A Technique for Adjusting Eigenfrequencies of WGM Resonators

NASA's Jet Propulsion Laboratory, Pasadena, California

A simple technique has been devised for making small, permanent changes in the eigenfrequencies (resonance frequencies) of whispering-gallery-mode (WGM) dielectric optical resonators that have high values of the resonance quality factor (Q). The essence of the technique is to coat the resonator with a thin layer of a transparent polymer having an index of refraction close to that of the resonator material.

Successive small frequency adjustments can be made by applying successive coats. The technique was demonstrated on a calcium fluoride resonator to which successive coats of a polymer were applied by use of a hand-made wooden brush. To prevent temperature-related frequency shifts that could interfere with the verification of the effectiveness of this technique, the temperature of the resonator was stabilized by means of a three-stage thermoelectric cooler. Measurements of the resonator spectrum showed the frequency shifts caused by the successive coating layers.

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

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-2240
E-mail: iaoffice@jpl.nasa.gov

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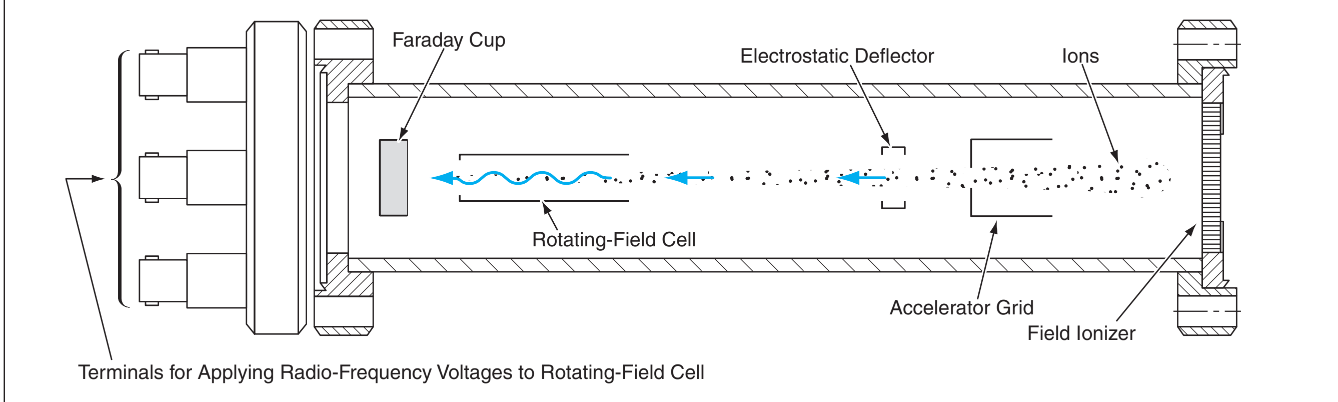
Low-Pressure, Field-Ionizing Mass Spectrometer

This lightweight, low-power instrument functions well in a low-grade (partial) vacuum.

NASA's Jet Propulsion Laboratory, Pasadena, California

A small mass spectrometer utilizing a miniature field ionization source is now undergoing development. It is designed for use in a variety of applications in which there are requirements for a lightweight, low-power-consumption instrument that can analyze the masses of a wide variety of molecules and ions. The device can operate without need for a high-vacuum, carrier-gas feed radioactive ionizing source, or thermal ionizer. This mass spectrometer can operate either in the natural vacuum of outer space or on Earth at any ambient pressure below 50 torr (below about 6.7 kPa) — a partial vacuum that can easily be reached by use of a small sampling pump. This mass spectrometer also has a large dynamic range — from singly charged small gas ions to deoxyribonucleic acid (DNA) fragments larger than 10^4 atomic mass units — with sensitivity adequate for detecting some molecules and ions at relative abundances of less than one part per billion.

This instrument (see figure) includes a field ionizer integrated with a rotating-field mass spectrometer (RFMS). The field ionizer effects ionization of a type characterized as "soft" in the art because it does not fragment molecules or initiate avalanche arcing. What makes the "soft" ionization mode possible is that the distance between the ionizing electrodes is less than mean free path for ions at the maximum anticipated operat-



A **Field Ionizer and a Rotating-Field Mass Spectrometer** are integrated into a single instrument that has a mass <1 kg and a power consumption <5 W.