Date & Time: April 19, 2012

Location: Home

Computing context: Macho Mac: /Desktop/Research/BodenheimerCode/workingdir/UnalteredCode/

Scripts/Software created today:

- Name: RunSim.py
    - What it does: You give it the name of the input parameters file you want to use, and it runs the simulation with growlnotify (n) and follow and captures the output according to my personal file/dir naming convention for these runs.
    - Where it lives /Desktop/Research/BodenheimerCode/RunSim.py
    - Language it's written in: Python
    - Still in progress. I'm working up updating my python-fu to allow this script to call other, pre-existing scripts I've written, and to pass arguments to them to streamline the data-parsing and plotting process.

Useful computer stuff figured out today:

- If you want to join several images together into a larger image (for example, Figure1a, Figure1b, Figure1c, Figure1d --> Figure1) the following ImageMagick commands will help you do that:
    - #If you want to append images horizontally, use this command
        - convert image1.jpg image2.jpg image3.jpg +append result.jpg
    - #If you want to append them vertically, change the + to a -
        - convert image1.jpg image2.jpg image3.jpg -append result.jpg

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Continuing from last time:

- Upload my group meeting presentation and advisor meeting notes to the wordpress blog
- Email the people I want to be on my quals committee
- Go talk to the people in the business office about computer purchase order stuff/ reimbursments/ etc.
- The low-mass stellar mass-radius relationship from last time:

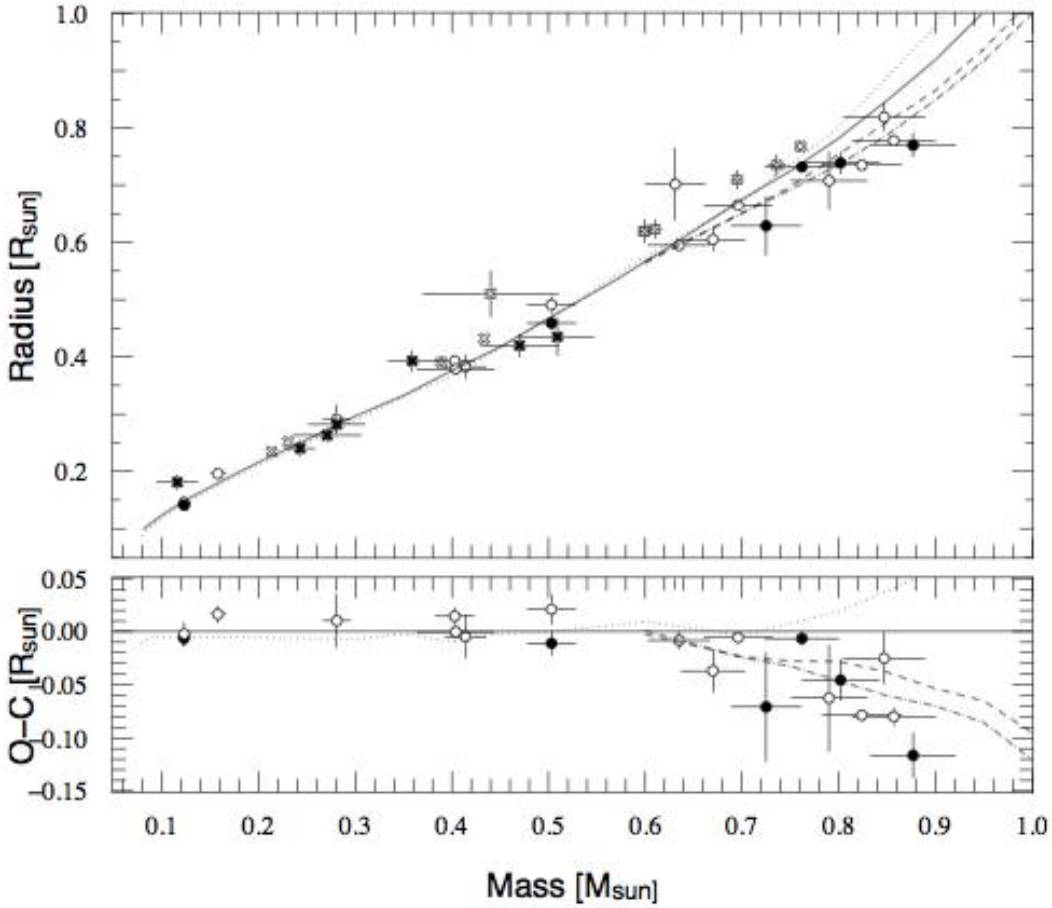


Fig. 8. Mass-radius relationship - masses and radii superimposed on 5 Gyr isochrones theoretical models (Baraffe et al. 1998). Our results appear as filled circles. Other long baseline interferometry measurements come from PTI (Lane et al. 2001), VLTI (Ségransan et al. 2003) and CHARA-FLUOR: Boyajian et al. (2008), di Folco et al. (2007), Kervella et al. (2008) and Berger et al. (2006) for GJ15A, all as empty circles. Solar metallicity with $L_{mix} = 1.0H_P$ (solid), $L_{mix} = 1.5H_P$ (dash) and $L_{mix} = 1.9H_P$ (dashdot) are shown as well as a metal deficient, [M/H]=-0.5 model with $L_{mix} = 1.0H_P$ (dot). Only radii measurements better than 10% are displayed. Solar neighboorhood eclipsing binary measurements are represented as empty crosses while OGLE-T transiting binaries are represented in filled crosses. Only residuals from long-baseline interferometry results are displayed.

