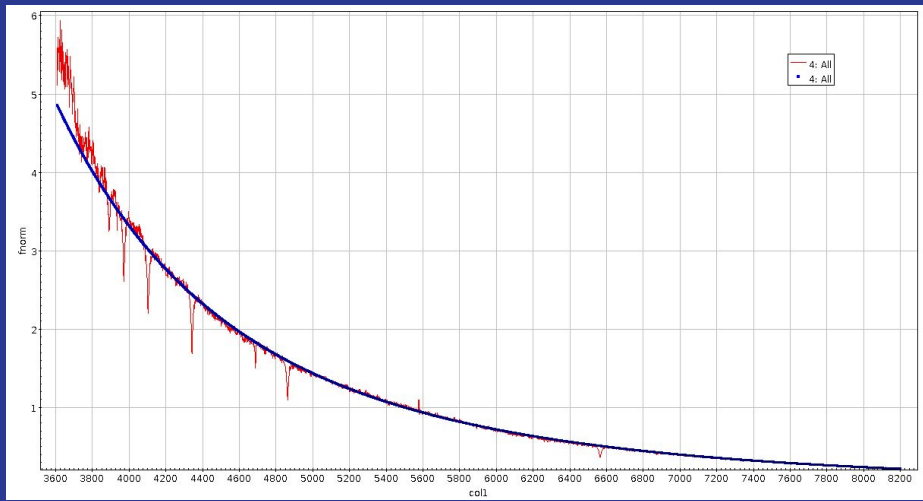
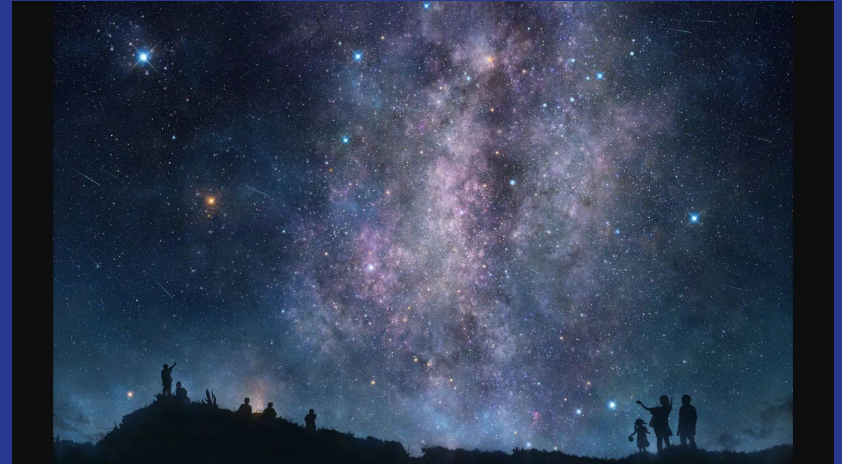




TEMPERATURA E RAGGIO DELLE STELLE

Francesca Franchetto
Elettra Anselmo
16/02/2022

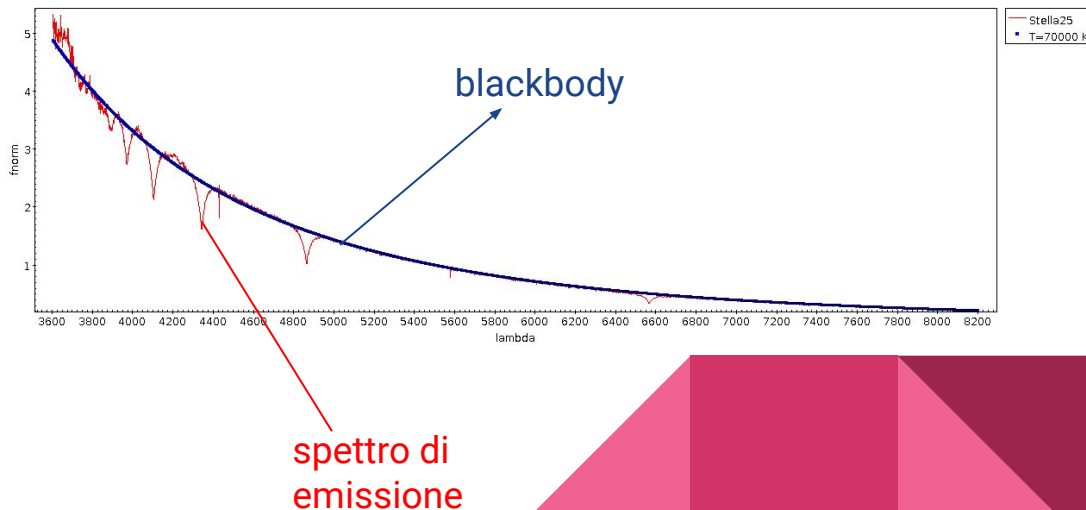
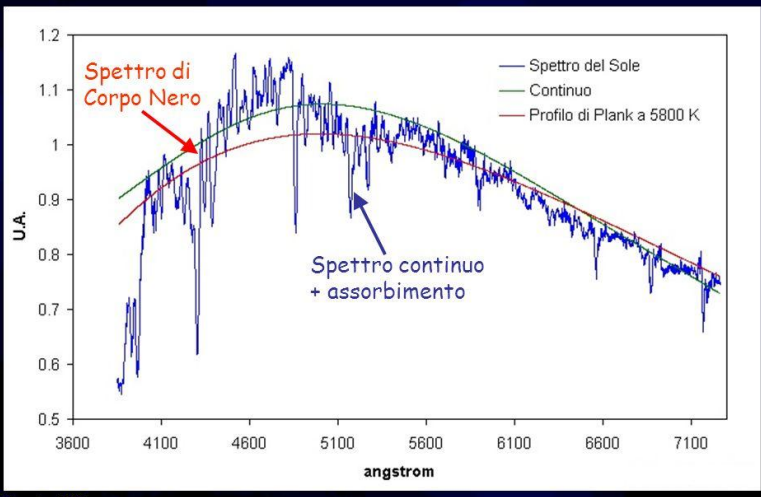


LO SPETTRO DI UNA STELLA

Lo spettro di una stella è costituito dalla somma

- dello **spettro di corpo nero** proveniente dall'**interno della stella**;
- dallo **spettro di assorbimento** dovuto alla fotosfera stellare

