On the Potential of Generalized EUV Spectrum Grids

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Stars and Planets in the Ultraviolet 2021



The Problem:

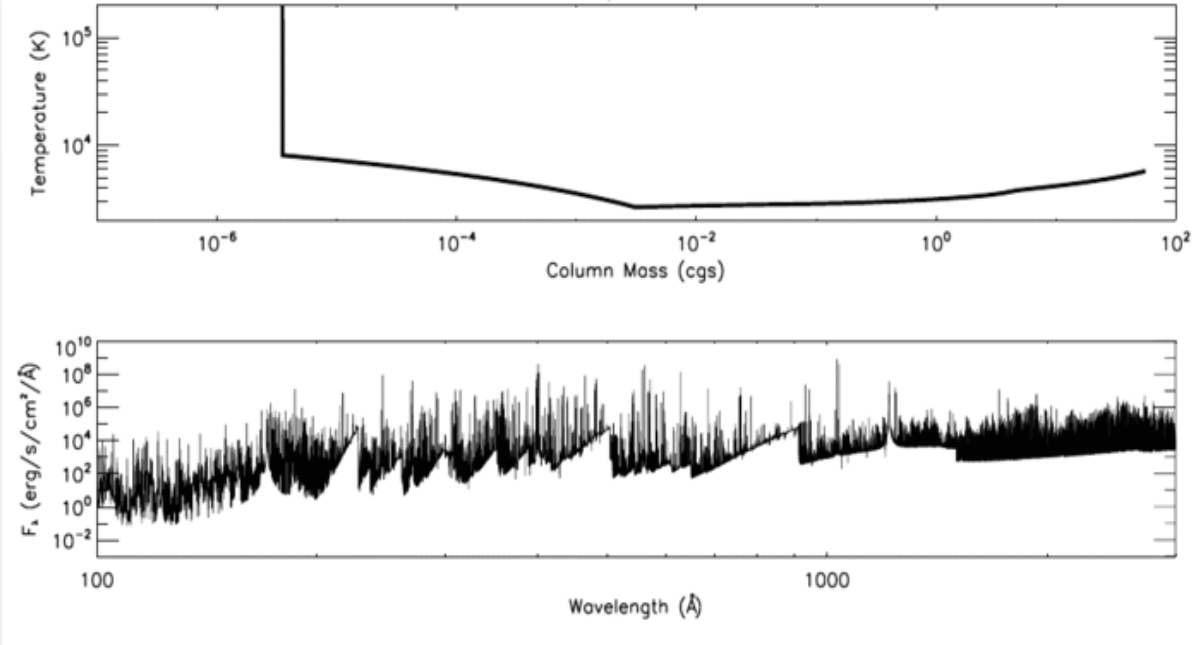
Stellar EUV flux contributes to atmospheric escape and water loss

The EUV spectrum is currently unobservable

Computing synthetic EUV spectra for 4,000+ planet host stars is computationally expensive

The Solution?

Build a generalized grid of EUV spectra that can be searched using GALEX photometric measurements of the desired star

