3s - 3p AND 3p - 3d TRANSITIONS IN NEON-LIKE IONS OF THE IRON GROUP ELEMENTS

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The spectra of highly ionized scandium, titanium, vanadium and chromium emitted from laser-produced plasmas have been recorded in the region 270 - 600 Å. The radiation from a Quantel NG24 Nd:YAG/glass laser giving the maximum energy 4J in 3ns pulses was focused on plane metal targets. The target was placed at the Sirk's focus of a 3-m normal incidence spectrograph with the target surface parallel to the slit. The laser beam was perpendicular to the target and to the entrance axis of the spectrograph. By this arrangement the spectral lines from different ionization stages differ in length, the highest states giving the shortest lines. Well-determined lines from spark recordings of sodium-, magnesium-, aluminium-, and silicon-like ions were used for the wavelength determinations.

The identification of 3s-3p and 3p-3d lines of the neon-like ions was based on two different methods of isoelectronic comparisons with theoretical predictions. The first method uses an ab-initio calculation of energy levels through Z-expansion with relativistic corrections (Bureeva and Safronova 1979). Wavenumbers for transitions between the theoretical energy levels were derived, and the differences between the calculated wavenumbers and those observed up to and including Ar IX were extrapolated to higher Z. The second method is based on the extrapolation of empirical scaling factors for Hartree-Fock values of energy integrals. These two methods have led to the identifications in the laboratory spectra of 3s-3p and 3p-3d lines in Sc XII, Ti XIII, V XIV, and Cr XV. Further extrapolation has led to the identification of the corresponding lines of Fe XVII in the spectra of solar flares (Jupén 1984).

In Ti XIII and Fe XVII the number of identified lines was large enough for establishing the energy level structure of $2p^5$ 3s, 3p and 3d. Comparisions with levels derived from Hartree-Fock wavefunctions were made by fitting Slater and spin-orbit parameters. This further improved the possibility to interpolate and extrapolate scaling factors for ab-initio integrals and thus to predict the wavelengths of the 3s-3p and 3p-3d lines in all neon-like ions of the iron-group elements. Accurate extrapolations to heavier elements would require relativistic calculations.

A full description of the work presented here will appear in Physica Scripta (Jupén and Litzén 1984). The investigation of the neon-like sequence is now being continued with an isoelectronic study of hydrogenic levels ($l > 2$), which will lead to improved values for the ionization potentials for these ions. Beam-foil spectra recorded at the Bochum 4MV Dynamitron tandem accelerator laboratory and the Lund University 3MV Pelletron accelerator will be used together with the spectra from laser-produced plasmas in that work (Jupén et al 1984).

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