N.G. Basov and A.M. Prokhorov, «Application of molecular beams for radiospectroscopic study of molecular rotational spectra» and «On the possible methods for obtaining active molecules for a molecular generator»

In the two papers *"Application of molecular beams for radiospectroscopic study of molecular rotational spectra"* (JETP v.27, no. 4 (10), pp. 431-438, 1954) and *"On the possible methods for obtaining active molecules for a molecular generator"* (JETP, v.28, no. 2, pp. 249-250, 1955), Basov and Prokhorov proposed a new principle for generating electromagnetic radiation via stimulated emission of molecules in an inverted state. This principle underlies the operation of masers and lasers.

The first of the two papers is devoted to the study of various methods for increasing the sensitivity and resolution of radiospectroscopic devices used in measuring rotational spectra of molecules. The parameters of a radiospectroscope with a waveguide absorbing cell were determined, and it was shown that the signal-to-noise ratio exceeding 50 can be expected even without rotational state sorting of molecules. Next, a version of a radiospectroscope with molecular rotational state sorting using a quadrupole capacitor was considered. The absorption cell was realized as a cavity resonator. It was shown that this system allows "studying not only the absorption spectra of molecules but also their emission spectra, because whenever desired, molecules in the top or bottom transition state can can be selected from the beam." Based on this result, the authors concluded that induced radiation can be obtained in this system: "Using a molecular beam that contains no molecules in the lower state of the transition under consideration, a "molecular generator" can be constructed." The operation principle and the self-excitation threshold of the molecular generator were also described.

In the second paper, the molecule sorting method by rotational states using a quadrupole capacitor was shown to be feasible in creating a microwave frequency range generator---an ammonia molecule maser. But because this does not allow obtaining active media capable of generating coherent radiation in the optical range, the authors suggested that inverse-population media can be obtained by high-frequency pumping of three-level systems.

The development of these ideas has led to further progress in quantum electronics of the optical range. In particular, the proposed scheme for obtaining inverse population is a key element of the first optical range generator (laser) with a ruby crystal. Currently, this scheme is used in a large number of lasers of different classes.

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