We study optical science aiming at creating new value for light. In particular, paying attention to the potential of infrared light, we are developing a state-of-the-art laser that emits a strong flash of infrared light. Using this ultrashort infrared light, we create a new method for identifying and manipulating the microscopic structures of matter. Prospects include applications to ultrasensitive molecular detection, chemical analysis imaging, chemical reaction control, and ultrafast optoelectronics.

**Infrared Femtosecond Lasers**

The ultrafast optical pulse is an electromagnetic wave that has a temporal duration of hundreds of femtoseconds. Mid-infrared ultrafast optical pulses consist of coherently superposed, or ‘mode-locked’ infrared electromagnetic waves, bringing high peak intensity and broadband spectrum.

**Spectroscopy & Reaction Control**

Infrared light can directly excite molecular vibrations, which enables us to investigate molecular structures and to control chemical reactions. We are developing novel molecular measurement and control methods utilizing state-of-the-art optical technologies including infrared ultrashort pulsed lasers.

**Optical-Field-Driven Electronics**

The intense optical field of infrared ultrashort pulses can control electron wave packets on the attosecond scale. We are developing a detector that can catch up with optical frequencies beyond 100 THz in combination with the field enhancement properties exhibited by metallic nanostructures.