Creating Blackbody Radiation Curves for SDSS Stars

We are going to create blackbody diagrams for a group of stars that are listed at the end of this document. A telescope called SDSS has already taken images for us in several different filters and measured the magnitudes of light in those images. We are going to use the magnitudes to create blackbody diagrams and then calculate the temperature using Wien's Law. Use google sheets.

1. For the basics of spreadsheets, visit the GCF Google Sheets webpage. Lessons 8-11 go over the basics of setting up a spreadsheet and how to format it. These are good lessons if you haven't set up a spreadsheet before.

2. A cell is one box in a spreadsheet. A cell has an address that is composed of the column and row where that cell is situated. Columns are usually identified by a letter (A, B, … Z, AA, BB, etc) and are listed first in a cell's address. Rows are identified by a number (1, 2, 3, …) and are listed 2nd. A formula is a calculation you do with items in the cells. These can be as simple as a math equation like adding cell A1 and A2 or as complicated where you look through a column of data to find or compare particular types of data. There are many, many formulas. This webpage lists the formulas available in Google Sheets. Whenever you use a formula, you have to enter = (the equal sign) first to let the computer know you are going to do a calculation.

3. The SDSS telescope use the five filters listed below. Anything it takes a picture of gets a picture in each filter. The telescope then measures the light in each picture and calculates the magnitude. Check here to identify what type of light each filter lets through.
    i. u = 3551 angstroms (Å)
    ii. g = 4686 Å
    iii. r = 6166 Å
    iv. i = 7480 Å
    v. z = 8932 Å

4. Create a new spreadsheet with Google Sheets. Sheets isn't as good as Excel but it is what we have. We will have to make some workarounds when we run into snags. If you ever have a chance to work with Excel DO IT. It might get you a job someday.

5. Create a chart (a graph is called a chart in Excel or Google Sheets) that has the star names and each magnitude for each star. Include a header row (text in columns that identify what the data is in those columns). Remember, the lower the magnitude the brighter it is. Lower magnitudes mean more light was measured in that filter. Since you will have to look for the peak wavelength, you

might want to use the wavelengths as your headers and not just the identifying letters (3551, 4686 instead of u, g).

6. Create a chart for each star. Remember the lower the magnitude number the brighter the star is. Google sheets does not let you reverse the order of y axis numbers. You will have to figure out a workaround to have a graph that has more light at the top of the y axis and less light at the bottom. What could you do to make this axis flip?

7. Use your header row as labels. Label the chart, the x axis and the y axis. You will probably want to use your header row as labels for each chart. This is automatically done if the header row is right above a data row. This is not automatic if working with data which might not be in the adjacent row. For example, if you are working with two stars, star 1 and star 2, imagine the header is in row 1 column A through F, star 1's data is in row 2 A-F and star 2's data is in row 3 A-F. To include the header row for star 1's chart, you will just have to identify the range of cells for the chart data as a1:f2. Star 2's data is in range a3:f3 but the header is in a1:f1. To include this in star 2's chart you need to go to Chart Editor, go to Data and add a1:f1 in the data range. Use a comma to separate ranges of data. You can either just type it in or click the spreadsheet icon and "Add another range" and click ok. Whatever range you want to use as labels, must be listed first. Then make sure "Use row _ as labels" is checked.

8. To see the graph, you will need to add a trend line (a line that connects the data points to make a best fit line). This can be done in the chart editor, under the "Customize" section. Under "Series" you can check the box to give you a trendline. Try different types to get the best fit line. When using the polynomial type, try different polynomial degrees to get the best fit line.

9. When you have your graphs, show them to your teacher.

10. Use the graph to estimate the peak wavelength for each star. Include this on your spreadsheet.

11. Then use Wien's Law to find the temperature of each star. Include this on your spreadsheet. Use a formula to calculate the temp. Watch this video to see how to enter formulas. Make sure you have the right units. Convert if you have to (you will have to - use another formula!). Format your temperature so there are no decimals.

12. Check over your spreadsheet.
    Do you label what columns or rows mean?
    Do you have a chart for each star?
    Is that chart labeled properly?
    Do your trendlines match the data?
    Do you have a formula to calculate temperature?
    Does your calculated temperature make sense with your graph?

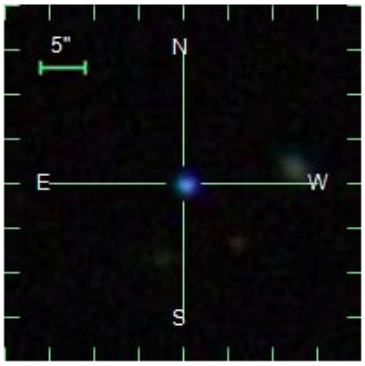
When your happy with your spreadsheet, turn it in.

Star 1

SDSS J094107.4-001949.7

STAR ra=145.281122, dec=-0.330482, ObjId = 582093483532812488

mode	PRIMARY
status	TARGET PRIMARY OK_STRIPE OK_SCANLINE FIRST_FIELD PSEGMENT RESOLVED OK_RUN GOOD SET
flags	MOVED BINNED1 INTERP COSMIC_RAY MANYPETRO CHILD
PrimTarget	TARGET_QSO_REJECT
SecTarget	



run	rerun	camcol	field	obj	rowc	colc
752	20	3	11	200	1256.3	892.6

u	g	r	i	z
19.37	18.94	19.06	19.21	19.39

fiberMag_r	petroMag_r	devMag_r	expMag_r	psfMag_r	modelMag_r
19.52	19.10	19.06	19.08	19.11	19.06

