HW2

Hasith Perera

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Q2

Solar Flux data was taken from the Australian Space weather Forcasting center.

Data was in an ascii format
specification here: plot and raw_data

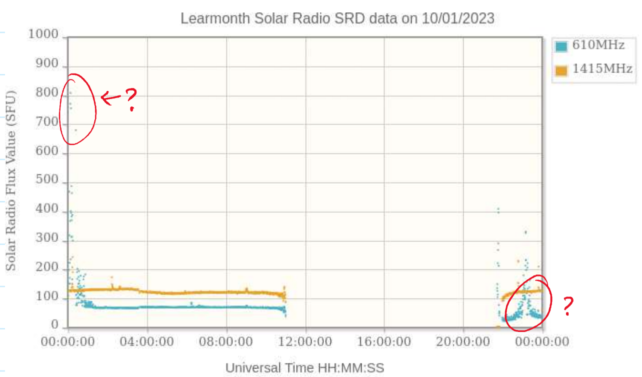
Wrote a matlab program to extract time + data.
Units were in Solar Flux units. (SFU)

1 SFU = 10^4 Jansky

Jan 10^{th} data

610 MHz : 69 SFU (median / removing the outliers at 0000 UTC)
1415 MHz : 123 SFU (visually from the plot on the website)

From the web site



Q: why the high outlier and spikes around 0000 UTC
there some clean days in January
– likely solar activity (CME's / flares)

Part 2

$P = kT(\Delta\nu)$ ← From class.

1 Jansky → $10^{-26} \frac{W}{m^2 Hz}$ ← $\frac{\text{Power}}{\text{Area, freq.}}$

From the telescope specs.

$R = 3m$

– $A = \pi R^2 = 28.2 \ m^2$

– $\Delta\nu = 10 \times 10^6 \ Hz$

$\frac{P}{A(\Delta\nu)} = I$

$P_{avg} = 69 + 123/2 = 96$ SFU ✓

$$\frac{P}{A(\Delta\nu)} = I$$

$P_{avg} = 69 + 123/2 = 96$ SFU ✓

confirmed by other reading

Quite sun is 105 Jy

$$P = I\, A(\Delta\nu) \quad -①$$

$$P_{avg} = 96 \times 28.2 \times 10 \times 10^{6} \times 10^{4} \text{ W}$$

$$P_{avg} = 2.707 \times 10^{4} \text{ W}$$

$$P = k_B T \Delta\nu$$

$$T = \frac{P_{avg}}{\Delta\nu\, k_B} = \frac{I A \cancel{\Delta\nu}}{\cancel{\Delta\nu}\, k_B} = \frac{96 \times 10^{4} \times 28.2 \times 10^{-263}}{1.38 \times 10^{-23}}$$

$$= \frac{96 \times 28.2}{1.38} \times 10$$

$$T = 1.96 \times 10^{4} \approx \underline{\underline{19669 \text{ K}}}$$

It could be inside the sun

temperature > 6000 K (surface)

– The value I have is too low for that ??

Q3

antenna temperatu 2K

① what is the power (per unit freq, W/Hz)

$$P = K_B T \Delta\nu$$

$$\frac{P}{\Delta\nu} = k_B T = 1.38 \times 10^{-26} \times 2 \text{ J} = 2.76 \times 10^{-26} \text{ W Hz}^{-1}$$

② $\Delta\nu = 250$ MHz

$$P = 2.76 \times 10^{\cancel{-26}\,20} \times 250 \times 10^{\cancel{6}}\text{ W}$$

$$= 690 \times 10^{-20} \text{ W}$$

$$P = \underline{6.90 \times 10^{-18}} \text{ W}$$

③ $P = VI \qquad V = IR$

$$P = \frac{V^2}{R}$$

$$V^2 = (6.90 \times 10^{-18}) \times 100$$

$$V^2 = 6.90 \times 10^{-16}$$

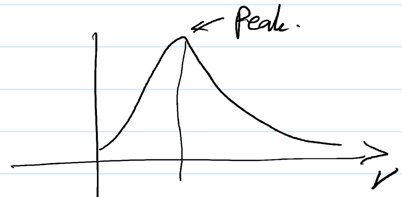
$$V = 2.62 \times 10^{-08}$$

$$= 26.2 \text{ nV}$$

Q4

CMB observation.