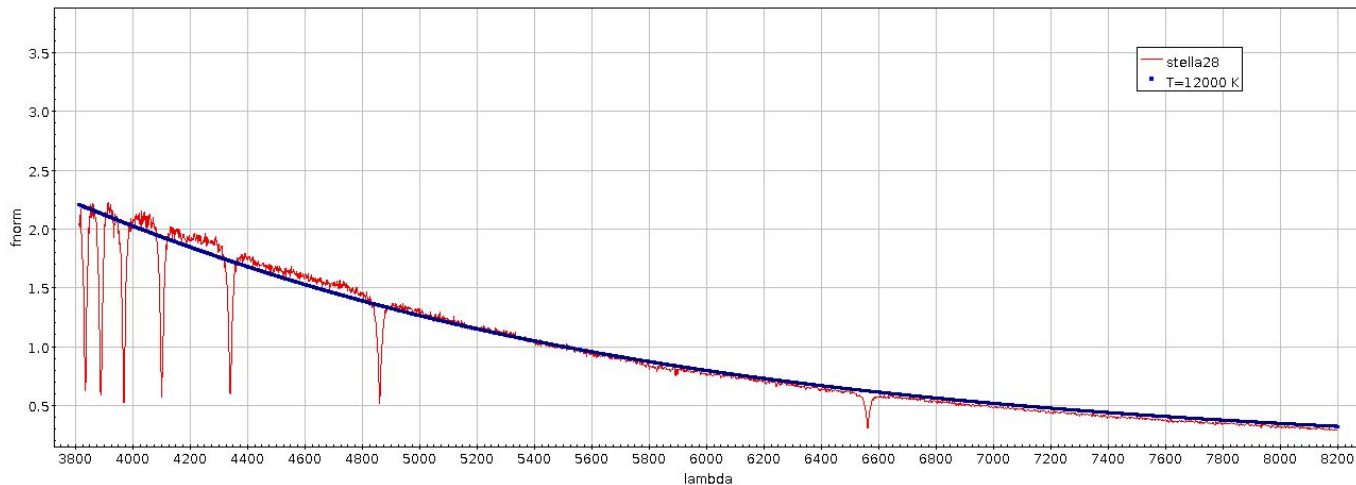
Gli Spettri Stellari



STIMA DELLA TEMPERATURA

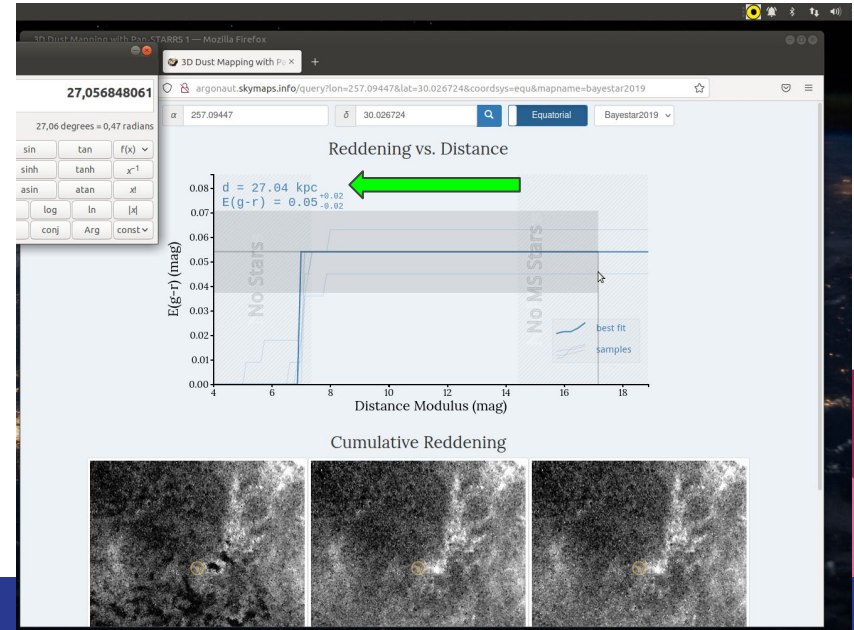
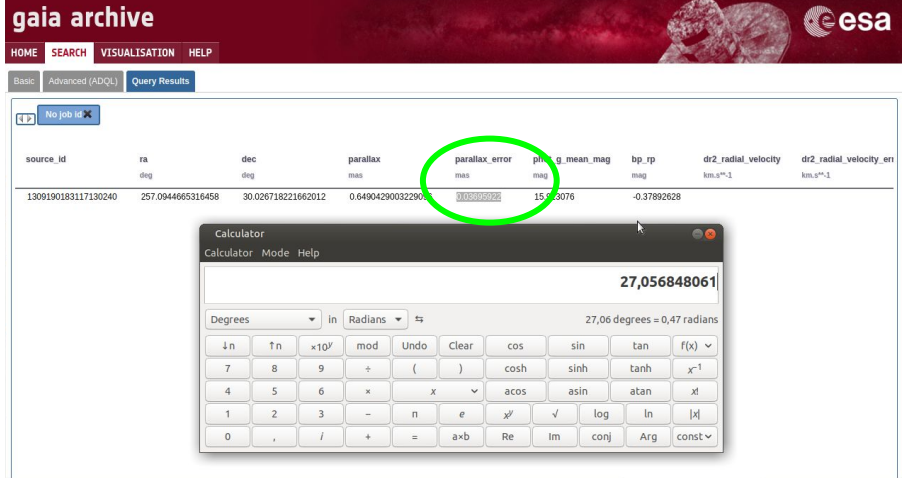
Dato che una stella si comporta approssimativamente come un corpo nero, il nostro obiettivo è applicare allo spettro di emissione l'equazione del corpo nero, per riuscire a ricavare la temperatura.

Il flusso della stella deve però essere **corretto**, dato che il flusso in g è più assorbito di quello in r. Quindi dobbiamo trovare **il valore di estinzione $E(g-r)$** per poi convertirlo in A_v (assorbimento).



PROCEDURA

1. dopo aver scelto la stella, inserire le sue coordinate (ra e dec) nell'archivio GAIA per trovare la parallasse.
2.
$$D = \frac{1}{\text{parallax}} \quad (\text{kpc})$$
3. digitare le stesse coordinate anche nel sito 3D Dust Mapping e, in relazione a D, ricavare il valore E(g-r).



4. trovare il parametro $A_v \approx 3.058 \times E(g-r)$

5. inserire lo spettro della stella desiderata, per poi incrociarlo con la funzione CCM89.

6. correggere il flusso, creando una nuova colonna.

