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Title

Principles and promise of Fabry-Perot resonators at terahertz frequencies

Source

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Abstract

Fabry-Perot resonators have tremendous potential to enhance the sensitivity of spectroscopic systems at terahertz (THz) frequencies. Increasing sensitivity will be of benefit in compensating for the relatively low power of current high resolution continuous wave THz radiation techniques, and to fully express the potential of THz spectroscopy as source power increases. Improved sensitivities, and thus scanning speeds, will allow detailed studies of the complex vibration-rotation-tunneling dynamics that large molecules show at THz wavelengths, and will be especially important in studying more elusive, transient species such as those present in planetary atmospheres and the interstellar medium. Coupling radiation into the cavity presents unique challenges at THz frequencies, however, meaning that the cavity configurations common in neighboring frequency domains cannot simply be translated. Instead, novel constructions are needed. Here we present a resonator design in which wire-grid polarizers serve as the input and output coupling mirrors. Using this configuration, Q-factors of a few times 10⁵ are achieved near 0.3 THz. To aid future investigations, the parameter space that limits the quality of the cavity is explored and paths to improved performance highlighted. Lastly, the performance of polarizer cavity-based Fourier transform (FT) THz spectrometers is discussed, in particular those design optimizations that should allow for the construction of THz instrumentation that rivals and eventually surpasses the sensitivities achieved with modern FT-microwave cavity spectrometers. (33 References).