

Current Limitations on Stellar Mass Estimates from Models

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KITP- Better Stars, Better Planets

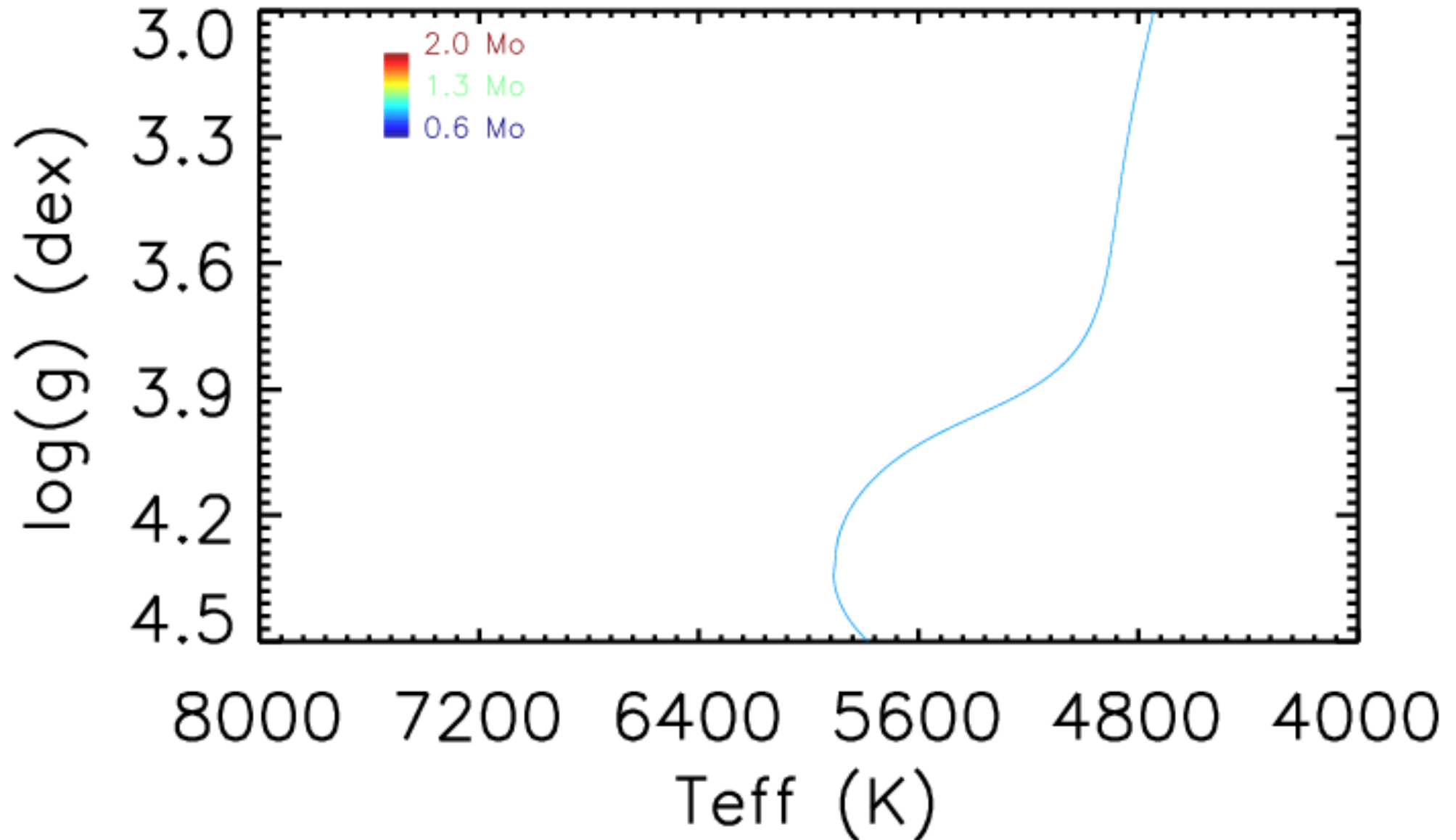
May 22, 2019



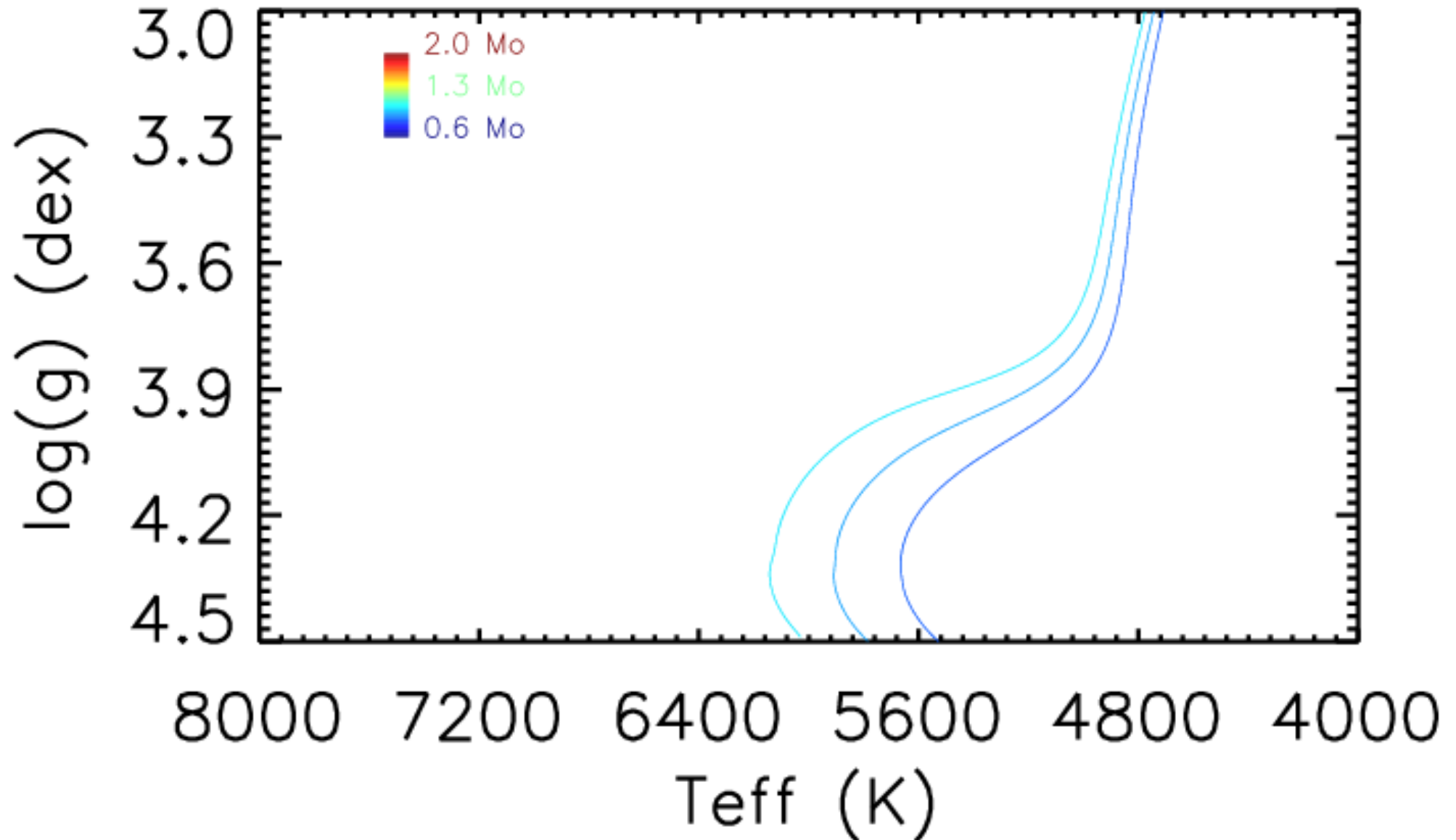
Summary

There is a $\sim 5\%$ uncertainty in the estimated stellar mass from models depending on the model chosen.

