Precision Time Measurements in Physics

Fine structure constant:
This constant characterizes the strength electromagnetic interaction within the Standard Model. As atoms are formed with positive and negative charges, this constant appears as a scaling factor of the expression of energy levels from which clock frequency is measured.

Fundamental constants:
Throughout all of the formulations of the basic theories of physics and their application to the real world, there appear again and again certain fundamental invariant quantities. These quantities are called the fundamental physical constants. See for instance: http://physics.nist.gov/cuu/Constants/.

Gravitational red shift:
Shift of the frequency of the light (or any electromagnetic field) with the position of the light source in the gravity field. This striking prediction of General Relativity has been experimentally verified to high precision using atomic clocks. The effect must be taken into account for operating global navigation satellite systems for these systems to deliver accurate timing and positioning information.

International AtomicTime (TAI):
It is a practical timescale for world-wide use. It is computed by the Bureau International des Poids et Mesures (BIPM) by judicious weighting of some two hundred atomic clocks in over 50 national laboratories. Note that further definitions related to the present topic can be found in French and in English on the BIPM website at http://www.bipm.org/.

Light shift:
This shift of energy levels of atoms appears when the frequency of the light interacting with the atom is not resonant with this atomic oscillator.

Second:
The definition of the second of the international system of units (SI) is as follows: “The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.”

Secondary representation as a second:
as any unit, the second relies on a very precise definition, based on the Cs atom. However if another clock is developed with performances as good as the official clock (which can be foreseen only with many comparisons with official clock) then this new realization can be used to realize practically this unit.

Laser-cooling and trapping of atoms:
These terms are referring to a variety of techniques making use of lasers to trap and cool a sample of atoms for various purposes. One application is to obtain a very well-controlled sample of atoms, suitable for making highly accurate atomic clocks.

Optical frequency comb:
The output of some special kind of lasers (mode-locked femtosecond lasers) is made of a large number of equality spaced optical frequency components. The light of such a comb can be used to measure optical frequencies. This technique has made optical frequency measurements considerably easier. This has been one of the key elements in recent developments in optical clocks and optical frequency measurements.