The light as seen through the silvered ends went up by about three *orders* of magnitude. The spectral half-width of the 6,943 Å emission narrowed to one-thirtieth of its normal value. These experiments confirmed and extended the evidence of such behaviour first reported by Maiman.

By the absorption of light in the green portion of the spectrum the chromium ions in ruby are raised to a higher state from which they decay—practically instantaneously, for our present purposes—to an excited state ^2E; and it is the transition from this excited state back to the ground state that is accompanied by the well-known red fluorescent emission. Under normal conditions of irradiation the number of atoms in the excited state ^2E will of course be very much less than in the ground state. But by increasing the intensity of irradiation, the population in the ground state can be depleted, so that actually more atoms are in the excited state. When the population inversion becomes sufficiently pronounced, the course of events become rapidly dominated by the effects due to induced emission (Section 1), and consequent coherent self-amplification of the fluorescent radiation in the ruby. One may say that each chromium ion is so engulfed by the fluorescent radiation due to the others that each ion tends to emit radiation in phase-relationship with the rest. The mutual phase-relationships which actually result in the present case is such that the resultant radiation is directed as a parallel beam along the axis. That this 'mode' of coherent emission of the assembly of ions gets 'preferred'—to the exclusion of others which one can conceive of—is due to the plane-parallel and semi-silvered ends of the cylinder. For example, a ray appreciably inclined to the axis would leave the system after a few reflections; while a ray nearly parallel to the axis gets reflected back and forth, getting progressively amplified all the while (due to the population inversion in the medium).

The enormous sharpening of the spectral line-width of the fluorescent emission arises mainly because the frequencies near the centre of the 'natural' line-width are more effective in stimulating emission than the rest, and are consequently amplified to a greater extent. The effect is in a sense the converse of the tendency *towards self-reversal* near the centre of the spectral line, observed under normal conditions where effects due to induced absorption predominate. The fact, that energy absorbed over a wide range in the green part of the spectrum is compressed to within a spectral range of 0·2 cm.$^{-1}$, also contributes to the enormous specific intensity. In terms of a black-body emitting the same spectral density of radiation, the effective temperature of the source corresponds to 10^{10} degrees kelvin!

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TWO-QUANTUM TRANSITIONS IN ELECTRON PARAMAGNETIC RESONANCE

BURGET *et al.*, of the Institute of Nuclear Research, Prague, report cases of two-quantum transitions in Electron Paramagnetic Resonance (EPR) spectra. The essence of two-quantum transitions consists in the simultaneous absorption of two energetically different photons or in the simultaneous absorption of one photon and the emission of another photon having a different energy (Raman process), on the assumption that the condition of the conservation of energy and the angular momentum is preserved for the system in which this transition occurs. If we apply to a system of electron spins two high-frequency fields $H_1 \cos \omega_1 t$ and $H_2 \cos \omega_2 t$, where the first is parallel to the external static field H_0, and the second is perpendicular to it, the simultaneous absorption or absorption and emission of two kinds of photons $\hbar\omega_2$ (σ photons) and $\hbar\omega_1$ (π photons) may take place if it holds that $\hbar\omega_2 \pm \hbar\omega_1 = g\beta H_0$.

The case of emission is particularly important since the mechanism can be used to realize a maser in a system with a positive temperature, while all other types of masers are based on the creation of negative temperatures in the spin system.

The apparatus used for observing these transitions consisted of an EPR spectrometer, working on a frequency $\nu_2 = 8500$ MH$_z$, and an autodyne spectrometer for NMR, working on a frequency $\nu_1 = 13$ MH$_z$. The autodyne spectrometer simultaneously served as a generator on frequency ω_1 and as a detector of two-quantum transitions. The small coil of the autodyne spectrometer containing the sample, was located directly in the resonance cavity of the EPR spectrometer.—(*Czech. J. Phys.*, 1960, **10,** 547.)