These observations will ultimately prove of significance to astronomers. With the completion of the Canada-France-Hawaii telescope in 1978, it will be possible to perform superior astronomical observations, not only in the region of visible light but also at infrared frequencies. Of particular importance in these studies is the spectrum of ammonia, a molecule which is present in interstellar space. Measurement of the shift in its spectral lines from the accurate standards established in Dr. Oka's laboratory will furnish important information about the properties of interstellar dust clouds and the nature of our universe.

While his apparatus is designed to detect two photon transitions, Dr. Oka soon realized that he was obtaining additional effects which had only been speculated upon by theoreticians. He deduced that certain transitions are taking place in which several photons are absorbed at the same time. The observation of these multiphoton processes has sparked increased activity amongst theoreticians. The velocity-tuned multiphoton processes, so named by Dr. Oka, were one of the central subjects discussed in Les Houches Summer School of Theoretical Physics in France last year.

In the case of an average experimentalist, the story would end with the perfection of an important tool for the investigation of matter. However, Dr. Oka wished to take a further step and increase the sensitivity of his apparatus by causing it to respond to transitions so faint that they could never be observed by conventional means. The original motive for using an infrared laser had been the investigation of vibrational excitations in small molecules. These transitions, in turn, possess a "fine structure" meaning that a single line may be resolved into a set of closely-spaced lines. These additional lines represent further excitations of the molecule associated with lower energies, for example, molecular rotations and inversions. These transitions lie within the energy range of the microwave photons and it therefore becomes possible to tune microwave radiation exactly to one of these rotational transitions. The technique, known as double resonance spectroscopy, differs in procedure from Two Photon Spectroscopy, although in both cases two photons are absorbed during the transition. In Two Photon Spectroscopy, the microwave apparatus acts as a stepladder to the laser and is tuned so that the resultant of the laser and microwave radiation exactly matches a transition. In the double resonance technique, the microwave radiation is tuned to one of the intermediate rotational levels and the function of the laser radiation is to complete the transition to a new vibrational level, its advantage lying in the power available to excite the gas molecules.

By using the laser as a power source, the double resonance technique is able to probe exceedingly faint details of the microwave region. For example, Dr. Oka has recently observed fine structures in the vibrational spectrum of tetrahedral molecules such as methane, silane and germane, which indicate that rotational excitations are taking place, transitions which had previously been thought to be impossible. By placing a sample of methane gas within the cavity of various lasers and employing the double resonance technique, Dr. Oka is able to increase the sensitivity of his instrument by over a million times. In Dr. Oka's hands, the combination of powerful stable laser radiation together with the versatility of microwave sources provides an important new tool in the exploration of matter. □

David Peat

J.C. Doppler, mathematician and physicist, was born in Salzburg in 1803 and held the Chair of Experimental Physics at Vienna. His best known contribution to physics was the prediction of a frequency shift in radiation emitted from a moving source. The "Doppler shift" was later confirmed for both sound radiation and light and, in the latter case, is employed in the discovery of double stars.

J.C. Doppler, mathématicien et physicien, est né à Salzburg, en 1803, et a été professeur de physique expérimentale à Vienne. Sa contribution la plus connue en physique a été de prévoir le décalage de fréquence dans les radiations émises par une source mobile. Le "décalage Doppler" ou "effet Doppler", plus tard confirmé à la fois dans le domaine des radiations sonores et dans celui de la lumière est employé, dans ce dernier cas, pour découvrir les étoiles doubles.

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