Constraints to the Radiative Lifetime of a Light Neutral Fermion in the Galactic Halo from IUE (*).

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Summary. — We present the negative result of a search for the radiative decay of a light neutral fermion, that might be the neutrino (if massive) or the photino, gravitationally bounded to our Galaxy. The limit obtained for the radiative lifetime of a particle of mass between 12.5 and 21.5 eV is $\sim 10^{18}$ years. These new data on UV background in the range $(1250 - 2000) \, \text{Å}$ show the presence of continuum emission and diffuse lines emission at high galactic latitude ($|b| > 45^\circ$). The lines are identifiable with C IV, $\lambda = 1549 \, \text{Å}$ and N III, $\lambda = 1749 \, \text{Å}$. The continuum level sharply rises at 1680 Å to the level of $(314 \pm 136) \, \text{photons/(cm}^2\text{s sr Å)}$ and remains nearly constant up to 2000 Å. Below 1680 Å we found no emission with an upper limit of $\sim 100$ units. These new data are briefly discussed in comparison with the results of previous experiments and theoretical expectations.

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1. - Introduction.

Since the work of Zwicky, many decades ago, the observational evidence for dark matter in the Universe is very strong and getting stronger (**), being

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one of the major discoveries of modern astronomy. The suggestion that the unseen matter could be in the form of neutral massive fermions was advanced since 1972 (1), well before the development of grand unified theories (GUT) and supersymmetric theories (SUSY), which can justify the existence of such particles.

It was suggested that if this nonbarionic matter exists, it could be detected in the halo of our Galaxy (2), through a radiative decay of the type \( f \rightarrow f' + \gamma \), where \( f \) is a higher-mass particle and \( f' \) a lower-mass one. For a decay at rest of \( f \), the photon energy is

\[
\nu = \frac{m_f^2 - m_{f'}^2}{2m_f}
\]

and, if \( m_f \gg m_{f'} \), one obtains \( \nu \sim m_f/2 \).

One natural candidate for this particle could be the neutrino. The recent indication (4) of a nonzero mass for the electronic antineutrino has renewed the interest in this topic. Radiative decay of the massious neutrino is possible in the GUT theories. In the «standard model» of electroweak interactions, extended to include neutrino masses and mixing, the decay of neutrino is strongly suppressed (5), thus its lifetime could be so large to be practically unobservable (\( \tau_\nu > \sim 10^{33} \) years).

Whatever the mechanism is, the same coupling that originates the decay of the neutrino would induce radiative decay of the muon (6): \( \mu \rightarrow e + \gamma \). Hence the widths of these two processes will differ only for the factor due to the phase-space volume. The experimental upper limit (7) to the branching ratio of the unseen radiative decay of the muon settles a lower limit to the lifetime of the neutrino:

\[
\tau_\nu \geq 2.7 \cdot 10^{17} \left( \frac{10 \text{ eV}}{m_\nu} \right)^3 \text{ y}.
\]

Supersymmetric theories of elementary particles give another candidate for a nonbarionic component of the Universe: the photino \( \tilde{\gamma} \) (8), which is the spin-\( \frac{1}{2} \) partner of the photon. From the cosmological point of view the photino is completely equivalent to the neutrino. If it has a nonzero mass, it is un-

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