THE IRON PROJECT AND THE RMAX PROJECT: Photoionization, Electron-Ion Recombination of Fe XVII and Oscillator Strengths for Fe XXII

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Synopsis The Iron Project and the Rmax Project aim in detail study of radiative and collisional processes of astrophysically abundant iron and iron-peak elements over a wide energy range from infra-red to X-rays. We will illustrate new features of high energy photoionization and high temperature electron-ion recombination of Fe XVII that are more prominent than the low energy and low temperature. We have noted that core excitations to high lying levels introduce much stronger, high peak resonances than those to the low lying ones.
We also report an extensive set of radiative transitions for Fe XXII. Oscillator strengths, line strengths, lifetimes and radiative decay rates for E1 transitions will be presented for 771 fine structure levels with $1/2 \leq J \leq 17/2$. The parameters for a large set of forbidden E2, E3, M1, M2 transitions will also be presented.

Fe XVII is represented by a close cupling wave function expansion that includes the ground and 59 excited fine structure levels of core Fe XVIII. The purpose is to study features forming due to core excitations to highly lying levels. The ground level photoionization appears to be unaffected by these excitations. However, photoionization of excited levels are considerably enhanced in the high energy region (Fig.1).

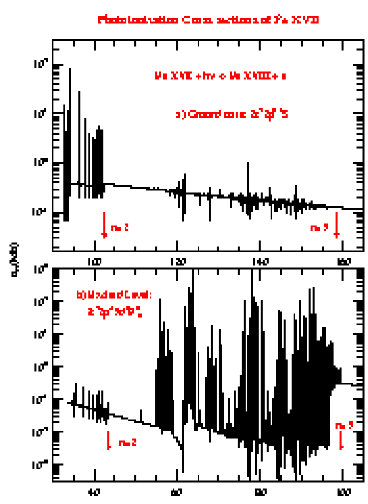

Fig. 1. Photoionization of the ground state and an excited state of Fe XVII.

Work is in progress for the calculations of total and level-specific recombination rates.

Allowed electric dipole (E1) and forbidden electric quadrupole (E2), electric octupole (E3), magnetic dipole (M1) and magnetic quadrupole (M2) transitions for Fe XXII obtained under the Iron Porject [1] will be presented. The E1 transitions, 70,372 in total, are obtained for the first time for the ion using the Breit-Pauli R-matrix method. All existing transitions are from various atomic structure calculations. The energies agree with the available observed energies from less than 1% to a few percent. The A-values for E1 transitions are in good agreement with other existing values for most transitions. The A-values for E2, M1 transitions agree very well with the available values.

References

[1] Hummer D G, Berrington K A, Eissner W, Pradhan A K, Saraph H E, and Tully J A 1993 *Astron. Astrophys.* 279 298

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