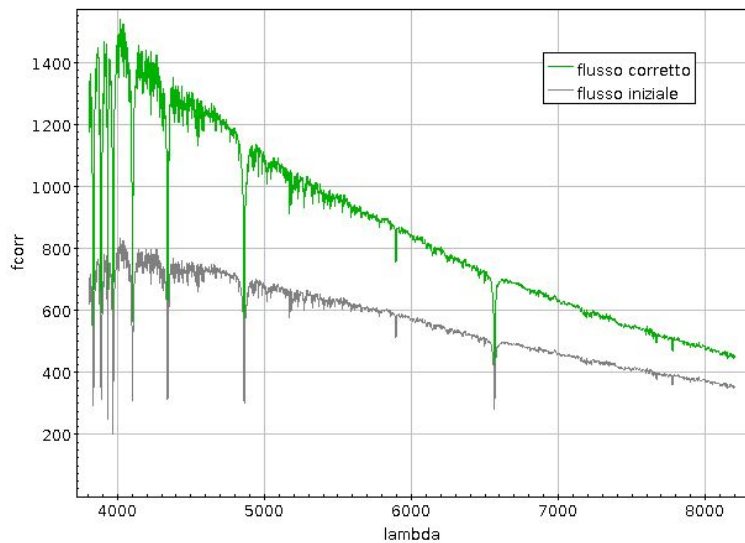
The screenshot shows the TOPCAT software interface. The 'Table List' on the left contains three tables: 'list100.txt', 'sp-4997-55738-252.txt', and 'ccm_function.txt'. The 'Current Table Properties' for 'sp-4997-55738-252.txt' are displayed in the center. The 'Match Tables' dialog is open on the right, showing 'Match Criteria' set to 'Exact Value' and 'Table 1' as 'sp-4997-55738-252.txt' with 'Matched Value column' as 'col1'. 'Table 2' is 'ccm_function.txt' with 'Matched Value column' as 'lam'. The 'Output Rows' are set to 'Match Selection: Best match, symmetric' and 'Join Type' is '1 and 2'. At the bottom, a data table is visible with columns: ra, dec, plate, mjd, fiberid, score, u, and g. The table contains 14 rows of data.

ra	dec	plate	mjd	fiberid	score	u	g
246.72584	8.42638	2532	54589	199	0.93637	14.31149	14.6428
18.4449	0.47464	695	52202	427	0.93815	14.50269	14.9618
248.56703	22.19474	1571	53174	193	0.96519	14.8899	15.1610
126.77306	31.50232	932	52620	126	0.90571	14.89592	15.3404
319.83902	0.96382	4192	55469	796	0.95217	15.13991	15.5100
257.09447	30.02672	4997	55738	252	0.97565	15.44041	15.6665
245.60509	23.63457	4184	55450	564	0.95057	15.66552	15.9320
243.08823	27.16251	5008	55744	296	0.96588	15.7749	16.0161
244.93812	7.5324	5212	56016	456	0.96228	15.81294	16.1902
171.06319	14.2295	5370	56003	716	0.99275	15.95243	16.3526
5.00756	13.87999	753	52233	282	0.86633	15.02934	15.1561
114.40501	15.69204	2713	54400	34	0.93866	16.39781	16.4366

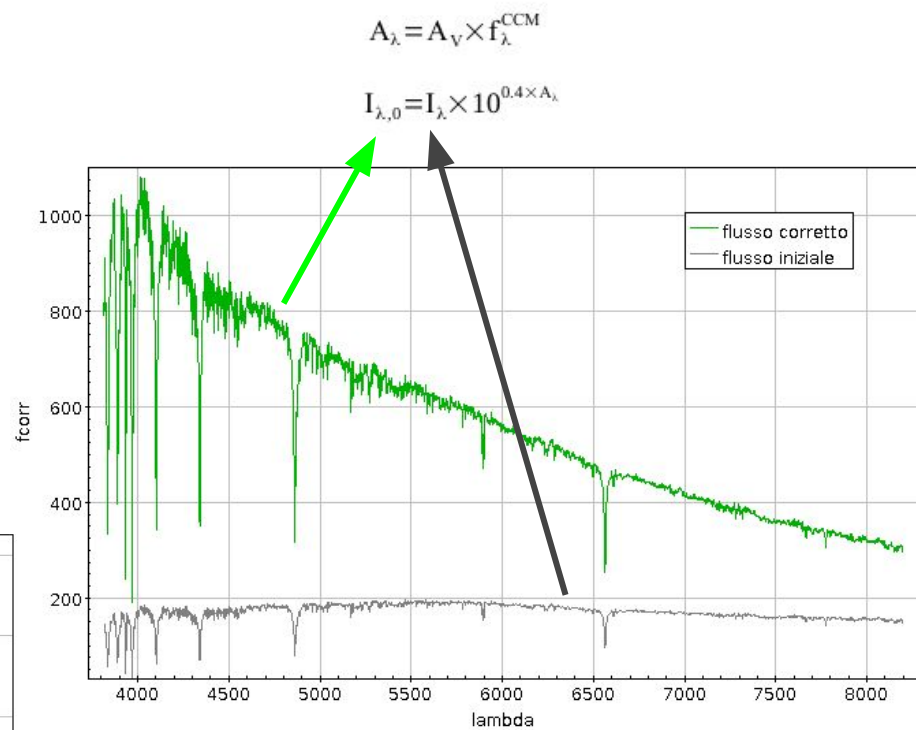
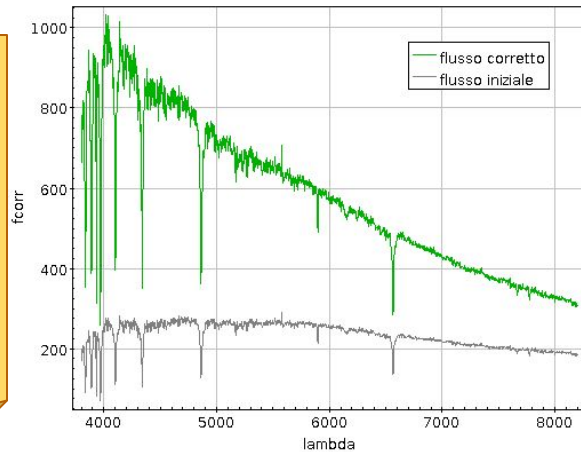
$$A_{\lambda} = A_V \times f_{\lambda}^{\text{CCM}}$$

$$I_{\lambda,0} = I_{\lambda} \times 10^{0.4 \times A_{\lambda}}$$

The 'Define Synthetic Column' dialog box is shown. The 'Name' field is 'fcorr'. The 'Expression' field contains the formula: $\$2^{\text{pow}(10, 0.4 * 0.1529 * \$4)}$. The 'Units' field is empty. The 'Description' field is empty. The 'UCD' dropdown is set to 'no UCD'. The 'Index' field is set to 5. The 'OK' and 'Cancel' buttons are at the bottom.



I valori del flusso corretto si discostano maggiormente a λ più basse (dato che la magnitudine g è più assorbita)



Le righe di assorbimento non cambiano lunghezza d'onda.

7. dividere le misure del flusso corretto per il valore corrispondente a $\lambda=5500 \text{ \AA}$, normalizzando il flusso. In questo modo a $\lambda=5500 \text{ \AA}$ l'intensità vale 1.

