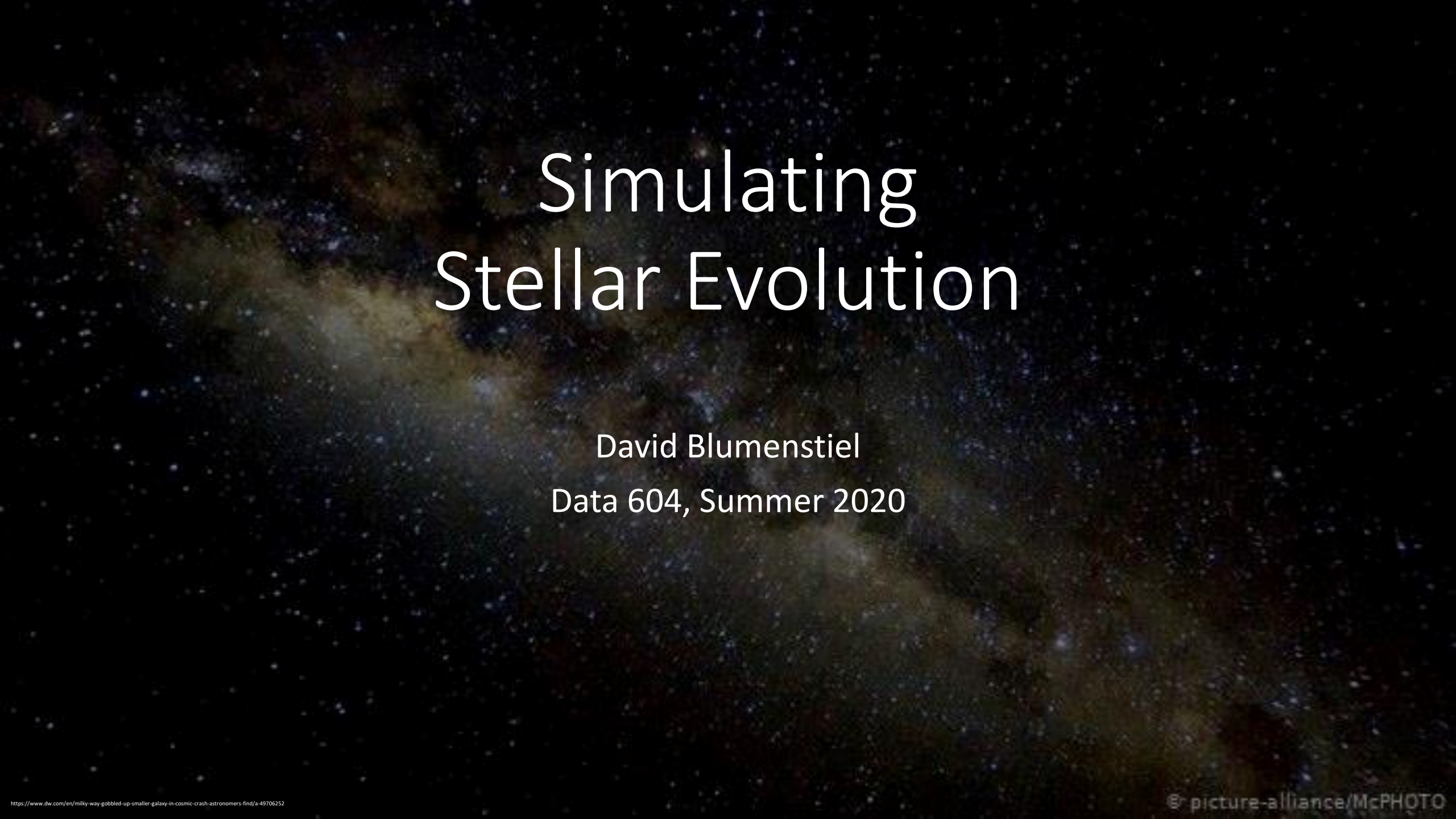


Simulating Stellar Evolution

David Blumenstiel

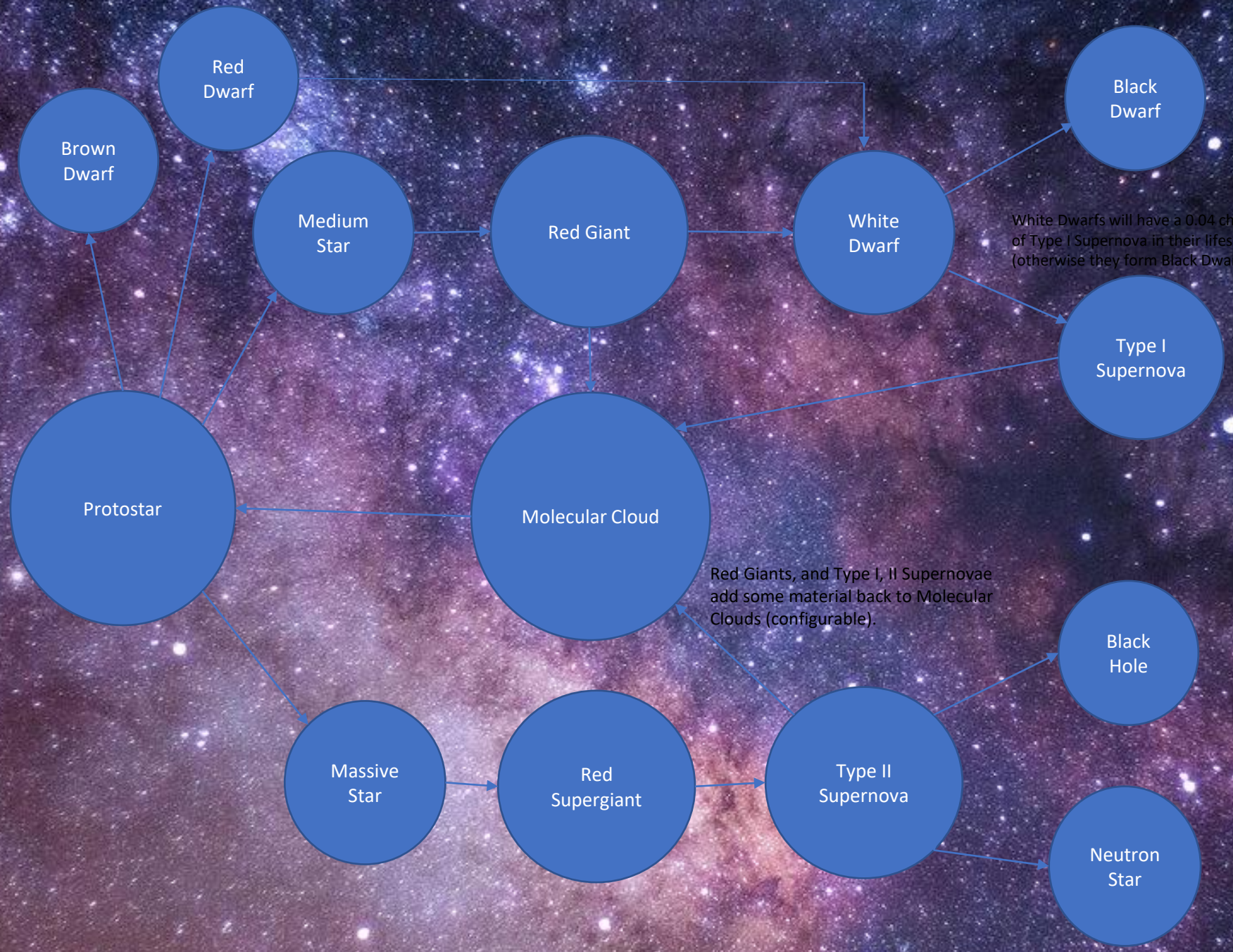
Data 604, Summer 2020

https://www.dw.com/en/milky-way-gobbled-up-smaller-galaxy-in-cosmic-crash-astronomers-find/a-49706252

What is Stellar Evolution?