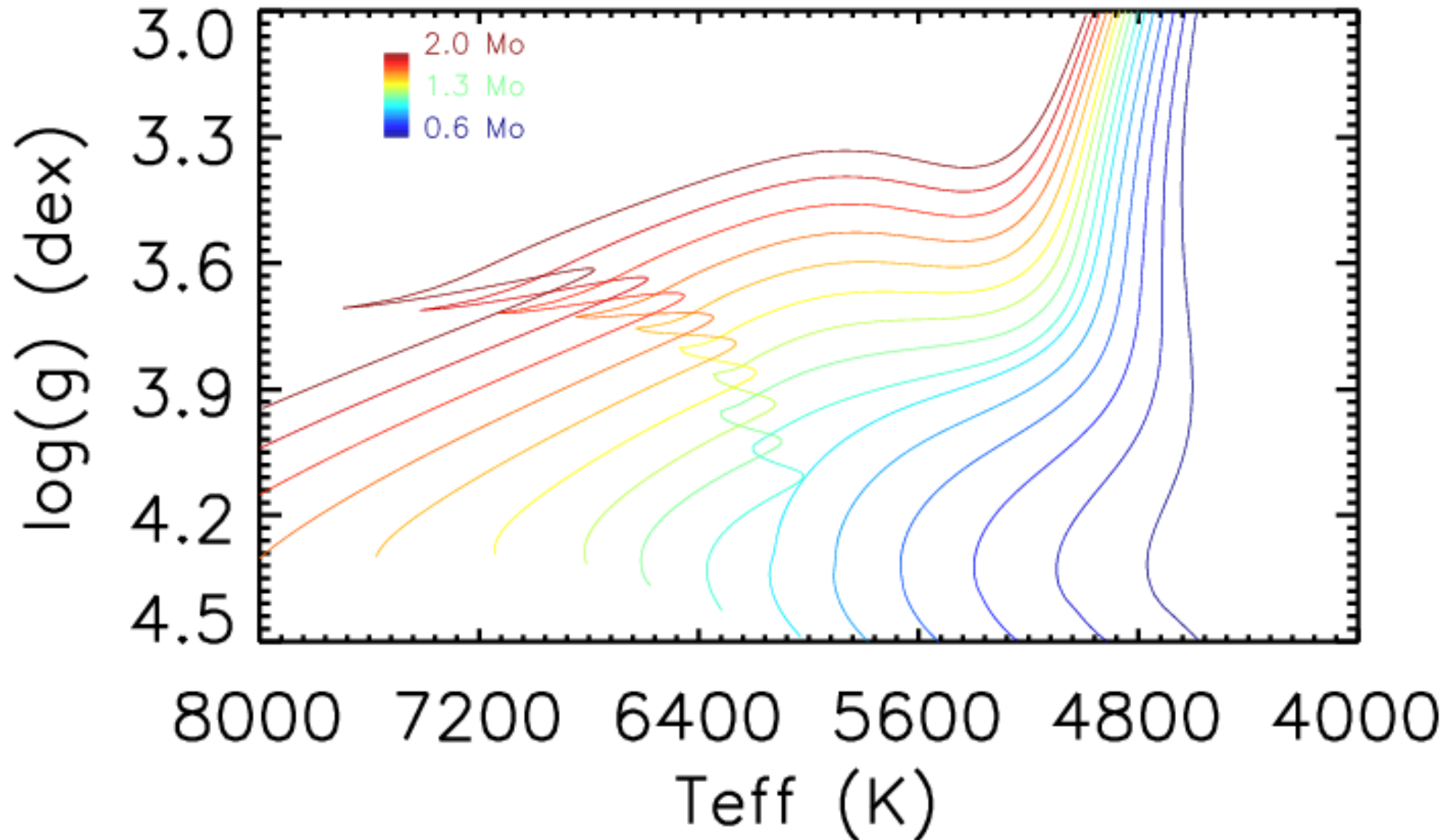
Past: Using $\log(g)$ + T_{eff}



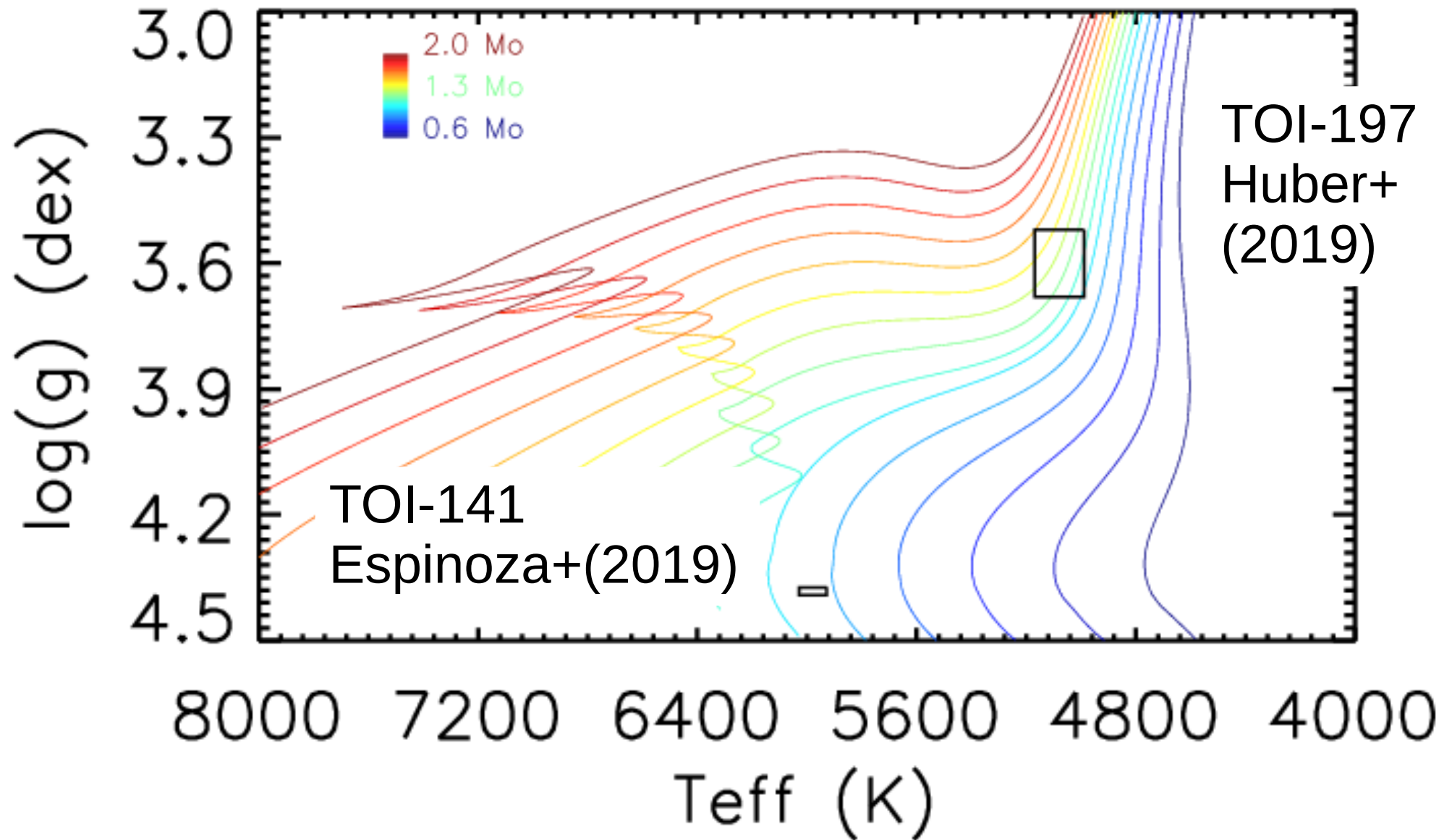
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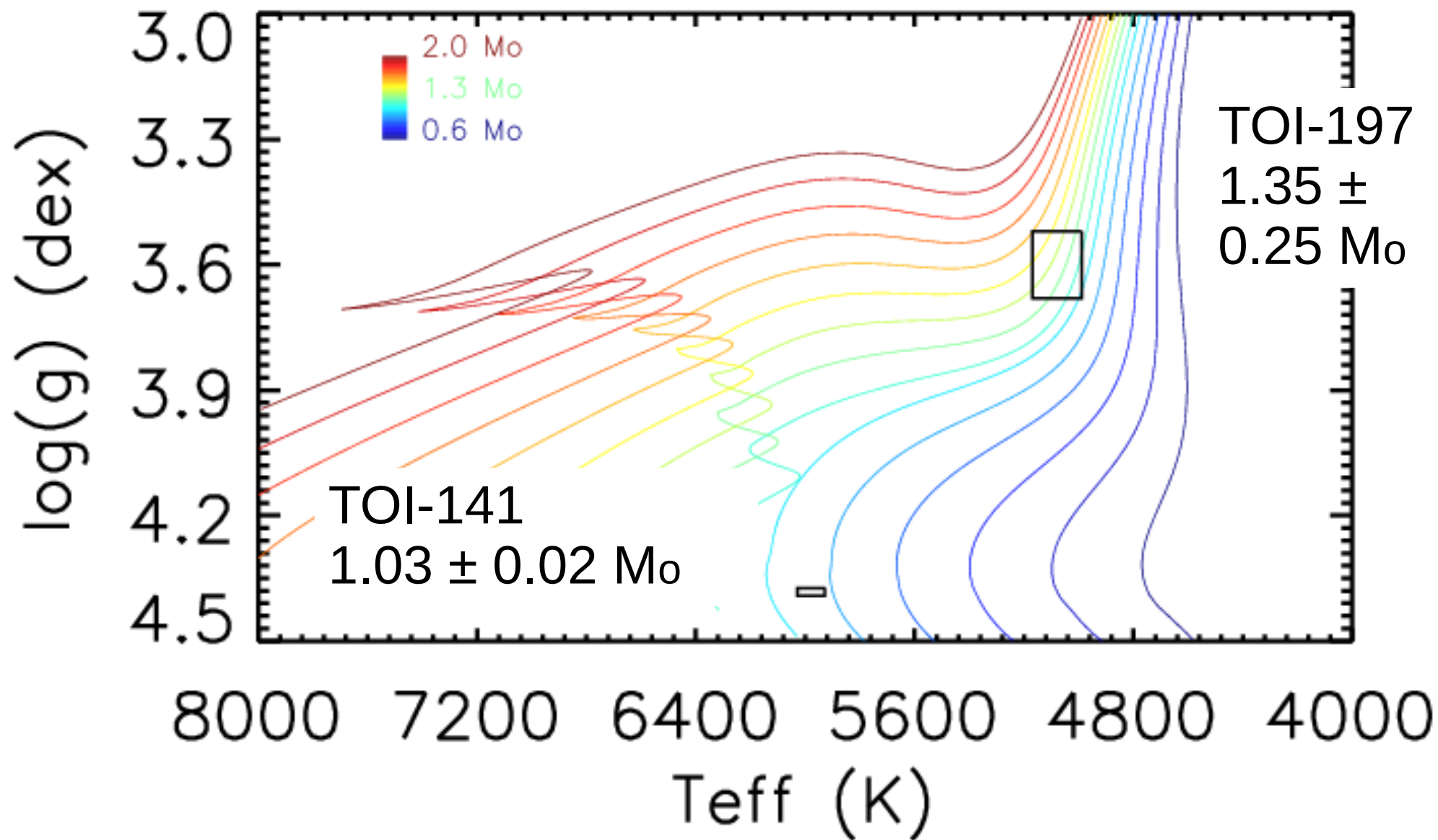
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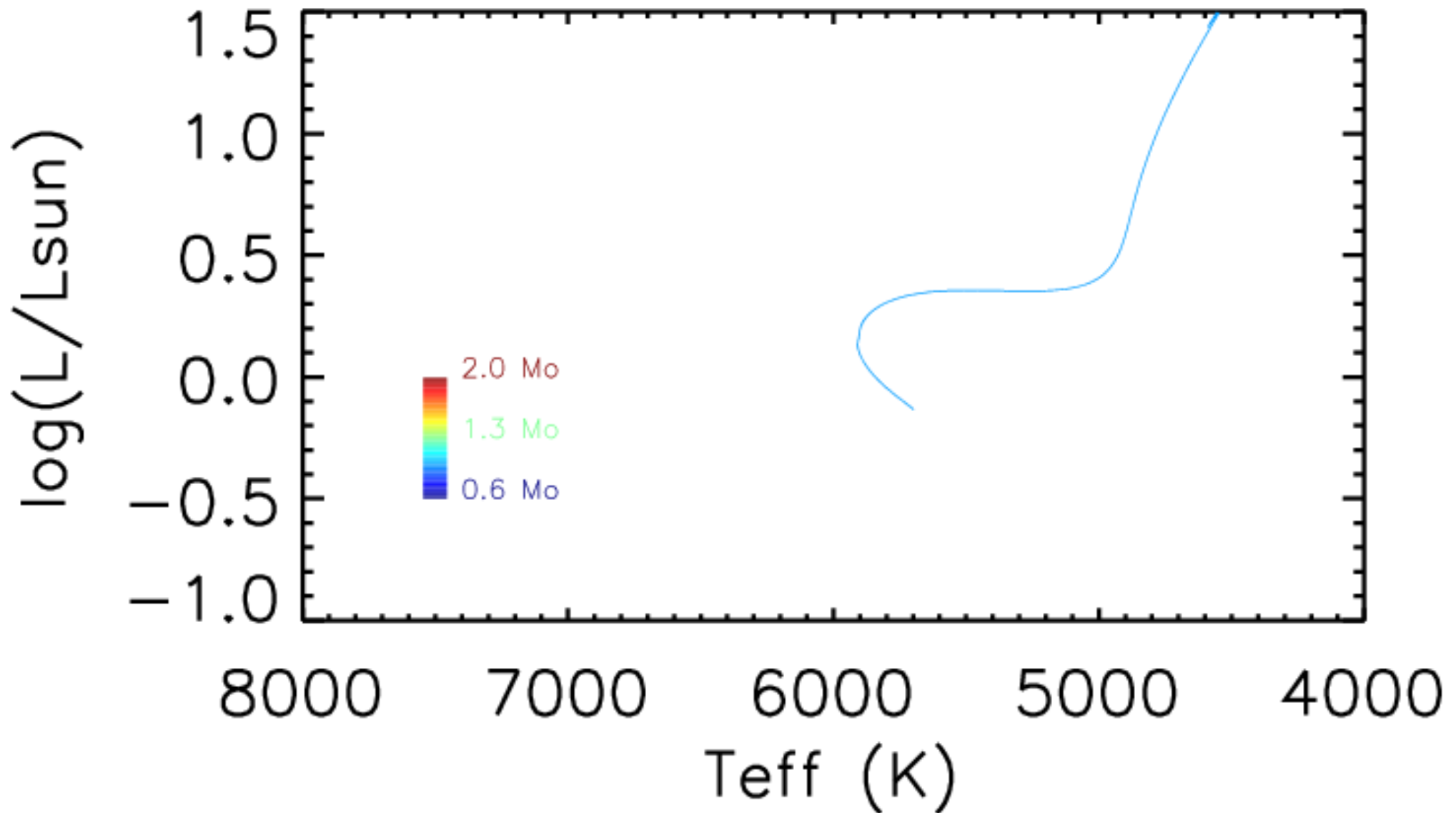
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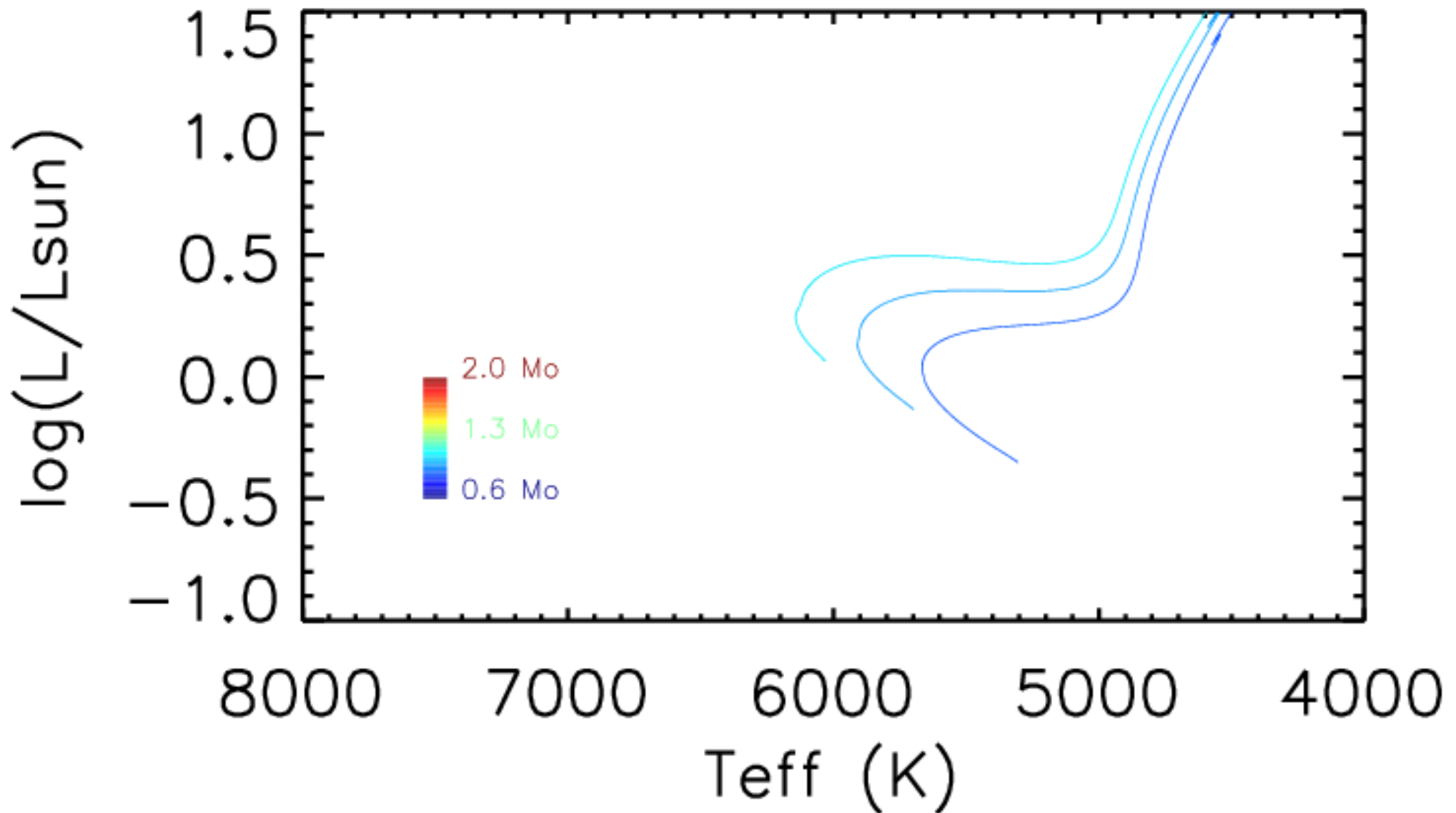
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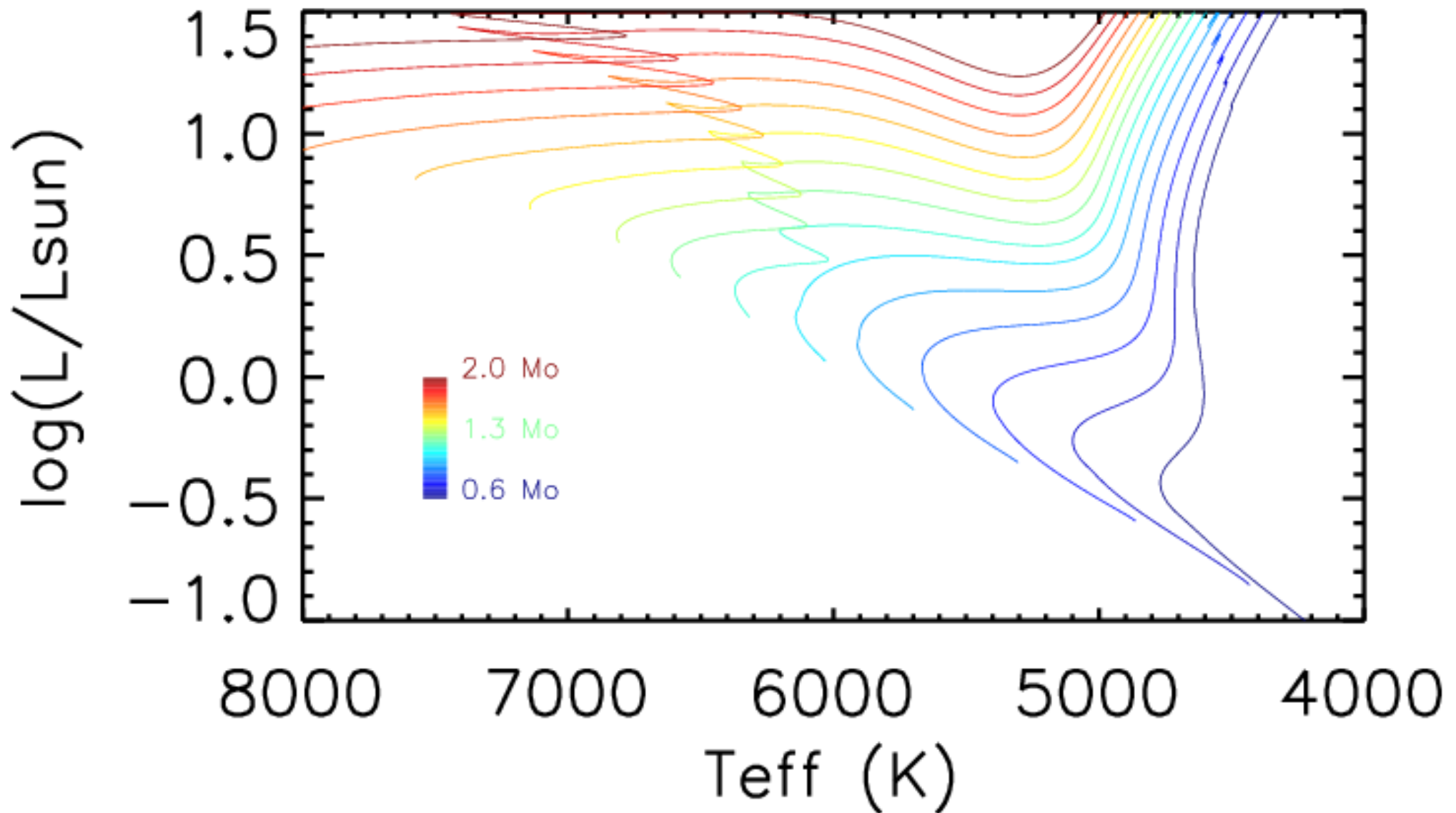
Present: Using Gaia L + Teff



