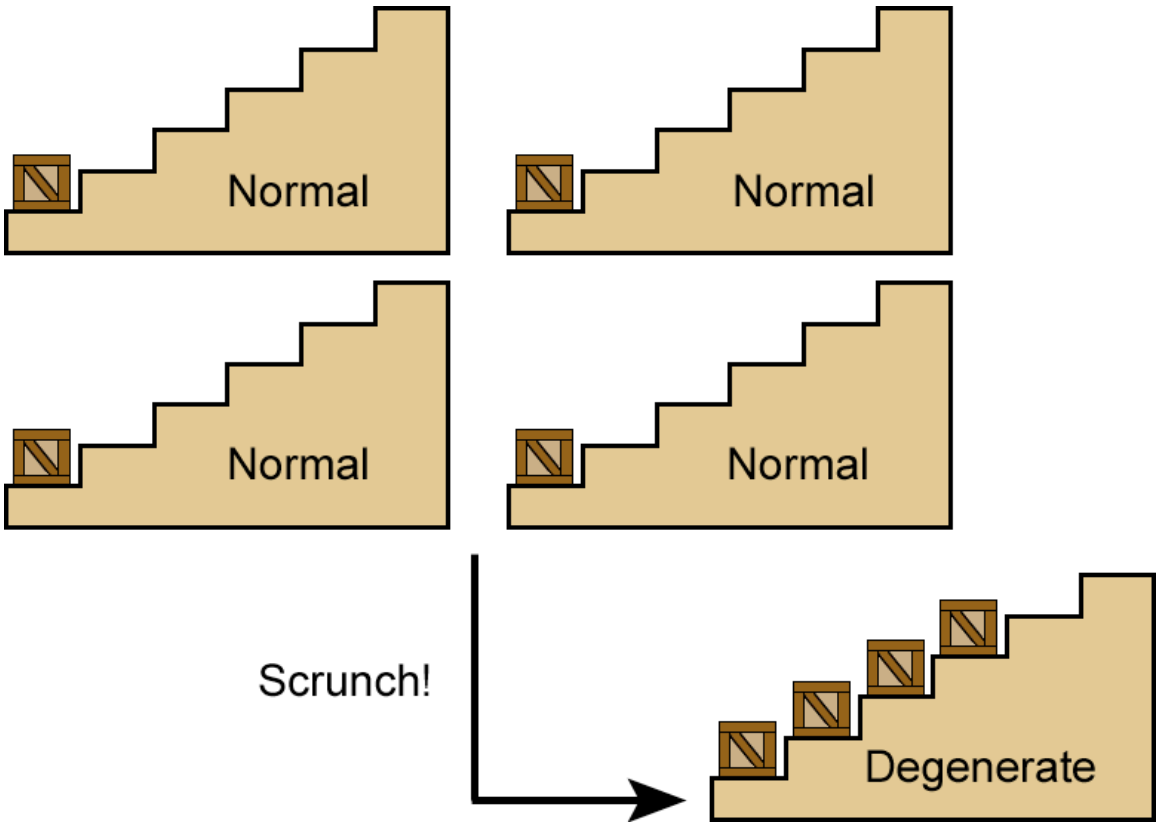
Plate 4



This schematic illustrates the difference between hydrogen at low density and hydrogen crushed to electron-degenerate density. If we think of one hydrogen atom as a separate staircase and its one electron as a crate, then the crate must sit at specific heights as represented by the steps. At lower pressure, the hydrogen atoms are far enough apart that each electron has its own staircase and can settle down the to the lowest energy level. Even if the electron is elevated to a higher level, for example by UV radiation, it will quickly "bounce down" the stairs to the lowest step again, something like water running down a ramp.

In an electron-degenerate gas, however, the atoms are so close together that the "probability clouds" of electrons from different atoms overlap. Quantum mechanics does not allow two electrons to occupy the same quantum state, so virtually all of the electrons are pushed to very high energy by the gravitational pressure. In other words, it is one crate per step, and the only way an electron can find an empty step is by climbing the stairs. That requires energy. Primarily for this reason, electron-degenerate matter is much more resistant to pressure than normal matter.

Degenerate electrons carry so much energy that they do not "belong" to any one nucleus, as their lower-pressure brethern do. They form the quantum-mechanical equivalent of a churning mob, flowing between the atomic nuclei like desperate Christmas shoppers searching for the last Cabbage Patch doll in town, except that the electrons are desperate to find the last unoccupied energy level.