Одиннадцатая Международная научно-техническая конференция
«Оптические методы исследования потоков»
Москва, 27 — 30 июня 2011 г.

УДК 004.942

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SIMULATION THE RANDOM LASER IN PLASMA OF GAS

Using Model calculations for laser action in He1 are carried out, when helium plasma is rapidly cooled by expansion. Results are presented for four transitions, they show strong population inversion.

RANDOM LASER, POPULATION INVERSION

INTRODUCTION

The Laser consists of three main parts (effective materials, resonator and pumping power), but some effective materials produces laser without resonator, they are based (in that case) on the many numbers of reflections of the photons inside the center, With very small attenuation distance (average free path) it must be less than the order wavelength. We call this cavity " random lasers", A “random laser” of ZnO_2/TiO_2 spheres glows with laser-like light. Monochromatic flashes are initiated by a few “lucky” photons that remain inside the material for a long time [1].

And we find the random lasers in the community conditions with a high temperature and high concentrations. It is available in surface layers plasma of stars [2].

METHOD OF STUDY

The theoretical study Indicate that, the random lasers is quantum system, It his working model is the four energy levels, The known equations to calculate the population inversion as follows [3]:

$$\dot{n}_i \equiv \frac{\mathrm{d}n_i}{\mathrm{d}t} = -n_e n_i S_i - n_e n_i \sum_{j \neq i}^{\infty} C_{ij} - n_i \sum_{j=1}^{i-1} A_{ij} + $$
$$+ n_e \sum_{j \neq 1}^{\infty} n_j C_{ji} + \sum_{j=i+1}^{\infty} n_j A_{ji} + \{\beta_i + \alpha_i n_e\} n_e n^+ ,$$

where i and j symbolically represent energy states available to the bound electron. n_+ io n density; n_e electron density; C_{ij} rate coefficient for excitation ($i<j$) or de-excitation ($i>j$) from level i to j by electronic collision; A_{ij} Einstein coefficient for radiative transition from level i to j; S_i rate coefficient for ionization from level i by electron collision; α_i that for three-body recombination to level i; β_i that for radiative recombination.

And can solve the equations for the limited numbers of photons that might exist in the effective materials, such as (He I) and ions of hydrogen, we need for solution the equations one function. which appointment of the relaxation state for the (He I) plasma in thermodynamic certain conditions, such as:

$$n_i = n_i^E \equiv Z_i n_e n^+ \quad \text{for } i > r\,,$$

$$Z_i = \{g_i/2\omega^+\}\,(h^2/2\pi mkT_e)^{3/2}\exp(\chi_i/kT_e)\,,$$

CONCLUSION

We find that, the laser plasma in the random stars with high abundance of helium, generating four random lasers are:

$$3^1S \rightarrow 2^1P^0(\lambda 7281), \text{ and } 3^1D \rightarrow 2^1P^0(\lambda 6678).$$
$$4^1S \rightarrow 2^1P^0(\lambda 5047) \text{ and } 4^1D \rightarrow 2^1P^0(\lambda 4922).$$

And that the relationship (with the available density of states of the population inversion) is one of the following form:

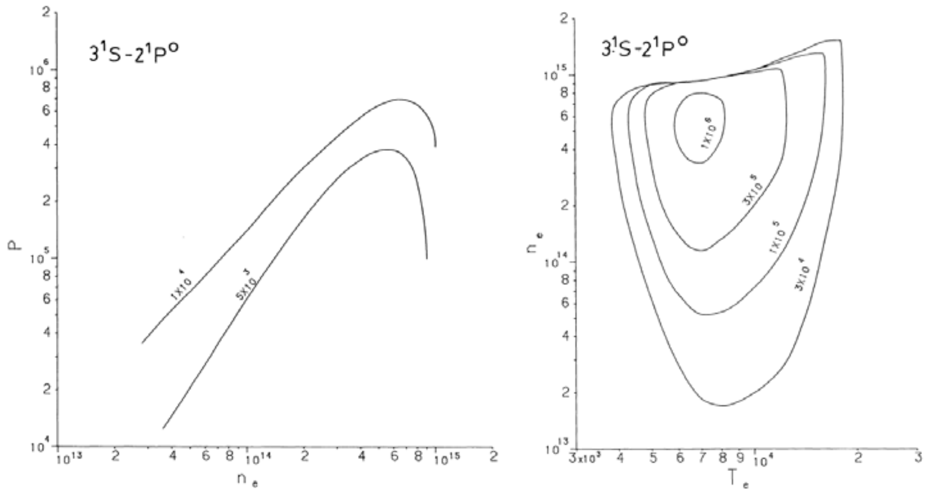

Fig. 9. P (population inversion) as a function of n_e for $\lambda = 7281$. The numbers by the side of curves represent T_e values in K. P (population inversion) as a function of n_e and T_e for 117281. The numbers by the side of contours represent P values in cm^{-3}

And all together to a potential Player schemes in particular, the relationship with temperature the plasma.

REFERENCE

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МОДЕЛИЗАЦИЯ ХАОТИЧЕСКОГО ЛАЗЕРА В ГАЗОВОЙ СРЕДЕ

Проведено численное моделирование работы лазера в среде He1 при быстром охлаждении плазмы, состоящей из ионов гелия, вызванном ее расширением. Представлены результаты для четырех переходов, все они имеют высокую степень инверсной населенности.

ХАОТИЧЕСКИЙ ЛАЗЕР, ИНВЕРСНАЯ НАСЕЛЕННОСТЬ