

# Astro exercise solutions

Determining the emission mechanism of OJ 287

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# What we can infer from the blazar SED

Low peak very likely synchrotron all from same region (correlated variability)

$$L_s \propto U_B - (1)$$

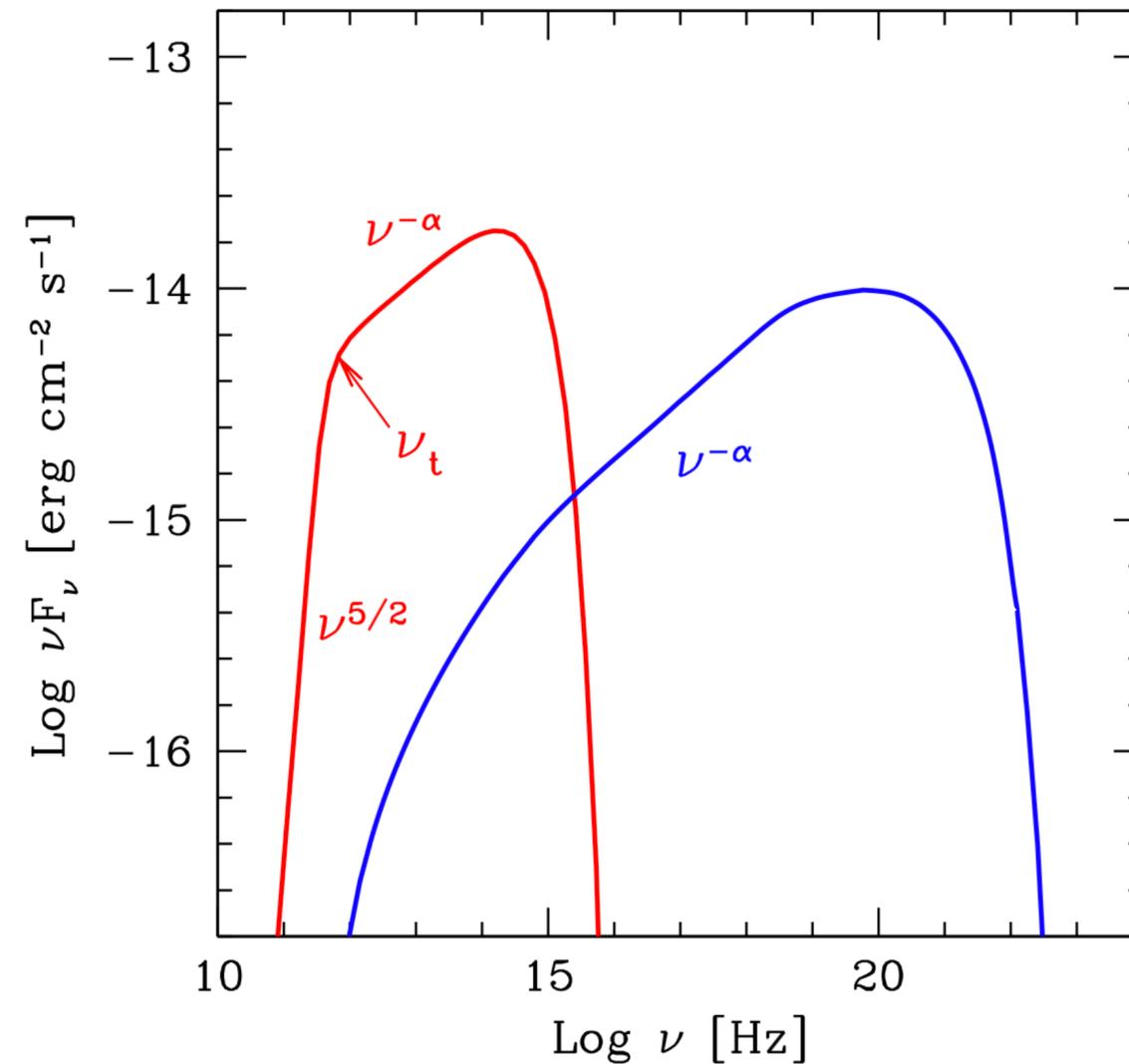
$$U_B = \frac{B^2}{8\pi} - (2)$$

Often correlated variability in high peak,  
-> Inverse Compton with synchrotron photons

$$L_{IC} \propto U_{rad} - (3)$$

$$U_{rad} = \frac{L_s}{4\pi R^2 \delta^4 c} - (4)$$

$$R = ct_{var} \frac{\delta}{1+z}$$



# What we can infer from the blazar SED

Combining (1), (2) & (3)