TOPCAT(4): Table Browser

Window Rows Help

Table Browser for 4: match(2,3)

	col1	col2	lam	func	fcorr
1929	5493.	164.925	5493	1.00032	189.87425
1930	5494.	166.6705	5494	1.00011	191.87813
1931	5495.	165.5831	5495	0.9999	190.62063
1932	5496.	163.466	5496	0.99969	188.17784
1933	5497.	162.2541	5497	0.99948	186.77721
1934	5498.	163.634	5498	0.99927	188.3601
1935	5499.	164.2829	5499	0.99906	189.10145
1936	5500.	164.2731	5500	0.99885	189.08458210597738
1937	5501.	164.0204	5501	0.99864	188.78813
1938	5502.	163.5056	5502	0.99843	188.19003
1939	5503.	162.4156	5503	0.99822	186.92994
1940	5504.	161.9532	5504	0.99802	186.3925
1941	5505.	162.8886	5505	0.99781	187.46351
1942	5506.	162.6556	5506	0.9976	187.18982
1943	5507.	160.9337	5507	0.99739	185.20272
1944	5508.	161.289	5508	0.99718	185.60611
1945	5509.	161.8295	5509	0.99697	186.2226
1946	5510.	161.9523	5510	0.99677	186.35866
1947	5511.	161.9547	5511	0.99656	186.35591

Total: 4,636 Visible: 4,636 Selected: 1

Define Synthetic Column

Window Help

f(x) ? X

Name: fnorm

Expression: $\$5/189.08458210597738$

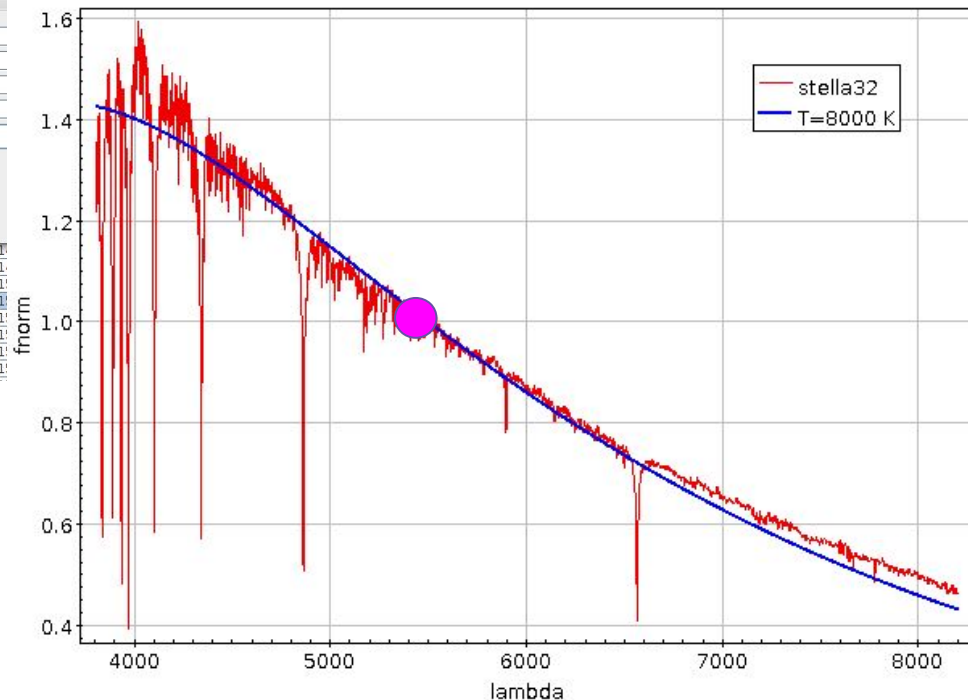
Units:

Description:

UCD:

Index: 6

OK Cancel



8. aggiungere, infine, un'ultima colonna denominata **blackbody** ed inserire l'equazione
$$\text{pow}(5500.,5)*((\exp((1.439*\text{pow}(10.,8)))/(5500.*50000.))-1))/(\text{pow}(\$1,5)*((\exp((1.439*\text{pow}(10.,8)))/(\$1*50000.)))-1))$$

9. far variare la temperatura (che, nell'equazione, è impostata a 50000 K) in modo da far combaciare la radiazione del corpo nero con il flusso normalizzato della stella.

TOPCAT(4): Table Columns

Window Columns Display Help

Table Columns for 4: match(2,3)

Δ	Index	Visible	Name	\$ID	Class	Expression	De
2	2	☒	col2	\$2	Double		
3	3	☒	lam	\$3	Short		
4	4	☒	func	\$4	Float		
5	5	☒	fcorr	\$5	Double	\$2*pow(...	

Define Synthetic Column

Window Help

f(x) ? X

Display help for this window in browser

Name: blackbody

Expression: $\text{pow}(\$1,5)*((\exp((1.439*\text{pow}(10.,8)))/(\$1*50000.)))-1))$

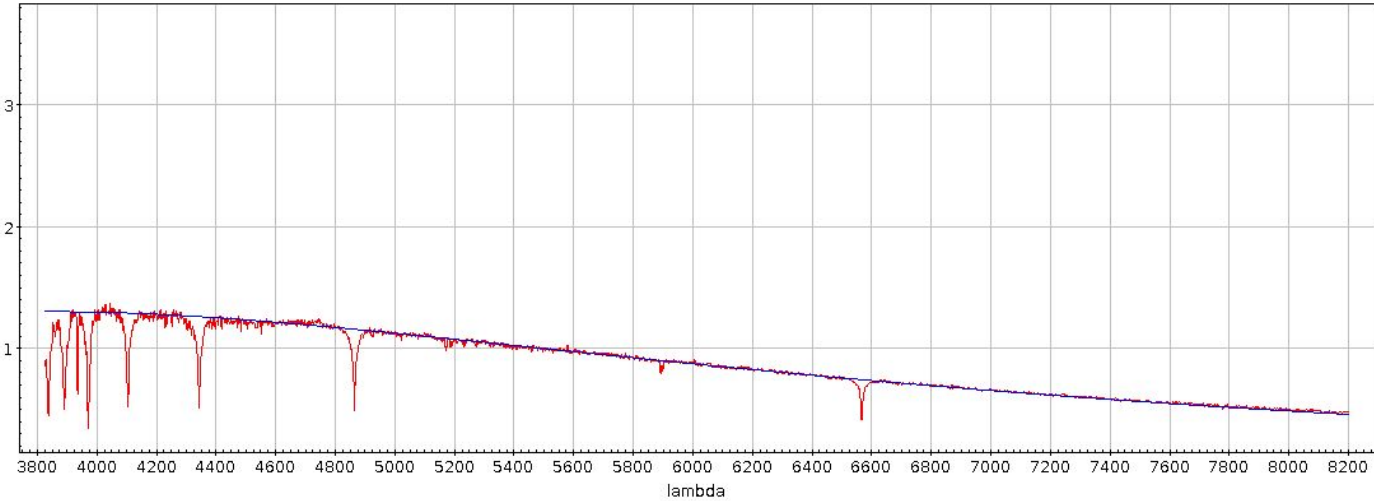
Units:

