The electron configuration of ununennium

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Main Article

The electron configuration of the first 118 elements has been observed to follow a simple pattern leading to some assumptions about the configuration of the next few elements. Each time a p sub-shell is completed, the s sub-shell just beyond is started. Element 118 has a complete 7p sub-shell, and no 8s electrons, so 119 (ununennium) is assumed to have 1 8s electron. While that is a possibility, another configuration is also possible.

The standard pattern is: 1s; 2s; 2p, 3s; 3p, 4s; 3d, 4p, 5s; 4d, 5p, 6s; 4f, 5d, 6p, 7s; 5f, 6d, 7p, 8s. The next group if the pattern holds would be: 5g, 6f, 7d, 8p, 9s. However, it is necessary to look at the underlying cause of the pattern. Treating the electrons as being in elliptical orbits with eccentricity rising in steps is one view of the cause. Here, the next sub-shell filled is the one with a vacancy whose high point is lower than any other sub-shell with a vacancy. This is the sequence: 1; 2; 2-x:2+x, 3; 3-x:3+x, 4; 3-2x:3+2x, 4-x:4+x, 5; 4-2x:4+2x, 5-x:5+x, 6; 4-3x:4+3x, 5-2x:5+2x, 6-x:6+x, 7; 5-3x:5+3x, 6-2x:6+2x, 7-x:7+x, 8; 5-4x:5+4x, …

From this view, a step size can be approximated. Since 2p fills after 2s and before 3s, the step size (x) is between 0.001 and 0.999. Since 3d fills after 4s and before 4p, the step size is between 0.501 and 0.999. Since 4f fills between 6s and 5d, the step size is between 0.667 and 0.999. If the step size is less than 0.750, the 5g will fill before the 8s. If the step size is greater than 0.750 the 5g will fill after the 8s. Had the 5g filled before the 7p, the step size would have been less than 0.666 which is not the case due to the 4f data point.

From secondary evidence, a step size (x) of 0.707 (the square root of 0.5) looks right. With energy falling as the square of distance from the nucleus, this gives an even pattern. The top of the orbits is now: 1.00, 2.00, 2.71, 3.00, 3.71, 4.00, 4.41, 4.71, 5.00, 5.41, 5.71, 6.00, 6.12, 6.41, 6.71, 7.00, 7.12, 7.41, 7.71, **7.83**, 8.00, …

It should be possible to find the exact step-size by analyzing the kinetic energy of the Hydrogen 1 atom with sufficient precision. A 1s electron has 13.598 517 eV in Kinetic Energy (with the proton having 0.007 406 eV). An 8s electron has 1/64th as much: 0.212 477 eV. The Kinetic energy of the 5g electron varies based on distance, with an average around 0.544 eV. The maximum energy (at the lowest point of the orbit) is around 2.9

eV, and the minimum energy (at the highest point of the orbit) is around 0.2 eV. If Kepler's law was exact, the mean energy would give an exact solution, but the relativistic effects (especially near the low point) make the calculation non-trivial. At the low point the effective mass is 0.0005% higher than at the high point, causing the velocity to be slightly lower than Kepler would have predicted. From the relativistic effects, the mean kinetic energy of the eccentric cases is very slightly higher than the spherical cases. The largest difference would occur in the 2p case (estimated to be about .0015% difference: 3.399 68 vs 3.399 63 eV), which should be examined with particular care. The easiest measurement would be the drop from each to the 1s case, 50 micro eV of 10.2 eV, which is normally within the uncertainty of measurements.

If ununennium has a 5g electron, the next 17 elements would fill the 5g sub-shell (with an 8s electron added temporarily after 9 5g electrons, due to the stability of a half-full sub-shell – similar to the configuration of Gadolinium). This would give 18 noble elements at the end of the periodic table (plus 2 alkalis: element 128 and 137). Dirac's limit sets a ceiling to atomic number around 137, so no additional configurations would occur. Boiling point on the final 20 elements is rather high for a noble gas (and the melting point of the alkalis is rather low), with at least some liquids at room temperature.