Making SEDs starting with WISE magnitudes using Excel (without the Spitzer Converter)

Unlike color-color diagrams and color-magnitude diagrams which use magnitudes or differences in magnitudes, SEDs use fluxes. The explanation of this can be found on the units page of the wiki and scrolling down to the Spectral Energy Distributions (SEDs) section. It is strongly recommended that you read through this section. However, a cookbook explanation is given below to speed things up a little.

The magnitude formula is $M = 2.5\text{xlog}\ (F_{Vega}/F)$ where M = magnitude & F=Flux

We need to solve this equation for F so first we will divide by 2.5

$M/2.5 = \log\ (F_{Vega}/F)$

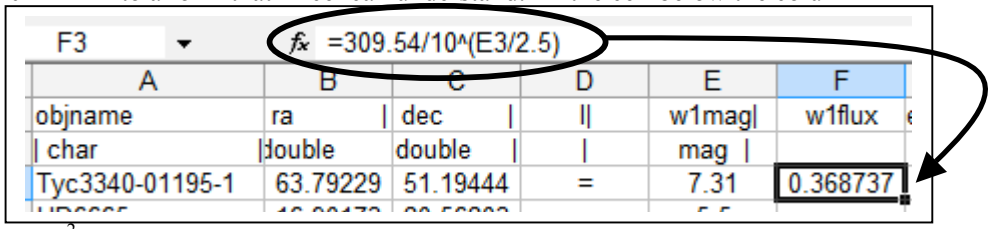
This is a log base 10 equation so raising 10 to the power of each side will remove the log

$10^{(M/2.5)} = F_{Vega}/F$ solving for F gives us $F = F_{Vega}/10^{(M/2.5)}$

Now we can enter this formula for flux into the Excel spreadsheet as long as we know the value of F_{Vega} which varies depending on the wavelength we are working with. Values of F_{Vega} can be found on the Central Wavelengths and Zero Points page on the Wiki. Values for 2MASS and WISE are listed below.

1) In your spreadsheet next to the magnitude column you are working with insert a new column. For a column header type Flux(band) for this example we will use WISE1. Now we are going to enter the equation $F = F_{Vega}/10^{(M/2.5)}$ into a form that Excel can understand. In the cell below the column header enter the formula

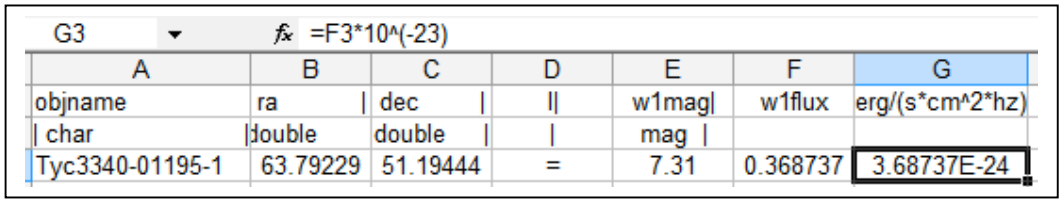
=309.54/(10^(CELL/2.5)) See example →



	A	B	C	D	E	F
	objname	ra	dec		w1mag	w1flux
	char	double	double		mag	
	Tyc3340-01195-1	63.79229	51.19444	=	7.31	0.368737

2) Now we need to convert the flux in Janskys to cgs units (1 Jy = 10^{-23} erg/(s*cm^2*Hz). Insert another column next to the flux column and below the header enter the formula

=(CELL)*10^(-23)



	A	B	C	D	E	F	G
	objname	ra	dec		w1mag	w1flux	erg/(s*cm^2*hz)
	char	double	double		mag		
	Tyc3340-01195-1	63.79229	51.19444	=	7.31	0.368737	3.68737E-24

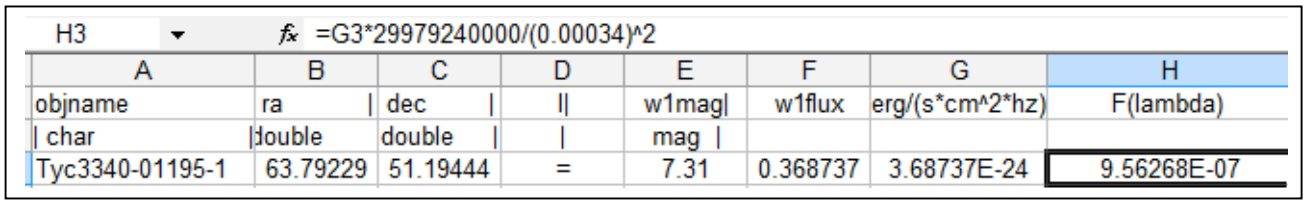
3) We now need to convert fluxes based on frequency (Hz) to units of F_λ or F_{Lambda} where λ = lambda = wavelength. Remember that the speed of light = frequency * wavelength, c = ν*λ. c = 2.997924*10^{10} cm/sec

F_{Lambda} $F_\lambda = F_\nu * (c/\lambda^2)$

entered in Excel in another inserted column

= (CELL)* 2.997924E10/((3.4E-4)^2)

note: 3.4 um from central wavelengths table converted to cm.