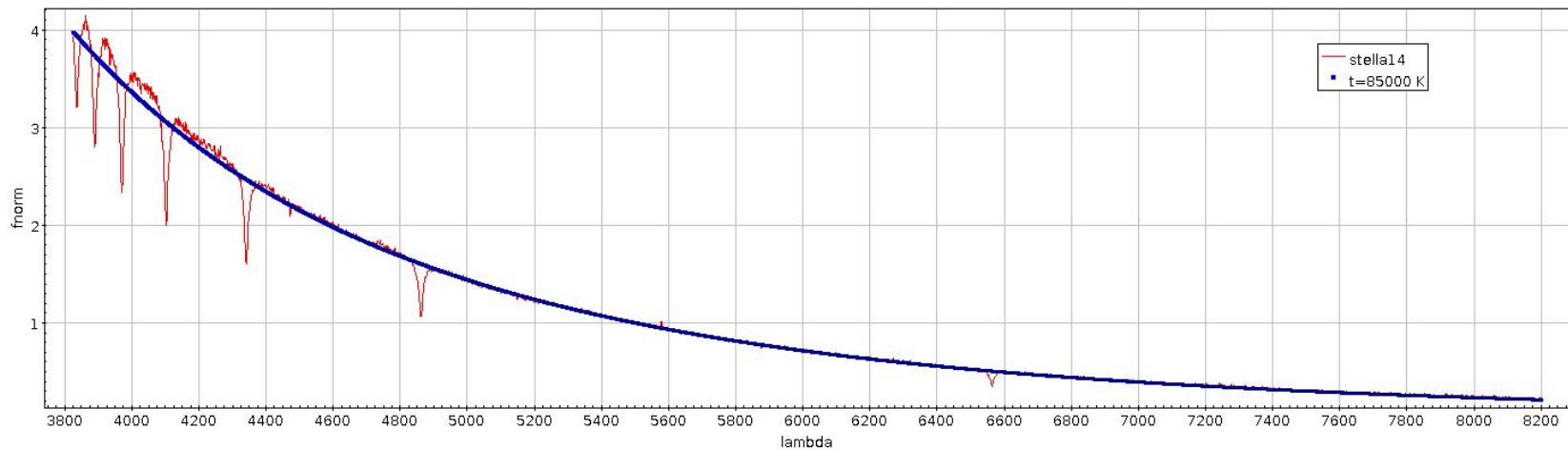
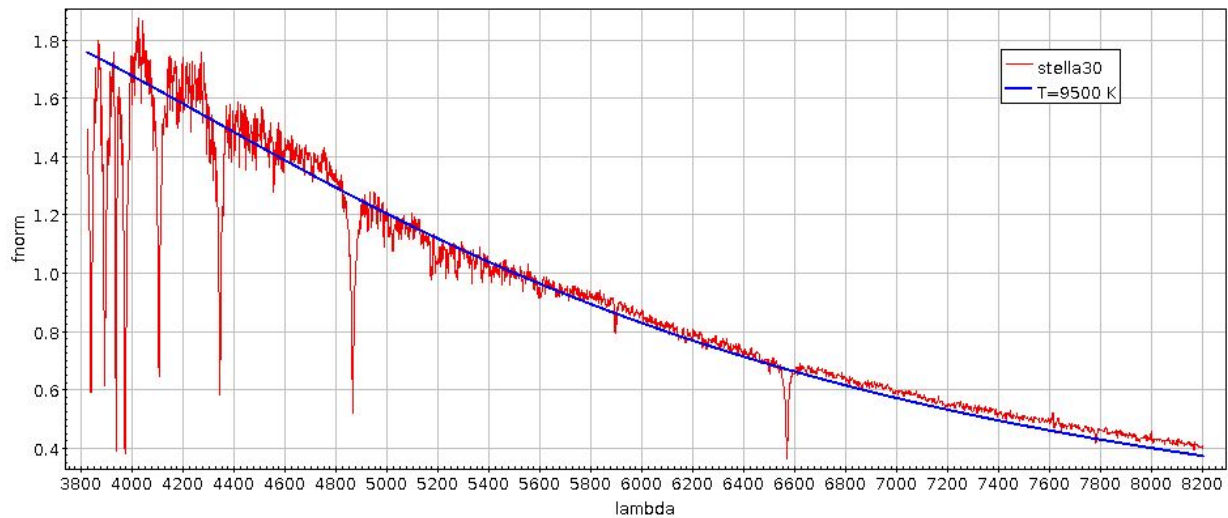
Description:

