One receiver would have the functionality of multiple traditional heterodyne microwave receivers.

In wide-band microwave receivers of a type now undergoing development, the incoming microwave signals are electronically preamplified, then frequency-up-converted to optical signals that are processed photonically before being detected. This approach differs from the traditional approach, in which incoming microwave signals are processed by purely electronic means. As used here, "wide-band microwave receivers" refers especially to receivers capable of reception at any frequency throughout the range from about 90 to about 300 GHz. The advantage expected to be gained by following the up-conversion-and-photonic-processing approach is the ability to overcome the limitations of currently available detectors and tunable local oscillators in the frequency range of interest.

In a receiver following this approach (see figure), a preamplified incoming microwave signal is up-converted by the method described in the preceding article. The frequency up-converter exploits the nonlinearity of the electromagnetic response of a whispering-gallery-mode (WGM) resonator made of LiNbO$_3$. Up-conversion takes place by three-wave mixing in the resonator. The WGM resonator is designed and fabricated to function simultaneously as an electro-optical modulator and to exhibit resonance at the microwave and optical operating frequencies plus phase matching among the microwave and optical signals circulating in the resonator. The up-conversion is an efficient process, and the efficiency is enhanced by the combination of microwave and optical resonances.

The up-converted signal is processed photonically by use of a tunable optical filter or local oscillator, and is then detected. Tunable optical filters can be made to be frequency agile and to exhibit high resonance quality factors (high Q values), thereby making it possible to utilize a variety of signal-processing modalities. Therefore, it is anticipated that when fully developed, receivers of this type will be compact and will be capable of both wide-band and narrow-band signal processing. Thus, one compact receiver of this type would afford the functionality that, heretofore, could have been obtained only by use of multiple heterodyne microwave receivers.

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