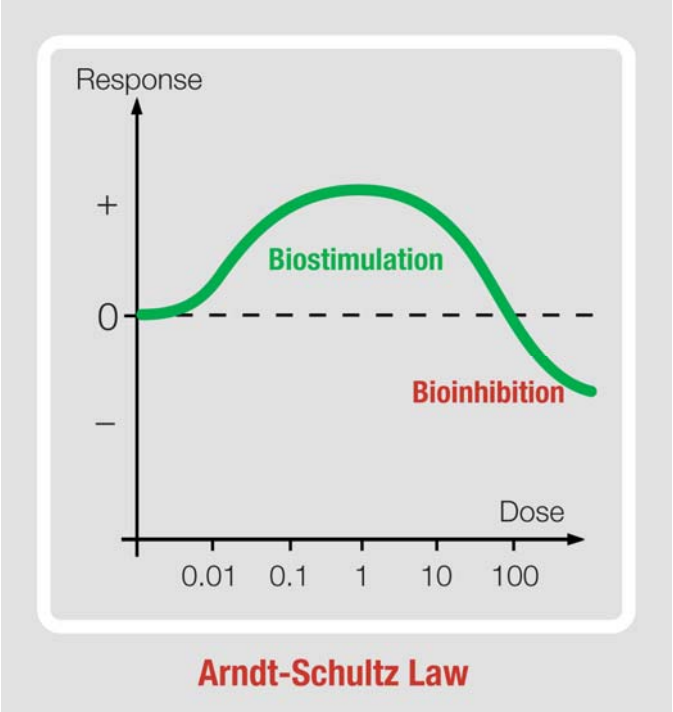
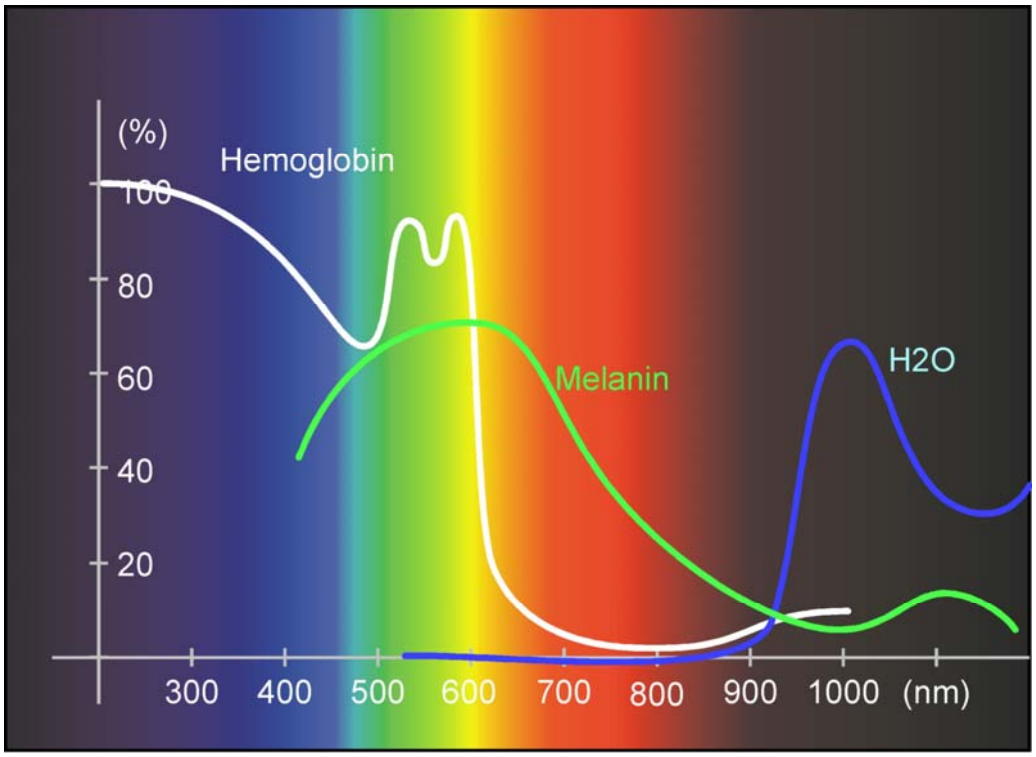
12 things you should know
before investing in a cold laser device