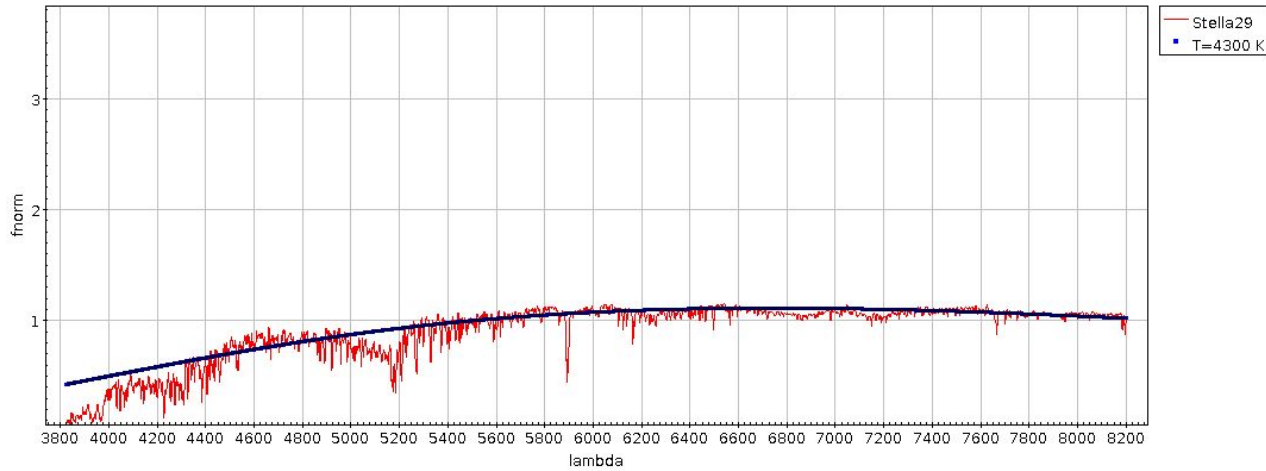
UCD: no UCD

Index: 6

OK Cancel

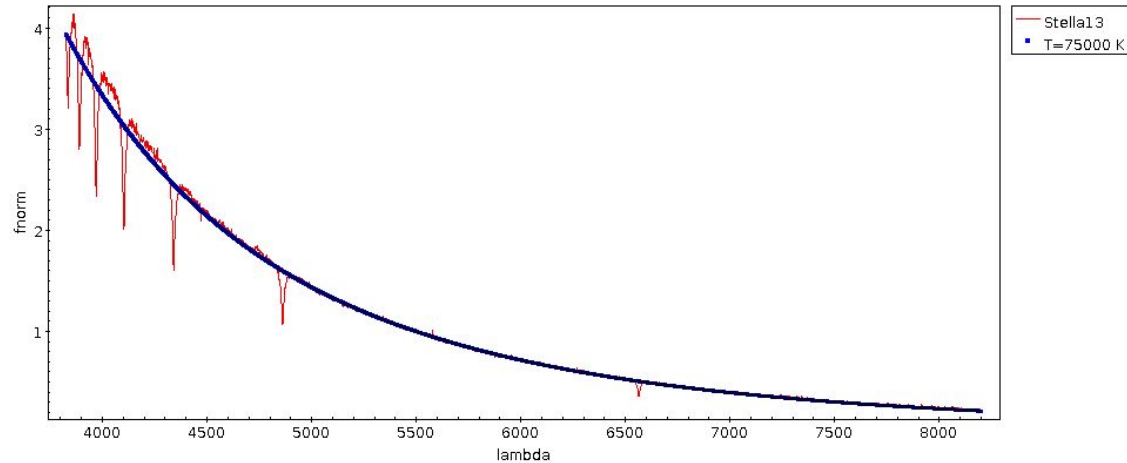


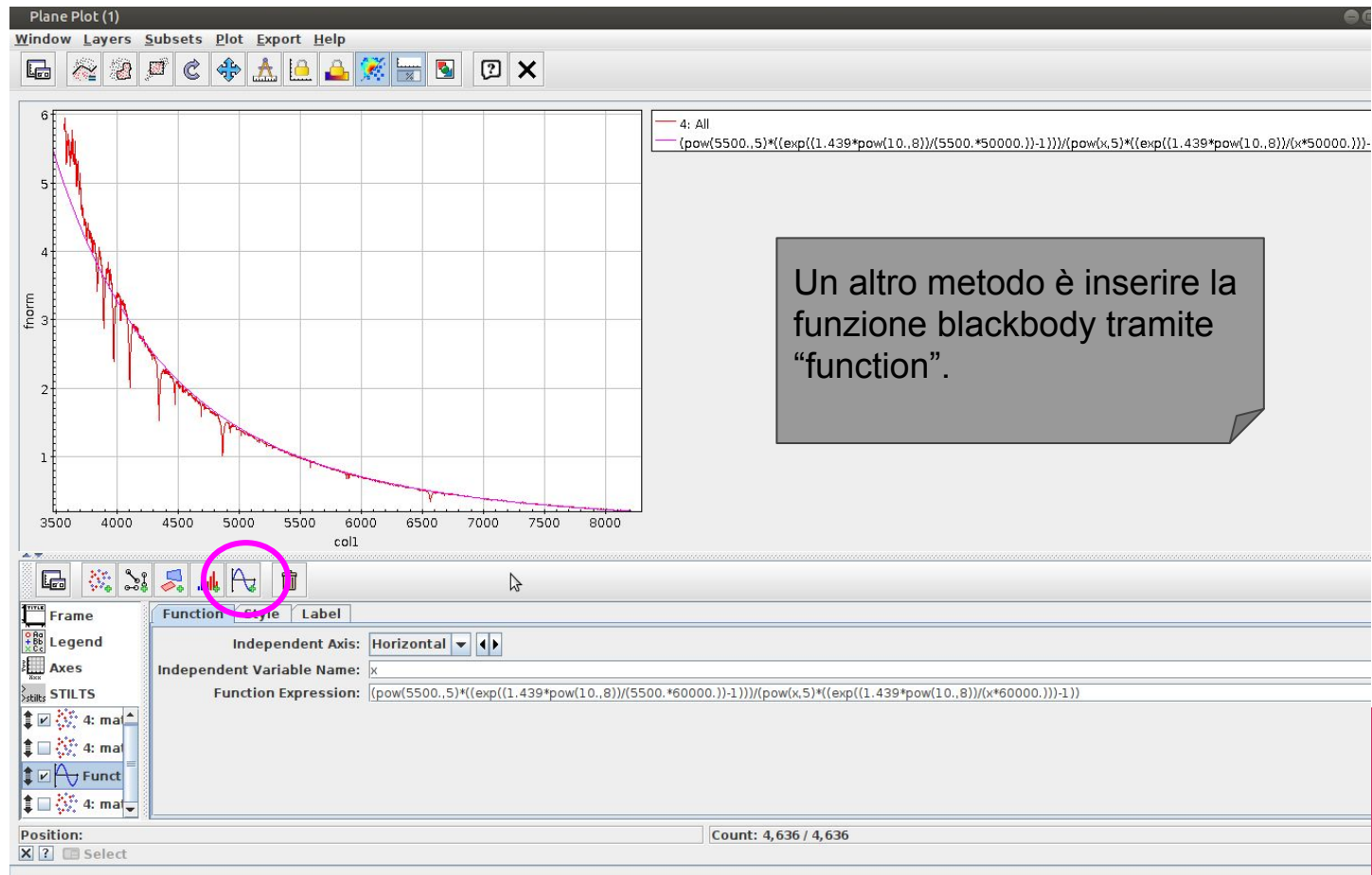




Lo spettro della radiazione emessa dal corpo nero dipende solo dalla sua temperatura.

Al crescere della temperatura la potenza irradiata aumenta rapidamente. Inoltre secondo la legge di Wien la lunghezza d'onda del massimo di emissione diminuisce.





STIMA DEL RAGGIO

1. aprire la tabella fornita, in cui figurano i parametri g e r , per poi calcolare la magnitudine apparente V , con cui è possibile ricavare la magnitudine assoluta M_v

TOPCAT(2): Table Browser

Window Rows Help

Table Browser for 2: lista100.txt

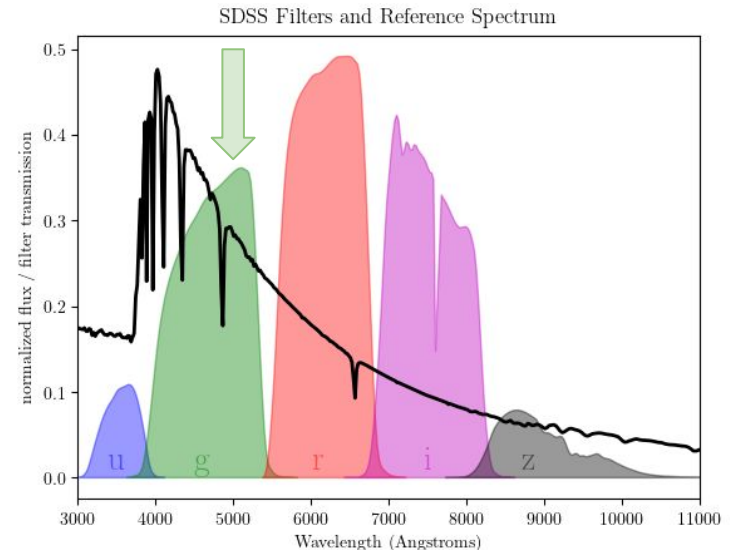
	u	g	r	i
1	14.31149	14.64284	15.12977	15.47654
2	14.50269	14.96184	15.49982	15.86399
3	14.8899	15.16105	15.63244	15.98325
4	14.89592	15.34044	15.93669	16.29833
5	15.13991	15.51008	16.00032	16.33501
6	15.44041	15.66656	16.13283	16.48177
7	15.66552	15.93203	16.36043	16.68092
8	15.7749	16.01614	16.4	
9	15.81294	16.19023	16.4	
10	15.95243	16.35266	16.4	

Total: 100 Visible: 100 Select

I parametri A_v e D ce li siamo ricavati precedentemente.
 D va in pc e non in kpc.