Figure 0.1:

Low mass stellar mass-radius relation taken from "Mass-radius relation of low and very low-mass stars revisited with the VLTI" Authors: Demory, B.-O.; Ségransan, D.; Forveille, T.; Queloz, D.; Beuzit, J.-L.; Delfosse, X.; di Folco, E.; Kervella, P.; Le Bouquin, J.-B.; Perrier, C.; Benisty, M.; Duvert, G.; Hofmann, K.-H.; Lopez, B.; Petrov, R. Astronomy and Astrophysics, Volume 505, Issue 1, 2009, pp.205-215

Link to the arXiv article: http://arxiv.org/abs/0906.0602

Debugging Runs: Case Names, Results:

Name of this run	Input/Starting Model	Mass of the system (in Msun)	Parameter being tweaked = new value	Version of TheCode.f used to run the simulation	Results
02NFSmax3long	02NoFusionCont, from model #59	0.2	NMOD = 1000, NRIT = 25, **and changed Smax (lum) = +1e28 (rather than -1e28)**	thecodeNoFusion	~~Crashed on model #616 (25th model it computed in this run) with a 'stop no convergence' (timestep problem).~~ <-- This was fixed by changing the SMAX (luminosity) value to a positive number (rather than keeping it negative).

I kept poking around with 02NFSmax3long, adjusting parameters to try to coax the simulation past model #844, but haven't found the key to it just yet. I'll leave my tomorrow-self Figure 4 below to help jog my memory about where I was and what was going wrong when I come back to this tomorrow:

