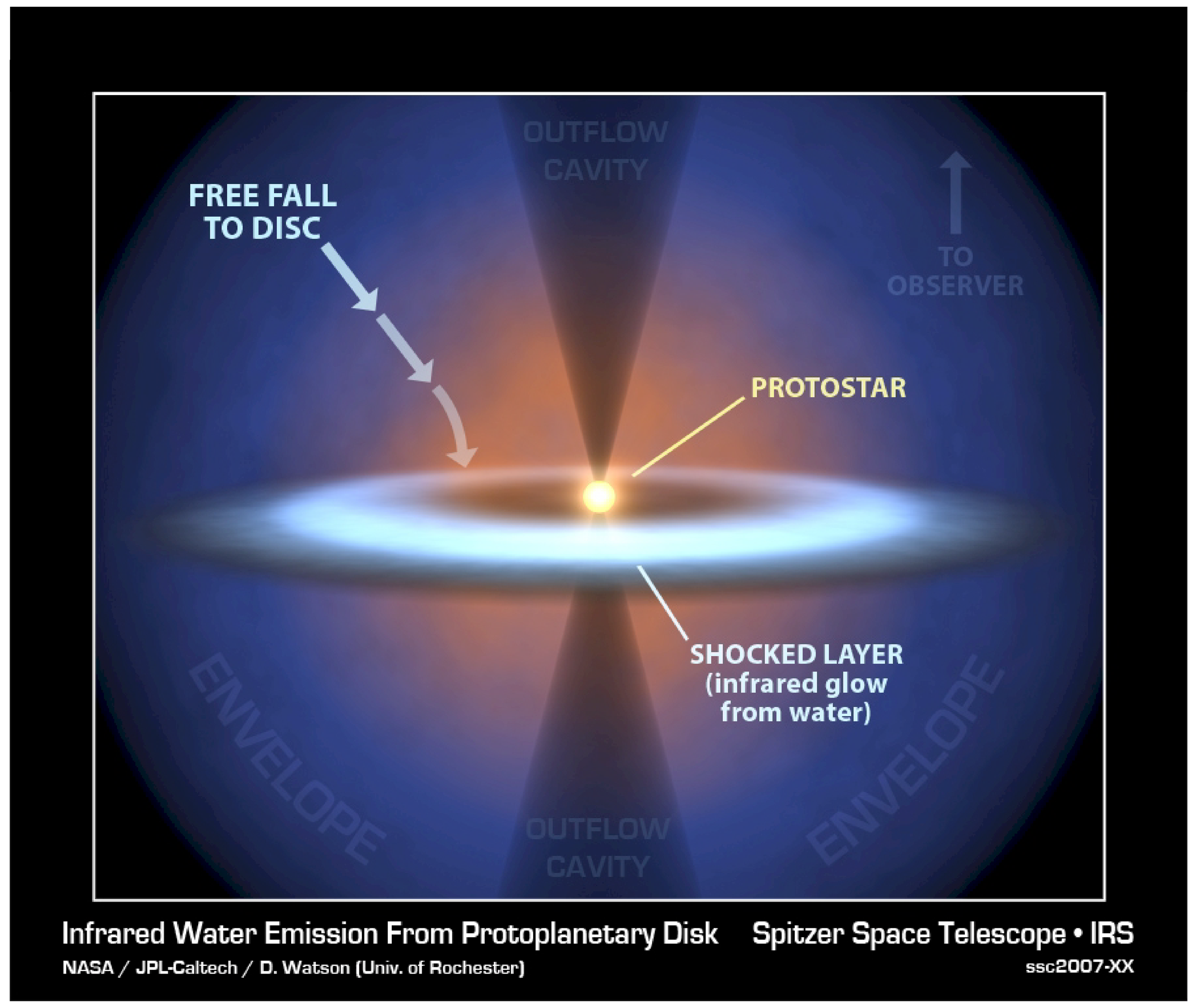

THE LIFE OF A PROTSTAR

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BACKGROUND

• Stars form in molecular clouds in the interstellar medium

• Cold temperatures and high densities of molecular clouds allow gravity to overcome thermal pressure and let the cloud begin to collapse

METHODS

1) Begin with cloud mass, cloud temperature (10 K), final star radius (what the cloud will collapse to), critical temperature (10^7 K), and heat capacity ratio (γ = 1.41)

2) Find the clouds Jean's length, initial volume, adiabatic constant, initial density, and free fall time

3) Use the Runge-Kutta 4 method to update positions

4) Calculate the new cloud temperature using adiabatic constant, new volume, and gamma

5) Terminate iteration when cloud temperature is greater than critical temperature

6) If the cloud radius is greater than the radius of the theoretical star and it has not turned on, continue collapse with increasingly smaller time step until cloud turns on.