1. **Classification**: all lasers are classified according to their output power. The classification is based on **average output power per source**. As a general rule following applies:
   - Class 3B: 5 – 500 mW (1 milliWatt = 1/1000 of 1 Watt)
   - Class 4: more than 500 mW (no upper limit, i.e. there is no Class 5)
2. **Average vs. peak output power**: the laser energy is either delivered as a continuous wave or a pulsed wave (also called frequency modulated). In a pulsed wave the ratio between average and peak output is called the duty cycle. See definitions.
   Some companies label their device based on peak output power and – as an example - market a device as a Class 4 laser that in reality is only 25 mW average output power. This is obviously misleading.
3. **One source vs. multiple sources**: many laser devices have more than one output source. In all devices available in today's marketplace this source is a laser diode. If the device has one laser diode with up to 500 mW it is a Class 3B laser. If has two laser diodes of 500 mW it is also a Class 3B laser. If it has 100 laser diodes of 500 mW, it is still a Class 3B laser. Many companies with 3 or 4 500 mW laser diodes label their device as Class 4, probably because it sounds like "more". This is not correct.
4. **Cold vs. hot laser**: the term "cold laser" is a popular nickname along with "soft laser" for a Class 3B laser. Hot lasers – or hard lasers – are Class 4 lasers.
5. **Is Class 4 better than Class 3B?** A Class 4 laser has more output power than a Class 3B laser according to definition, that much is obvious. But Class 4 lasers will cut, burn or vaporize and are normally used for a variety of surgical procedures. A Class 3B laser, on the other hand, has a biostimulating effect and enhances the natural cell activity and the immune system. A Class 4 laser that is used for biostimulation is in reality defocused* so much that it becomes a Class 3B laser. So the question is rather:
6. **Is more power better?**:
   Yes and no. When a large volume of tissue needs to be treated, a high output power - distributed over an area and not too concentrated - is beneficial and will cut down the treatment dramatically. This is clearly an advantage. On the other hand, a high output power can easily lead to an overdosage, see below. On high powered units it is very important to be able to reduce the output power for sensitive areas.
7. **Can laser therapy be overdosed?**
   Very easily. According to the Arndt-Schultz Law, too much stimulation will inhibit rather than stimulate the cell activity. This is especially the case in areas with very small volume of soft tissue, like an elbow. For indications like this, WALT recommends max 100 mW/cm2.



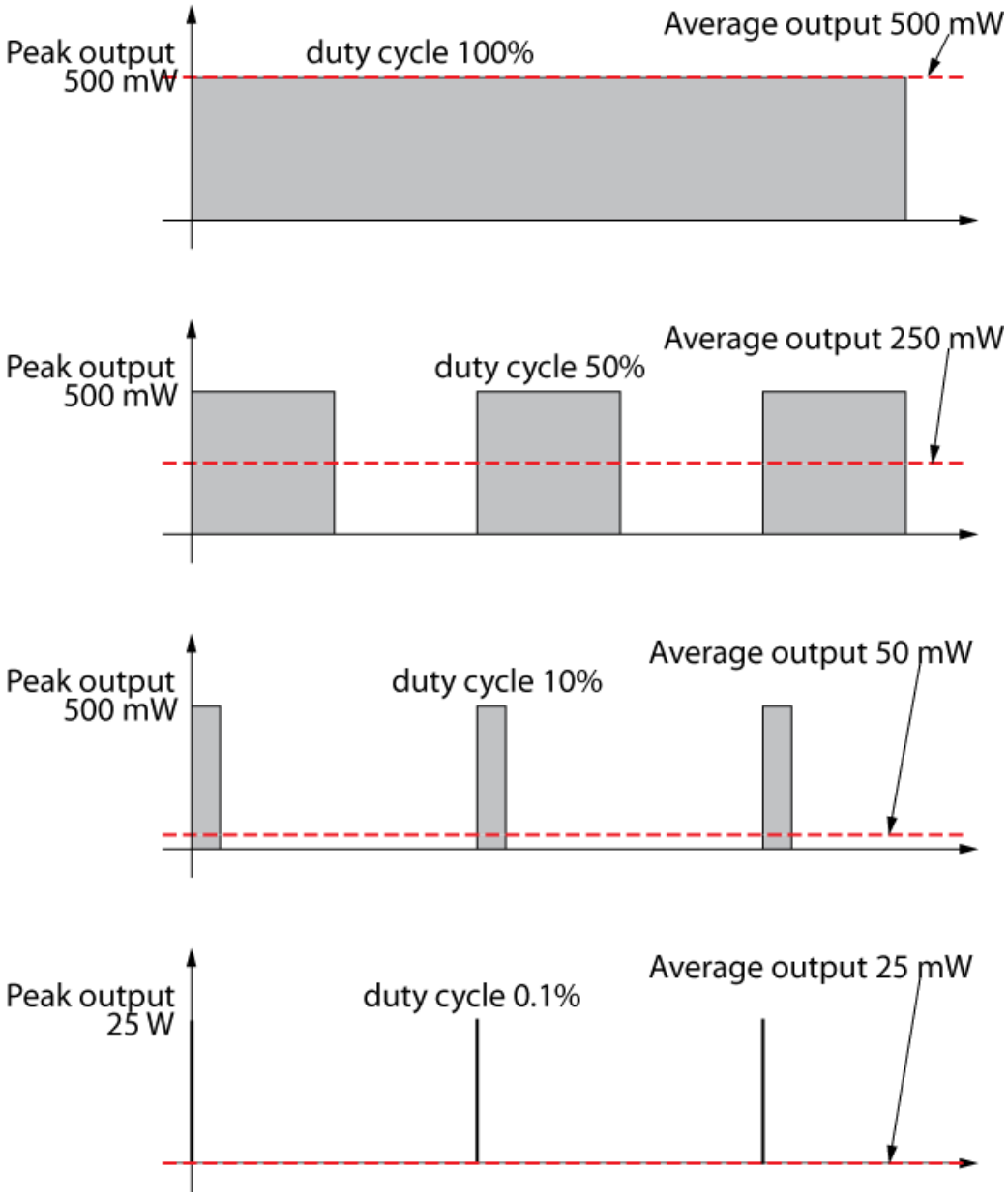
8. **Continuous wave vs. super-pulsed, is one better than the other?** according to WALT* continuous wave and super-pulsed lasers have exactly the same indications. Tables with recommended dosages for both continuous mode and super pulsed lasers are available at www.walt.nu and they show the exact same applications. The only difference is that super-pulsed lasers need 2-4 times less energy dose, i.e. on average they are 3 times more effective when compared on average output power. In other words, a 500 mW continuous mode laser equals a 167 mW super-pulsed laser in efficiency.
9. **Laser vs. LED**: because of the coherence (see def.) laser with the right wavelength will penetrate several cm's into the tissue. LED's are non-coherent and do not have the ability to penetrate more than a few mm's into the tissue. They will, however, have an effect in the superficial layers of tissue.
10. **Are certain frequencies better than others? Or none at all?**: Since the discovery of biostimulating laser therapy in the 1960's several thousand more or less scientific trials and studies have been performed, in order to isolate the most important parameters for a successful therapy. The general conclusion, assembled in various meta analyses, is that the two most important parameters are: **correct dosage** and **correct power density**. Frequency has no bearing at all. A few, isolated studies have shown certain frequencies to be more efficient for certain indications, but other studies have shown completely different frequencies for the exact same indications. In other words, no studies with frequencies have been reproduced with the same results.
11. **Wavelength, which is better?** Various components in the human body absorb light in different ways, as shown below. There are two windows with minimum absorption: one from 600 to 900 nm and another from 1100 to 1300 nm. Minimum absorption equals maximum penetration, so for deep tissue therapy, these are the optimal windows.



