MAGNETIC FIELDS IN RADIO-QUIET QUASARS

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As an hypothesis the sharp far-infrared turnovers in the spectra of several radio-quiet galactic nuclei [1-3] are attributed to the modifications of synchrotron emission arising from the presence of a thermal background plasma. We calculate the synchrotron emission from a power-law distribution of relativistic electrons $N(\gamma) = N_0\gamma^{-s}$ in a large-scale random magnetic field of strength B embedded in a thermal plasma of density n_e. Two major modifications of the classical vacuum theory of synchrotron emission are established [4]:

A) synchrotron sources can be optically thick only in a small frequency range around the Razin-Tsytovich frequency, $\nu_R = 20\ (n_e/\mathrm{cm}^{-3})\ (B/G)^{-1}$ Hz, whereas at smaller and higher frequencies the sources are optically thin;
B) at frequencies above ν_R the synchrotron intensity in a plasma behaves exactly the same way as in the vacuum case, $I(\nu>\nu_R) \propto \nu^{-\alpha}$, a = (s-1)/2, whereas at frequencies below ν_R the intensity is exponentially reduced, $I(\nu<\nu_R) \propto \exp(-\nu_R/\nu)$.

Applying these findings to the observations we find:

1) the low-frequency exponential cutoff below the Razin-Tsytovich frequency provides an excellent fit to the observed spectra from radio-quiet quasars, if $\nu_R \simeq 2\cdot10^{12}$ Hz. The value of ν_R suggests the relation $B = 10^{-11}\ (n_e/\mathrm{cm}^{-3})$ G between the magnetic field strength and the plasma density in these objects;
2) none of the existing observations [1-3] are incompatible with the synchrotron origin of the emission.

References

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