- Simply put: how stars change over the course of their life
- The objective: simulate stars form and evolve
  - Galactic evolution?
- Open ended simulation
  - See how different parameters (e.g. lifespan) affect the simulation
  - Different time-frames

https://phys.org/news/2010-03-star-link-galactic-evolution.html



Stellar Evolution Flow Chart

Default Time to Maturity:

Molecular cloud: 10
Protostar: 1
Medium Star: 12000
Massive Star: 10
Red Dwarf: 1250000
Red Giant: 1500
Red Supergiant: 0.8
White Dwarf: 20000000
Type I Supernova: Negligible
Type II Supernova: Negligible

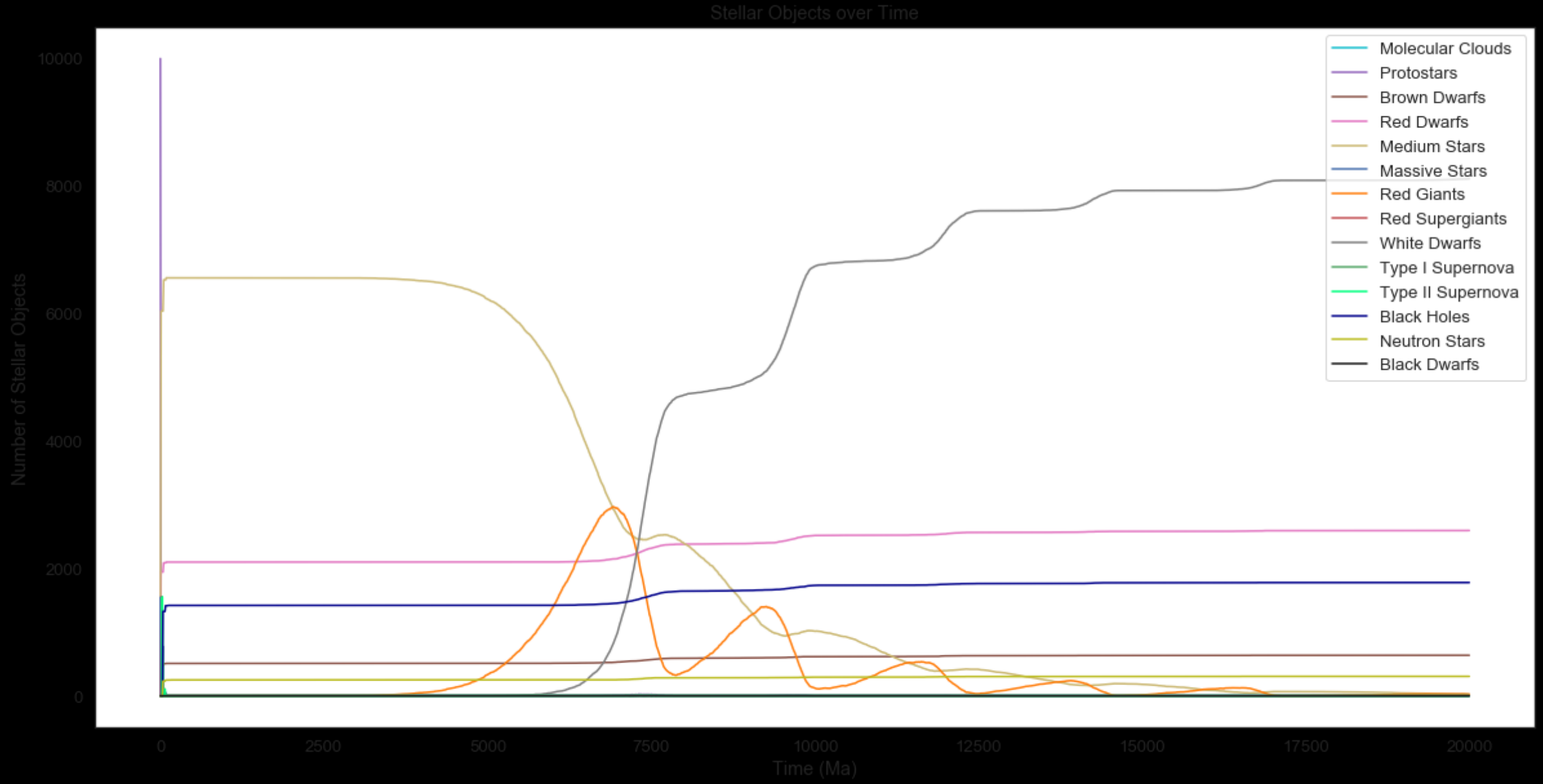
How's The Simulation Work?

