Parametric Decay Instability In 3C 273

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ABSTRACT: The parametric decay instability (PDI) causes anomalous absorption of strong electromagnetic (e.m) radiation under specific conditions of energy and momentum conservation. It is shown that in the source 3C 273, the conditions are conducive to the excitation of PDI. This process also contribute towards the absorption of 21-cm radiation.

1. INTRODUCTION.

It has been recognized for a long time that the intense thermal and/or non-thermal UV and X-ray radiation emitted by AGN is responsible for heating and ionizing the line emitting regions. Davidson and Netzer (1979) have reviewed some of the additional heating processes. We propose a process for the absorption of radio waves and hence the heating of line-emitting regions due to the collective plasma process called PDI which can be driven by the intense radio radiation emanating from the central region. The incident e.m radiation is anomalously absorbed in the plasma at a rate which is much larger than the collisional absorption rate. The excitation of PDI in the emission-line regions of quasars was first discussed by Krishan (1987).

2. PARAMETRIC DECAY INSTABILITY (PDI).

An incident e.m pump wave $(\omega_o, \vec{K}_o)$ excites a high frequency electron plasma wave $(\omega_e, \vec{K}_e)$ and a low frequency ion-acoustic wave $(\omega_i, \vec{K}_i)$ such that

$$\omega_o = \omega_e + \omega_i, \quad \vec{K}_o = \vec{K}_e + \vec{K}_i \tag{1}$$

3. FORMATION OF 21-CM ABSORPTION LINE IN THE EMISSION-LINE REGION.

21-cm is believed to originate in the neutral hydrogen clouds in the vicinity of the QSO. This absorption line can also originate when the radiation of frequency 1420 MHz (21-cm) drives the PDI in the plasma having electron plasma frequency close to 1420 MHz. This effect was first considered by Krishan (1988). This process has line charter in principle since it occurs only when a frequency matching condition is satisfied but due to the density inhomogeneity the line will be significantly broadend. The presence of 21-cm absorption line indicates that the electron density in the emission-line region must be $\simeq 2.5 \times 10^{10} cm^3$.

4. RESULTS AND CONCLUSIONS.

(1) For circularly polarized pumps the general picture remains unchanged, since growth rates are again determined by the component of $\vec{K}_o$ parallel to $\vec{K}$.

(2) The absorption rate of e.m wave due to PDI depends on the ratio (L_{41}/r_{pc}^2) and it is much larger than the free-free absorption rate ν_o.

(3) Electron temperate T_e and ion temperature T_i increase by multiples of tens for moderate radio luminosities.

(4) The observed dip in the spectrum of 3C 273 at 5.0×10^9 Hz (Cowsik and Lee 1982) may be due to the anomalous absorption of radio waves through PDI. We are modeling the details of this absorption profile.

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