Uncovering the Secret Life of Molecules: Adventures in Physics and Chemistry
At the bottom of the image:

Atomic masses in parentheses are those of the most stable or common isotope.

Note: The subgroup numbers 1–5 were adopted in 1989 by the International Union of Pure and Applied Chemistry. The names of elements 1–118 are the Latin equivalents of their chemical symbols.
‘Picture’ of an atom
Molecules: Water

Electron density around the Oxygen atom is 10x that around the Hydrogen atoms
Dimer (2 water molecules)

Hydrogen bond
Structure of Ice: Solid water

*more is different!*
Laser lab in Amsterdam
Absorption Spectrum of Liquid Water
The Horse in Motion: Muybridge 1878
Water Molecule Vibrations

- $v_1$: symmetric stretch
- $v_3$: asymmetric stretch
- $v_2$: bend
- $x$, $y$, $z$: librations
Femtosecond lasers
Intermolecular Proton Transfer
Diffraction Patterns: Learning about the arrangement of atoms
Making Movies of Molecules with Ultrafast Electron Diffraction

UED is a stroboscopic technique that can determine the ‘instantaneous’ atomic configuration of molecules and materials during photoinduced processes.
Ultrafast (t<10^{-10} s) diffractometer
An atomic level view of melting

Lattice temperature rises (vibrational excitation)

Homogeneous nucleation of melt zones – structural collapse

Liquid-like disordered state is reached
Time-Resolved (150 ps) X-ray Crystallography at the ESRF

Watching a Protein as it Functions