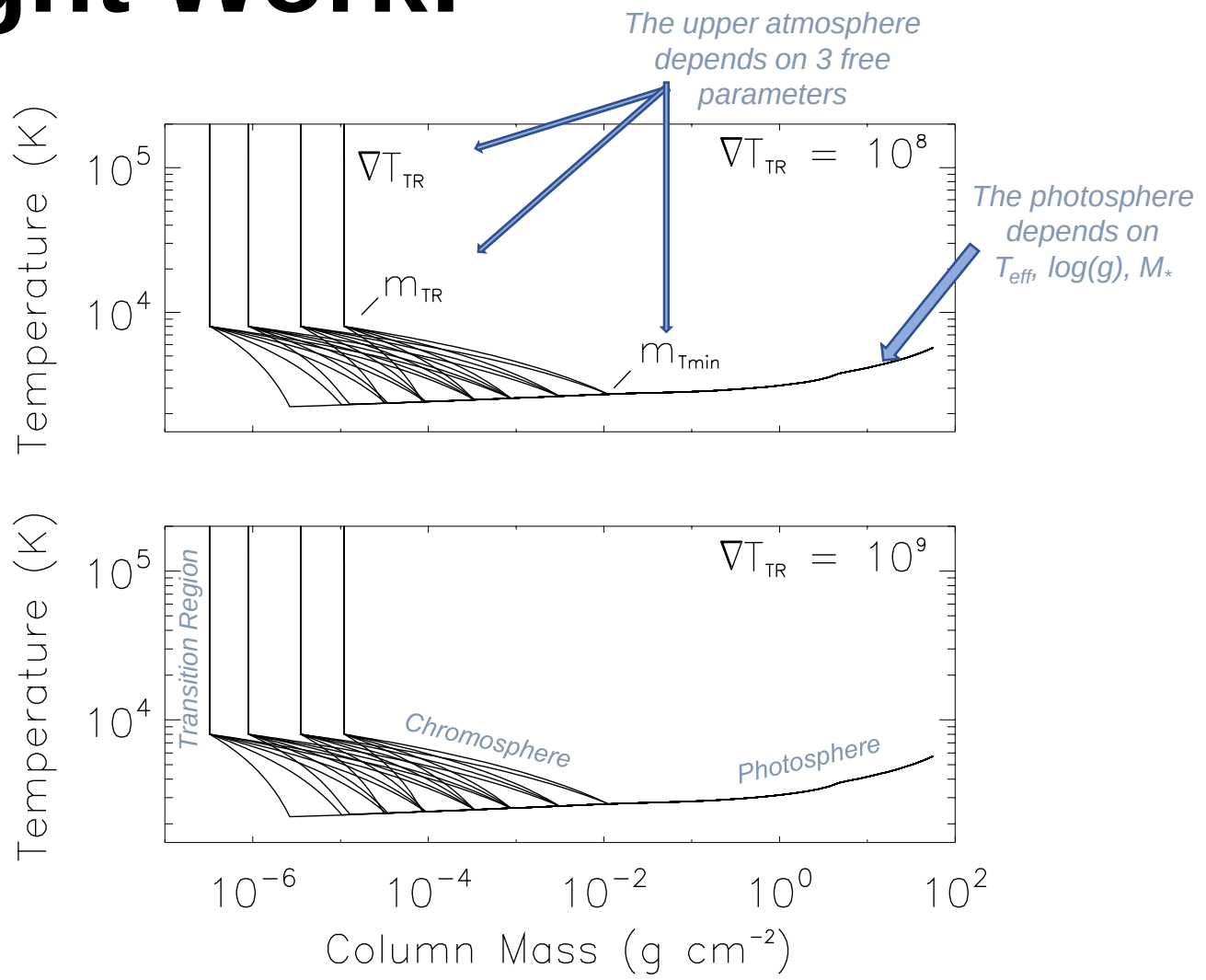


The Reason It Might Work:

EUV flux originates in the stellar upper atmosphere and has no photospheric flux contribution

These PHOENIX models consist of ad-hoc prescriptions for the transition region and chromosphere attached to an underlying photosphere

If we eliminate the photospheric component, grids of upper atmosphere models should be the same…*right*?

