In this work we have calculated the transformations necessary for a relativistically expanding source. The procedure is general and may be applied to any spectrum, but a detailed study for power-law emission is made. We have taken into account the doppler shift in frequency and the effects of beaming. The results are analyzed, and applications to astrophysical sources are discussed.

4.05

Waves in Neutron Stars

R. I. Epstein (Los Alamos National Laboratory)

In much of the inner crust and core of neutron stars the free neutrons or protons, or both, form superfluids. The motion of a superfluid is partially decoupled from that of the other components. This decoupling allows new wave modes to propagate and creates "acoustic discontinuities" in which wave velocities or polarizations change abruptly at the boundaries where a component becomes superfluid. Both of these effects, the increase in the number of wave types and the increase in the number of discontinuities, create new oscillatory modes in neutron stars.

4.06

The Signature of a Black Hole Transit

J. F. Dolan (Laboratory for Astronomy & Solar Physics, NASA/Goddard)

A black hole transiting the stellar disk of a companion star will produce a time-varying intensity profile as observed at the Earth because of the Einstein photometric effect (gravitational lens phenomenon). If the transited star is an OB supergiant with electron scattering as its dominant atmospheric opacity source, then variable linear polarization will also result from the destruction of the circular symmetry of the observed stellar disk. The simultaneous variation of the three Stokes parameters I, Q and U may be thought of as the signature of a black hole transit. Monte-Carlo calculations will be presented which show that the effect has the properties expected from qualitative considerations (Dolan, Ap. Space Sci., 52, 201, 1975). The amplitude of the effect in a typical X-ray binary is too small to be observed with present instrumentation, however. The signature is also masked in close binaries by the much larger variability caused by the changing aspect of the tidally distorted OB star. The effect might possibly be visible in a binary system with a large separation of the components.

4.07

Soliton Stars: Are They Real?

H. Y. Chiu (NASA/GSFC)

Recently, T. D. Lee and his associates proposed the possible existence of a new class of astronomical objects: the soliton stars. Briefly, the soliton star is a coherent quantum state with a large mass composed of either spin 0 (Higgs-type boson) or spin 1/2 fields. Consider the spin 0 case; the total mass of an aggregate of N such bosons is less than Nm where m is the particle mass. Including gravitational effects, Lee et al. showed that for such an object, the Schwarzschild mass may be as large as 10^{15} solar mass, with a radius in the range of hundreds of light years. The soliton star essentially consists of materials which make up a false vacuum state, whose role in inflationary cosmological models has been extensively discussed. Energetically, it would be extremely difficult for soliton stars to be created out of stellar or galactic processes we know of. Soliton stars, if they exist, could possibly be relics of the inflationary phase when a false vacuum state dominated, thus providing a link to the inflationary past of our universe. Although the material making up soliton stars is presumably highly unstable, because of the strong self interactions the decay of soliton star materials is energetically forbidden. One important property of Higgs-type bosons is its ability to modify the masses of other fields. We present several interesting consequences of soliton stars.

4.08

The 1973 X-Ray Outburst of V0332+53--More Detailed Time History

J. Terrell (Los Alamos National Laboratory)

The X-ray pulsar V0332+53 was discovered by the Vela 5B spacecraft during its strong transient outburst of 1973 June-August (J. Terrell and W. C. Priedhorsky, Ap. J. 285, L15 (1984)). After this discovery, the source was not seen again until the outbursts of 1983 November - 1984 January, detected by Tenma and Exosat. The Vela 3-12 keV data have recently been analyzed in more complete detail, giving the time history of this transient source during each of the many long observations of this source at 56-hour intervals, half of the spacecraft orbital period.

The re-analysis gives more convincing evidence for a possible weak precursor to this outburst, lasting for several days, at JD≅2441800 (1973 April 27). This event occurred about one orbit (34 days) before the beginning of the main outburst in 1973, and was similar in strength to the 1983 recurrence.

4.09

Quasirelativistic Coulomb-Born-Exchange Collision Strengths for Hydrogenic Ions

D.H. Sampson, H. Zhang, A.K.Mohanty, (Penn State)

A quasirelativistic Coulomb-Born-exchange method in which the small component of the solution of the Dirac equation is dropped and the large component is normalized as though it were the complete solution has been used to calculate collision strengths for $n\ell j$-$n'\ell'j'$ transitions in hydrogenic ions with nuclear charge number $Z \geq 18$. For lower Z, where relativistic effects are minor, results can be obtained from those for Z = 18 by multiplication by the factor $(18/Z)^2$. The accuracy of this quasi-relativistic approach has been tested for line strengths by comparison with fully relativistic results[1]. Even for Z = 90 it was found to be accurate to within 10% for transitions from the $1s_{1/2}$ level and to within 5.5% for all other transitions. The results are expected to be of interest for plasma modeling and diagnostics, where taking account of j dependence is sometimes found to be significant[2] even for relatively low Z.

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