

dwarf stars it might be possible to see the circular polarization. Sure enough, when Kemp and John Swedlund looked at such a star, GRW 70°8247, they found the circular polarization. It was then quickly confirmed by Landstreet and Angel.

Since then the observations have been refined and extended to longer wavelengths by Kemp and Swedlund, by Angel and Landstreet and by Thomas Gehrels (University of Arizona). If a normal star were to contract to white-dwarf radii without loss of angular momentum, then one would expect periods of minutes. But Angel and Landstreet find no variation either in the polarization or in the intensity for time scales from 24 sec to a few days.

So far the peculiar dwarf continues to be unique. Angel and Landstreet have looked at six other continuum dwarfs, one DA dwarf and one DBP

dwarf, and found no circular polarization within a 0.1% accuracy.

Recently Kemp⁷ has suggested that the very striking rise in circular polarization at 12 000 Å could be caused by cyclotron resonance in a field of 10⁸ gauss.

—GBL

References

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ASTRA project monitors atmospheric pollution

Astronomy, a field for which few have claimed relevance, is now becoming relevant to a pressing problem, atmospheric pollution. It turns out that those pesky atmospheric contaminants that have been annoying astronomers looking at the sun and other stars, have been leaving tell-tale lines on spectra, which can be measured to infer their presence and strength. Serendipitously, for decades observatories throughout the world have been collecting plates from which such pollution data can be inferred, which can now be used to establish trends, either regionally or globally.

Such spectral analysis is one approach being tried by an interdisciplinary team of astronomers, atmospheric physicists, chemists, geophysicists and civil engi-

neers, who are organizing Project ASTRA (Astronomical and Space Techniques for Research on the Atmosphere) at the University of Washington. They are also doing atmospheric extinction measurements and studying the aerosol component of the atmosphere of the earth.

Paul Hodge, E. Mannery and T. P. Snow of ASTRA have used photoelectric techniques to study extinction, the light intensity absorbed and scattered by the atmosphere over a broad spectral band. For example, they compared Charles G. Abbott's 1911 measurements at Mt. Wilson with measurements made there in the 1960's. They find that in the ultraviolet the extinction (also called "turbidity") of the atmosphere increased 26%; in the blue the increase was 11%, and in the yellow,

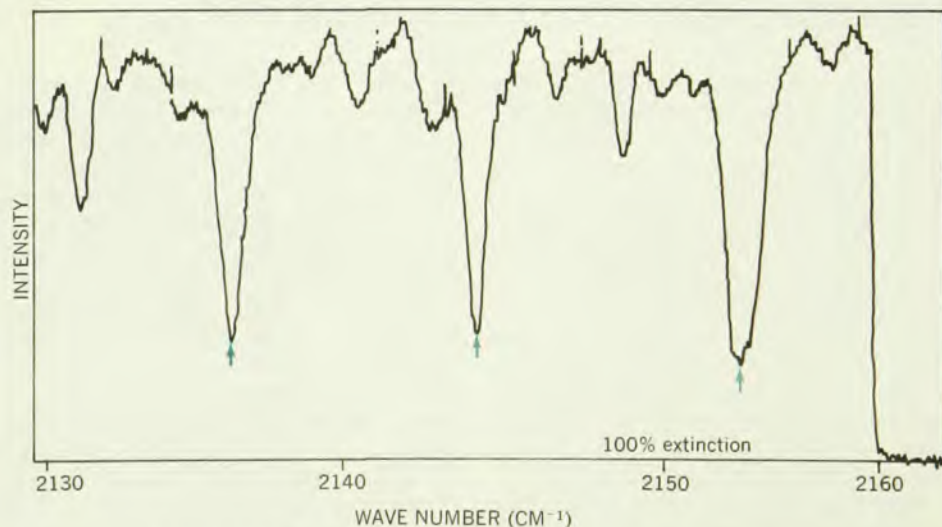
10%.

Another ASTRA group, Robert J. Charlson, William M. Porch and Lawrence F. Radke recently reported (*Science* **170**, 315, 1970) light-scattering measurements at Point Barrow, Alaska and Mount Olympus, Wash. to determine that a background level of atmospheric aerosols (particulates) does exist.

By using calibrated high-dispersion astronomical spectra one can do a curve-of-growth analysis to determine the amount of a particular pollutant that is between the source and observer. Hodge told us that although the sun's spectrum can give us information on lines caused by atmospheric contaminants, it is not an ideal light source because it has many absorption lines of its own throughout the optical region. On the other hand very hot, rapidly rotating stars, whose spectra have only broad hydrogen and helium lines, offer a smooth continuum to display the polluting absorption lines. Using these stars instead of the sun would, however, require relatively large telescopes to collect enough light to detect trace pollutants.

Molecules identified so far in solar spectrograms include CO₂, C¹³, O¹⁶, CH₄, N₂O, CO, SO₂ and possibly NO₂. By looking at old spectra Hodge feels that pollutant trends can be established for these molecules, particularly when they have lines in the visible range and near infrared. One contaminant of particular interest is carbon dioxide. Two years ago Reed Bryson suggested that the abundance of CO₂ in the atmosphere had increased by about 13% per decade, suggesting that by the year 2000 or so we'd all be in serious trouble. It might be possible to check this trend over recent decades by looking at existing infrared data in observatory archives. Hodge feels that many other of the 5000 or so suspected atmospheric pollutants would probably be recognizable and measurable by setting up in large city a telescope and spectrograph and using high-temperature stars as background sources.

—GBL



Spectrum of atmospheric carbon monoxide in the infrared solar spectrum (after M. Migeotte, L. Nevin, J. Swensson, *Infrared Solar Atlas*, *Memoirs de Societes* vol. Hors Série Nr. 1, 1956). Carbon-monoxide absorption lines are indicated in color.

Continuous dye laser

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Snively feels that the cw dye laser is presently the most attractive high-intensity tunable light source for the visible region of the spectrum. The parametric oscillator remains attractive as a tunable source for the infrared, however. In the visible region, where both devices operate, the dye laser appears to have an advantage by virtue of its simplicity, Snively says.

High-sensitivity spectroscopy is the most immediate application for the dye