Rubric for Cume 412

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|---|---|---|---|
| 2 (14 pts) | 2a (2) | 1 pt | 3 electrons |
| | | 1 pt | 2 electrons |
| | 2b (6) | 3 pts | Fine structure lines with the same n,l (principle and angular momentum quantum numbers) |
| | | 3 pts | For a diagram showing same n,l with different j quantum numbers |
| | 2c (2) | 2 pts | Spin-orbit coupling interactions |
| | 2d (4) | 2 pts | OIII] is semi-forbidden line, does not obey dipole selection rules, must be collisionally excited, not photo-excited |
| | | 2 pts | CIV is allowed transition, obeys dipole selection rules, so in principle can be photo-excited (though it is not in this gas structure) |
| 3 (15 pts) | 3a (4) | 2 pts | Ionization balance that is density, temperature, and photon field dependent. Photon field NOT in equlibrium with particle field. |
| | | 1 pt | Ionization from lower ions is due to photoionization, so depends on SED of local radiation field |
| | | 1 pt | Recombination of free electrons onto higher ions, so density and T dependent |
| | 3b (4) | 2 pts | The excitation of the b-b transition is due to collisional excitation with free electrons, density and T dependent |
| | | 2 pts | The de-excitation of the b-b transition is due to spontaneous emission, depends upon Einstein A coefficient |
| | 3c (4) | 3 pts | E = hc/lambda = 0.57 Ryd |
| | | 1 pt | The authors state that the emission is due to collisional excitation at about 0.5 Ryd |
| | 3d (3) | 3 pts | T = E/k = 79,000 K |
| 5 (10 pts) | 4a (4) | 1 pt | 1+z = lambda_obs/lambda_rest |
| | | 1 pt | z(1660.81) = 6.1031 |
| | | 1 pt | z(1666.15) = 6.1045 |
| | | 1 pt | z_ave = 6.1038 |
| | 4b (2) | 2 pts | lambda_obs = 1215.67*(1+6.1038) = 8635.88 Ang |
| | 4c (4) | 1 pt | Dlambda/lambda = Dv/c |
| | | 2 pts | lamda_obs(Lya)=8642.5 Ang, c*(8642.5-8635.88)/8635.88 = 230 km/s |
| | | 1 pt | The wavelength of the line peak flux is not the same as the line flux-weighted mean quoted in Table 1 and used for our calculation |
| 5 (6 pts) | 5a (2) | 2 pts | Resonance lines are transitions of a single active electron from the ground state to the lowest energy excited state. (optional: They obey the dipole slection rules and have large cross sections). |
| | 5b (4) | 2 pts | The resonant lines are optically thick so that the photons in the line are effectivey "scattered". |
| | | 2 pts | Thus, peak line flux reflects the velocity of last scattering at whch the lines become optically thin |
| 6 (8 pts) | 6a (2) | 1 pt | Ionization, not excitation; if HeII existed, excitation would occure readily |
| | | 1 pt | The line from HeII is not present because HeII ion is not abundant |
| | 6b (4) | 2 pts | The galaxy is selected to be in low mass regime. Lower mass galaxies typically have lower metallicity<br>the strong Ly-alpha may also bias the galaxy toward low metallicity and low dust (the line is not self-absorbed)<br>so, the selection of this galaxy may have biaed it toward being a low metallicity galaxy |
| | | 2 pts | From Figure 4 (left) there are only two such galaxies ever meaured! That's not much to stand on! Jury still out!!!<br>however, I will accept most any answer here as long as it is sensical. |
| | 6c (4) | 2 pts (i) | A galaxy with a large offset will have a higher escape fraction of Lya photons further out into the IGM |
| | | 2 pts (ii) | Lya emitters are good probes for determining the ionzation state of the IGM, and the distribution of velocity offsets is a critical input to the models that try to determine the ionization state of the IGM. |