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Limits of Bioparticle Detection in NanoLaser Microfluidic Chips and Application to Cancer Detection in Single Cells and Mitochondria PAUL L. GOURLEY, BRETT A. GOURLEY, HighLight, HIGHLIGHT RESEARCH LABS TEAM — BioChips comprising light-emitting semiconductors can be configured as microfluidic laser cavities used for ultrafast analysis of bioparticles such as whole cells, organelles, virons, and macromolecules (protein,DNA,RNA). Three regimes of operation include: 1.Geometrical limit (particle radius a$>>\lambda$ the laser wavelength), laser exhibits multimode spectra useful to study particle morphology, shape, and composition. 2. Mie regime (a$\approx\lambda$) laser exhibits nano-squeezed light with single mode operation to study particle size and composition. 3.Rayleigh limit (a$<<\lambda$) laser exhibits cavity mode fluctuations to study nanoparticle mass and motion. We have recently used these biochips to study the nanolaser spectra of submicron mitochondrial bioparticles as a new probe of cancer in single cells. These high-speed, nanophotonic tools may play an important role in advancing early detection of cancer and offer improvements over conventional tumor pathology that relies on labor-intensive microscopic examination and/or older cell-staining methods that can be time-consuming and may give false readings.

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