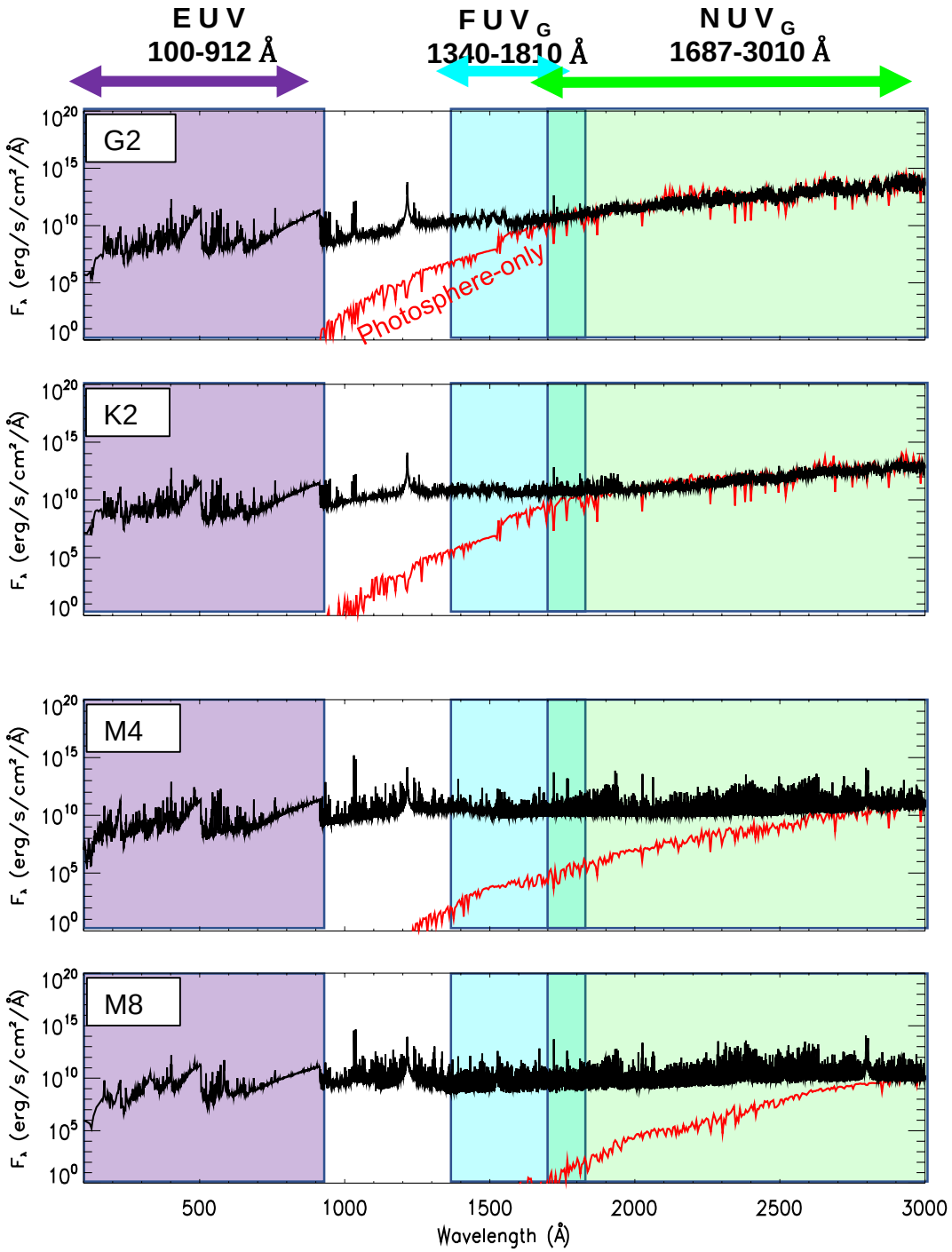


Photospheric Flux Contribution to the UV

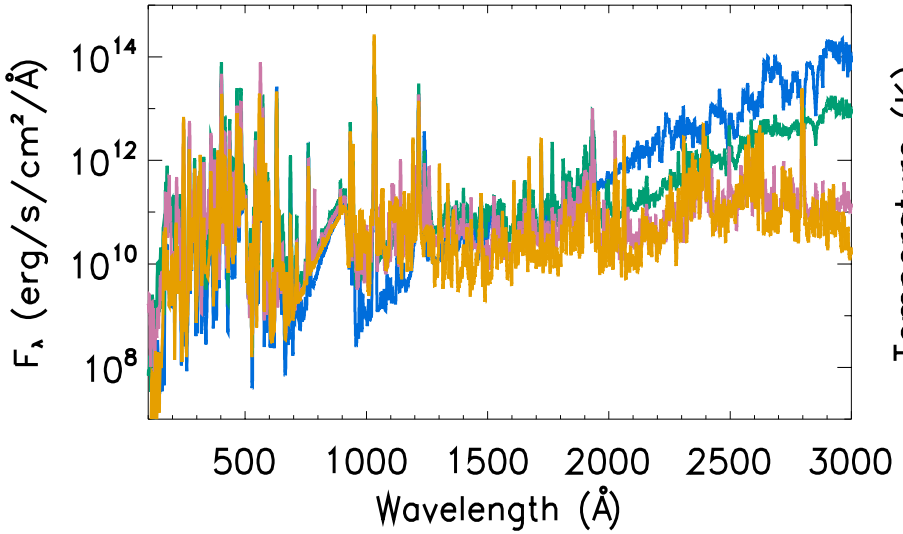
Hotter stars peak at shorter wavelengths, so as T_{eff} increases, the UV is increasingly made up of more photospheric flux

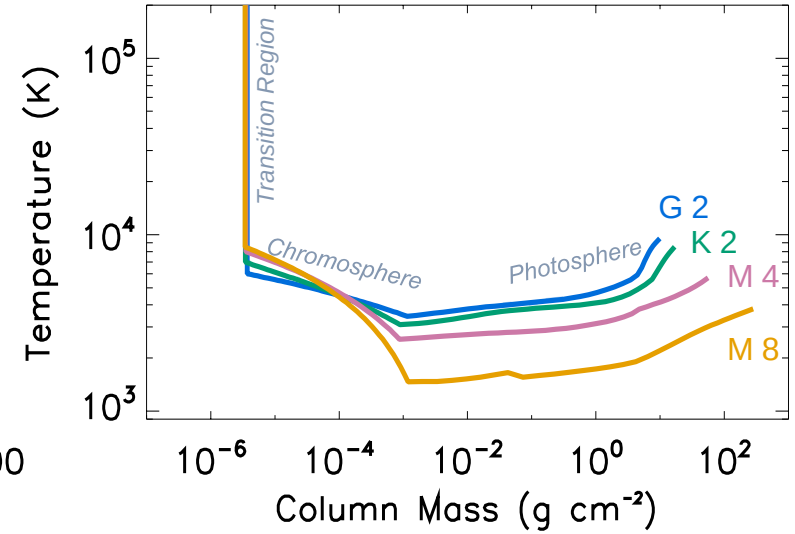
Plan: *remove any flux from the photosphere from both the models and GALEX fluxes used to identify the appropriate EUV spectrum*

	Photospheric Parameters:			Photospheric Contribution To:		
	T_{eff}	log(g)	M_*	EUV	FUV	NUV
G2	5700 K	4.3	1.0	0%	12%	100%
K2	5000 K	4.5	0.8	0%	4%	100%
M4	3600 K	4.8	0.4	0%	0%	1%
M8	2800 K	5.0	0.1	0%	0%	1%