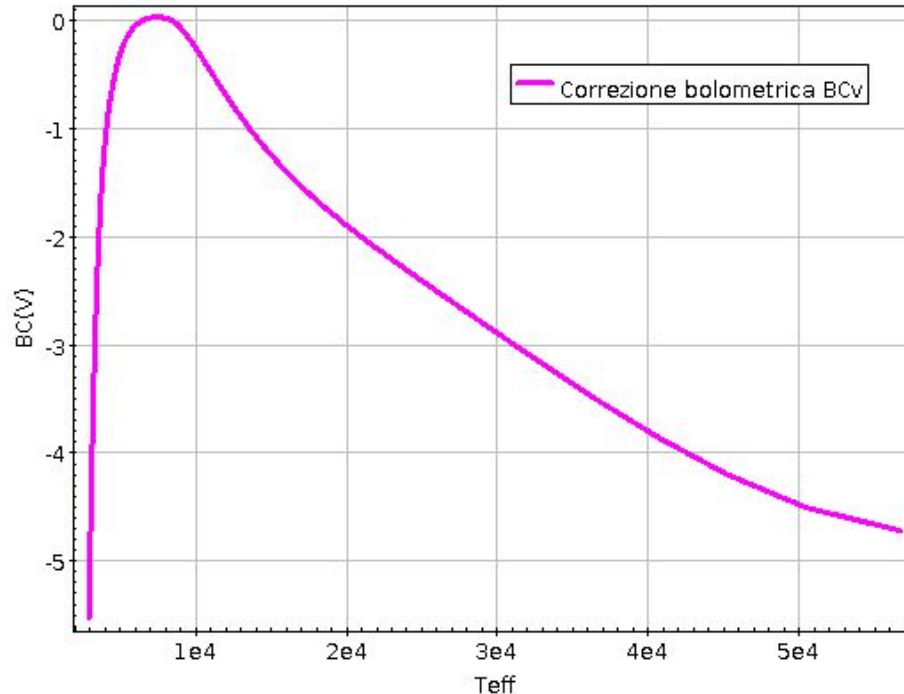
$$\rightarrow V = g - 0.565 \times (g - r) - 0.016$$

$$\rightarrow M_v = (V - A_v) + 5 - 5 \times \log_{10}(D)$$



$$M_{\text{bol}} = M_V + BC_V$$

2. BC_V si stima grazie alla funzione flower. Bisogna tenere in considerazione la temperatura stimata prima. Si ricava quindi la magnitudine bolometrica.



Stella	Temperatura	Raggio
1	60000 K	1 543 025 km
3	30000 K	2 220 410 km
36	8000 K	12 722 284 km
21	12000 K	2 043 499 km
17	20000 K	195 245 km
9	25000 K	249 330 km

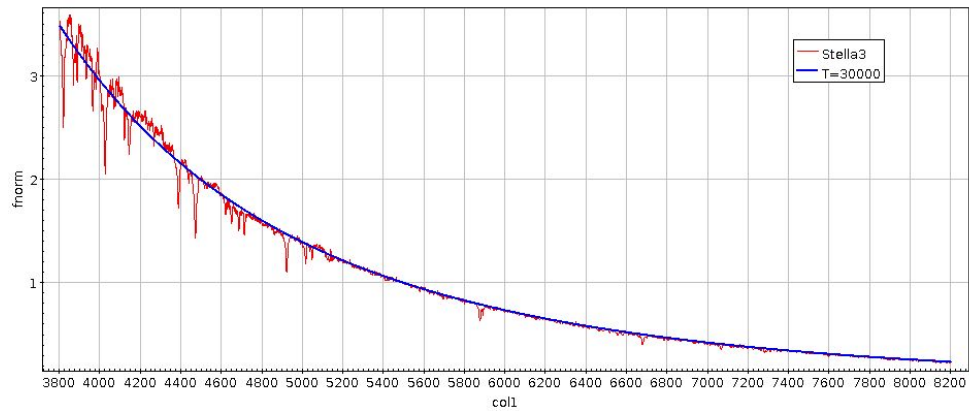
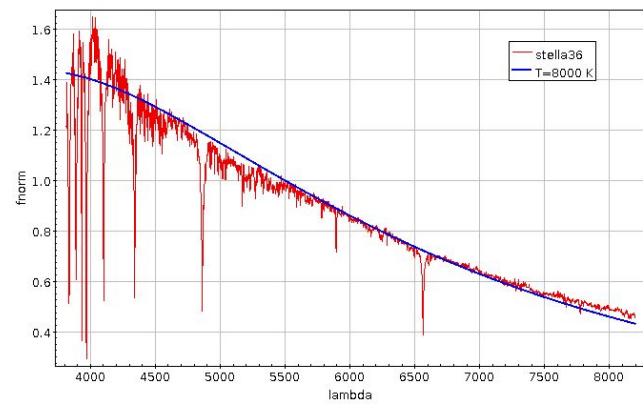
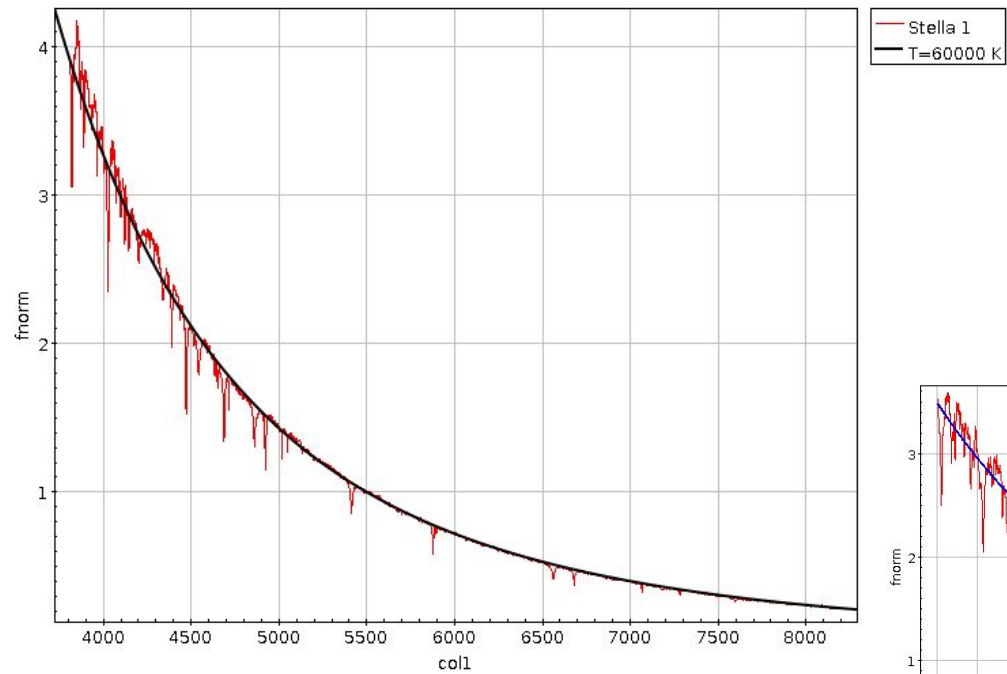
$$\frac{L_{\text{bol}}}{L_{\text{bol},\odot}} = 10^{-0.4 \times (M_{\text{bol}} - M_{\text{bol},\odot})}$$