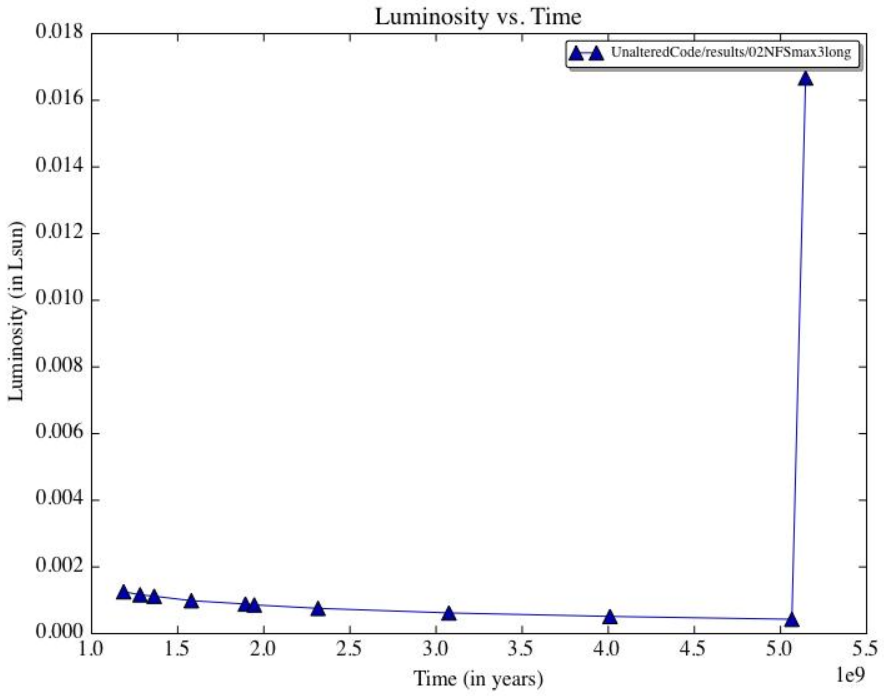


Figure 4

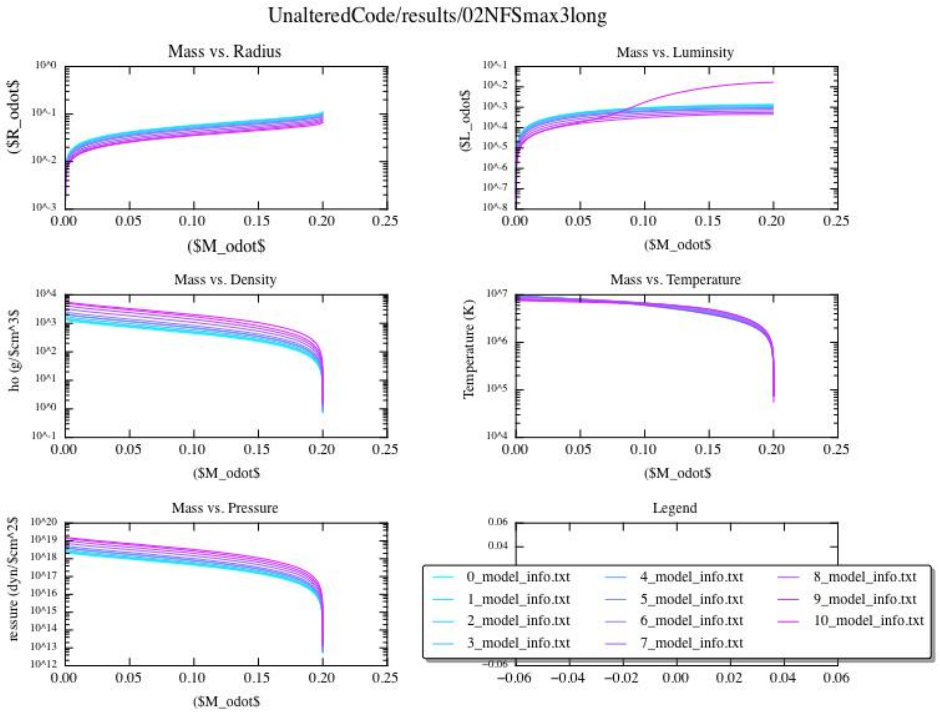


Figure 5:

It's the luminosity profile that's still the culprit.

Start here next time by looking at what happens between the next-to-last and last recorded model for this run.

(I wonder why the luminosity 'flipping' problem has only surfaced with these lower-mass systems. What kept it from happening with the 0.25 or 0.3 Msun systems?)

To Do/Today:

Start from the next-to-last recorded model in the 02NFSmax3long run and run the model forward with identical input parameters, but have it record models at every timestep to try to get a better handle on why that run crashed when it did. In particular, I want to see if the discontinuity in the luminosity's second derivative springs up suddenly, or develops gradually.

It's important to remind myself that the reason for figuring out what's going on with this particular case is that I need to be confident that once I feed TheCode.f a jupiter-mass and -luminosity input model, it won't crash or go off the rails and produce a physically un-possible result. To that end, I should also make sure to run a 0.1Msun model through TheCode.f in more detail and see what's been causing that case to crash. Is it a luminosity lower-limit thing? Is it something to do with TheCode.f not being able to successfully invert a Henyey matrix containing a wide dynamic range of values? This is the heart of what I need to figure out, here.

Name of this run	Input/Starting Model	Mass of the system (in Msun)	Parameter being tweaked = new value	Version of TheCode.f used to run the simulation	Code's final exit status	Notes	Figures
02NFSmax3long	*02NoFusion Cont, from model #59*	*0.2*	*NMOD = 1000, NRIT = 25,* ***and changed Smax (lum) = +1e28 (rather than -1e28)***	*thecodeNoFusion*		*~~Crashed on model #616 (25th model it computed in this run) with a 'stop no convergence' (timestep problem).~~ <-- This was fixed by changing the SMAX (luminosity) value to a positive number (rather than keeping it negative).*	

02NFSmax3L1	02NFSmax3L1, from record 10	0.2	NRIT = 1	thecodeNoFusion	`VARIABLE BELOW LIMIT: X( 625,3) = -1.04742E+33`
					
					`VARIABLE BELOW LIMIT: X( 381,3) = -1.63617E+29`
					
					`VARIABLE BELOW LIMIT: X( 380,3) = -8.86900E+29`
						The luminosity profile goes loopy on model 77, seems to start to recover (though still plagued by a 'kink'), and then shoots way up on model 88, which ends up being the final model the run produce.
						
						I wonder if the negative luminosity values that end up crashing the simulation are an artifact of TheCode.f's attempts to bring that luminosity spike in model #88 back down.
						
						Next step: maybe try decreasing the SMAX luminosity parameter even more, and running a simulation forward from model 60 of this run?
						
						Oh wait, I changed Smax for the temperature to 0.04 (from 0.08) last night and didn't record that change. So, instead, let's first see what happens when I repeat this simulation but with that parameter decreased even more to, say, 0.01
							Figure 1