- Uses expected lifespan, age, and probabilities
  - As age approaches lifespan, chance to progress increases exponentially
  - Simulates each object individually, but with averaged age

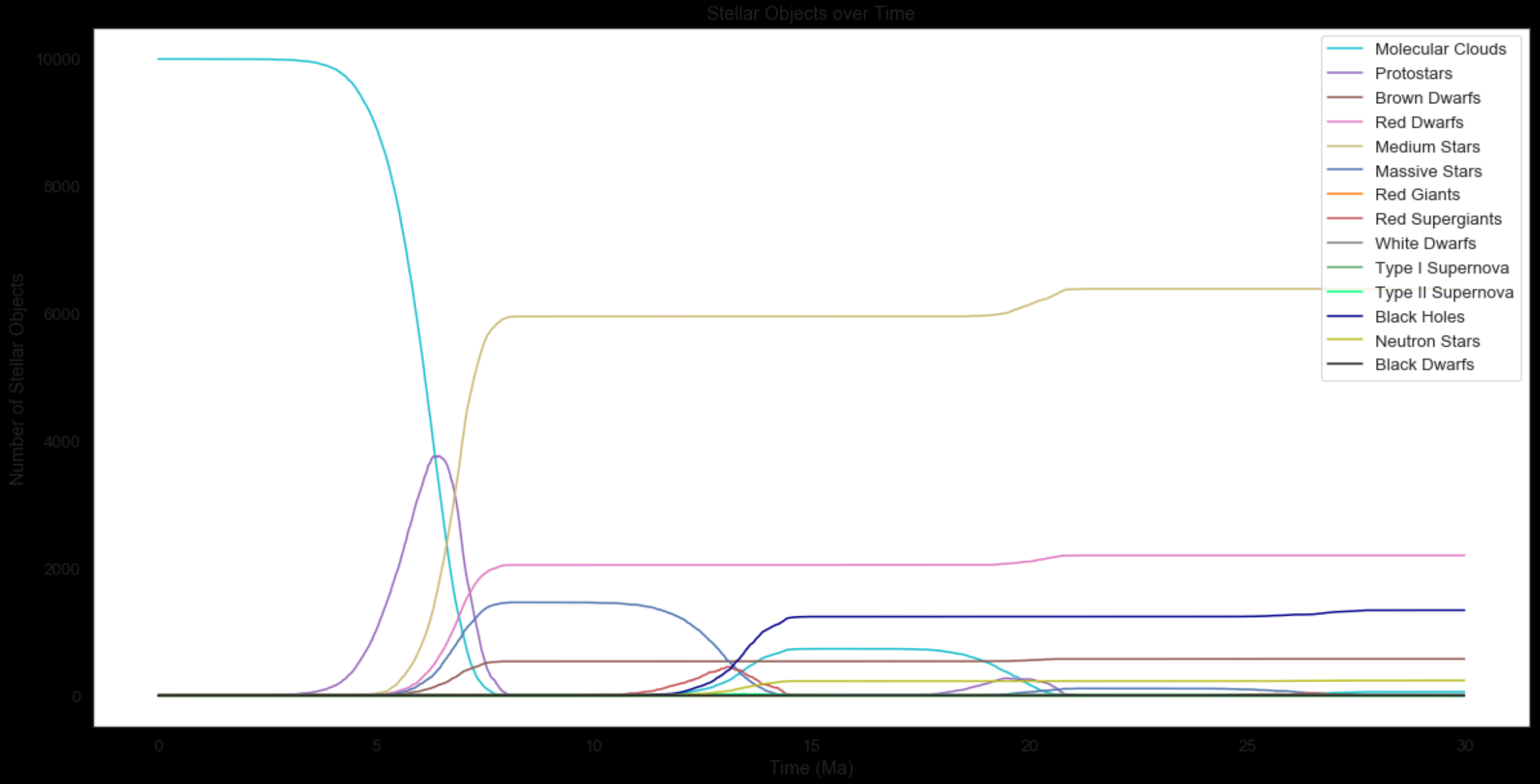
- Flexible parameters
  - Configure probabilities, lifespans, starting conditions, etc
  - Can run over different length of time
  - Good for testing out theories

