Wavelength tunable, GHz repetition rate picosecond pulse generator using an SBS frequency comb

Background
Precise frequency and time measurements constantly require better reference clocks such that microwave clocks, which are approaching their intrinsic limitations, are slowly being replaced by optical clocks. The challenge with current optical clocks based on mode-locked femtosecond laser frequency combs is to obtain repetition rates (or mode spacing) above 10 GHz, which is required by many applications. Moreover, the disadvantage with mode-locked lasers is that they require active cavity control. More compact and robust generators are also needed for use outside the lab.

Technology
A completely new type of frequency comb is proposed based on self-phase-locked stimulated Brillouin scattering (SBS) in a single length of fiber, seeded by a CW laser. Since SBS doesn’t rely on oscillating modes, no fine adjustments to the cavity are required, and the output is much more stable in temperature. Picosecond coherent pulses can be generated at a very stable repetition rate of a few tens of GHz which depends on the nature of the fiber. The concept has been tested at wavelengths suitable for optical communications but could work at any wavelength.

Application
The possible applications include metrology for time, frequency and distance measurements and LIDAR as well as a wide range of spectroscopic methods such as time-resolved or high precision molecular spectroscopy and terahertz spectroscopy. The latter is applicable for example to quality inspection in the plastic and paper industries and remote detection of explosives or illicit drugs. The clock can also be used for calibrating tunable lasers or astronomical spectrographs used for exoplanet searches. As a source for optical coherence tomography (OCT), the generator opens up new possibilities in medical imaging. In the telecom industry, the larger number of individual lasers used for each channel could be replaced by a single laser coupled to a frequency comb.

Competitive Advantages
- Tunable wavelength simply controlled by the input wavelength
- High and very stable repetition rate (20 GHz)
- Stable in temperature
- Tunable pulse width and repetition rate
- Linear dependence with temperature, which could be used for fine tuning
- Self-starting and low threshold
- Simple and robust design (doesn’t require fine adjustments to the laser cavity)
- Low cost and compact

Patent

Next Steps
This technology is already available for licensing.

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