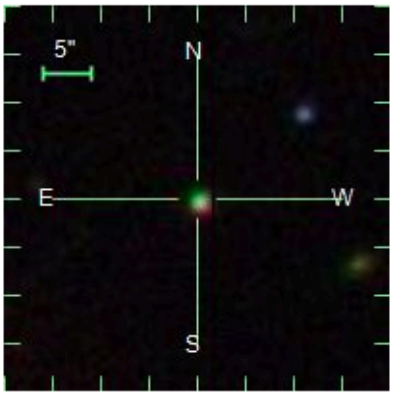
extinction_r	petroRad_r	parentId	nChild
0.17	2.204	582093483532812487	0

Star 2

SDSS J102854.8-005558

STAR ra=157.228673, dec=-0.932797, ObjId = 582093499387936935

mode	PRIMARY
status	PRIMARY OK_STRIPE OK_SCANLINE PSEGMENT RESOLVED OK_RUN DUPLICATE GOOD SET
flags	PSF_FLUX_INTERP INTERP_CENTER BINNED1 INTERP
PrimTarget	
SecTarget	



run	rerun	camcol	field	obj	rowc	colc
756	20	1	277	167	67.9	1127.0

u	g	r	i	z
22.21	19.72	18.30	17.98	17.27

fiberMag_r	petroMag_r	devMag_r	expMag_r	psfMag_r	modelMag_r
18.62	18.35	18.30	18.30	18.30	18.30

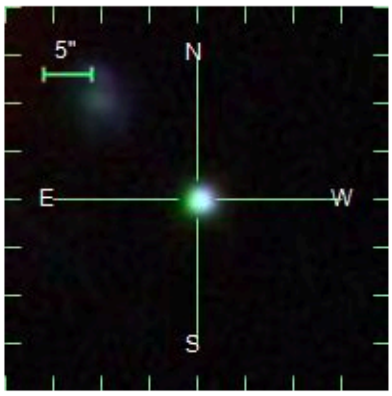
extinction_r	petroRad_r	parentId	nChild
0.14	1.175	0	0

Star 3

SDSS J132050.1-000430.9

STAR ra=200.209028, dec=-0.075252, ObjId = 582093500480487449

mode	PRIMARY
status	TARGET PRIMARY OK_STRIPE OK_SCANLINE PSEGMENT RESOLVED OK_RUN GOOD SET
flags	BINNED1 INTERP MANYPETRO
PrimTarget	TARGET_ROSAT_D TARGET_ROSAT_C
SecTarget	



run	rerun	camcol	field	obj	rowc	colc
756	20	3	564	25	247.0	1291.5

u	g	r	i	z
19.55	17.23	16.32	16.01	15.86

fiberMag_r	petroMag_r	devMag_r	expMag_r	psfMag_r	modelMag_r
16.67	16.36	16.32	16.32	16.32	16.32

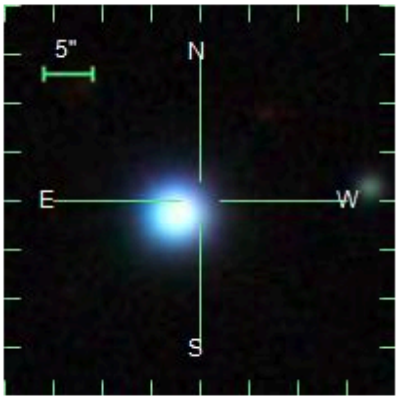
extinction_r	petroRad_r	parentId	nChild
0.06	1.492	582093500480487448	0

Star 4

SDSS J094811.4-001939.6

GALAXY ra=147.047911, dec=-0.327694, ObjId = 582093483265163325

mode	PRIMARY
status	TARGET PRIMARY OK_STRIPE OK_SCANLINE PSEGMENT RESOLVED OK_RUN GOOD SET
flags	DEBLEND_NOPEAK MOVED BINNED1 INTERP COSMIC_RAY NOPETRO CHILD
PrimTarget	TARGET_GALAXY
SecTarget	



run	rerun	camcol	field	obj	rowc	colc
752	20	3	23	61	989.3	918.7

u	g	r	i	z
19.81	17.55	17.08	22.79	22.74

fiberMag_r	petroMag_r	devMag_r	expMag_r	psfMag_r	modelMag_r
17.27	17.43	17.08	17.58	18.67	17.08

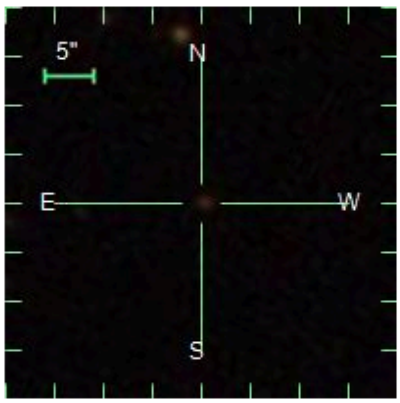
extinction_r	petroRad_r	parentId	nChild
0.35	6.731	582093483265163323	0

Star 5

SDSS J172607.4+274930.7

STAR ra=261.530897, dec=27.825196, ObjId = 582099909625513271

mode	PRIMARY
status	PRIMARY OK_STRIPE OK_SCANLINE PSEGMENT RESOLVED OK_RUN GOOD SET
flags	BINNED1 NOPETRO
PrimTarget	
SecTarget	



run	rerun	camcol	field	obj	rowc	colc
2248	20	5	260	1335	675.1	1741.0

u	g	r	i	z
24.81	23.01	21.59	20.47	19.91

fiberMag_r	petroMag_r	devMag_r	expMag_r	psfMag_r	modelMag_r
22.03	21.61	21.59	21.65	21.69	21.59

extinction_r	petroRad_r	parentId	nChild
0.15	1.545	0	0