021).
- Results in fewer tightly-orbiting binaries.

Image: NASA/ESA/CSA JWST

The Results

- Arches cluster shows a higher number of stellar remnant pairs than the Kroupa initial mass function.
- Need to increase sample size to find remnant mergers
- **Next Steps:** Build larger models, find locations that generate lots of gravitational wave detections