Black body radiation in frequency.



$$B_\nu(T) = \frac{2h\nu^3}{c^2} \frac{1}{\left(e^{h\nu/kT} - 1\right)}$$

look at $\frac{\partial B}{\partial \nu} = \frac{2h}{c^2} 3\nu^2 \left(\frac{1}{e^{()} - 1}\right) + \frac{2h\nu^3}{c^2}(-1)\left(e^{h\nu/kT} - 1\right)^{-2} \times \frac{h}{kT} e^{h\nu/kT}$

to get the max set $\frac{\partial B}{\partial \nu} = 0$

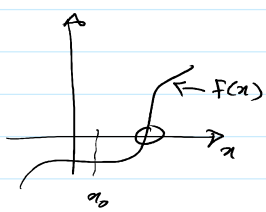
$$\cancel{\frac{2h}{c^2}}(3\cancel{\nu^2})\cancel{\left(\frac{1}{e^{()} - 1}\right)} = \frac{\cancel{2h}\nu^{\cancel{3}}}{\cancel{c^2}}\left(e^{h\nu/kT} - 1\right)^{-\cancel{2}\,1} \frac{h}{kT} e^{h\nu/kT}$$

$$3\left(e^{h\nu/kT} - 1\right) = \frac{\nu h}{kT} e^{h\nu/kT}$$

$$3 = \frac{\nu h}{kT}\left(\frac{1}{1 - e^{-h\nu/kT}}\right)$$

this needs to be solved neumerically.

Review root finding (newton Rapson)



$f(x) = 0$

Initial guess: x_0

$$f'(x) = \frac{f(x_{n+1}) - f(x_n)}{(x_{n+1} - x_n)}$$

$$x_{n+1} = \frac{\left[f(x_{n+1}) - f(x_n)\right]}{f'(x)} + x_n \quad (f(x_{n+1}) \to 0)$$

$$\left[x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}\right]$$ do this for a threshold.

$$f'(x) = \frac{f(x_n) - f(x_{n-1})}{(x_n - x_{n-1})}$$ ⇒ approx for $f'(x)$ need two guess.

→ Test this algorithm with.

$$f(x) = (x-5)(x+1)$$
$$f(x) = x^2 - 4x - 5$$

Tested my code for this case.

Verification.

Verification.

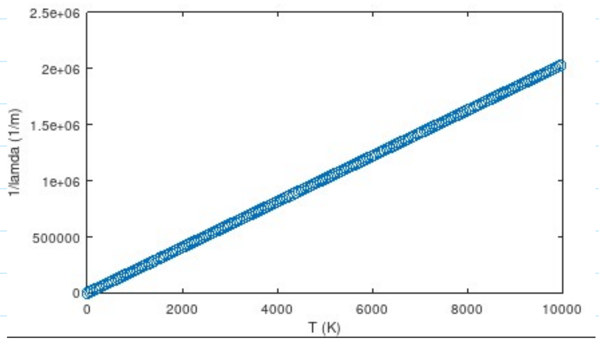
Tested my code for this case.

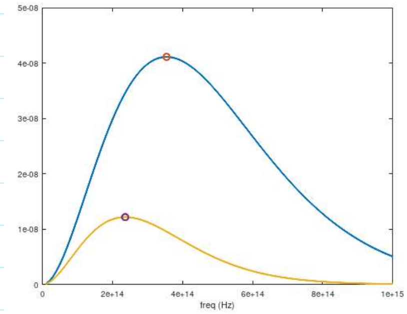
$T\lambda = \text{cost}$ (wein displacement)

$(T) = \text{cost}\,(1/\lambda) \Rightarrow$ If my root is correct it should show a line

Code to find the roots: [here]

Print out attached





for 2.7 K $\Rightarrow$ peak freq: 1.5×10^{11} Hz

150 GHz

multiplier

M	10^6
G	10^9

atmospheric transmission on this window.

- Based on what I could find 3 GHz $\rightarrow$ 100% transmission.
- up to 200 MHz there are some specific blocked band.

$\Rightarrow$ Both types would be use full

- Earth based observations would be good for the most part based on other factors. such as cost.
- for the specific bands that are showing low trans mission space based observation are needed.

Q1

Radio astronomy	Optical astronomy
- Detects the amplitud + phase of the wave.	- CCD's are the main sensor.
- Interferometry to increase resolution	- they count individual photon's
- 1D FFT to look at the power spectrum	- Spacial FFT (2D) for filtering/deblurring
	- Spectral analysis to find what chemical components are in the signals

Digital TV

- uses much more powerful transmissions.
  in the VHF / UHF ranges
- Since its digital. you get all or nothing
- Encording / Decording the video/audio data. is included.
- Error correction scheams are implemented.