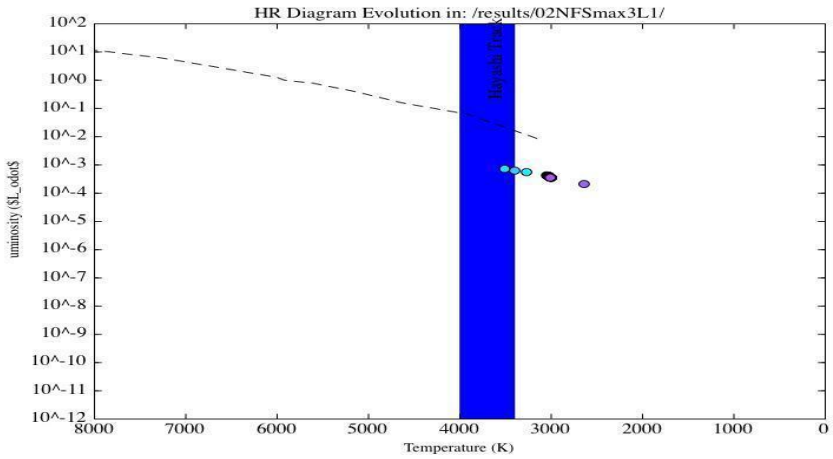
02NFSmax4	02NFSmax3 L1, from record 10	0.2	SMAX (Temperature) = 0.01	thecodeNoFusion	MODEL: 871 TIME: 1.6632D+17 STORED AS RECORD 30 ON UNIT 3 VARIABLE BELOW LIMIT: X(621,3) = -1.16919E+33 VARIABLE BELOW LIMIT: X(363,3) = -1.67376E+29 VARIABLE BELOW LIMIT: X(362,3) = -2.29587E+29	As I suspected, changing the SMAX (temperature) value has very little effect on the simulation run's sudden but inevitable demise.	
02NFSmax5	02NFSmax3 L1, from record 60	0.2	SMAX (lum) = 1e+25 SMAX (temperature) = 0.08 dTMN= 1.0e0	thecodeNoFusion	MODEL: 872 TIME: 1.6842D+17 STORED AS RECORD 21 ON UNIT 3 VARIABLE BELOW LIMIT: X(594,3) = -2.70956E+33 VARIABLE BELOW LIMIT: X(327,3) = -7.27117E+29 VARIABLE BELOW LIMIT: X(327,3) = -6.83865E+29	Not much improvement, here.	

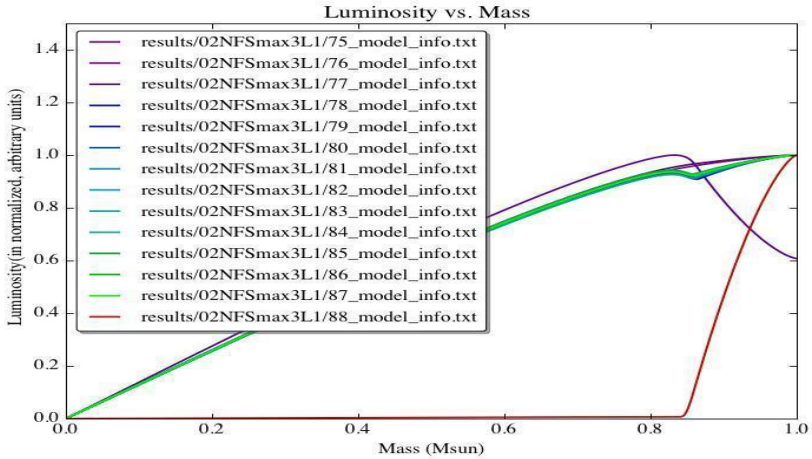
02NFSmax6	02NFSmax3 L1, from record 60	0.2	SMAX = -1e25	thecodeNoFusion	--- CONVERGENCE NOT POSSIBLE: 1274 517 7.63E-06 517 -2.06E-06 11 5.76E-04 516 -4.97E-04 81	Runs for 421 timesteps before failing to converge. However, the timestep sizes are very small (most likely limited by the small SMAX value). In comparison with, say, 025NoFusionHappyAccident, the model barely evolves at all. I wonder if it might be a good idea to run these starting conditions forward from model #1 of the with-fusion model (02NoFusionStart)? I suspect that the 60th record/model from 02NFSmax3 might already be too subtly but strangely shaped to allow the code to converge it with any set of input params in a non-pathological way.	
02NFS6FromStart	02FusionSta rt, from record #1	0.2	starting model	thecodeNoFusion	--- CONVERGENCE NOT POSSIBLE: 118 406 3.31E-04 462 -1.40E-04 1 -3.22E-05 463 1.19E-02 81	The luminosity profile (and surface luminosity, too) don't change throughout the run, so the SMAX constraint on this one may have been too strict. The next thing I want to try is starting from the same model, with a looser SMAX (lum) restriction (though still negative), but a tighter epsL condition.	
02NFepsL1	02FusionSta rt, from record #1	0.2	epsL = 1e-5, SMAX = ~~-1e30~~ -1e37, ITMX = 1000	thecodeNoFusion	I ended the simulation by hand-- it was taking a very long time to converge each model.	I think the sluggishness in convergence in this run was due to the fact that it was trying to change the 'with fusion' lum profile shape to the 'without fusion' lum profile shape while observing the strict limitations I'd imposed on how much the lum profile was allowed to change overall.	