G, K, and M models with the same prescribed upper atmosphere

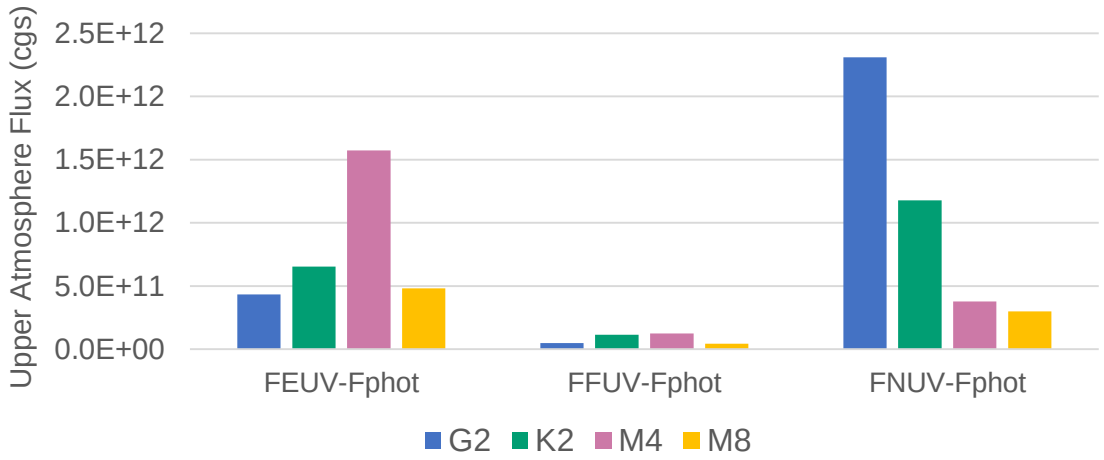




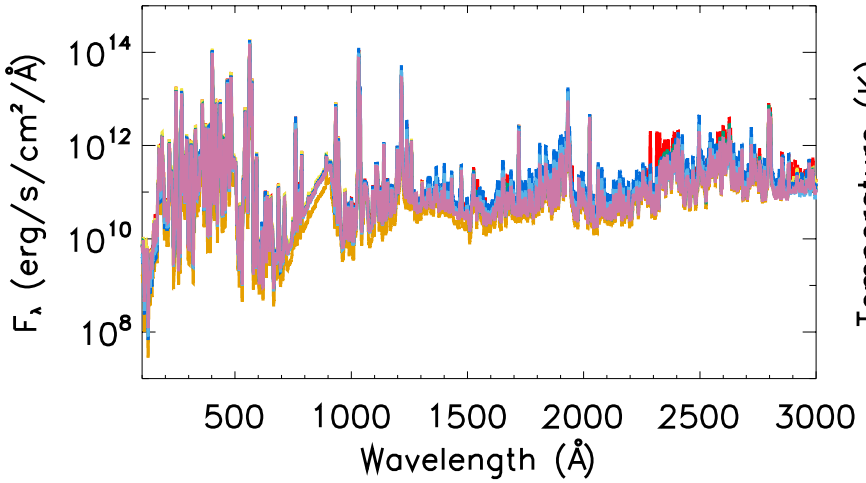
	T_{eff}	log(g)	M_*
G2	5700 K	4.3	1.0
K2	5000 K	4.5	0.8
M4	3600 K	4.8	0.4
M8	2800 K	5.0	0.1

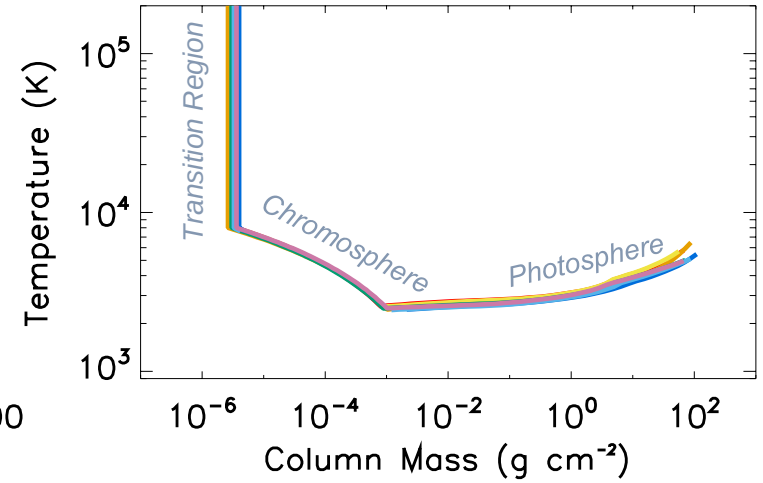
Dividing out the photospheric contribution, the models do not yield consistent EUV, FUV, or NUV predictions

This is due to the **difference in the slope of the chromosphere + different minimum temperatures in the transition region**