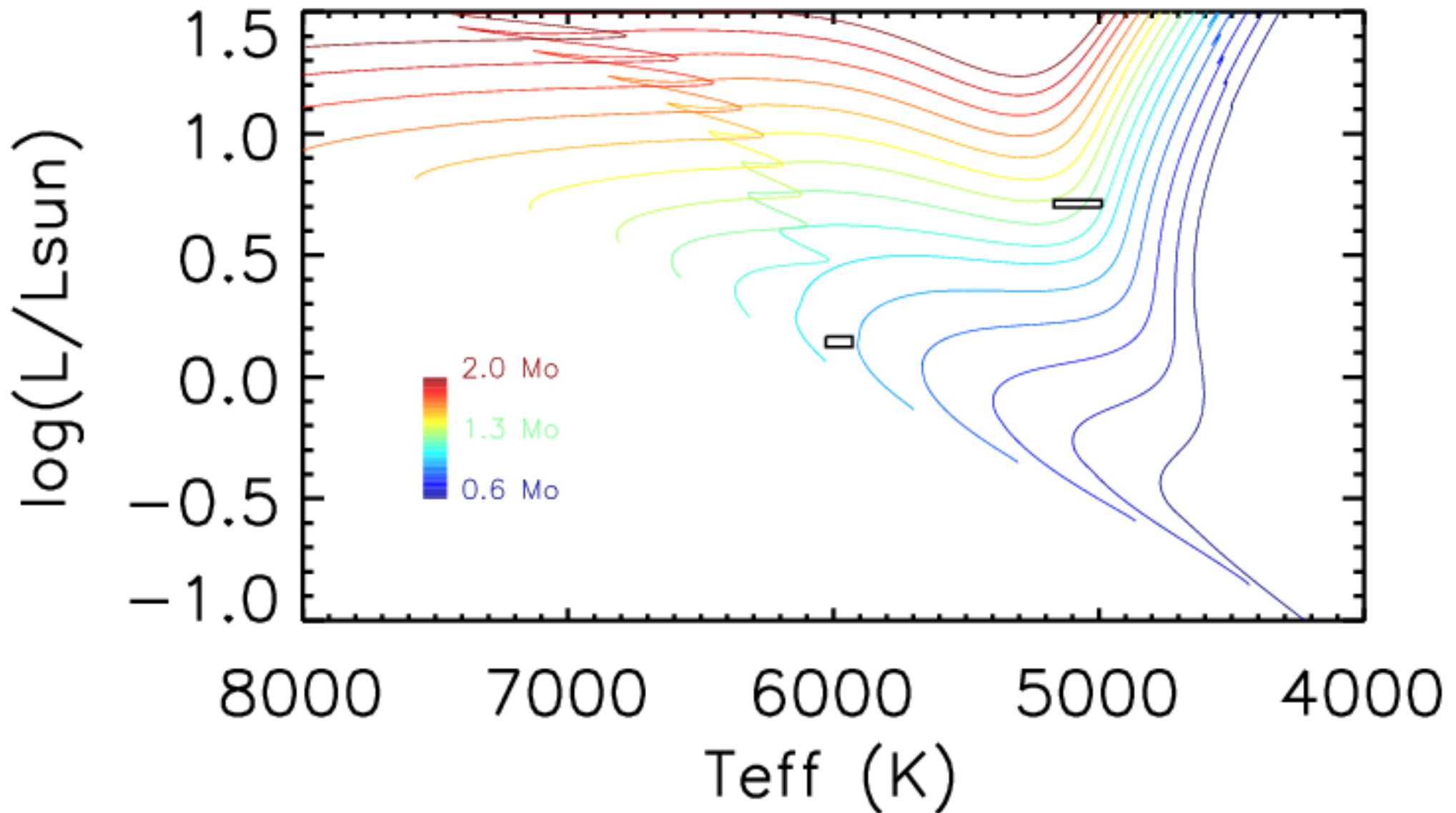
Present: Using Gaia L + Teff



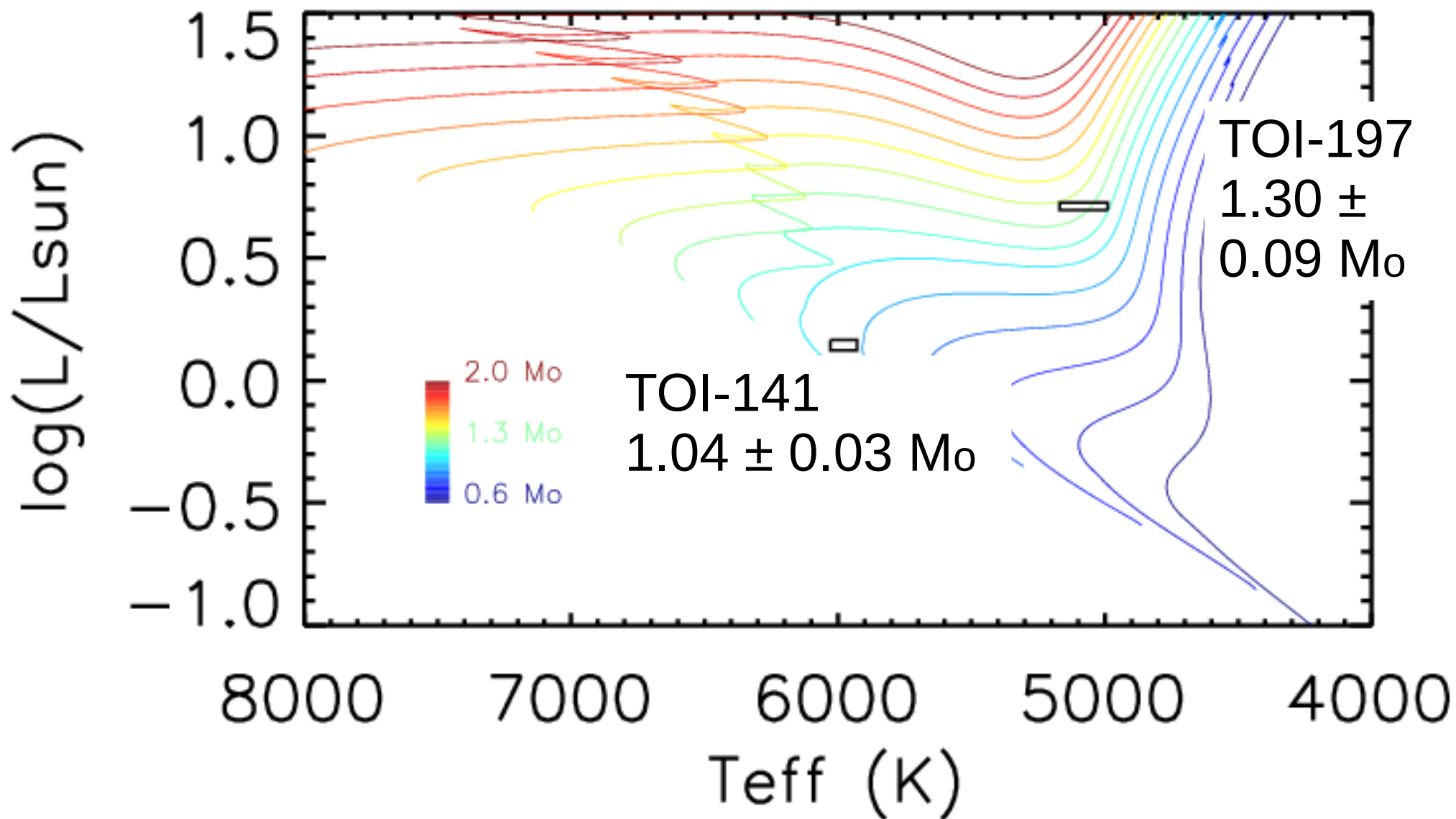
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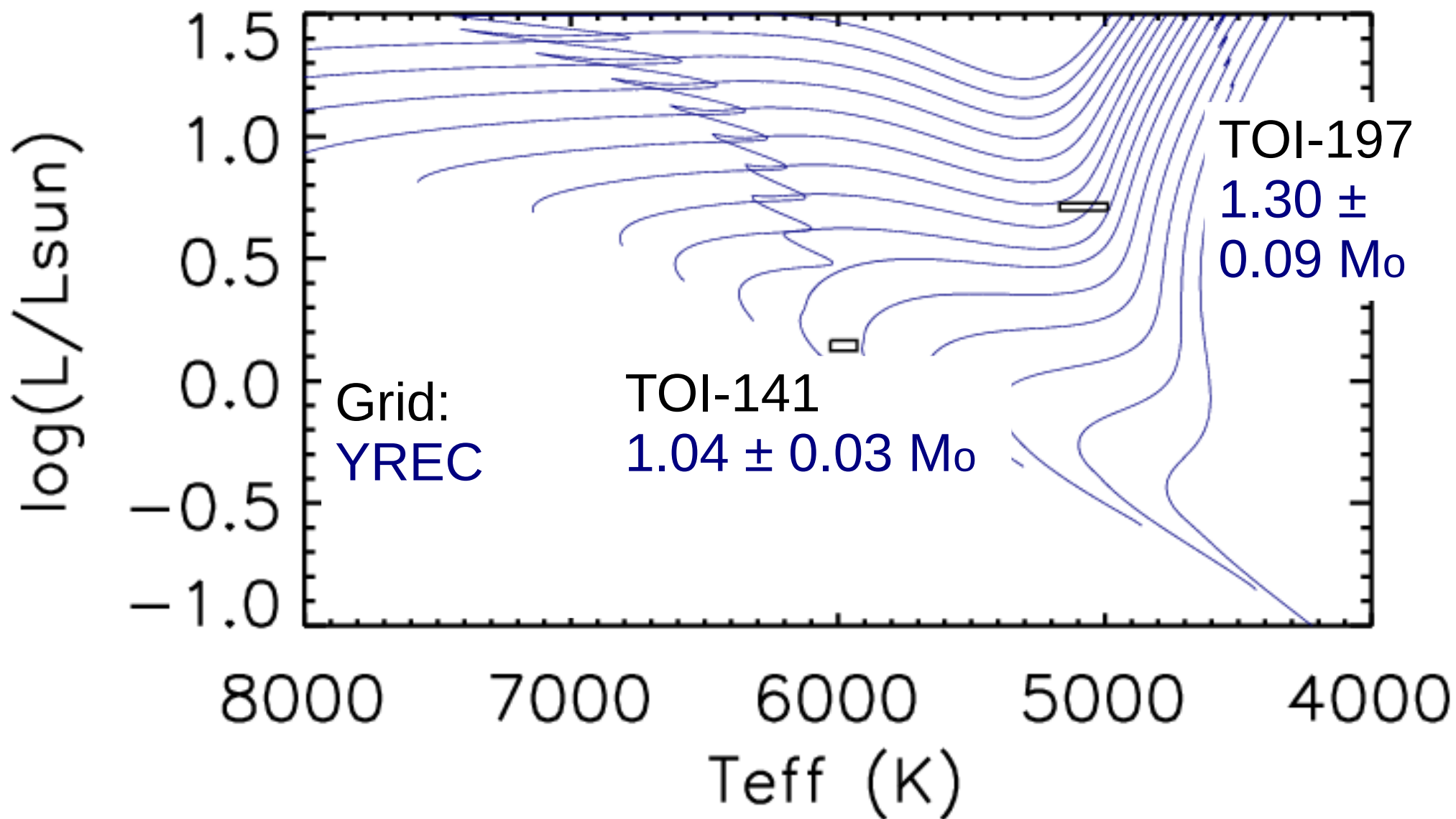
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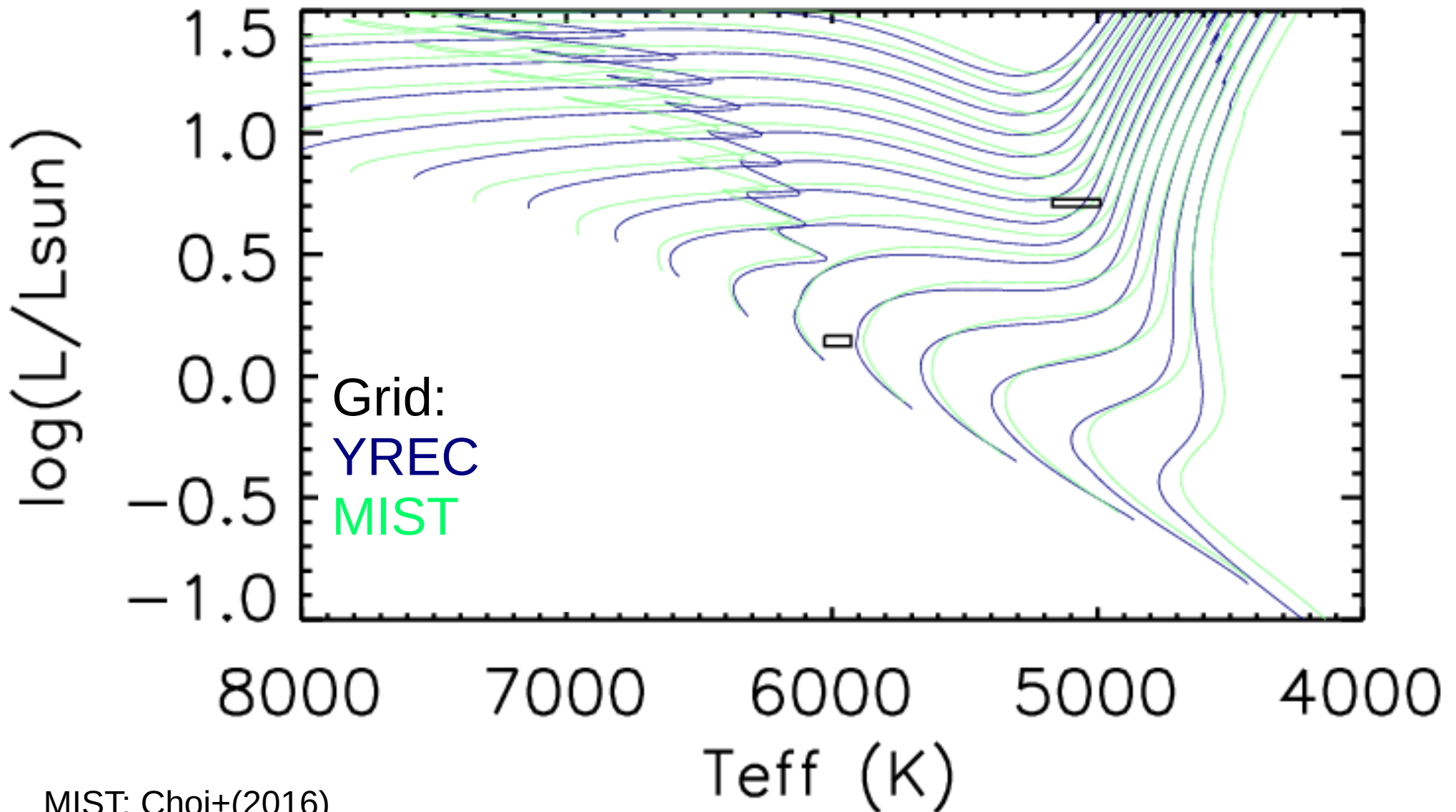
Present: Using Gaia L + Teff



Impact of Model Choice: YREC

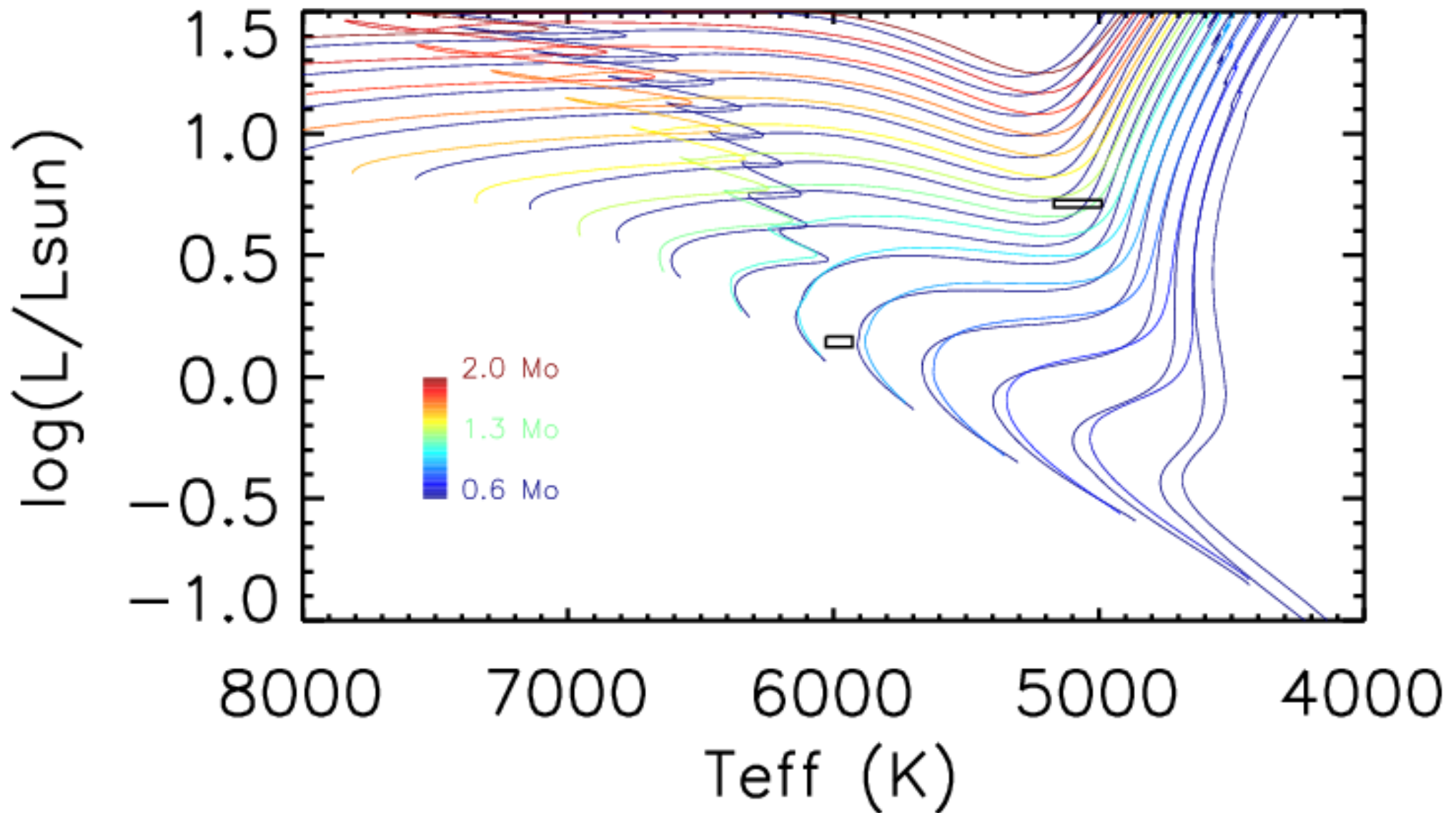


Impact of Model Choice: MIST

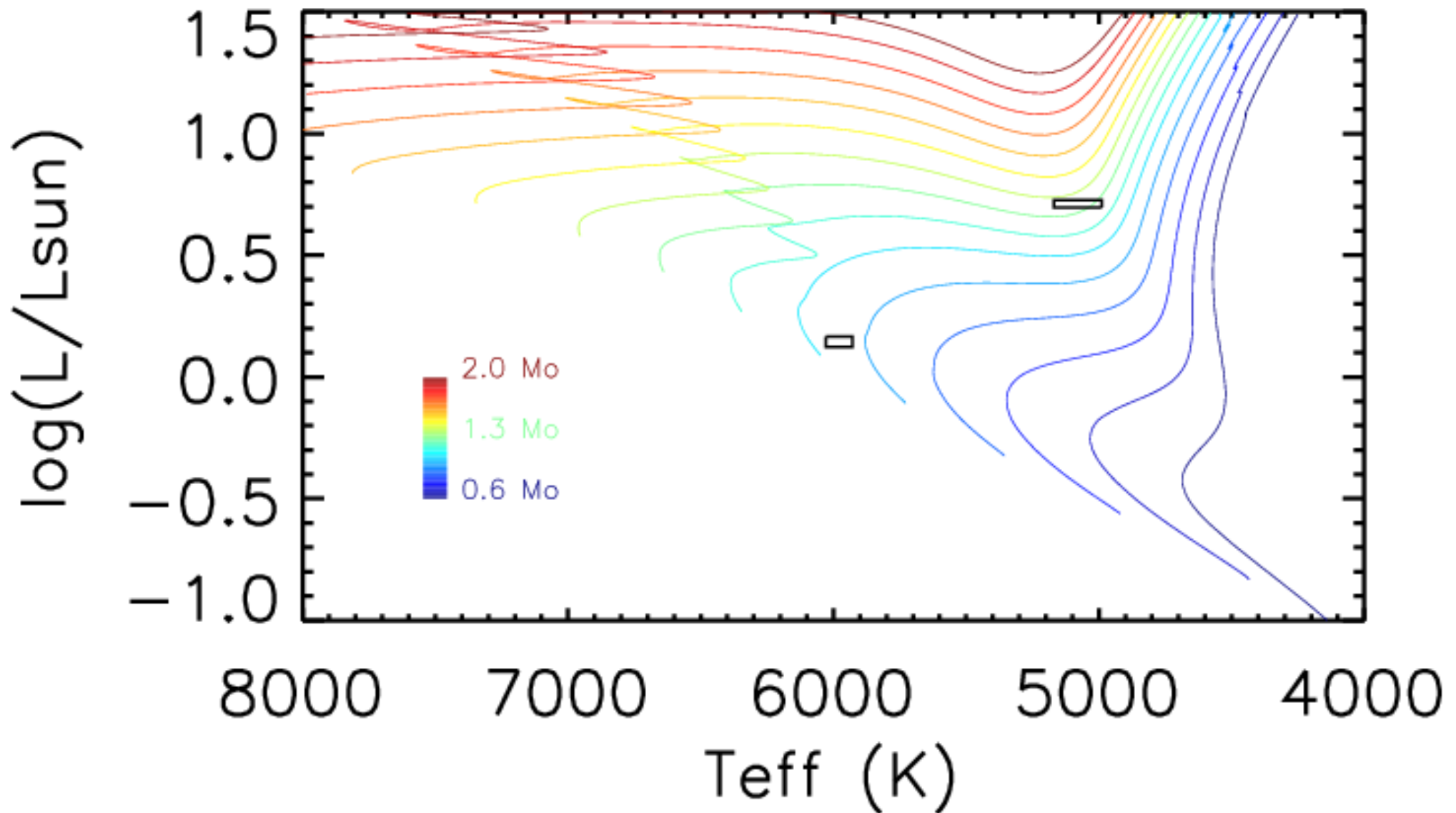


MIST: Choi+(2016)