$$\frac{L_C}{L_S} = \frac{U_{\text{rad}}}{U_B} = \frac{2L_S}{R^2\delta^4cB^2}$$

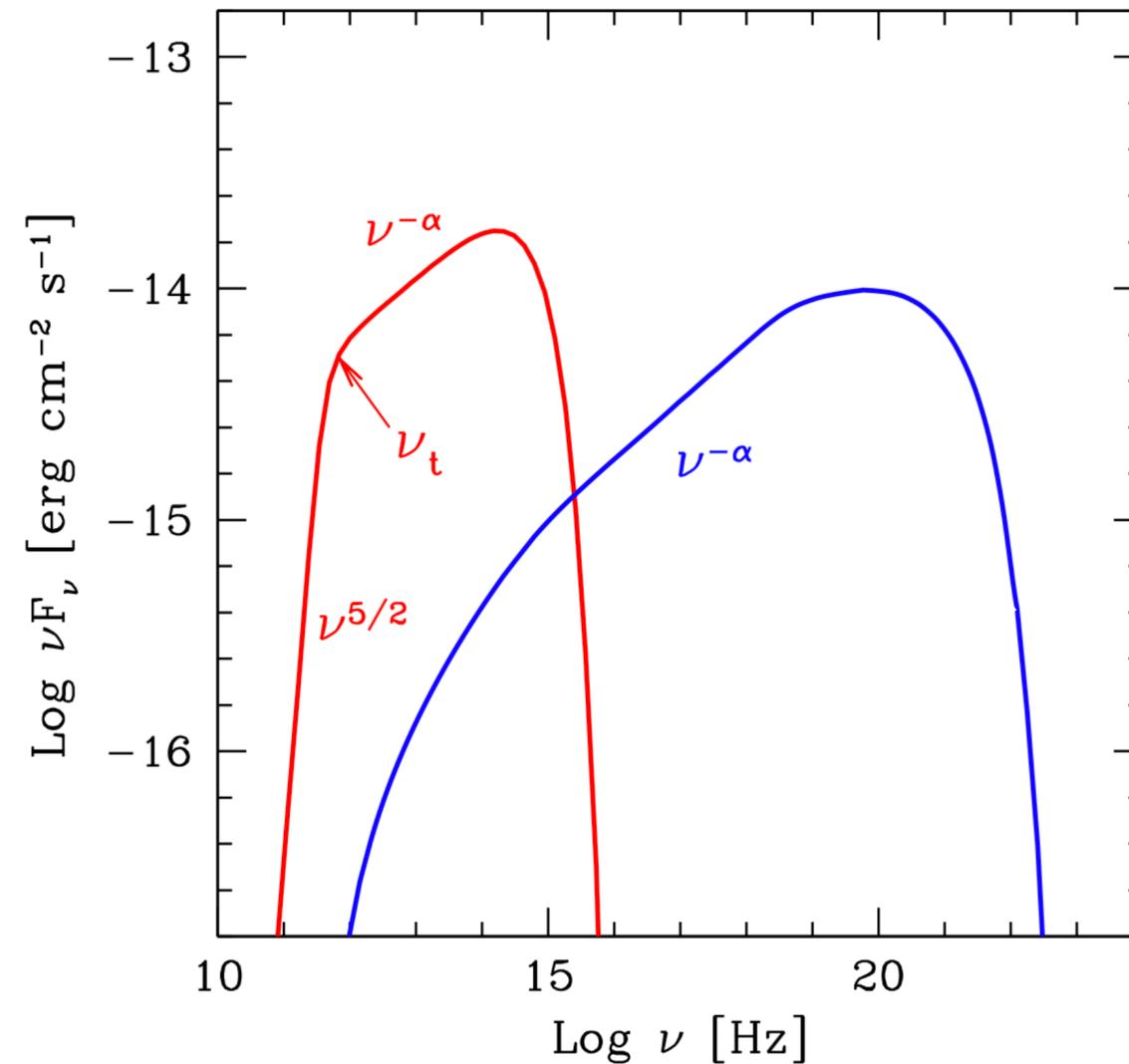
Rearranging, we get,

$$B^2\delta^3 = (1+z)\frac{L_S}{ct_{\text{var}}}\left(\frac{2}{cL_C}\right)^{1/2} \quad (5)$$