Early M stars with the same prescribed upper atmosphere

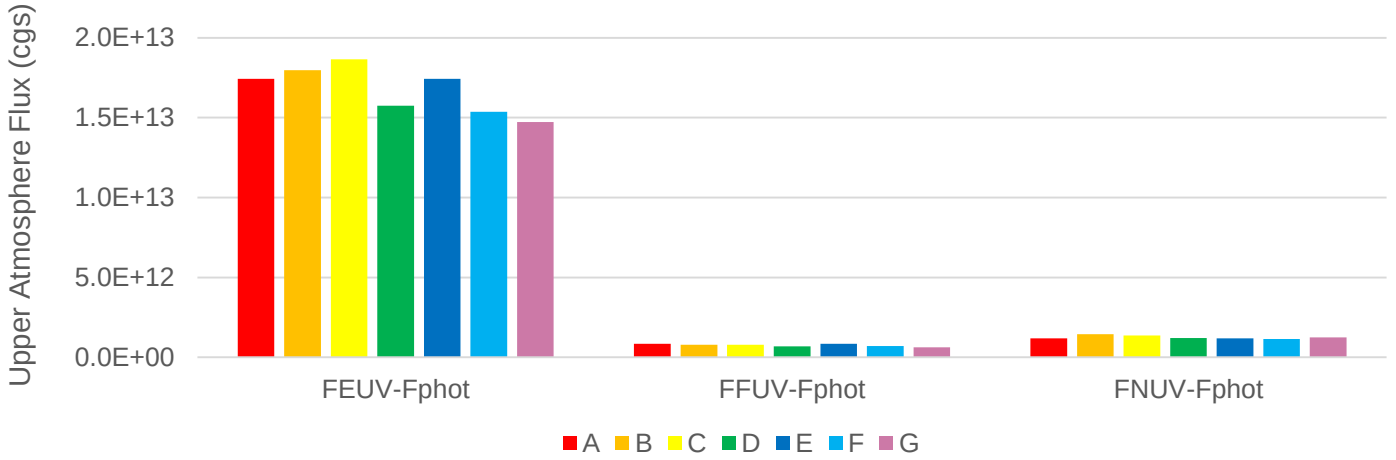




	T_{eff}	log(g)	M_*
A	3550 K	4.2	0.35
B	3600 K	4.6	0.35
C	3600 K	4.8	0.35
D	3400 K	4.2	0.45
E	3400 K	4.6	0.45
F	3450 K	4.8	0.45
G	3450 K	5.0	0.45

Dividing out the photospheric contribution, the models yield consistent EUV predictions within 15%