						I think the next step should be to start from the first converged model in the 02NoFusionCont case, using the same input parameters from this run. In other words, start from a 'no-fusion' shaped luminosity profile.	
02NFepsL2	02NoFusion Cont, from record #1	0.2	the starting model	thecodeNoFusion	INVSTATE 31: Gas pressure is negative 8 Pr,temp,Prad,Pgas: 1.3190E+15 2.8463E+07 1.6552E+15 -3.3620E+14 INVSTATE 31: Gas pressure is negative 9 Pr,temp,Prad,Pgas: 1.3197E+15 2.8463E+07 1.6552E+15 -3.3554E+14 INVSTATE 31: Gas pressure is negative 10 Pr,temp,Prad,Pgas: 1.3190E+15 2.8463E+07 1.6552E+15 -3.3620E+14	Got to model 824! (Which took ~45 minutes...) (Final recorded) MODEL: 811 TIME: 3.2626D+16 STORED AS RECORD 32 ON UNIT 3 {restricting solns to smaller region of chi-sq space by reducing epsL really works!} **{Try re-starting this simulation from last record, evolving forward further, with increased ITMX allowance (2000 instead of 1000, for ex.}** {If the ITMX adjustment doesn't work, then re-try same thing but with either Cwrk or Crad reduced.}	Figure 2
02NFepsL2ITMX1	02NFepsL2, from record #32 (final one on record)	0.2	ITMX = 2000, the starting model	thecodeNoFusion	ITERATION 1266 NEW VALUES: 483 5.67E+18 556 7.09E+07 510 -7.57E+34 15 3.89E+07 INVSTATE 31: Gas pressure is negative	Increasing the number of allowed iterations per attempt didn't lead the code to find a converged solution, so I'm going to move on to tweaking the Crad/Cwrk parameters.	

					8 Pr,temp,Prad,Pgas: 3.2323E+19 3.6773E+08 4.6115E+19 -1.3792E+19 INVSTATE 31: Gas pressure is negative 9 Pr,temp,Prad,Pgas: 3.2339E+19 3.6773E+08 4.6115E+19 -1.3776E+19 INVSTATE 31: Gas pressure is negative 10 Pr,temp,Prad,Pgas: 3.2323E+19 3.6773E+08 4.6115E+19 -1.3792E+19		
02NFCwrk1	02NFepsL2, from record #32 (final one on record)	0.2	Cwrk = 1e-10 (I'm not sure how physically motivated this is, though...)	thecodeNoFusion	ATMOS: First values of P,RHO,T,AKM: 1.3258E+04 1.0440E-07 2.7891E+03 3.1362E-02 after 12 iterations ERROR EXIT IN SUBROUTINE GIRL	Let's try this again, but with dTIM set to 1e11 initially.	
02NFCwrk1dTIM1	02NFepsL2, from record #32 (final one on record)	0.2	dTIM = 1e11	thecodeNoFusion	INVSTATE 31: Gas pressure is negative 10 Pr,temp,Prad,Pgas: 3.8780E+12 6.7365E+06 5.1938E+12 -1.3158E+12	Looks like maybe we should turn Crad 'off', instead of decreasing Cwrk	

02NFCrad2	02NFepsL2, from record #32 (final one on record)	0.2	Crad = 1e-40 (Cwrk set back to 1, and dTIM set back to -1e11)	thecodeNoFusion	ITERATION 1813 NEW VALUES: 557 1.02E+13 76 2.08E+10 257 -5.07E+37 67 2.79E+07 ERROR EXIT IN SUBROUTINE GIRL	Gets to model 825 before crashing. Maybe try this set of input parameters on the penultimate model from 02NFepsL2, rather than from the final one. If that doesn't work, I'm giving up on trying to get this 0.2Msun no-fusion system to work.	Figure 3
02NFCrad3	02NFepsL2, from record #31 (penultimate one on record)	0.2	new starting model number	thecodeNoFusion	ERROR EXIT IN SUBROUTINE GIRL	Only gets to model #812 before crashing. I may need to rethink my approach, here.	


HR Diagram Evolution in: /results/02NFSmax3L1/
Temperature (K)