From the peak frequencies we have,

$$\nu_C = \frac{4}{3}\gamma_{\text{break}}^2\nu_S$$

$$\gamma_{\text{break}} = \left(\frac{3\nu_C}{4\nu_S}\right)^{1/2}$$



# What we can infer from the blazar SED

From the peak frequencies we have,

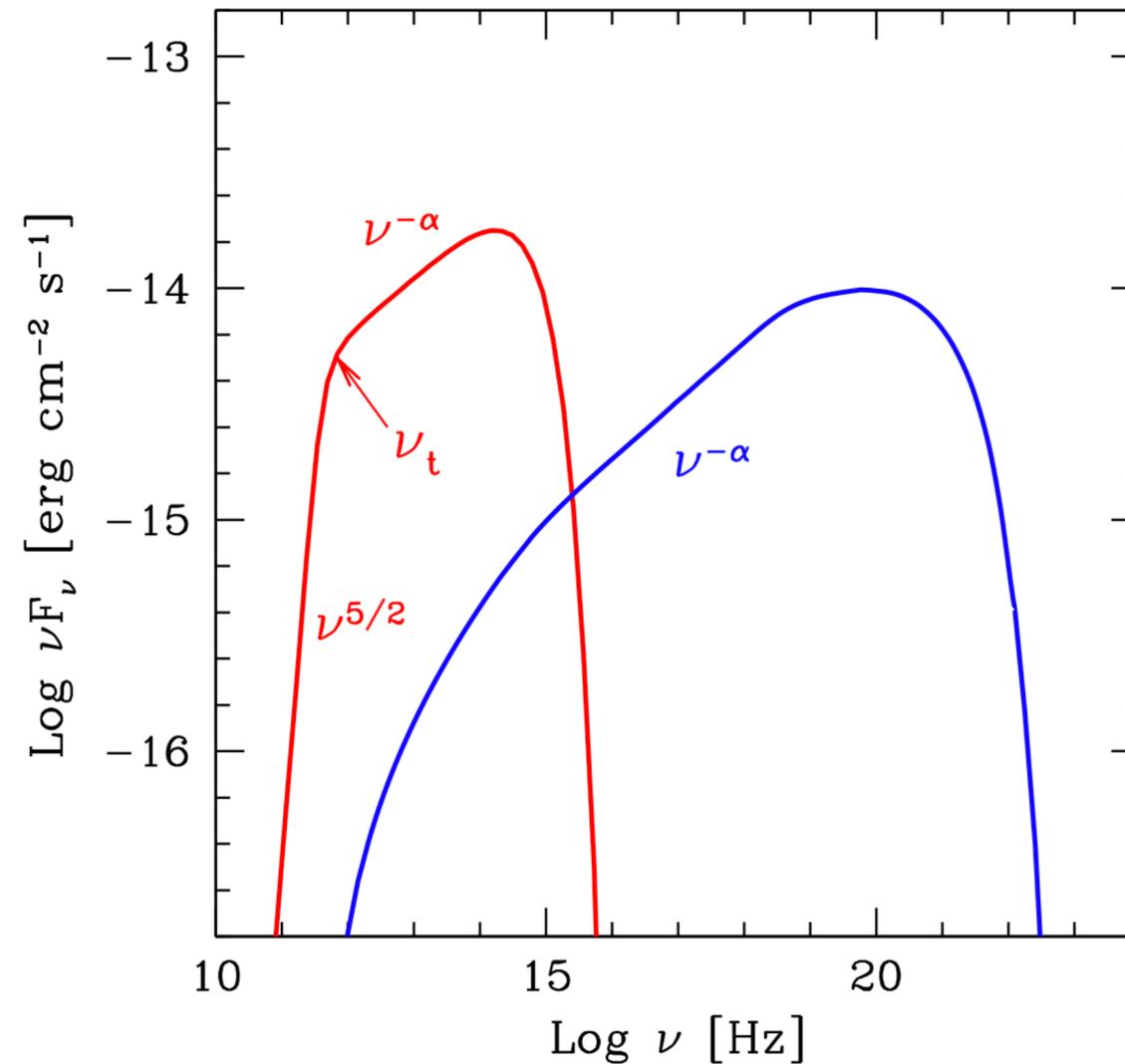
$$\nu_C = \frac{4}{3} \gamma_{\text{break}}^2 \nu_S$$

$$\gamma_{\text{break}} = \left( \frac{3\nu_C}{4\nu_S} \right)^{1/2} \quad - (6)$$

$$\nu_S = \frac{4}{3} \gamma_{\text{break}}^2 \nu_B \approx 3.7 \cdot 10^6 \gamma_{\text{break}} B \frac{\delta}{1+z}$$