20 Billion Years

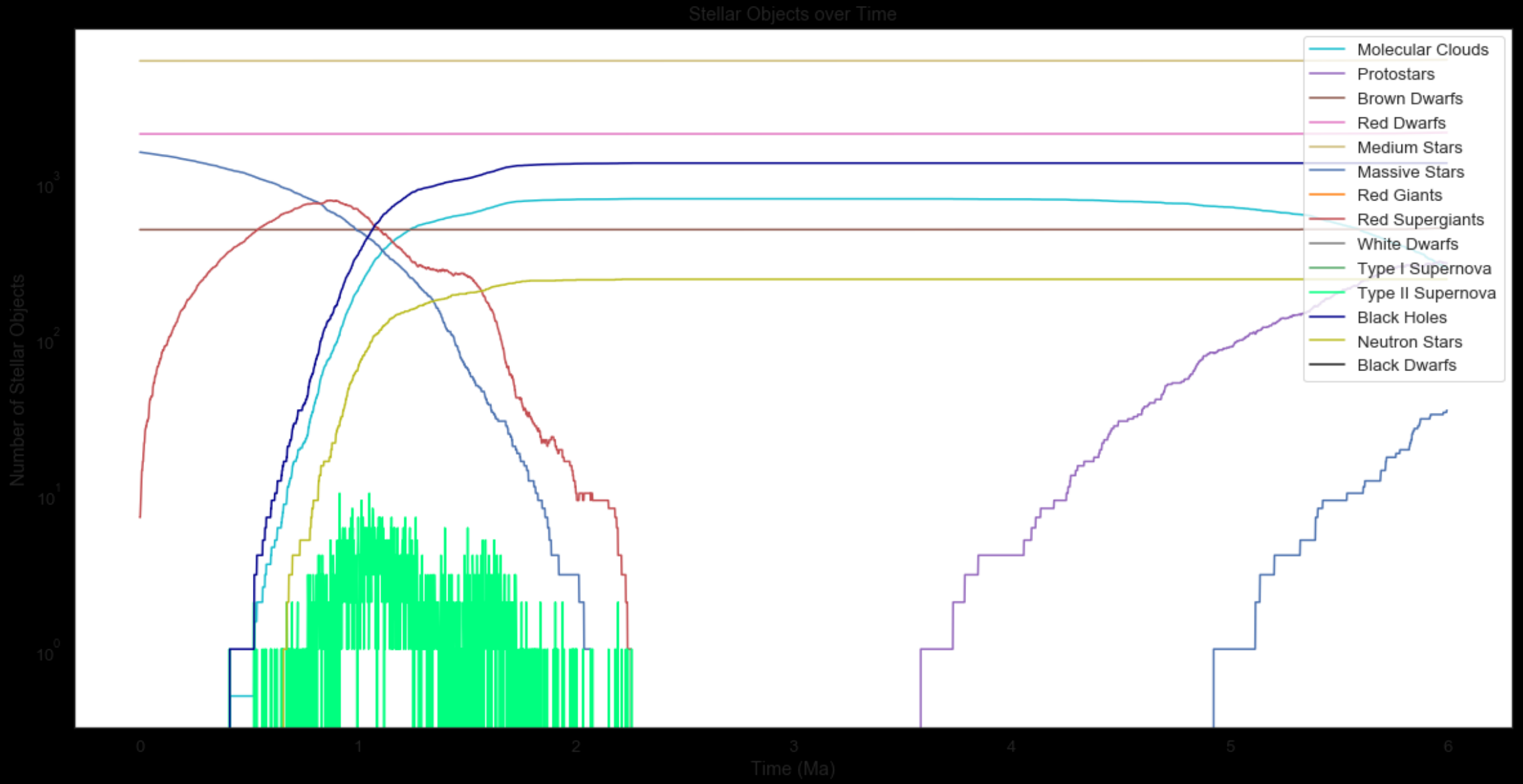
(Starting from 10000 Molecular Clouds)