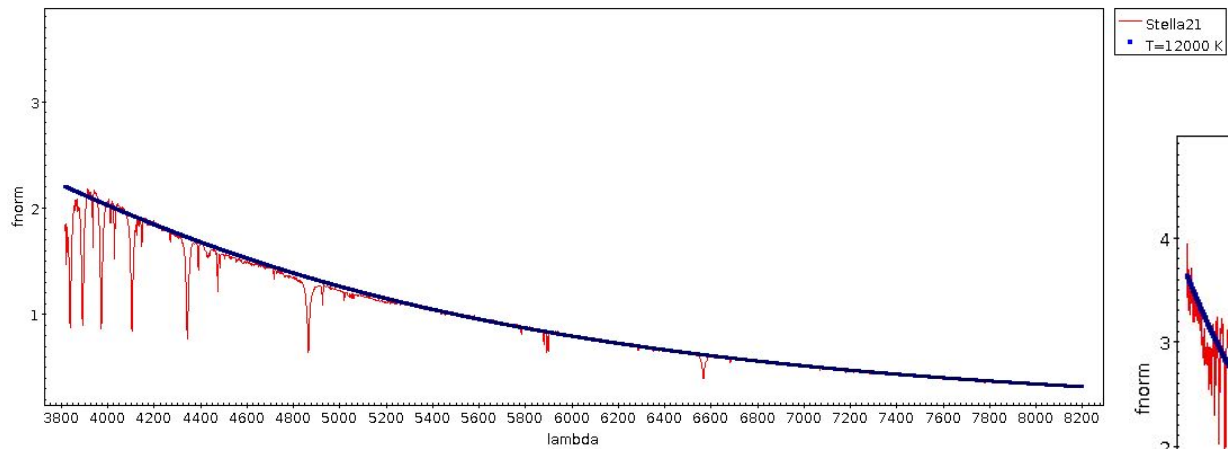
$$\frac{R}{R_{\odot}} = \sqrt{\frac{L_{\text{bol}}}{L_{\text{bol},\odot}}} \times \left(\frac{T_{\odot}}{T} \right)^2$$

$$M_{\text{bol},\odot} = +4.74$$

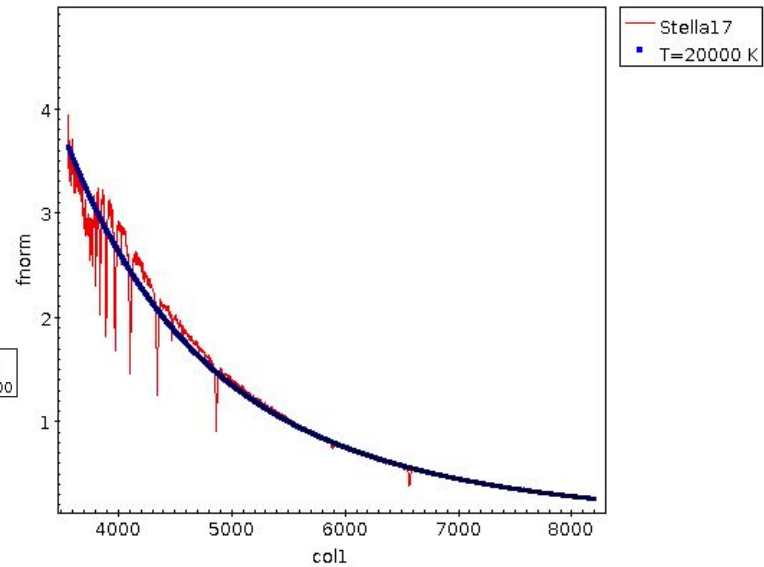
$$T_{\odot} = 5780 \text{ K}$$

$$R_{\odot} = 696\,340 \text{ km}$$

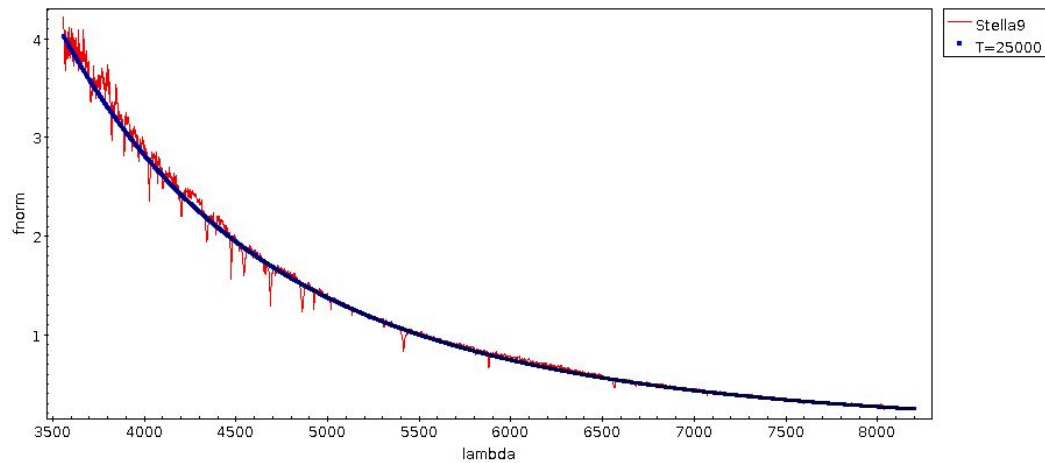




Stella21
■ T=12000 K



Stella17
■ T=20000 K



Stella9
■ T=25000 K