RESULTS

Cloud	**60.0**
theory R_star:	3.02e-07
Jean radius:	1.09
initial volume:	5.43
initial density:	11.04
free fall time:	2.44
ending radius:	1.05e-05
ending temp:	1.49e+07

Cloud	**25.0**
theory R_star:	2.25e-07
Jean radius:	0.45
initial volume:	0.39
initial density:	63.60
free fall time:	1.01
ending radius:	2.99e-06
ending temp:	2.37e+07

Cloud	**15.0**
theory R_star:	1.17e-07
Jean radius:	0.27
initial volume:	8.49e-02
initial density:	176.67
free fall time:	0.61
ending radius:	2.94e-06
ending temp:	1.23e+07

Cloud	**9.0**
theory R_star:	9.24e-08
Jean radius:	0.16
initial volume:	1.83e-02
initial density:	490.75
free fall time:	0.37
ending radius:	1.49e-06
ending temp:	1.59e+07

Cloud	**5.0**
theory R_star:	6.53e-08
Jean radius:	9.09e-02
initial volume:	3.14e-03
initial density:	1.59e+03
free fall time:	0.20
ending radius:	1.06e-06
ending temp:	1.17e+07

Cloud	**3.0**
theory R_star:	4.96e-08
Jean radius:	5.45e-02
initial volume:	6.79e-04
initial density:	4.42e+03
free fall time:	0.12
ending radius:	6.28e-07
ending temp:	1.19e+07

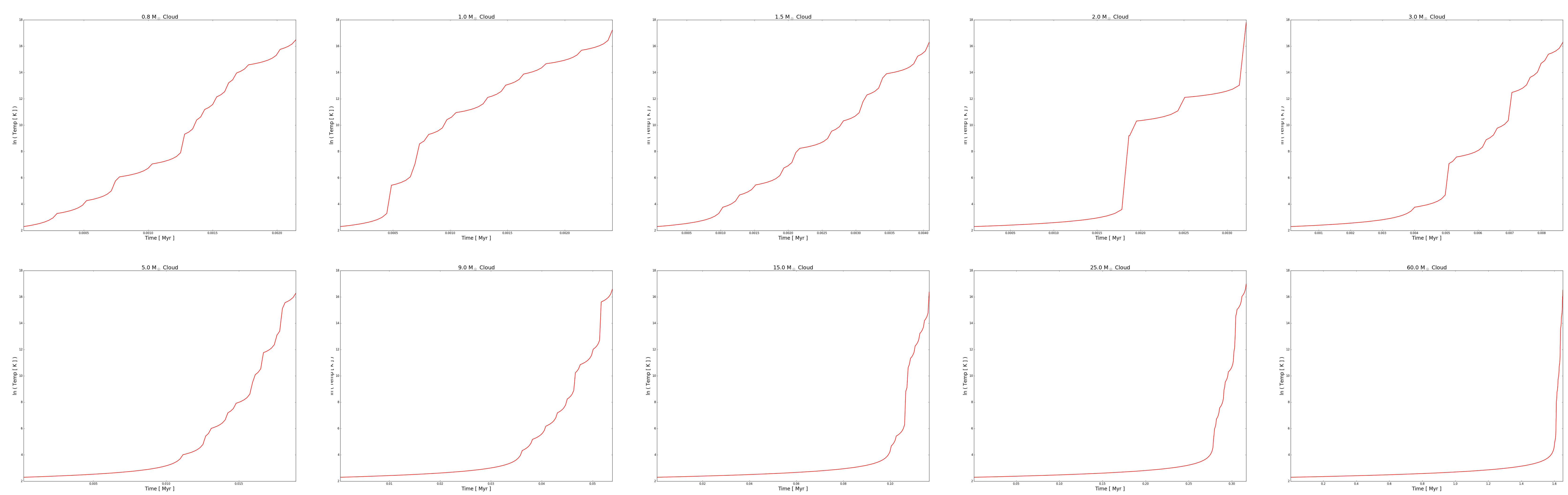
Cloud	**2.0**
theory R_star:	4.06e-08
Jean radius:	3.64e-02
initial volume:	2.01e-04
initial density:	9.92e+03
free fall time:	8.12e-02
ending radius:	1.23e-07
ending temp:	5.37e+07

Cloud	**1.5**
theory R_star:	2.70e-08
Jean radius:	2.73e-02
initial volume:	8.49e-05
initial density:	1.77e+04
free fall time:	6.09e-02
ending radius:	3.13e-07
ending temp:	1.19e+07

Cloud	**1.0**
theory R_star:	2.25e-08
Jean radius:	1.82e-02
initial volume:	2.52e-05
initial density:	3.98e+04
free fall time:	4.06e-02
ending radius:	9.82e-08
ending temp:	3.01e+07

Cloud	**0.8**
theory R_star:	2.09e-08
Jean radius:	1.45e-02
initial volume:	1.29e-05
initial density:	6.21e+04
free fall time:	3.25e-02
ending radius:	1.43e-07
ending temp:	1.44e+04

Cloud	**0.7**
theory R_star:	1.80e-08
Jean radius:	1 .27e-02
initial volume:	8.63e-06
initial density:	8.11e+04
free fall time:	2.84e-02
ending radius:	6.97e-08
ending temp:	2.963+07



An artist's impression of the circumstellar disc and outflow from a young, massive O-type star. Image credit: ESO/L. Calada.

SUMMARY

Our model shows that given enough time, a molecular cloud will eventually collapse into a star with a core temperature greater than that which is required for fusion burning to start. Future work includes adding in the various modes of resistance that fight to prevent the collapse of molecular clouds (i.e thermal, rotational, magnetic, and turbulent engeries).

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