12. **Advice**: Ask for complete data, the most important being **average output power** and **wavelength**. Ask about laser classification. If it differs from the definitions given here, ask for an explanation. How concentrated is the laser output? Is it possible to reduce the output power? Is it stationary or portable? What are your specific needs? Is it easy to use? What is the backup? Education? Warranty?

Definitions:

Continuous wave laser diode: most laser diodes are designed to work in continuous wave, i.e. when it is ON it is ON constantly, like the headlight on your car. They can be pulsed – as shown below – by switching them on and off, like the turn signal on a car. Continuous wave laser diodes are available in all wavelengths from around 300 nm to well above 1000 nm.



Super-pulsed laser diode: this type of laser diode is designed to work only in an extreme pulsed mode: they are turned ON for a very short time with a very high peak output – and then left OFF for a time period equal to 1000 times the ON time. This is equivalent to triggering a camera flash (with a typical on-time of 1/1000 sec.) once every second. This type of laser diode is called a super-pulsed laser diode. The wavelength is always 904 nm (or more rarely, 905 nm). It is important to understand that a super-pulsed laser is turned OFF 999 times more time than it is ON. For example, if a super-pulsed laser is used for 10 seconds, the laser has only been ON for 10 milliseconds, or 1/100 of a second. The remaining time it has been OFF. The ratio between the on-time and the total time is called the duty cycle. This is also equal to the ratio between the peak power and the average power. A typical super-pulsed laser has a duty cycle of 0,1% and with a peak output power of 25 W the average output power is 25 mW.

WALT: World Association of Laser Therapy. A non-profit organisation devoted to promoting research, education and clinical application of laser photo stimulation world-wide. www.walt.nu

LASER: laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser is light that is monochromatic and coherent. In more layman's terms, this means that the light is very pure and very precisely organized. These properties enable the laser light to penetrate deep into the the tissue (if it is the right wavelength), much deeper than LED's.

LED: LED's are Light Emitting Diodes and they are used everywhere, from traffic lights to stoplights in cars, in gigantic billboards and in miniature flashlights. Hence they are very cheap and the marketplace is being flooded with LED devices.

Dosage: total energy dosage measured in Joules. Calculated as (average) Power x Time, measured in Watt x seconds.

Power density: Watt/cm2, an indication of how concentrated the laser beam is. For deep tissue work 500 mW/cm2 is fine, more sensitive points should be limited 100 mW/cm2.

Defocused: instead of being concentrated in a focal point, the laser beam is expanded over a larger area.

Biostimulating laser therapy: also known as Low Level Laser Therapy, LLLT, or laser photo stimulation, or Laser Phototherapy.