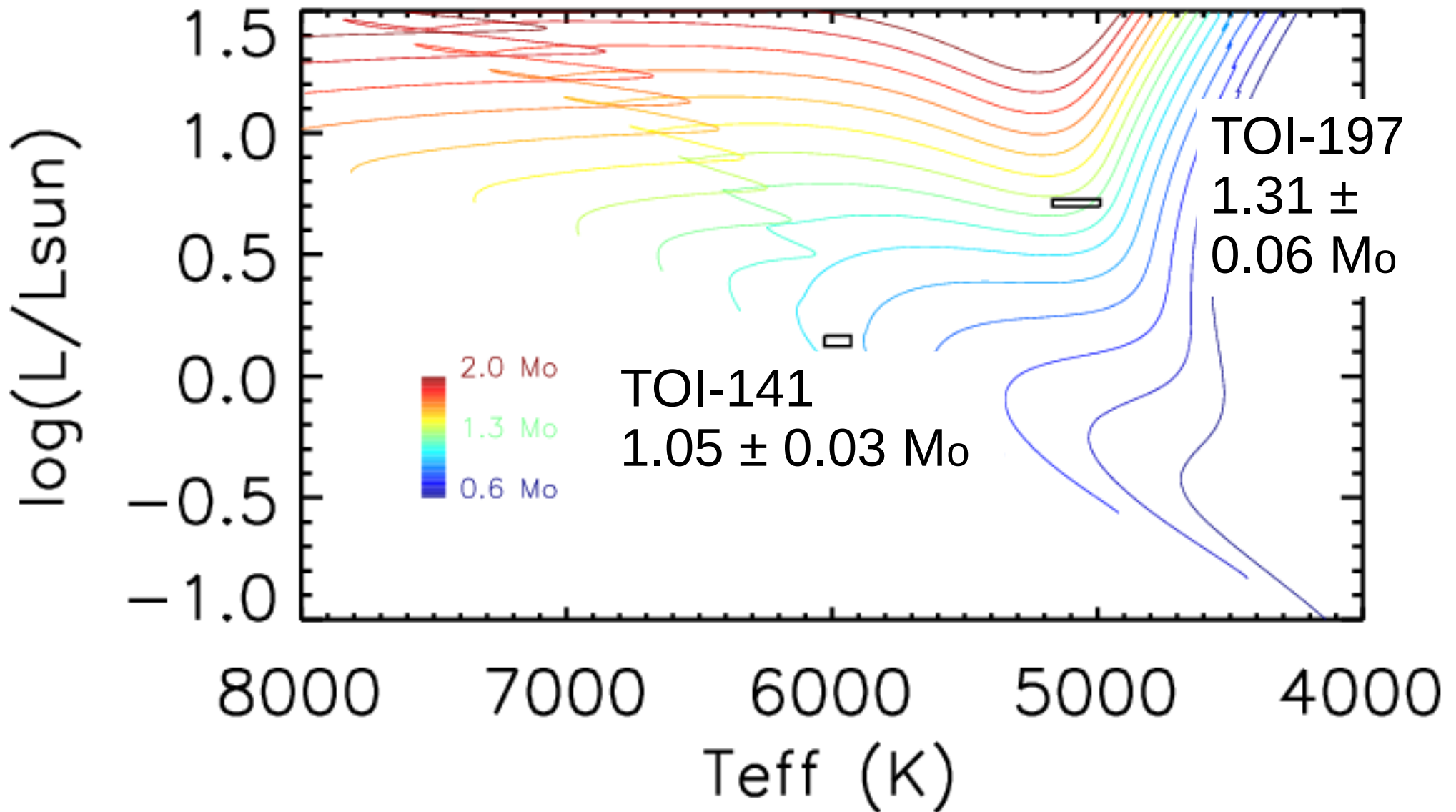
Impact of Model Choice: MIST



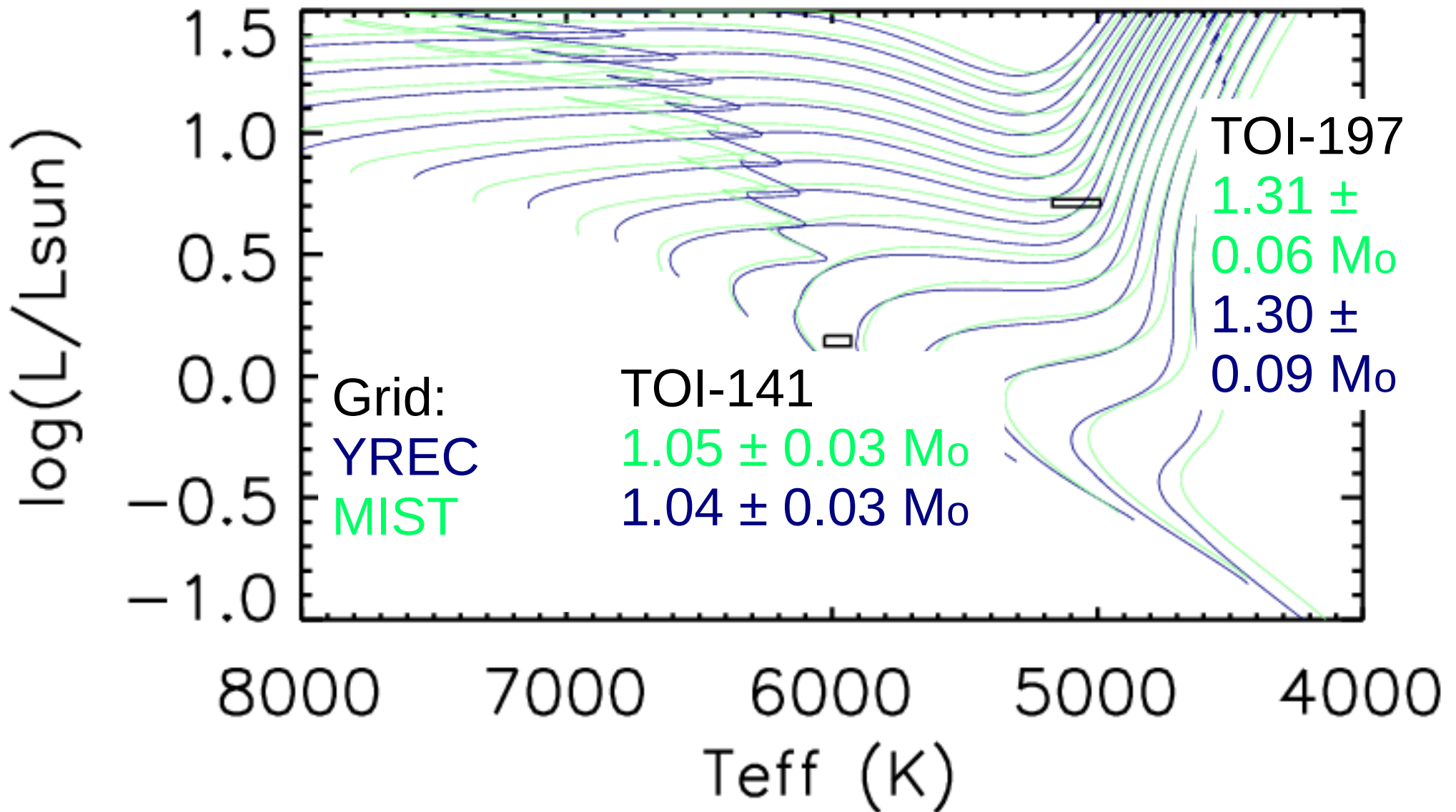
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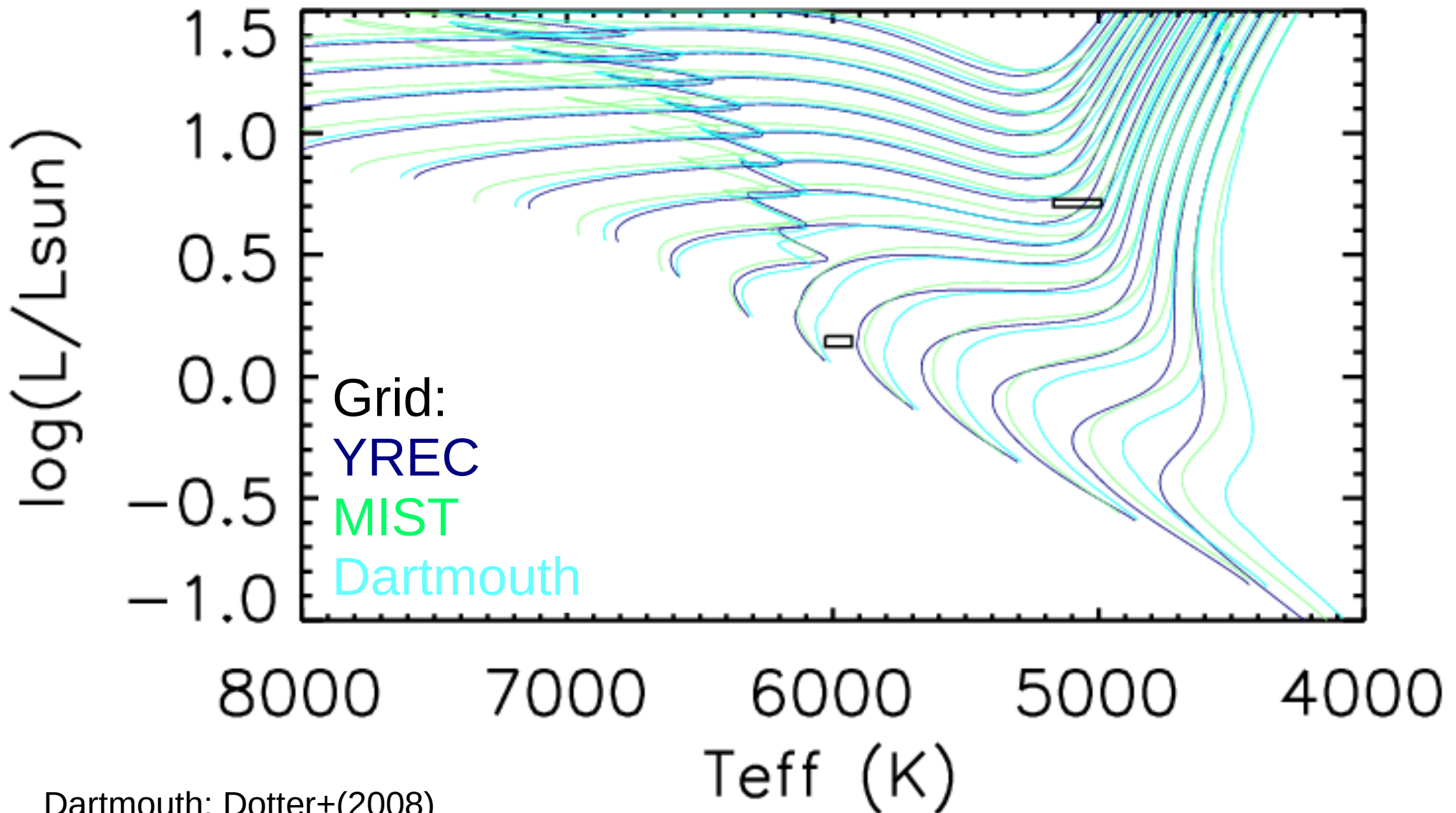
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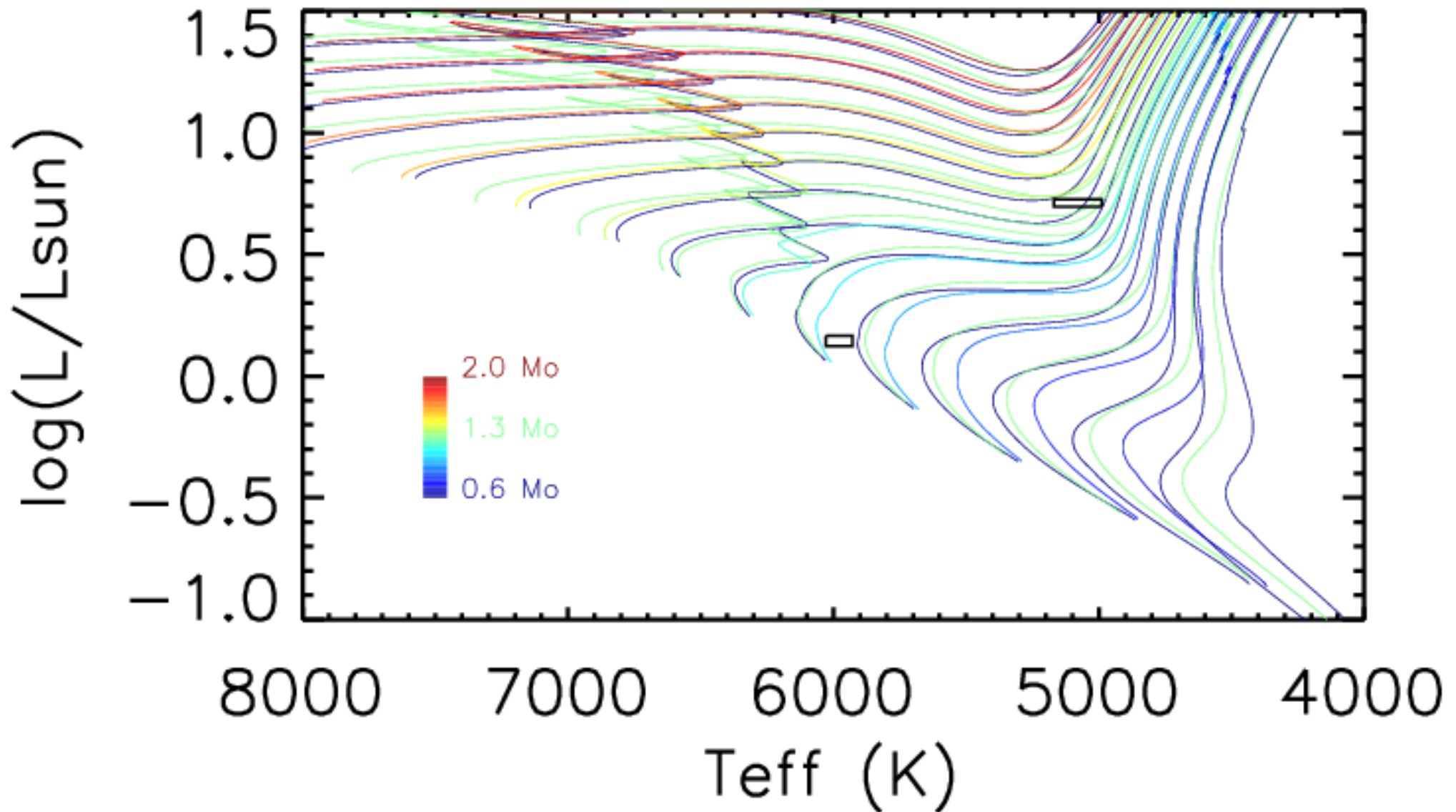


