optical parametric oscillator

**Acronym:** OPO

Light source similar to a laser, but based on 'non-linear optical gain' from parametric amplification rather than on stimulated emission.

**Notes:**
1. The device is a powerful solid-state source of broadly tunable coherent radiation. It consists of a crystal, usually BBO (BaB$_2$O$_4$), located inside an optical resonator and pumped by a very intense laser beam (typically provided by a pulsed neodymium laser or a diode laser). The pump beam (wavelength $\lambda_p$, frequency $\nu_p$) is partially converted into two coherent beams, the signal and the idler, with wavelengths ($\lambda_s$, $\lambda_i$) and frequencies ($\nu_s$, $\nu_i$) such that $\nu_s + \nu_i = \nu_p$. By simultaneous rotation of the crystal and adjustment of the optical resonator, the wavelength of the signal beam is continuously tunable, theoretically from $\lambda_p$ to $2 \times \lambda_p$ and practically over a slightly more reduced range.

2. For example, for $\lambda_p = 355$ nm (3$^{rd}$ harmonic of a Nd:YAG laser), $\nu_s$ can be tuned from 400 nm (with $\lambda_i \approx 3.15$ $\mu$m) up to 600 nm (with $\lambda_i \approx 870$ nm).

3. This 'splitting of one photon into two photons' is the reverse of the 'sum frequency mixing' used, for instance, to generate the 3$^{rd}$ harmonic of a laser emission by mixing in a convenient crystal the fundamental and the frequency doubled beams (a way to get the 3$^{rd}$ harmonic much more efficiently than by pure frequency tripling as described under harmonic frequency generation).

**Source:**
PAC, 2007, 79, 293 (Glossary of terms used in photochemistry, 3rd edition (IUPAC Recommendations 2006)) on page 378