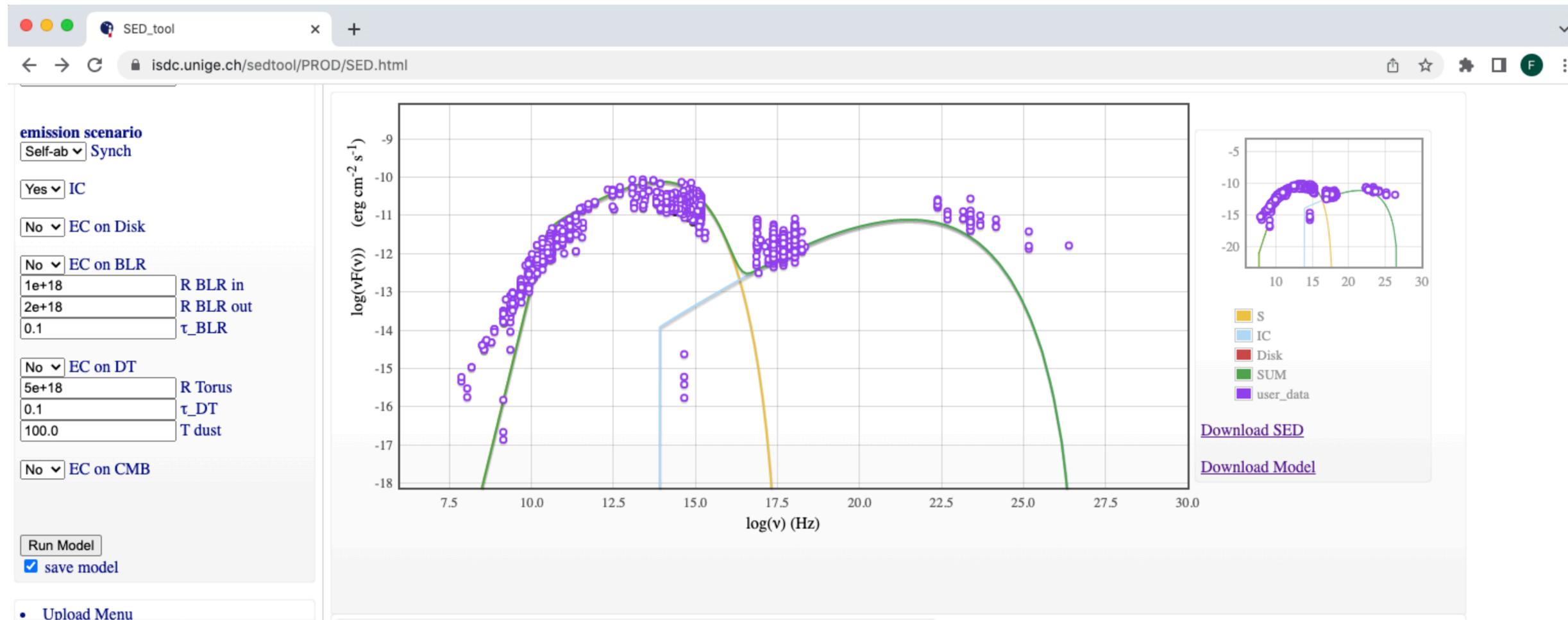
Using (6) we get

$$B \cdot \delta = (1+z) \frac{\nu_S^2}{2.8 \cdot 10^6 \nu_C} \quad - (7)$$



We now have 2 equations (5,7) and 2 unknowns

# My solution



Model parameters used:

```

z_cosm 0.306
do_EC_BLR 0
T_disk_max 100000.0
R_inner_Sw 3.0
T_DT 100.0
gmax 100000.0
accr_eff 0.1
gamma_cut 8000.0
R_BLR_in 1e+18
do_EC_DT 0
BulkFactor 31
R_BLR_out 2e+18
theta 0
L_disk 1e+47
tau_DT 0.1
B 0.01
R_ext_Sw 500.0
gmin 1.0
N 100.0
tau_BLR 0.1
R 3e+17
DISTR plc
do_EC_CMB 0
do_SSC 1
do_EC_Disk 0
R_DT 5e+18
R_H 1e+17
p 2.0
do_Sync 2
  
```

A decent fit with SSC only but not perfect in the gamma-ray range. Can be interpreted as additional external Compton emission.