Impact of Model Choice: Dartmouth

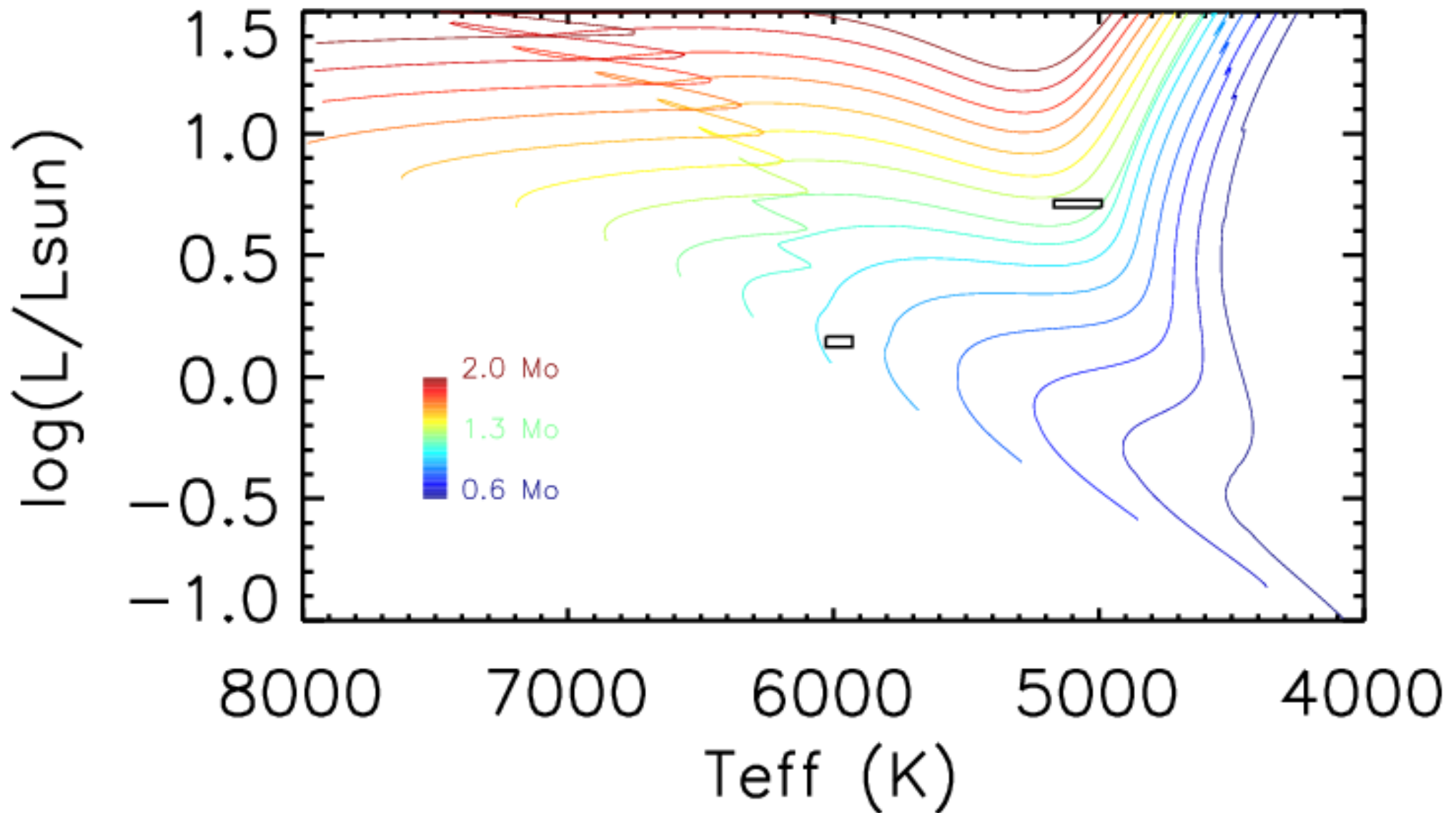


Dartmouth: Dotter+(2008)

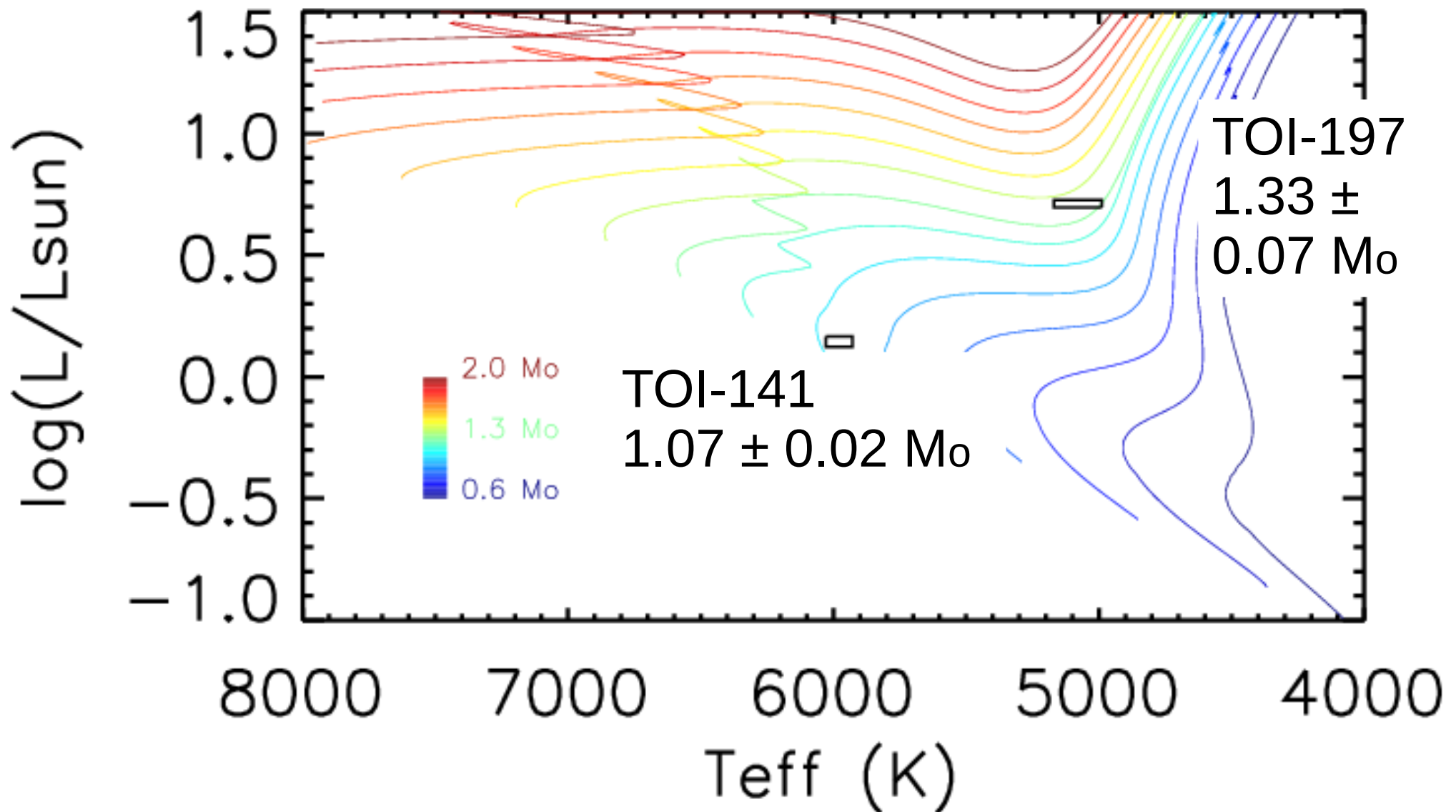
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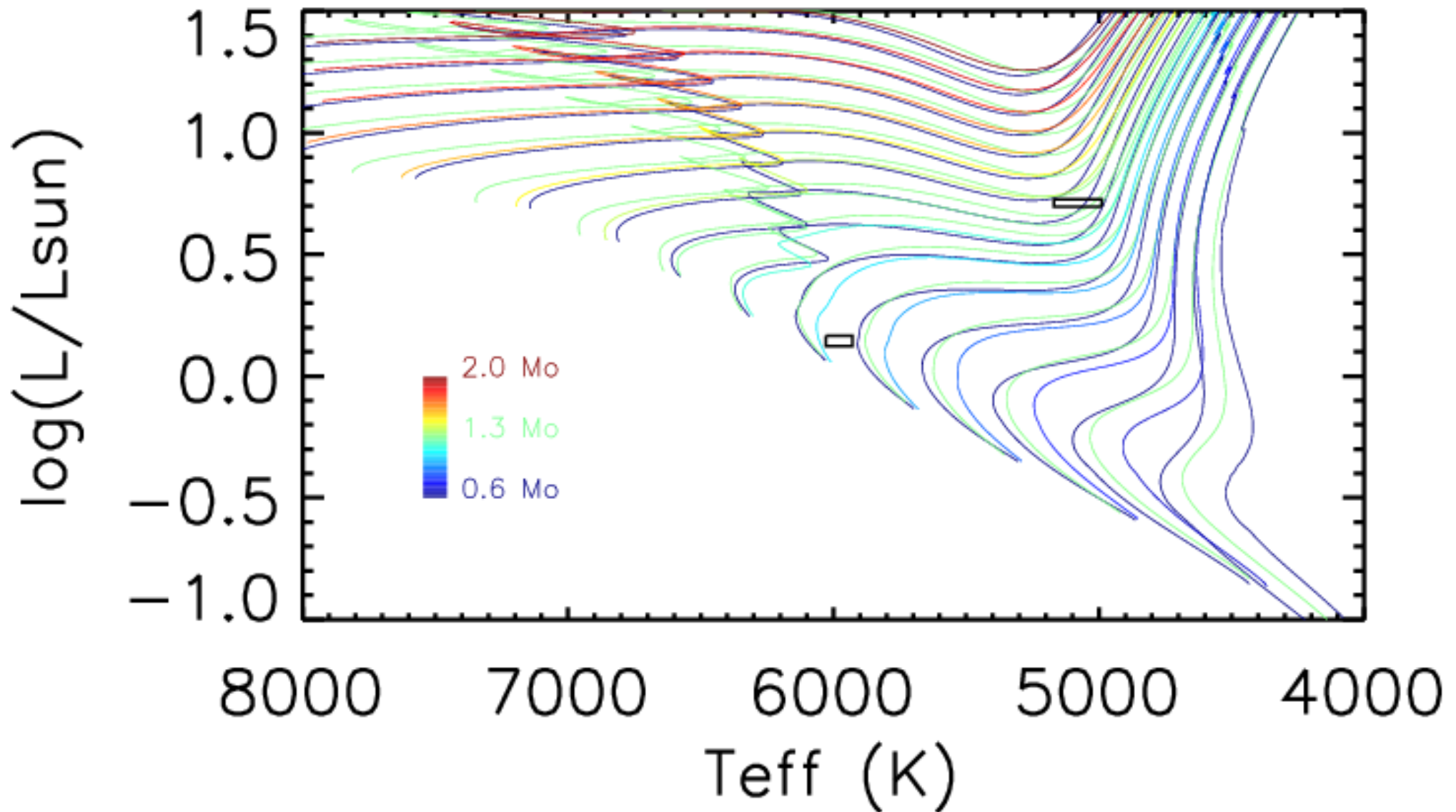
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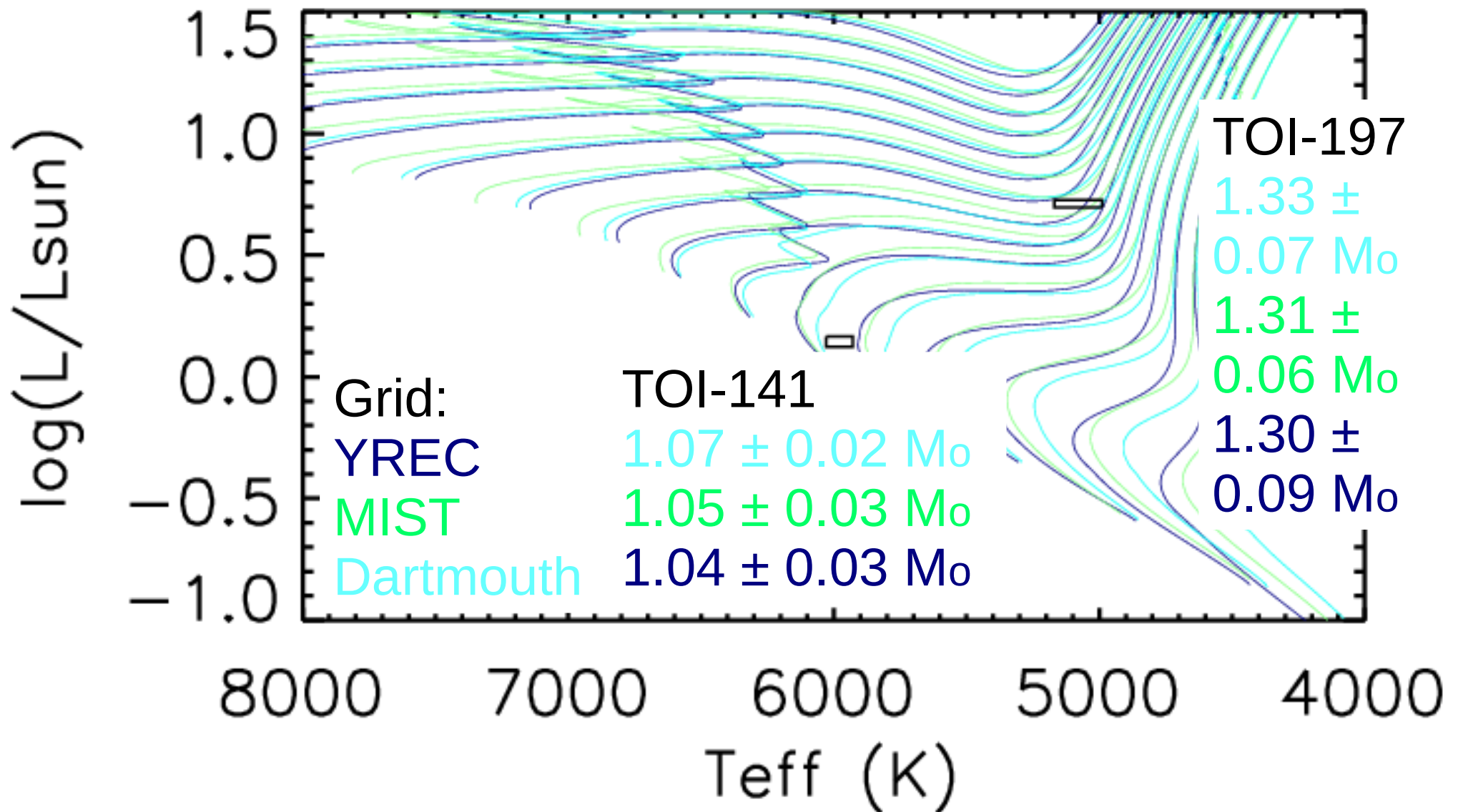
Impact of Model Choice: Dartmouth