Luminosity vs. Mass
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results/02NFSmax3L1/76_model_info.txt
results/02NFSmax3L1/77_model_info.txt
results/02NFSmax3L1/78_model_info.txt
results/02NFSmax3L1/79_model_info.txt
results/02NFSmax3L1/80_model_info.txt
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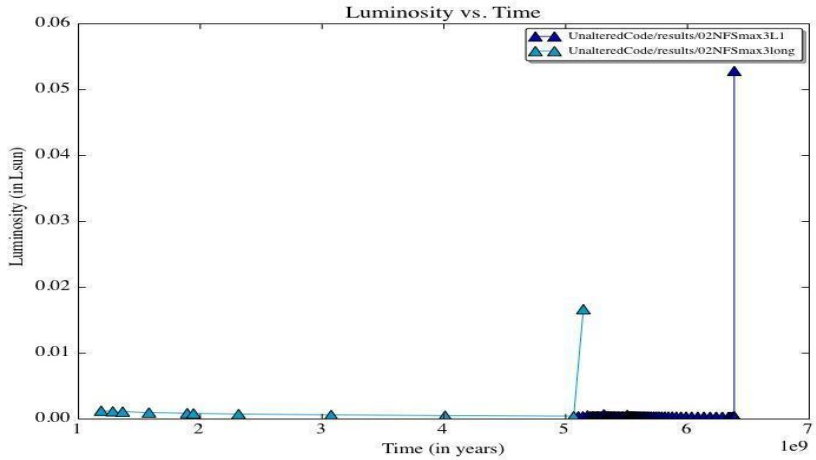
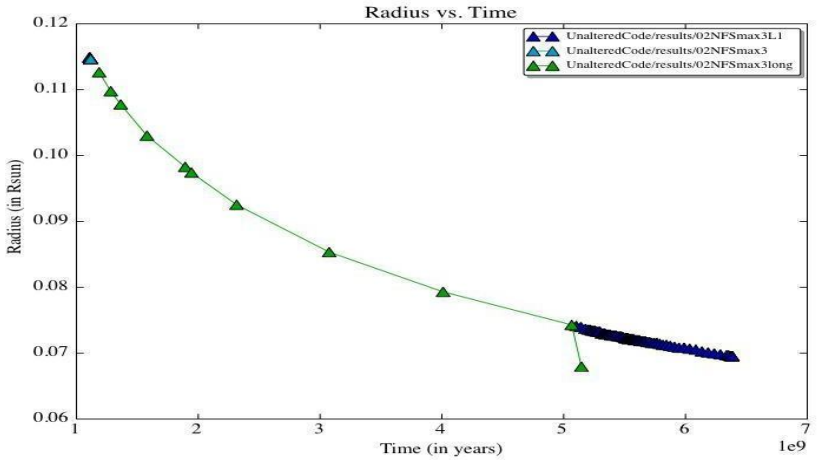
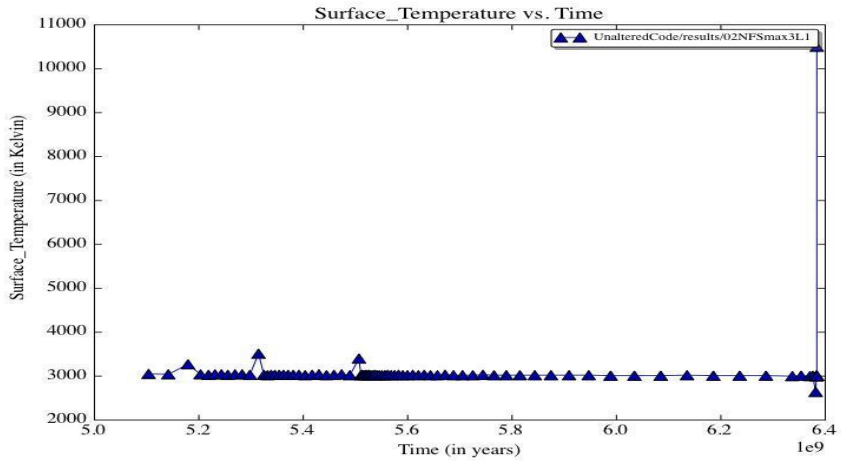
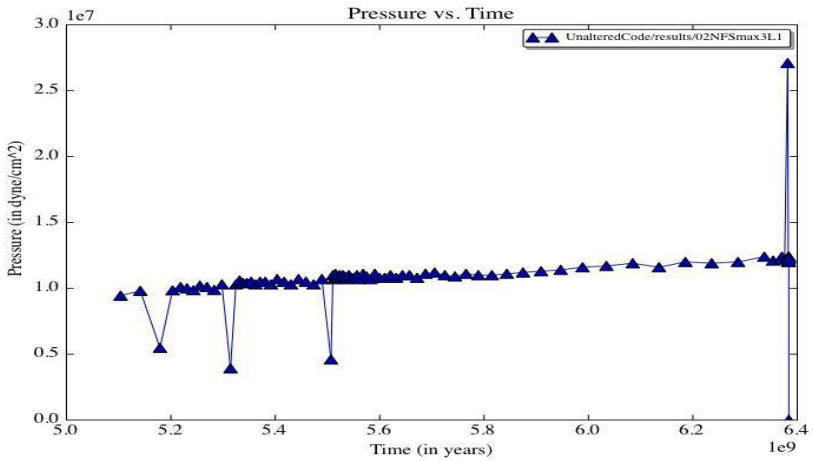
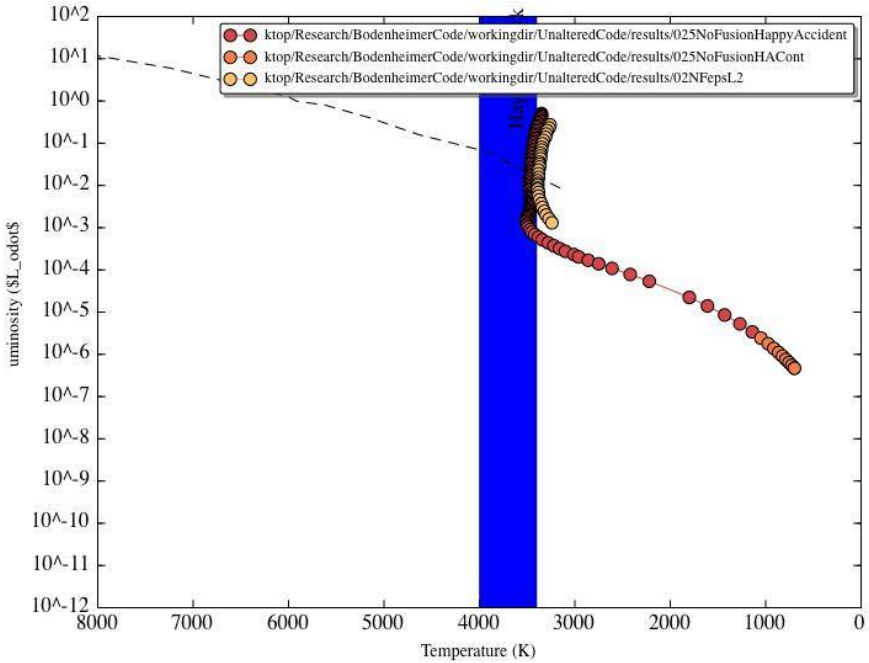
results/02NFSmax3L1/85_model_info.txt
results/02NFSmax3L1/86_model_info.txt
results/02NFSmax3L1/87_model_info.txt
results/02NFSmax3L1/88_model_info.txt
Luminosity(in normalized, arbitrary units)
Mass (Msun)


