

orientation. To excite the resonant whispering-gallery modes, light is introduced into the WGM resonator via another optical fiber that is part of a pigtailed fiber-optic coupler.

Light extracted from the WGM resonator is transformed into a high-angular-momentum beam inside the extraction optical fiber and this beam is emitted from the polished flat output end. By adjusting the geometry of this apparatus, it is possible to generate a va-

riety of optical beams characterized by a wide range of parameters. These beams generally have high angular momenta and can be of either Bessel or Bessel-related types.

*This work was done by Anatoliy Savchenkov, Lute Maleki, Andrey Matsko, Dmitry Strelakov, and Ivan Grudinin of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

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## Imaging Spectrometer on a Chip

**One integrated circuit would perform the functions of a conventional several-kilogram spectrometer.**

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A proposed visible-light imaging spectrometer on a chip would be based on the concept of a heterostructure comprising multiple layers of silicon-based photodetectors interspersed with long-wavelength-pass optical filters. In a typical application, this heterostructure would be replicated in each pixel of an image-detecting integrated circuit of

the active-pixel-sensor type (see figure).

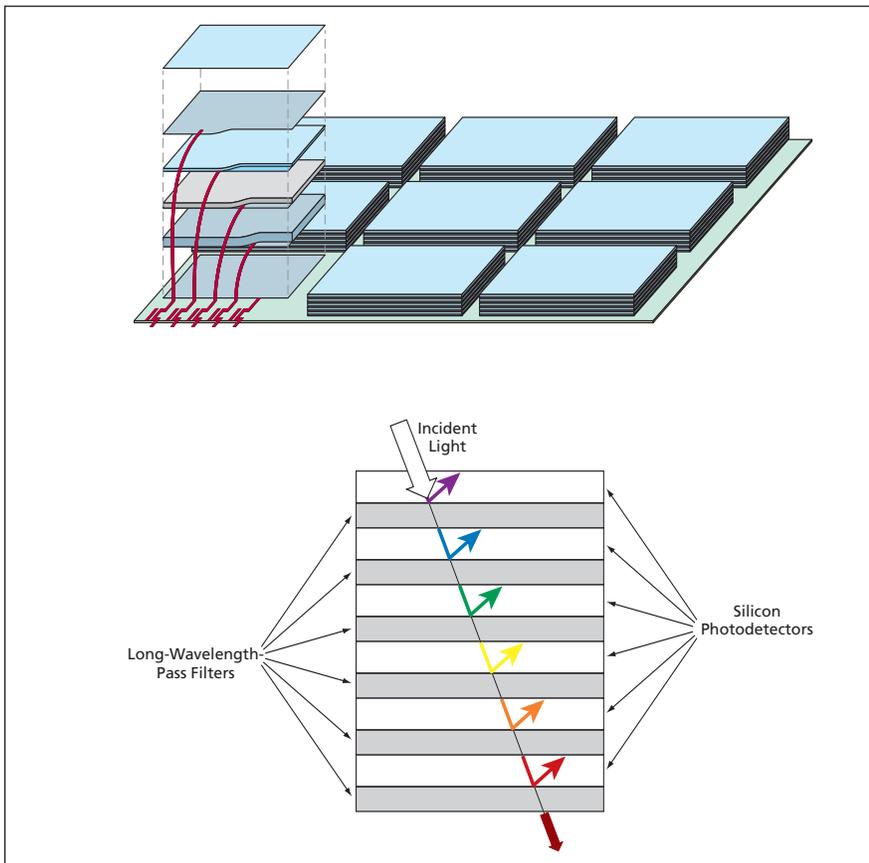
The design of the heterostructure would exploit the fact that within the visible portion of the spectrum, the characteristic depth of penetration of photons increases with wavelength. Proceeding from the front toward the back, each successive long-wavelength-pass filter would have a longer cutoff

wavelength, and each successive photodetector would be made thicker to enable it to absorb a greater proportion of incident longer-wavelength photons.

Incident light would pass through the first photodetector and encounter the first filter, which would reflect light having wavelengths shorter than its cutoff wavelength and pass light of longer wavelengths. A large portion of the incident and reflected shorter-wavelength light would be absorbed in the first photodetector.

The light that had passed through the first photodetector/filter pair of layers would pass through the second photodetector and encounter the second filter, which would reflect light having wavelengths shorter than its cutoff wavelength while passing light of longer wavelengths. Thus, most of the light reflected by the second filter would lie in the wavelength band between the cutoff wavelengths of the first and second filters. Thus, further, most of the light absorbed in the second photodetector would lie in this wavelength band. In a similar manner, each successive photodetector would detect, predominantly, light in a successively longer wavelength band bounded by the shorter cutoff wavelength of the preceding filter and the longer cutoff wavelength of the following filter.

*This work was done by Yu Wang, Be-dabrata Pain, Thomas Cunningham, and Xinyu Zheng of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-41125*



Each Pixel of an Active-Pixel Sensor would contain multiple photodetector/filter pairs operating at successively longer wavelengths.