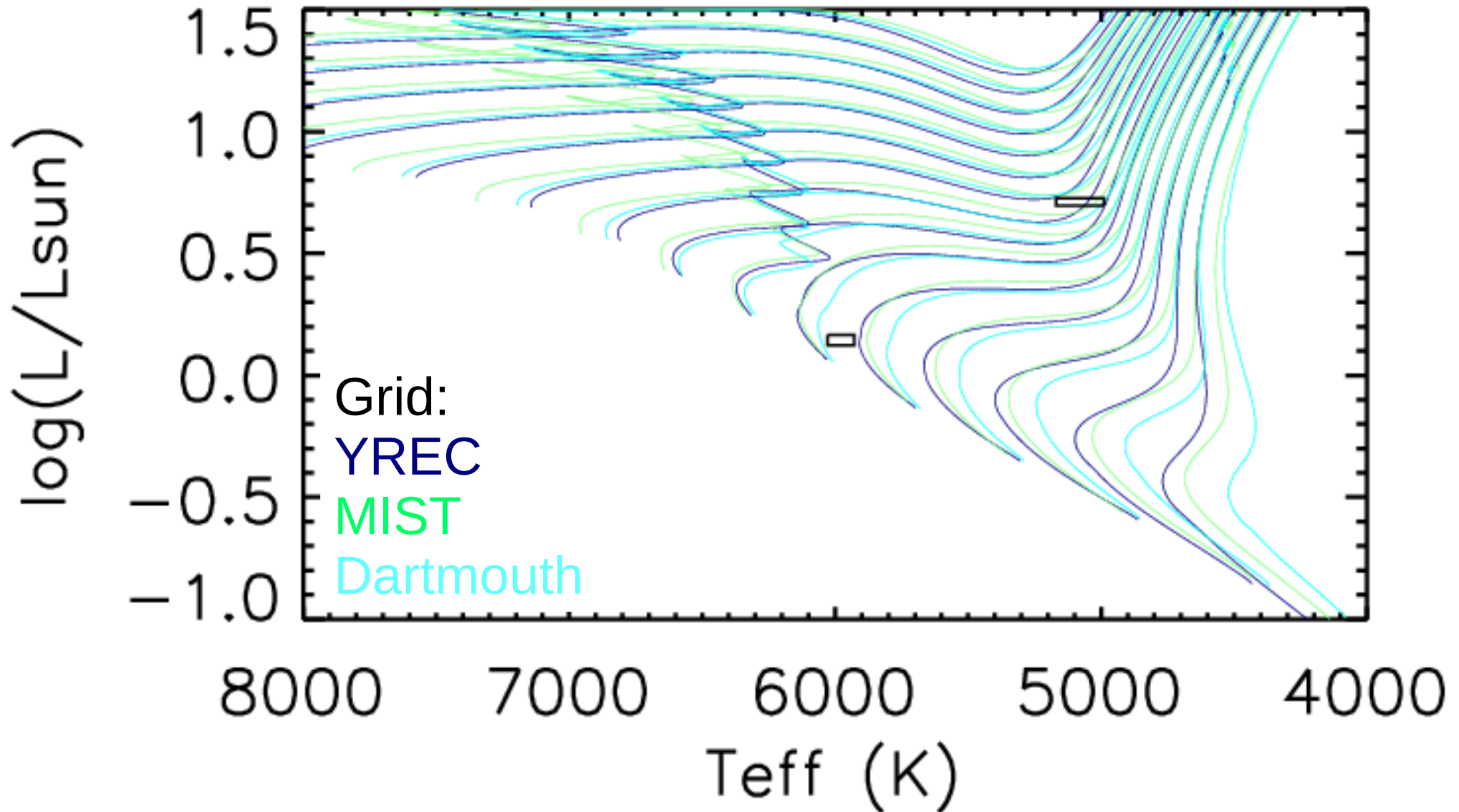
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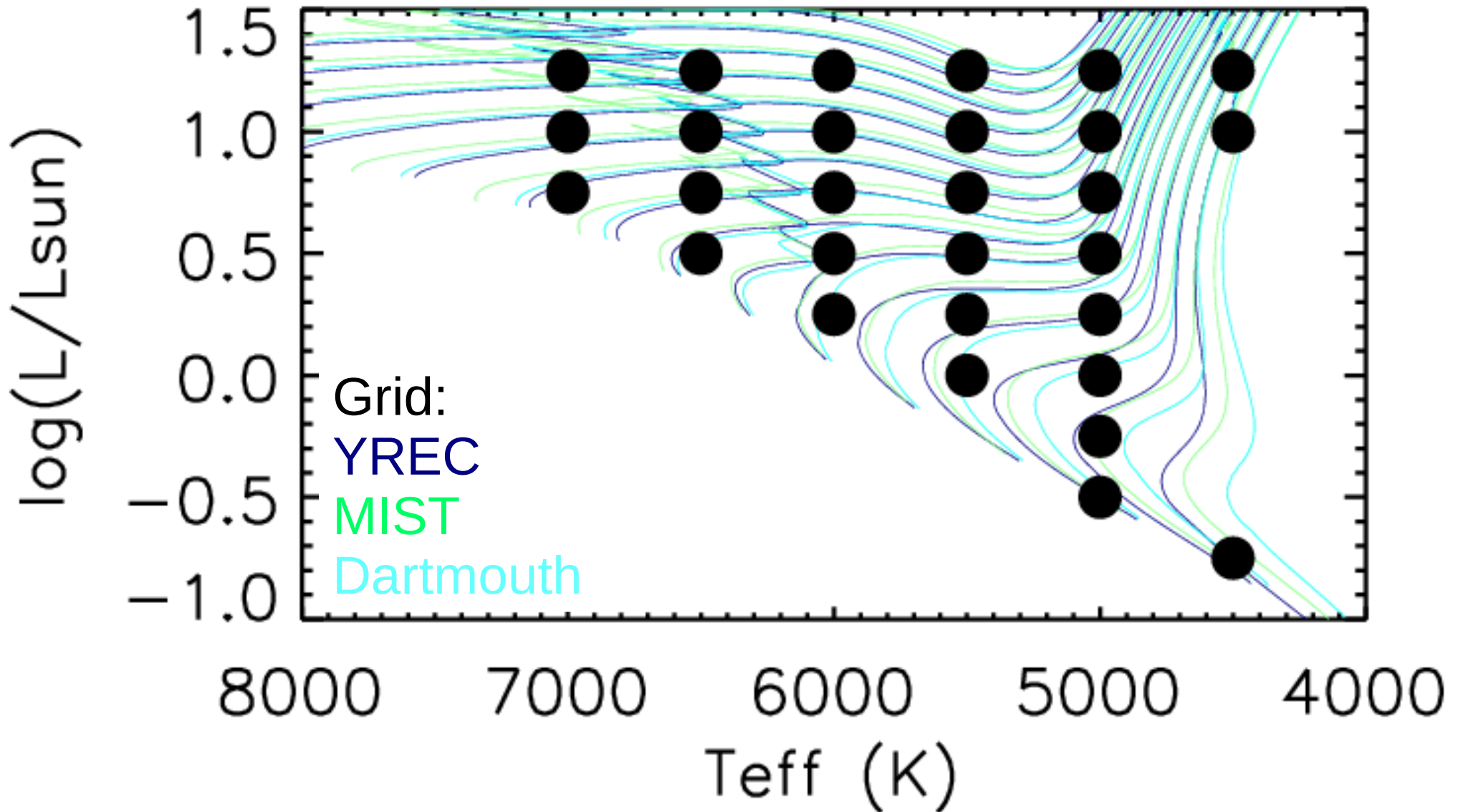
Impact of Model Choice: Dartmouth