Luminosity vs. Time
UnalteredCode/results/02NFSmax3L1
UnalteredCode/results/02NFSmax3long
Luminosity (in Lsun)
Time (in years)
1e9


Radius vs. Time
UnalteredCode/results/02NFSmax3L1
UnalteredCode/results/02NFSmax3
UnalteredCode/results/02NFSmax3long
Radius (in Rsun)
Time (in years)
1e9


Surface_Temperature vs. Time
UnalteredCode/results/02NFSmax3L1
Surface_Temperature (in Kelvin)
Time (in years)
1e9


Pressure vs. Time
1e7
UnalteredCode/results/02NFSmax3L1
Pressure (in dyne/cm^2)
Time (in years)
1e9


ktop/Research/BodenheimerCode/workingdir/UnalteredCode/results/025NoFusionHappyAccident
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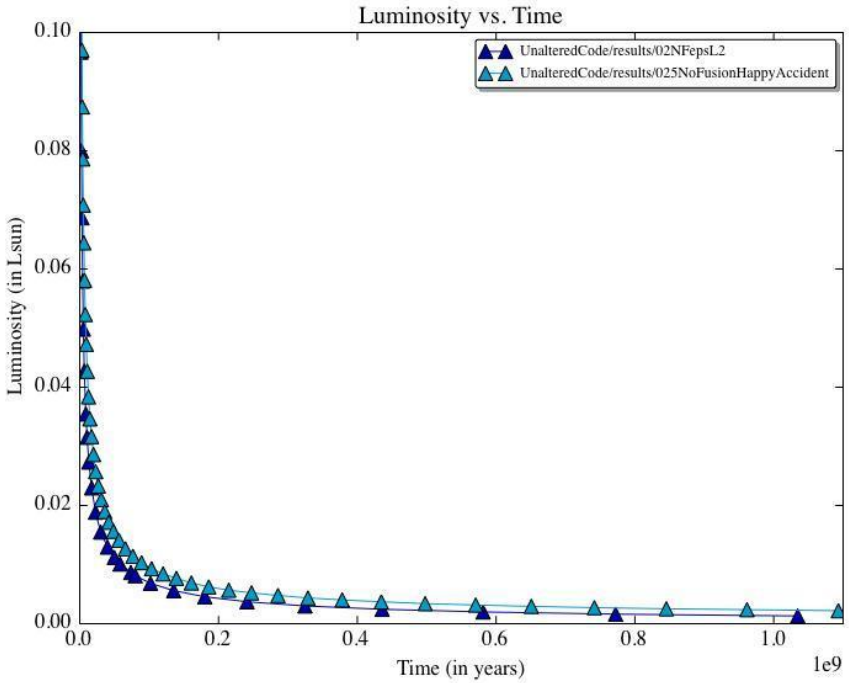
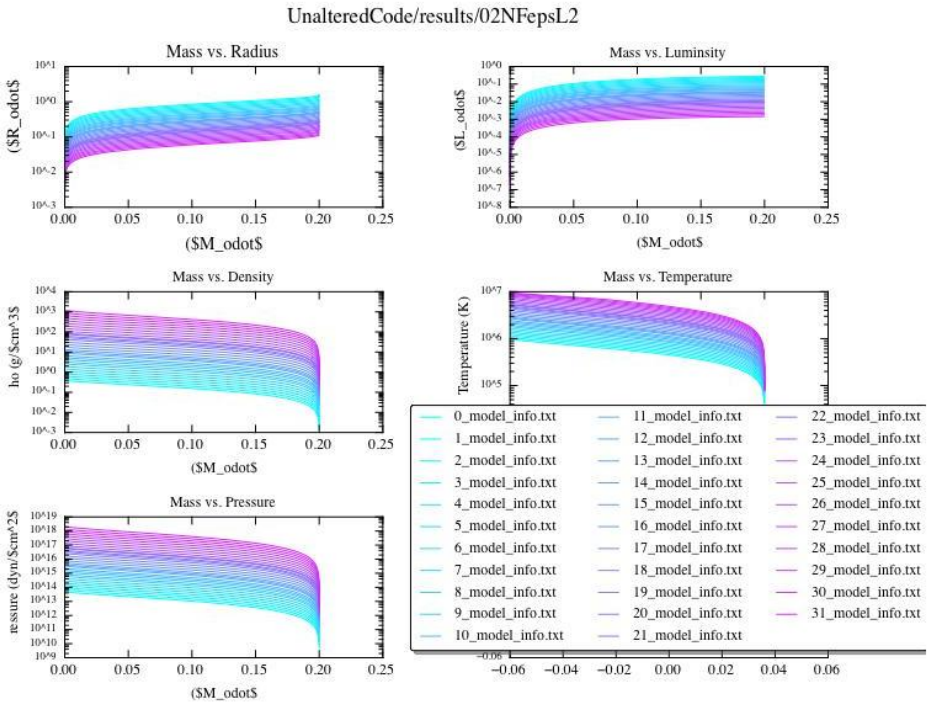
uminosity (L_odot
Temperature (K)


