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Brief 71-10308

NASA TECH BRIEF

NASA Pasadena Office

Energy Levels and Transition Probability Matrix Elements of Ruby for Maser Applications

The problem:

To determine, to the first order, the performance of ruby (chromium doped Al_2O_3) as a maser material by investigating the ruby's basic maser properties, among which are five-structure energy levels and theoretical transition probabilities.

The solution:

A computer program which computes the fine-structure energy levels as a function of magnetic field and gives the transition probability matrix elements for chromium (+3) in ruby.

How it's done:

The paramagnetic energy levels of the ground state of chromium in ruby are calculated as a function of an externally applied magnetic field at an angle θ with the "C" axis. Additional results provided include the orthonormal eigenvectors, the transition probability matrix elements, the energy differences between all energy levels, and the figure of merit, $T\Delta f_L/(\%Cr+3)Qm$, where T is the temperature in Kelvin, Δf_L is the magnetic resonance linewidth in units of megahertz, (%Cr+3) is the percent concentration of chromium, and Qm is the magnetic Q.

Included in the computer program is the formation of a matrix, each row of which contains the magnetic field and the four corresponding energy levels. This matrix is set up for the user's convenience for plotting energy levels as a function of magnetic field.

Notes:

1. This program was written in FORTRAN V for use on the UNIVAC-1108 computer.
2. Requests for further information may be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B71-10308

Patent status:

No patent action is contemplated by NASA.

Source: R. W. Berwin of
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