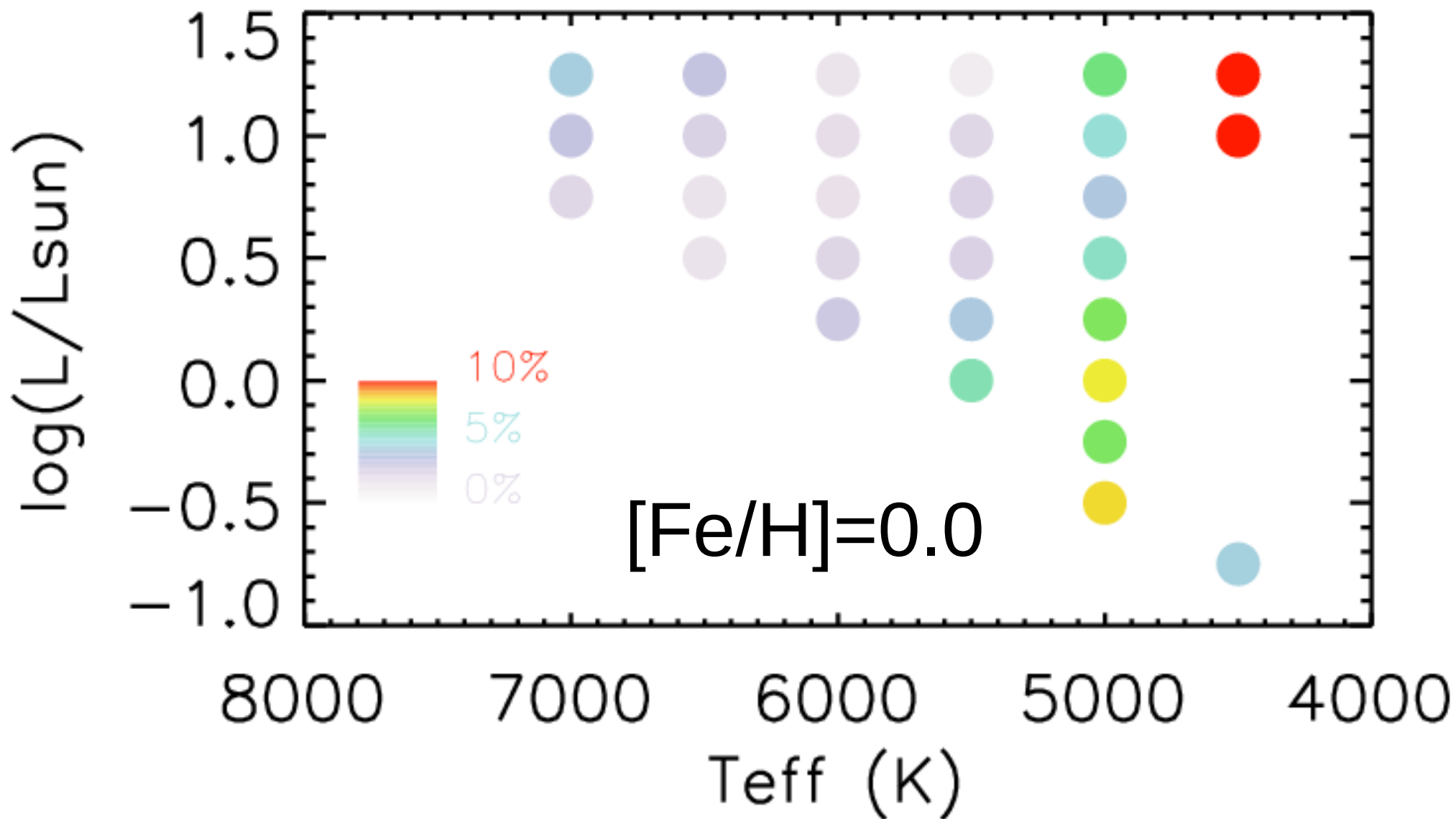
L and Teff Dependence



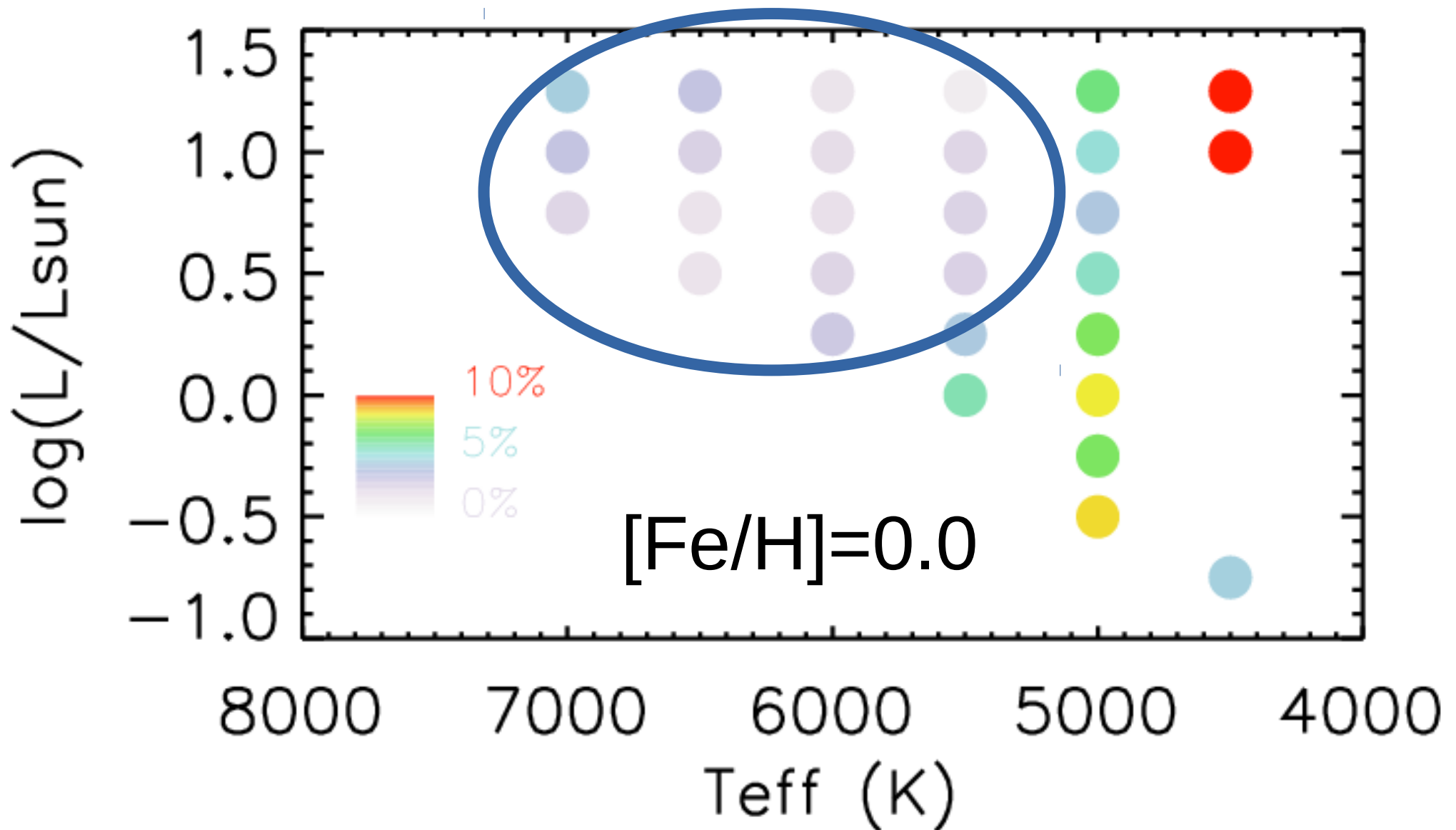
Mass Uncertainty From Models



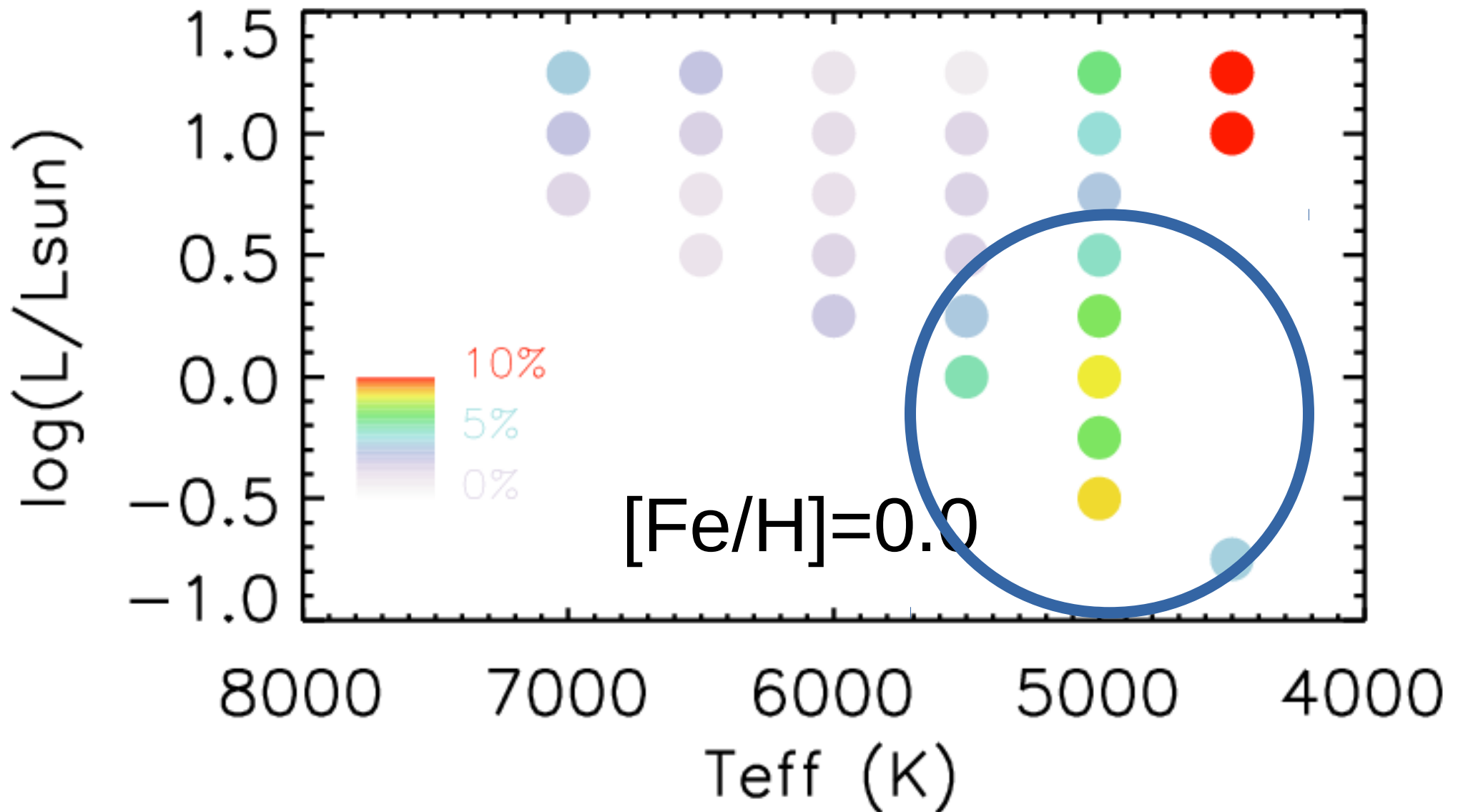
Mass Uncertainty From Models



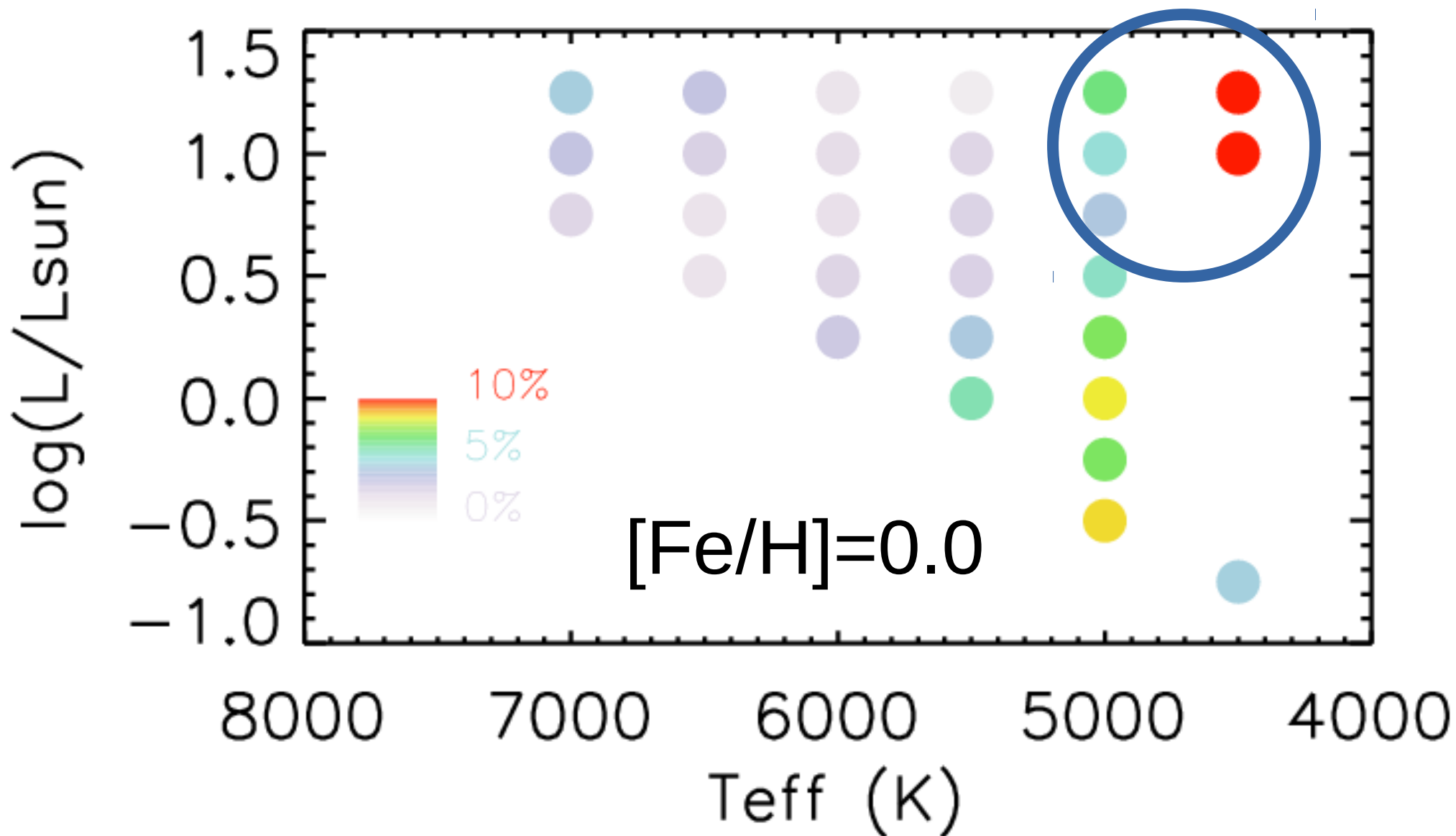
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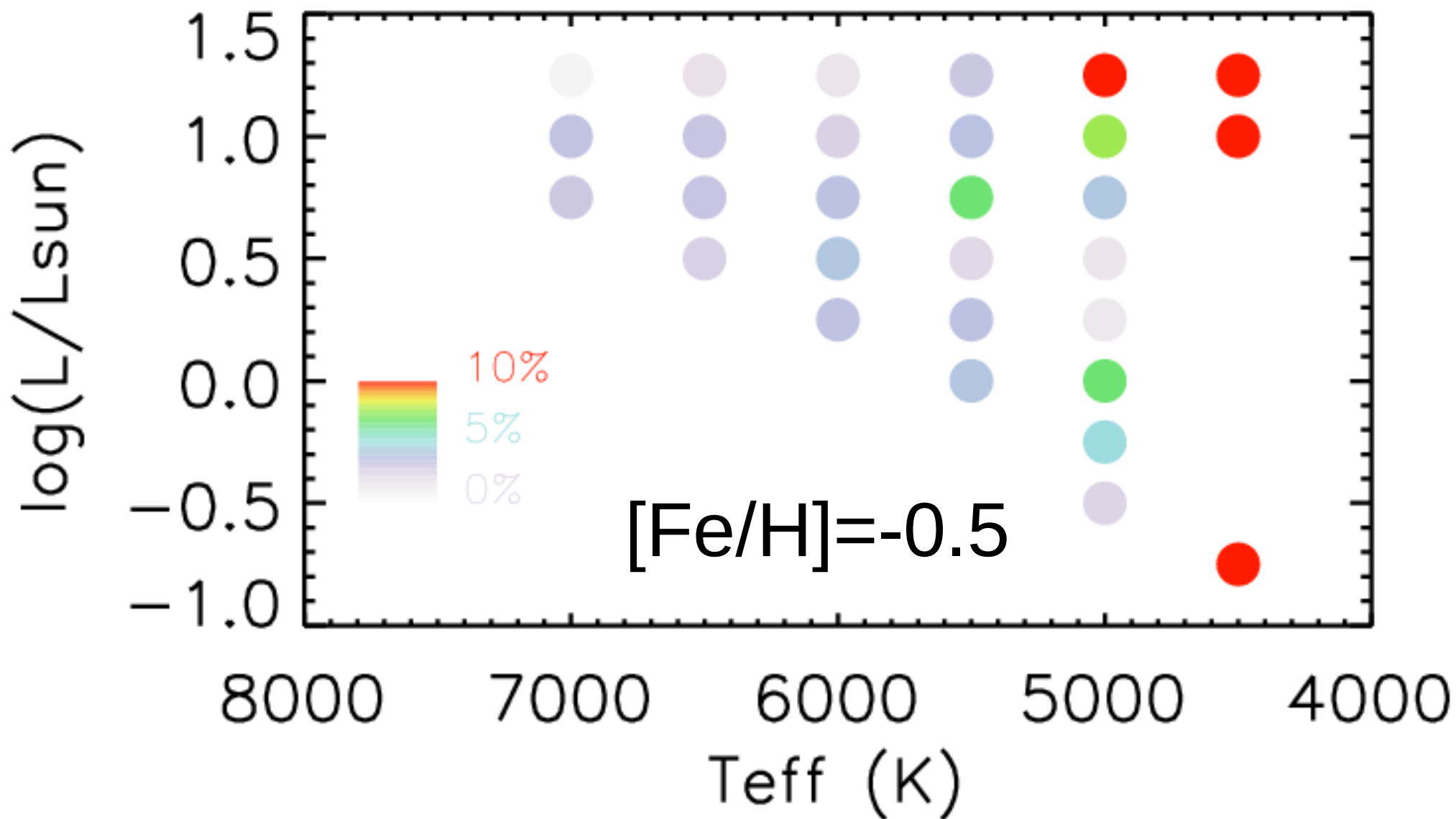
Mass Uncertainty From Models



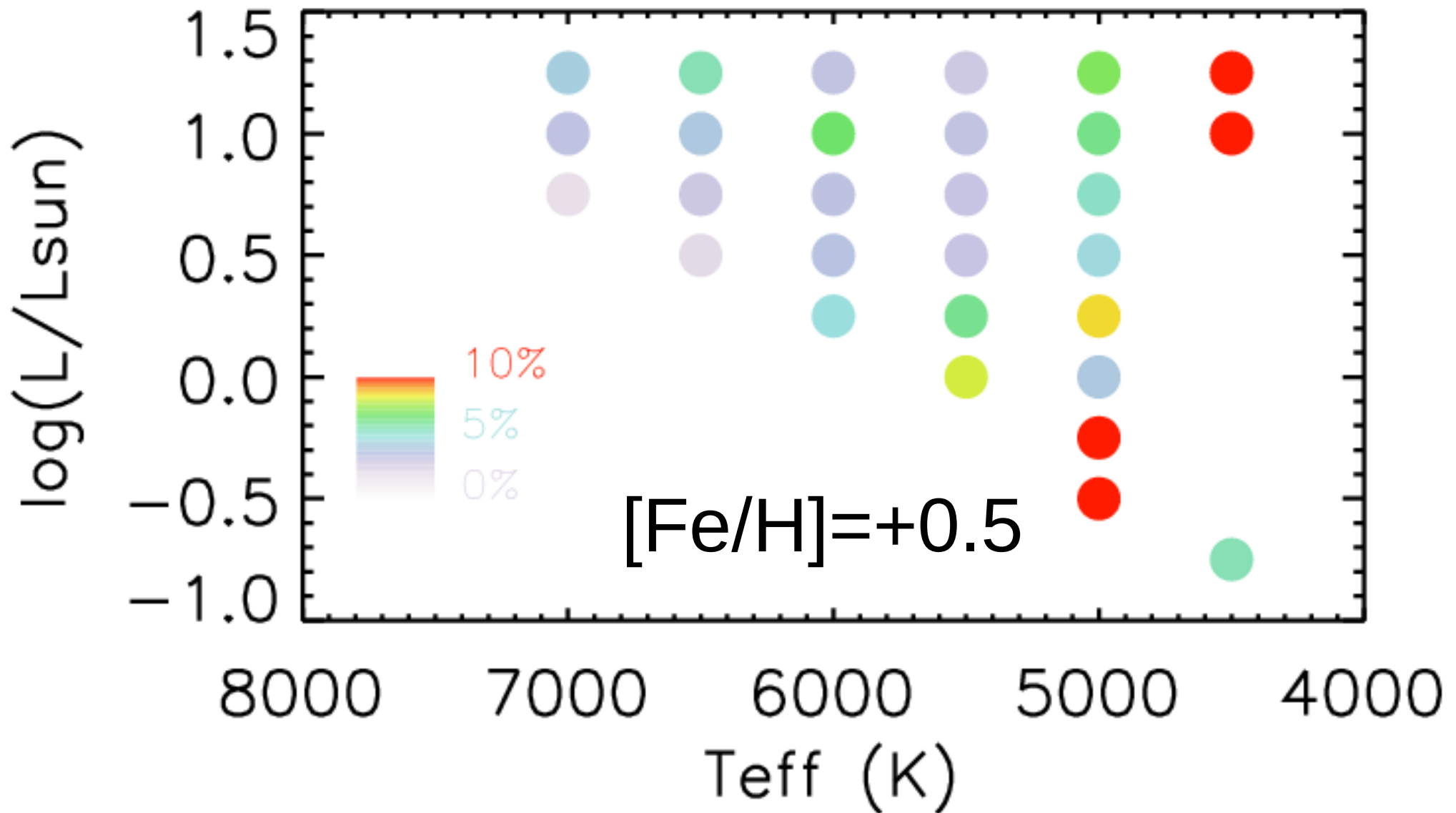
Mass Uncertainty From Models



Metallicity Dependence



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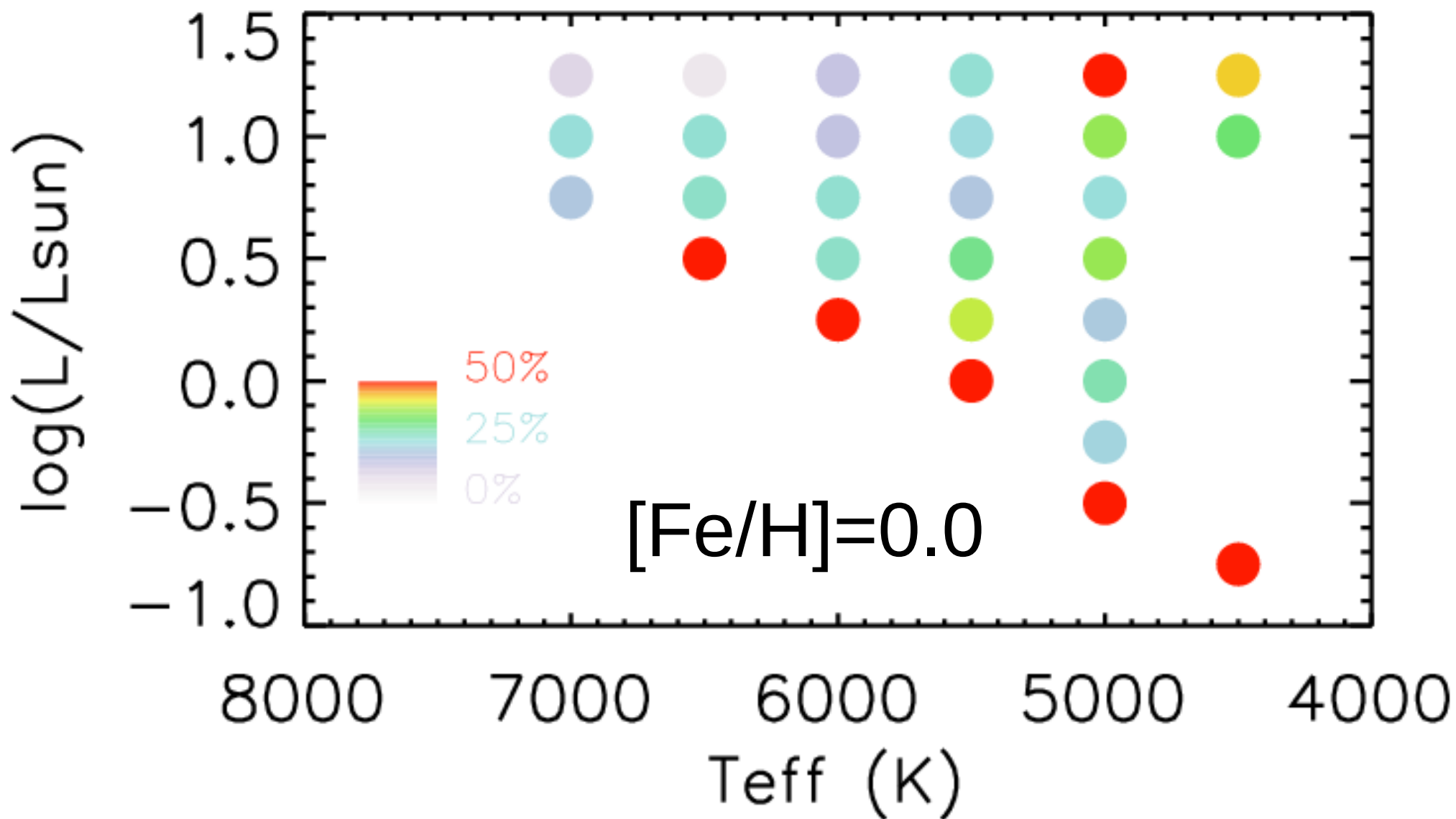
Summary

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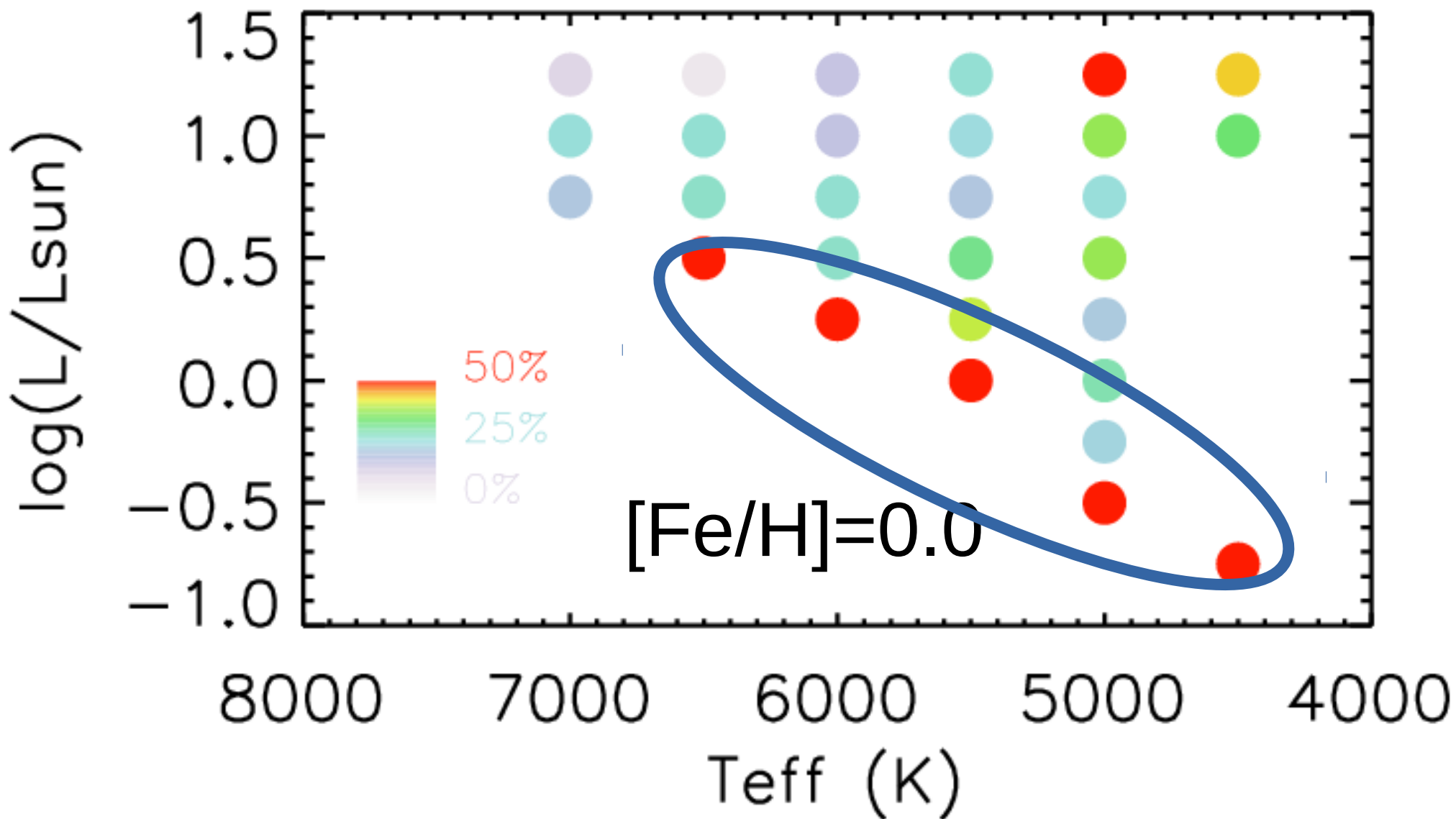
Why so uncertain?

