

Regarding the frequency/velocity axis of PPV cubes, S3Map does the following to build the line emission cube for a single galaxy :

1/ From the rest-frequency of the line ν_0 and the redshift z , it computes the central frequency of the emission line

$$\nu_c = \frac{\nu_0}{1+z}$$

2/ It turns this into a line-of-sight velocity v_c via

$$v_c = c \frac{\nu_0^2 - \nu_c^2}{\nu_0^2 + \nu_c^2} = c \frac{(1+z)^2 - 1}{(1+z)^2 + 1}$$

3/ It computes the line width by computing the velocities associated with both ends of the line profile (for instance the two peaks of the double-horned profile). This is where the error came in as the pre-March 2012 S3Map computed this :

$$v_1 = v_c - \frac{w}{2} \quad \text{and} \quad v_2 = v_c + \frac{w}{2}$$

with w the line width, then turned these into frequencies via

$$\nu_1 = \nu_0 \sqrt{\frac{c - v_1}{c + v_1}} \quad \text{and} \quad \nu_2 = \nu_0 \sqrt{\frac{c - v_2}{c + v_2}}$$

Of course, the speed composition is problematic, from a relativistic point of view ! The proper speed composition is

$$v_1 = \frac{v_c - \frac{w}{2}}{1 - \frac{v_c w}{2c^2}} \quad \text{and} \quad v_2 = \frac{v_c + \frac{w}{2}}{1 + \frac{v_c w}{2c^2}}$$

the velocity to frequency conversion being the same. The error is of course important only when v_c is not small compared to c , i.e. at high redshift. Users of S3Map who built cubes before March 2012 for high-redshift lines should download the latest version and re-build their data.