Luminosity vs. Time
UnalteredCode/results/02NFepsL2
UnalteredCode/results/025NoFusionHappyAccident
Luminosity (in Lsun)
Time (in years)
1e9


UnalteredCode/results/02NFepsL2
Mass vs. Radius
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(M_odot
Mass vs. Luminsity
(L_odot
(M_odot
Mass vs. Density
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Mass vs. Temperature
Temperature (K)
Mass vs. Pressure
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(M_odot
0_model_info.txt
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2_model_info.txt
3_model_info.txt
4_model_info.txt
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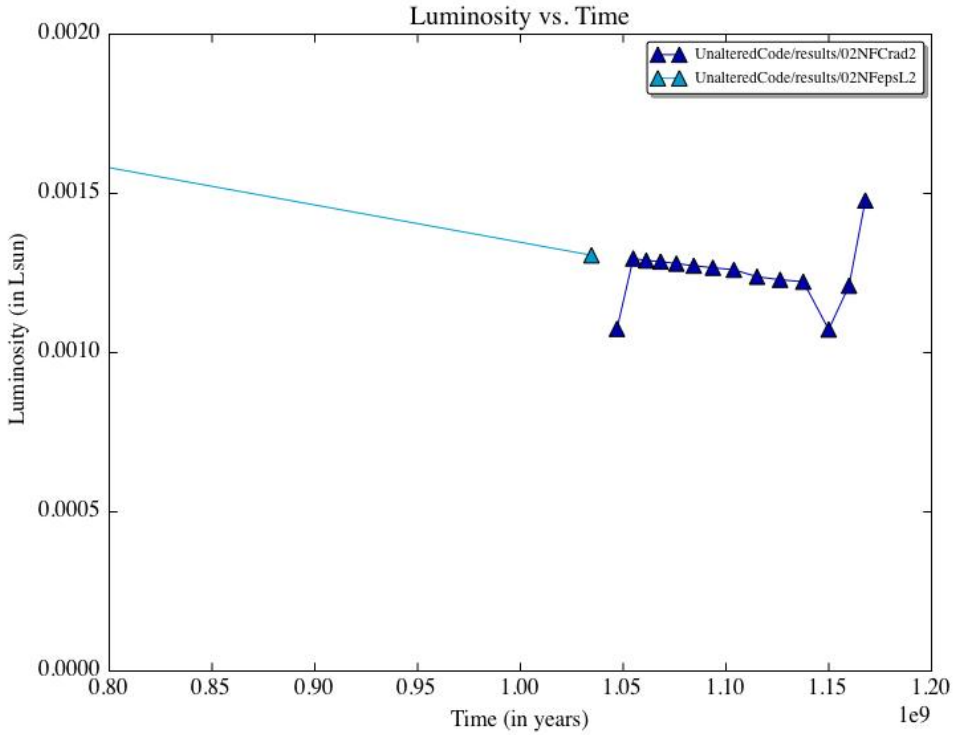

Figure 3:

Results from 02NFCrad2 run. Still have the more-stringent epsL conditions in effect, but now the luminosity (and surface temperature) is jumping around.

My (Tentative) Guide to Getting These No Fusion Models To Converge In Peter's Code:

1. Converge one timestep with fusion to go from the polytropic input --> more realistic profile.

2. Run the result through 1 timestep of the code withOUT fusion --> no-fusion profile. Make sure to turn Cwrk on, increase the limits on SMAX lum, and set SMIN lum to 1(?).

3. Run the result through as many timesteps of the NO fusion code as possible. Make sure to decrease epsL (to prevent the model from wandering into problematic regions of solution space). Also make sure to raise the ITMX limit to compensate for the fact that the code is going to have to search the soln space a lot more rigorously to find a solution that satisfies these stricter requirements.