- Many poorly constrained model physics choices
 - Convection
 - Helium
 - Overshoot
 - Diffusion
 - Atmosphere boundary condition
 - Opacities
 - etc.

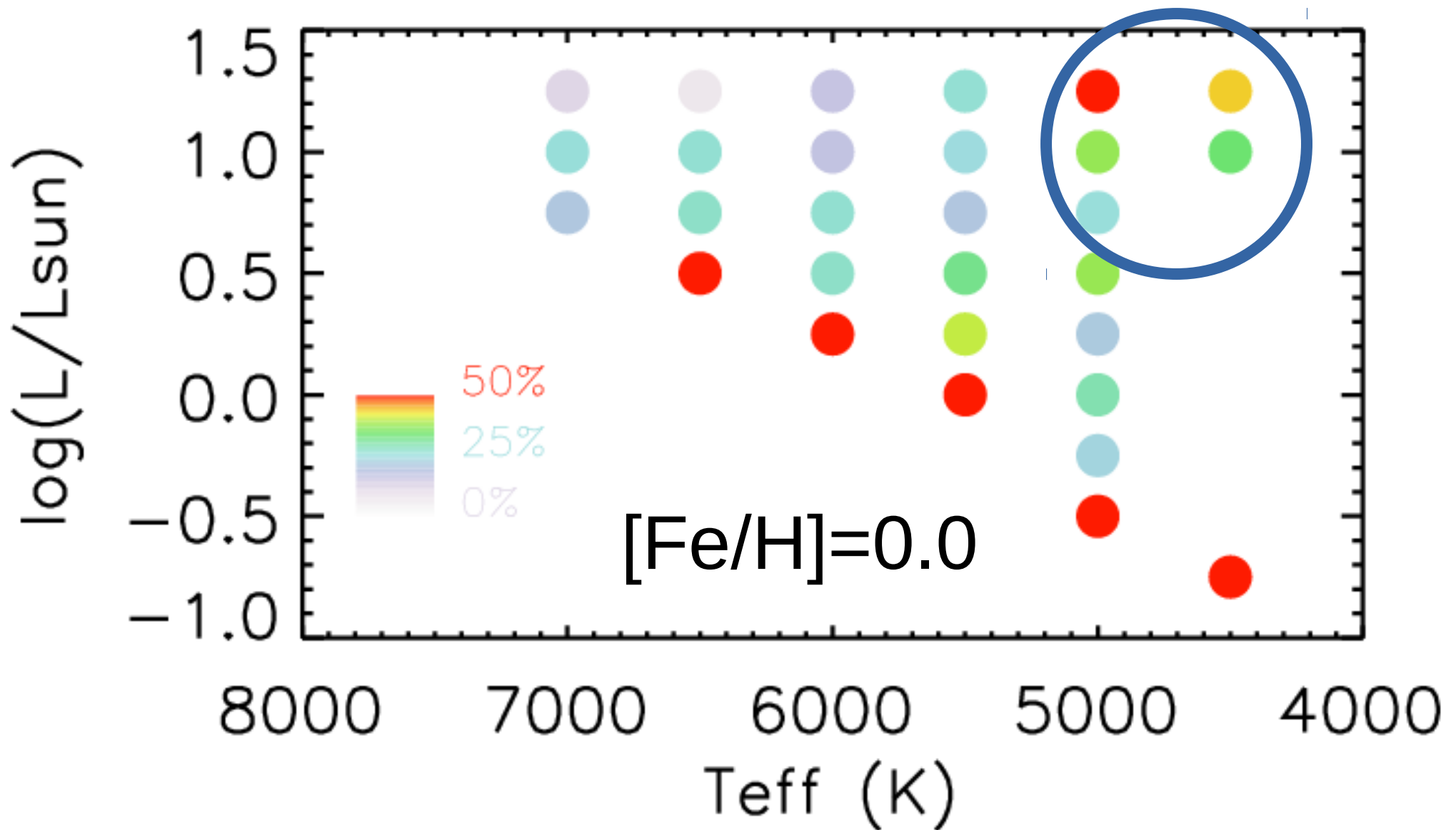
Age Uncertainties



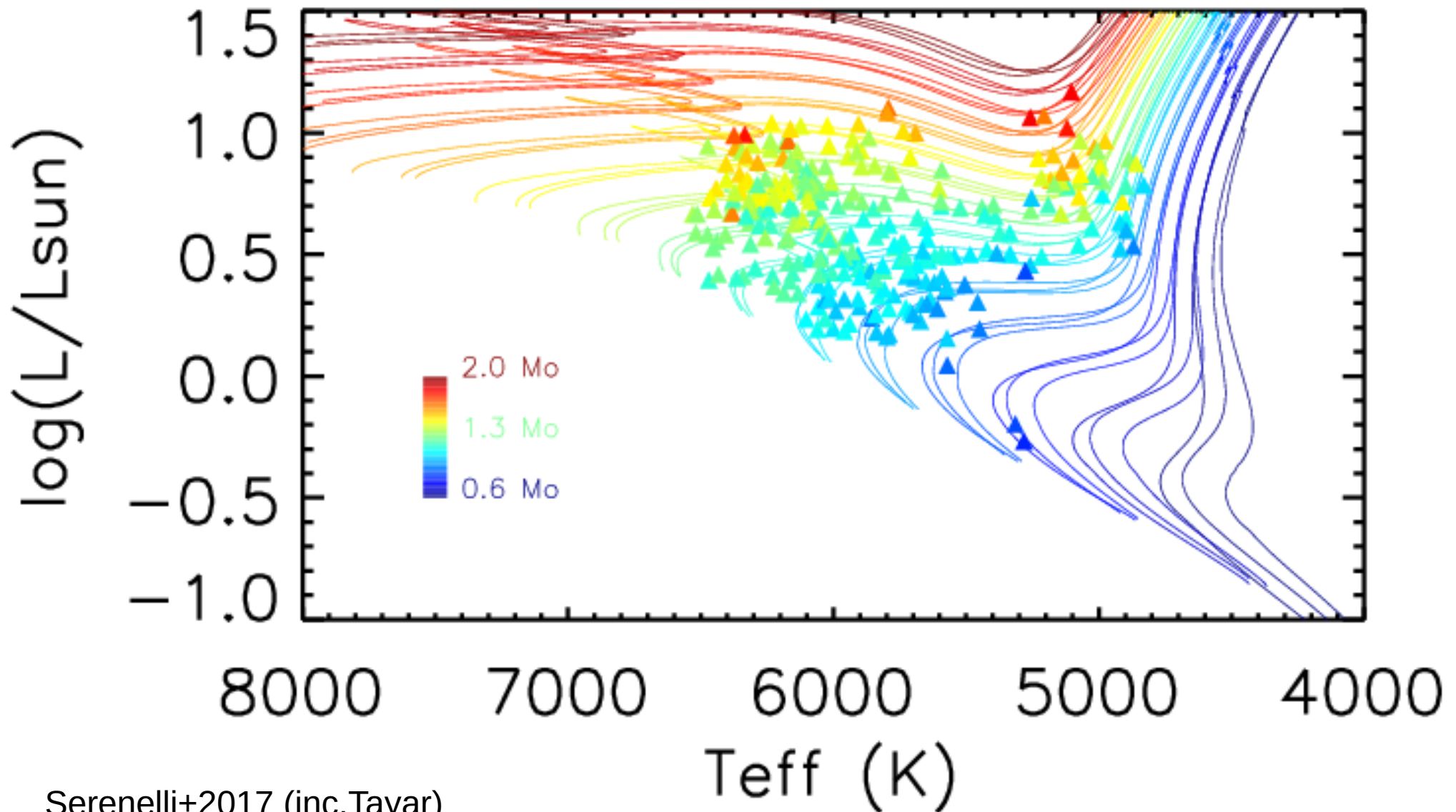
Age Uncertainties



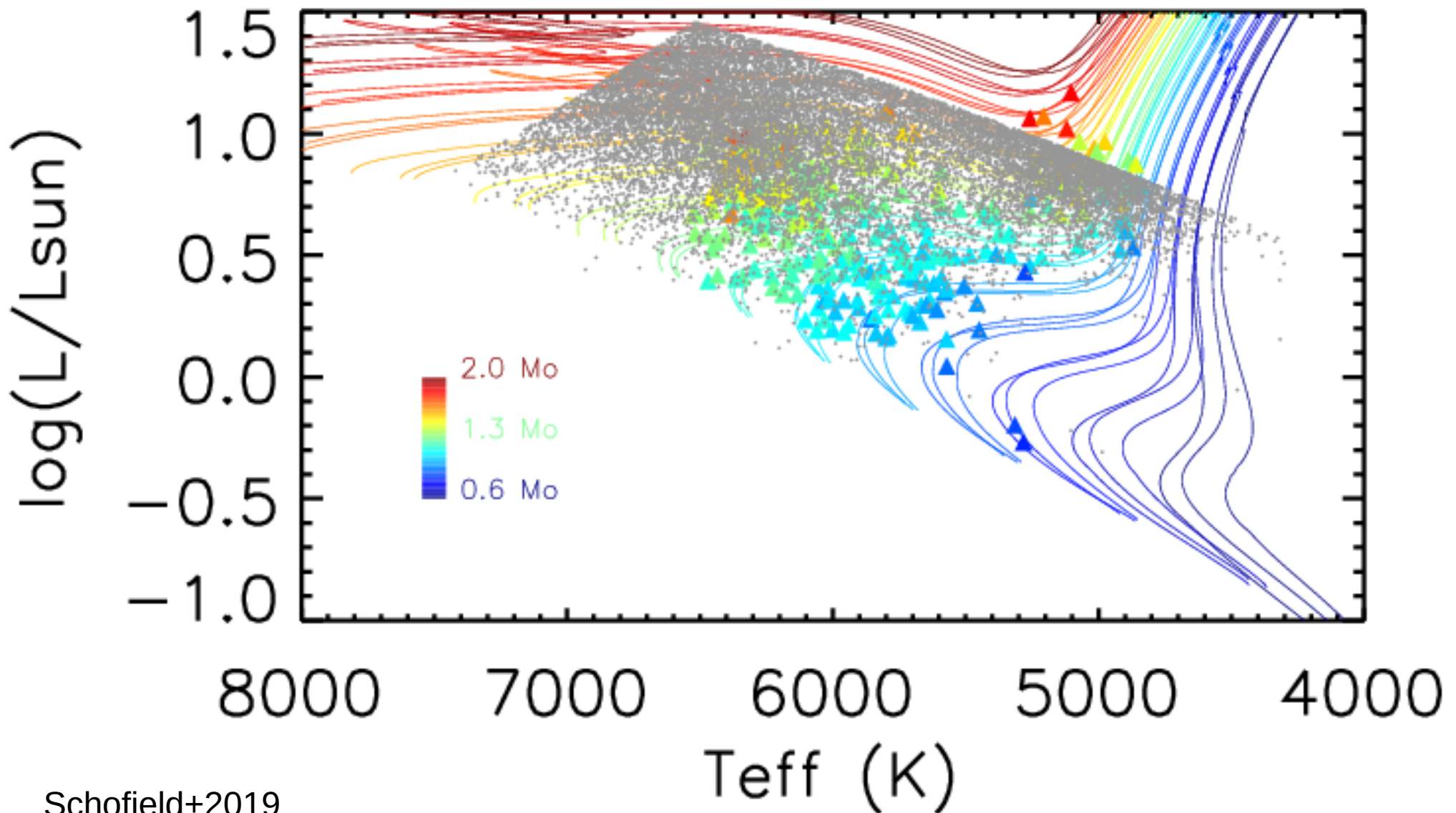
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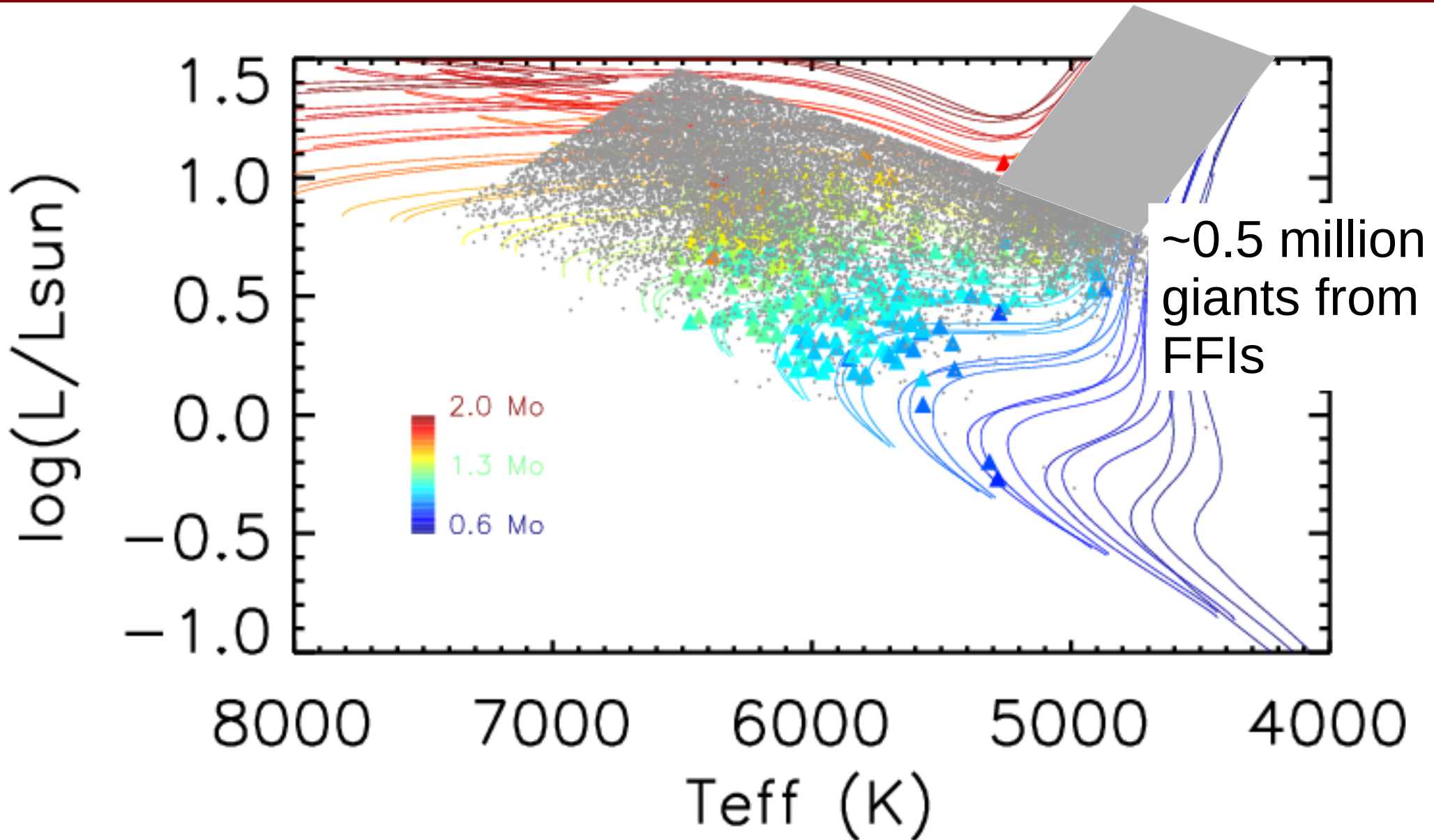
Available Seismic Data



Future Seismic Data: TESS



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Summary

- There is a $\sim 5\%$ uncertainty in stellar mass from choice of models
- Exact uncertainty depends slightly on T_{eff} , Luminosity, and $[\text{Fe}/\text{H}]$
- Even larger impact on ages
- Good idea to either add error term or compare different model grids
- Be cautious comparing heterogeneously derived masses
- In the future, we can use Kepler and especially TESS data to better calibrate the models