This is due to the upper atmospheres being nearly identical



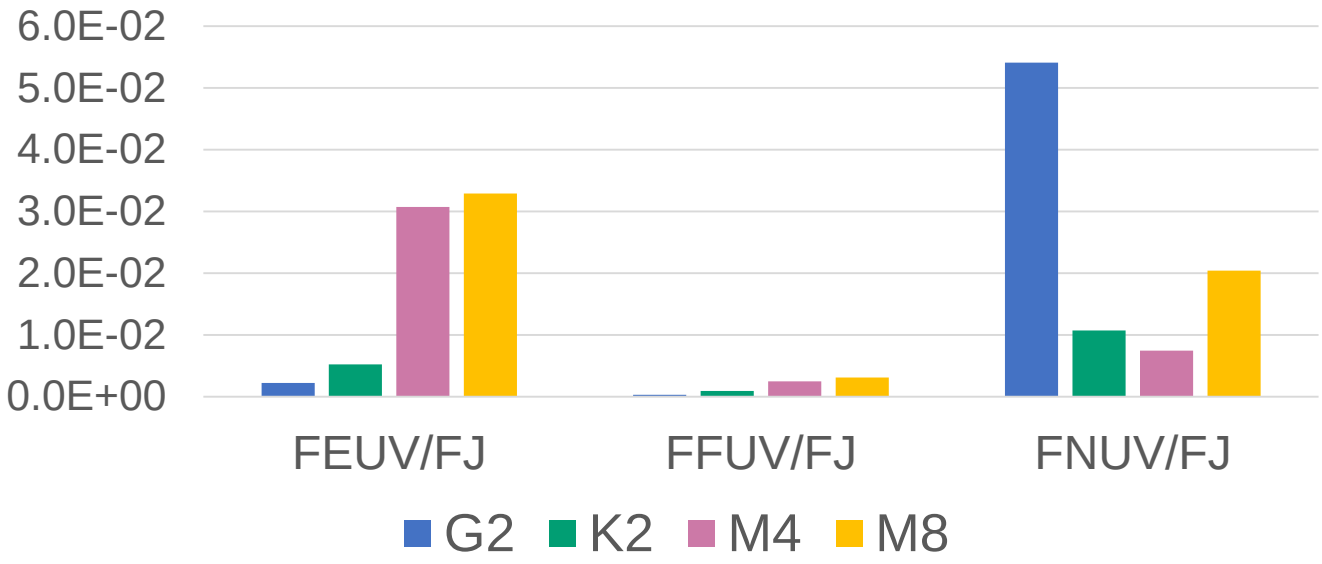
Summary

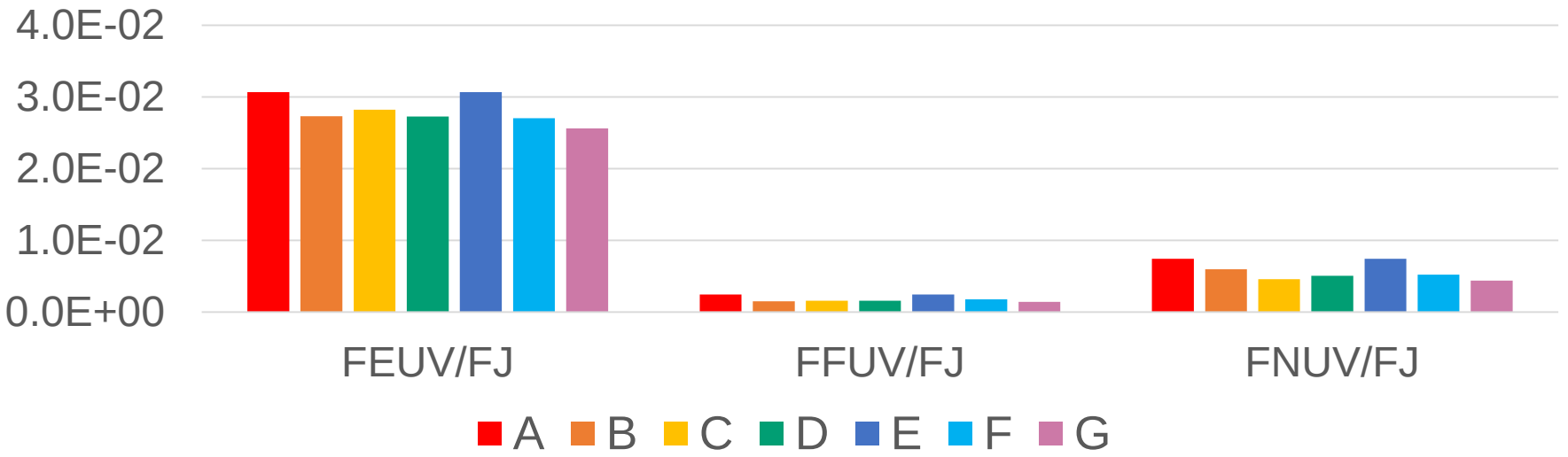
Would a stand-alone grid of UV spectra yield the same predicted EUV flux as individualized models if the photospheric flux contribution is removed from both the model and GALEX fluxes of the wanted star?

