Atomic data calculations for X-ray spectra observed by SMM

- Satellite line atomic data code: AUTOLSJ
- Interactive code for fitting SMM spectra: BCSFIT

Atomic data for (Li-like) satellite lines of He-like ion lines

In 1976, Françoise B-D and AHG defined the future collaboration, including also: S. Volonté, M. Loulergue, and myself, ...

Before 1976: In 1969, AHG and C. Jordan analyzed the possibility to obtain spectral diagnostics from He-like and their satellite spectra. In 1972, AHG produces an "alphabetical" list of the most interesting lines: 4 He-like lines and 22 Li-like $n = 2$ satellite lines. Furthermore, AHG and different collaborators calculated data for the $n = 2$ satellites. Besides, BCS/XRP instrument(on SMM) was under construction to observe the corresponding spectra for Ca and Fe:

He-like resonance: w, $1s^2$ - $1s2p\ ^1P_1$; (y, $1s^2$ - $1s2p\ ^3P_1$)
dielectronic satellite: j, $1s^22p\ ^2P_{3/2}$ - $1s2p^2\ ^2D_{5/2}$: $I_j/I_w \propto 1/T_e$
inner-shell sat.: q, $1s^22s\ ^2S_{1/2}$ - $1s2s2p\ ^2P_{3/2}$: $I_q/I_w \propto N_{Li}/N_{He}$

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The Collaboration: In 1976, the goal was to calculate the intensities of the $n = 3$ satellite lines, with inclusion of $n = 2$.

My personnal contribution was the construction of a new atomic data code for these lines (AUTOLSJ), computing: wavelengths, radiative and autoionization probabilities. To build the code, I started from UCL codes: SUPERSTRUCTURE, Distorted Wave(DW) and JAJOM. SUPERSTRUCTURE calculate: wavelengths, radiative probabilities. DW+JAJOM (a mixture of them) calculate autoionization probabilities. At last, in a little code, all the data were collected to print easily readeable tables.

After $n = 3$ satellite lines, the collaboration was extended to $n = 4$ as well as the convergence for $n = 5 \rightarrow \infty$. The satellite of H-like lines were also considered. Besides, improvements were done to AUTOLSJ, to perform Be-like, B-like, ... satellite lines.

Unresolved Satellites of (Fe XXV) w and y lines

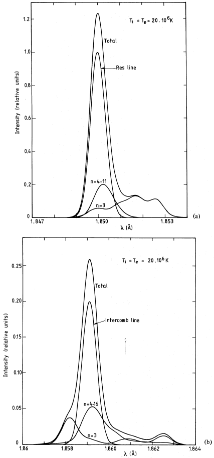

Figure 4. Total spectrum close to the resonance line (a), and the intercombination line (b). The effect of satellites on the shift, breadth and intensity of the apparent resonance line is clearly shown. The intercombination feature does not include the effect of nearby $n = 2$ satellites. Spectra are normalized to the peak intensity of the resonance line.

- w (1.850 Å) line
  λ region: 1.847- 1.854 Å.
- y (1.859 Å) line
  λ region: 1.856- 1.864 Å.

Temperature, $T_e = 20 \times 10^6 K$.

From the top curve:

(1), Total (apparent) intensity
(2), contribution of resonance w (or y), i.e. I_w
(3), contribution of $n = 4, ..., 11$ satellites
(4), contribution of $n = 3$ satellites

BCS interactive code (BCSFIT)

With AHG help, all the group members became Guest Investigators for SMM. My personnal contribution was to continue the construction of a code started by AHG. The purpose of this code was to construct a synthetic spectrum over the observed spectrum. To help at the adjustement, we selected the most intense observed line of the spectra (w line) using a cursor. The most intense synthetic line (w line) was then shifted to fit the observed line. The code calculated the synthetic spectra using only few parameters: T_i, T_e, N_{Li}/N_{He}, N_{Be}/N_{He} and N_H/N_{He}, which were used to calculate the intensities of Fe XXV He-like, Li-like and Be-like lines.
N_H/N_{He} contributes mostly to the line intensities of y, x ($1s^2$ - $1s2p\ ^3P_2$) and z ($1s^2$ - $1s2p\ ^3P_2$). In 1969, AHG and C. Jordan were the first to indentify this line (z). It is one of the most intense line of FeXXV and Ca XIX solar flare spectra.