	A	B	C	D	E	F	G	H
	objname	ra	dec		w1mag	w1flux	erg/(s*cm^2*hz)	F(lambda)
	char	double	double		mag			
	Tyc3340-01195-1	63.79229	51.19444	=	7.31	0.368737	3.68737E-24	9.56268E-07

Almost there!!!! To get energy densities for the SEDs we now need to multiply F_{Lambda} by lambda

4) New column with header lambda F(lambda) and enter the equation

=(CELL)*3.4e-4

I3 =H3*0.00034

A	B	C	D	E	F	G	H	I
objname	ra	dec		w1mag	w1flux	erg/(s*cm^2*hz)	F(lambda)	lambdaF(lambda)
char	double	double		mag				
Tyc3340-01195-1	63.79229	51.19444	=	7.31	0.368737	3.68737E-24	9.56268E-07	3.25131E-10

5) The SEDs will use a logarithmic scale so add one more column needs to be added that is equal to the log of lambdaF(lambda) so enter =log(cell)

Now we get to recreate these steps for each of the bands that we are using, **but remember, each band has its own Zero Point and Central Wavelength, so refer to the wiki page and make those adjustments for the other bands you are using.**

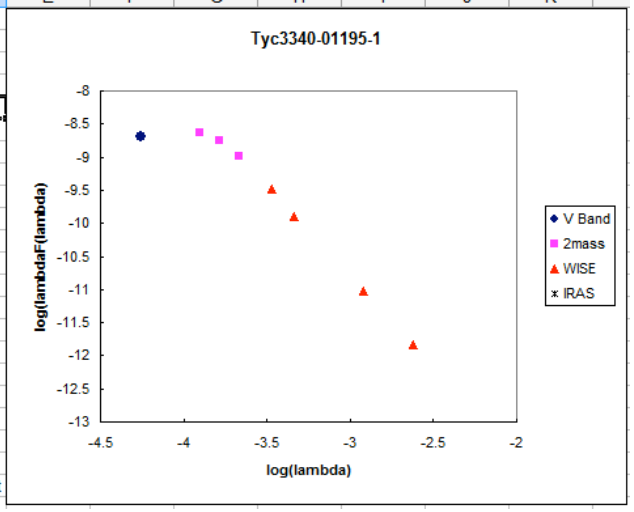
6) Once you have found lambdaF(lambda) for each band you are ready to start making your SEDs. Be very careful creating the first SED plot because once you have it completed, you will be copying the worksheet in a new tab and just changing the row number references for each cell. This will keep the formatting the same for each SED.

The SED is a plot of lambdaF(lambda) vs lambda on a logarithmic scale.

One example is to the right. Wavelengths are in microns (μm). Log(lamnda) in column C is just the log of the wavelength converted to cm (column B) and column D is the log(lambdaF(lambda)) found by taking the log of lambdaF(lambda) from the main data sheet of our spreadsheet.

D5 ='Making SEDs'!I22

	A	B	C	D
1	Tyc3340-01195-1			
2				
3	Band	Wavelength (um)	log(lambda)	log(lambdaF(lambda))
4				
5	v	0.55	-4.259637311	-8.695567827
6	J	1.25	-3.903089987	-8.633601077
7	H	1.65	-3.782516056	-8.750363369
8	K	2.17	-3.663540266	-8.99170866
9	w1	3.4	-3.468521083	-9.48794152
10	w2	4.6	-3.337242168	-9.894939333
11	w3	12	-2.920818754	-11.02963029
12	w4	24	-2.619788758	-11.843214
13	iras1	12	-2.920818754	#NUM!
14	iras2	25	-2.602059991	#NUM!
15	iras3	60	-2.22184875	#NUM!
16	iras4	100	-2	#NUM!
17				
18				
19			= LOG(B5*10^-4)	= 'Making SEDs'!I22
20				
21			log of lambda in cm	log of lambdaF(lambda)
22				referenced from data sheet



Central wavelengths and zero points from the Wiki page of the same name

Band	Wavelength (um)	Zero point (Jy)
V	0.55	3597.28
J	1.25	1594
H	1.65	1024
Ks	2.17	666.7
→ **W1**	**3.4**	**309.54** ←
W2	4.6	171.79
W3	12	31.676
W4	22	8.3635

If you want teach data set to have its own marker type and color first make a scatter plot of only one data set, such as 2MASS and then add additional data sets to the plot by right clicking in the plot area. Most of the rest is cosmetic adjustments like changing the scale maximum and minimum values and axis locations. This again can be done by right clicking on the plot area and selecting the various options you want to work with.