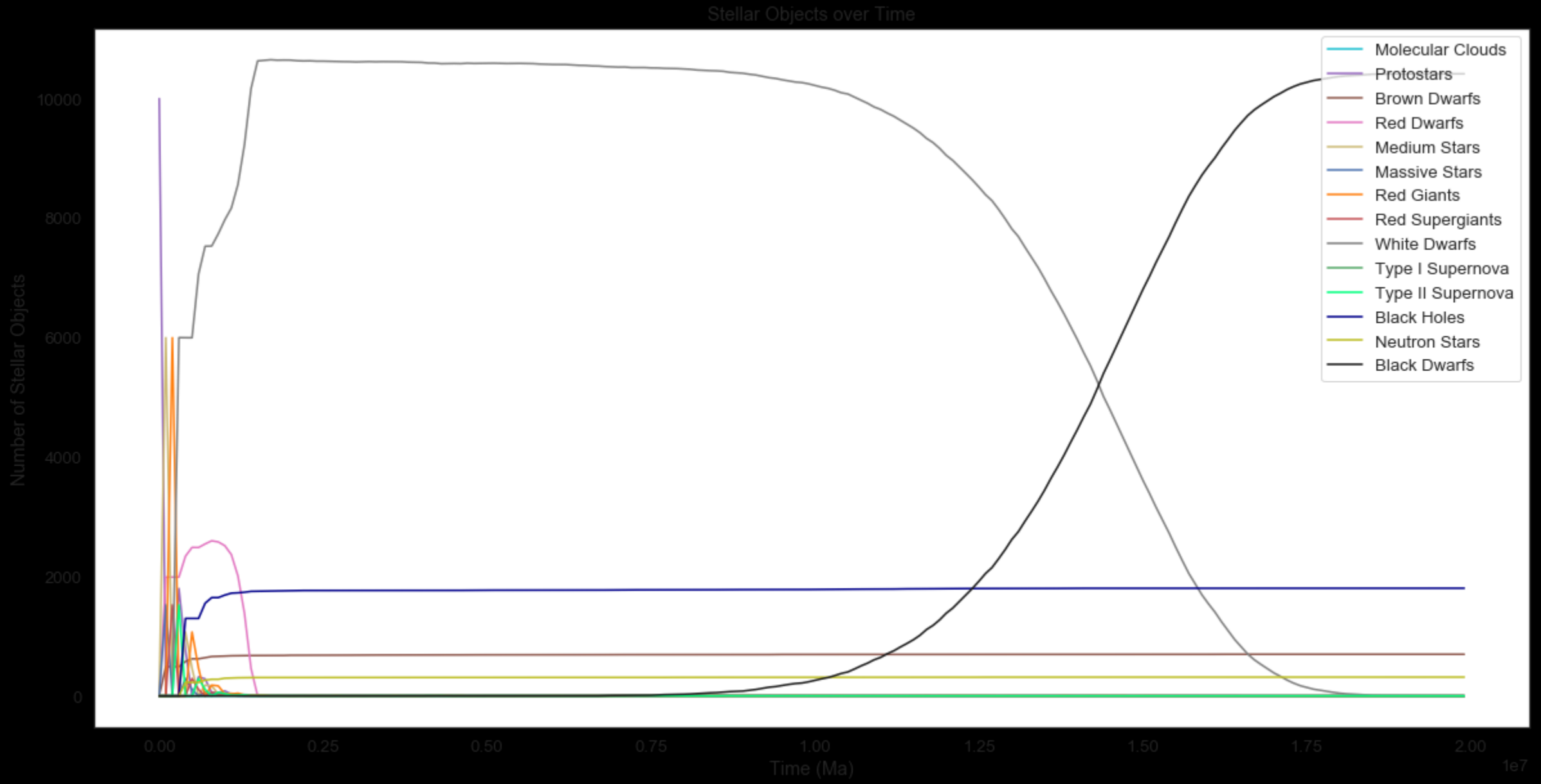
30 Million Years



12 to 18 Million Years
(y is log scale)



20 Trillion Years



Conclusions

- This simulation allows for simulation of stellar evolution with different sets of parameters
- The progression of stellar evolution that I've suggested is a reasonable simplification. More research could be put into finding parameters to run the simulation with. It would also be beneficial to program into the simulation the option to output different figures or statistics.
- Overall, I'm fairly happy with how this turned out, and may further improve it in the future.