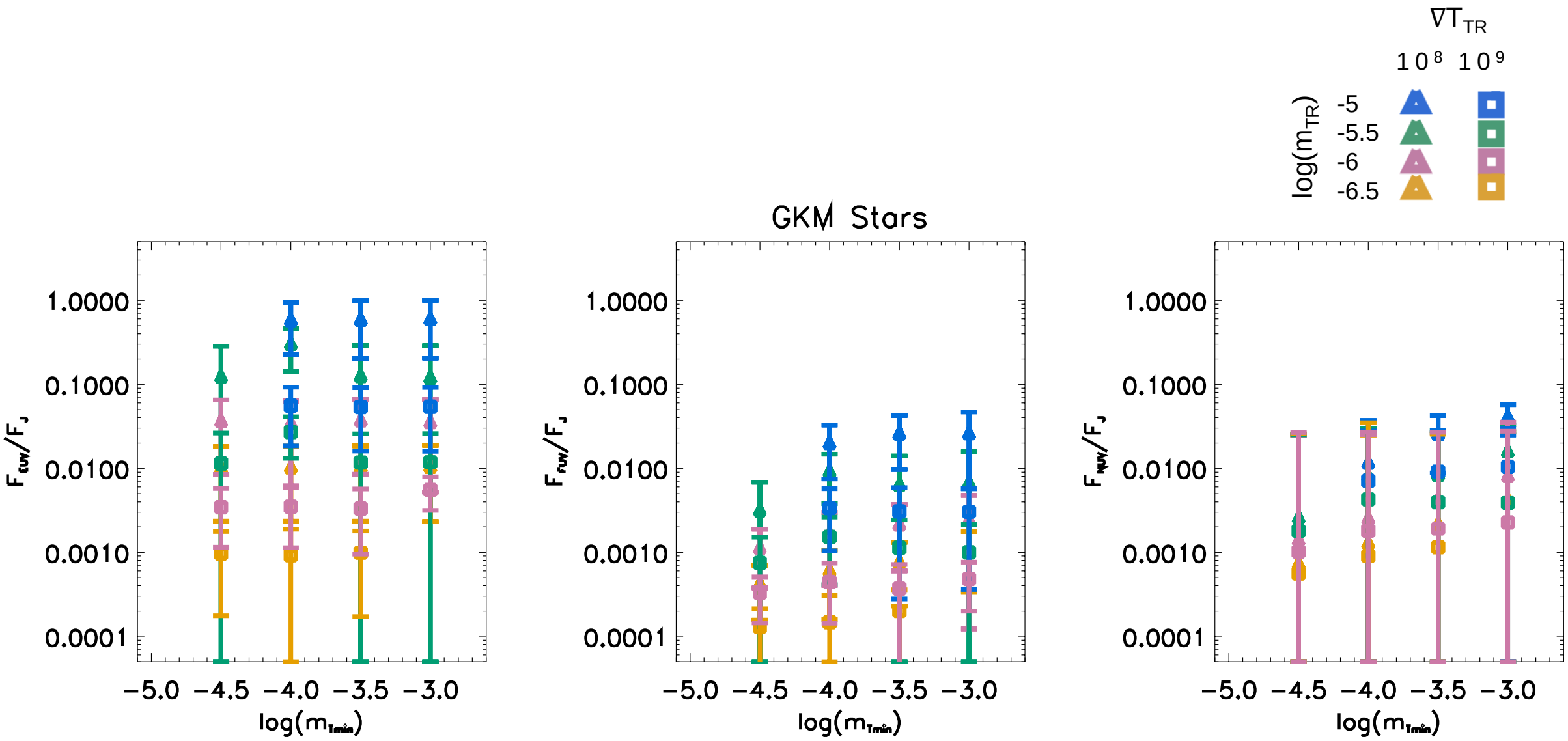
- A single universal grid of EUV spectra for GKM stars will **NOT** work because:
  - The underlying photospheres are too different
  - The transition regions begin at different temperatures (due to when neutral hydrogen is fully depleted)
- **Generalized grids for spectral subtypes would work!**

Backup Slides

Dividing out 2MASS J band flux






GKM Stars
∇T_TR
10^8 10^9
log(m_TR)
-5
-5.5
-6
-6.5
F_FUV/F_J
F_NUV/F_J
1.0000
0.1000
0.0100
0.0010
0.0001
−5.0 −4.5 −4.0 −3.5 −3.0
log(m_Tmin)