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Analysis of Atomic Structure Calculations with Einstein Coefficients and Radiative Data of Ne-like Se (Se XXV)

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ABSTRACT

Applied Multi-Configuration Dirac-Fock (MCDF)approximation, the following radiative data have been computed for the lowest 50 levels: transition wavelength, transition rates, oscillator strength, line strength, and radiative rates such as electric dipole (E1) and electric quadrupole (E2) as well as magnetic dipole (M1) and magnetic quadrupole (M2) transitions of highly ionized Ne-like Se^{+24} ion (Se XXV). The results were calculated using GRASPand FAC. Our measured excitation energies, wavelengths, oscillator strengths, and line strengths for Se XXV all show good agreement with the NIST data and other available data. Additionally[1,2,3], for Se XXV, we have computed Einstein Coefficients for E1 transitions' spontaneous emission, stimulated emission, transition dipole moment, emission and absorption oscillator strength. We have also calculated life times for the lower levels of Se XXV. The identification and assessment of spectral lines from different fusion plasma, solar, plasma modelling, and astrophysical investigations should benefit from our recently calculated atomic and radiative data of Ne-like Se.

INTRODUCTION

Important studies in theory, experimentation, and application have focused on the energy structures and spectra of neon-like ions. The neon-like ions are a multielectron system with a closed shell structure, according to theory. It is an excellent illustration of how relativistic, electron correlation, relaxation, and quantum electrodynamic (QED) phenomena contribute to the precise analysis of energy structures and transition features. The neon-like charge state is comparatively stable in the experiment. Over a broad range of plasma temperatures, it is frequently the predominant ionization state. Many high-temperature plasma sources, including tokamak, laser-produced plasmas, gas-puff Z-pinch, solar atmosphere, EBIT, and more, frequently contain the neon-like ions of middle- and high-Z. Consequently, the easiest lines to observe are those of neon-like ions. For instance, the neon-like ions are used in tokamak to investigate the confinement and transport of high-Z impurity ions. Additionally, the spectra from the neon-like systems may offer diagnostic data on ion temperatures, charge-state abundance, electron density, and plasma electron temperature. Furthermore, it is crucial for comprehending the energy levels and excitation mechanisms of x-ray lasers

METHODS

(a) Multi-configuration Dirac Fock Method
(b) Flexible Atomic Code Method

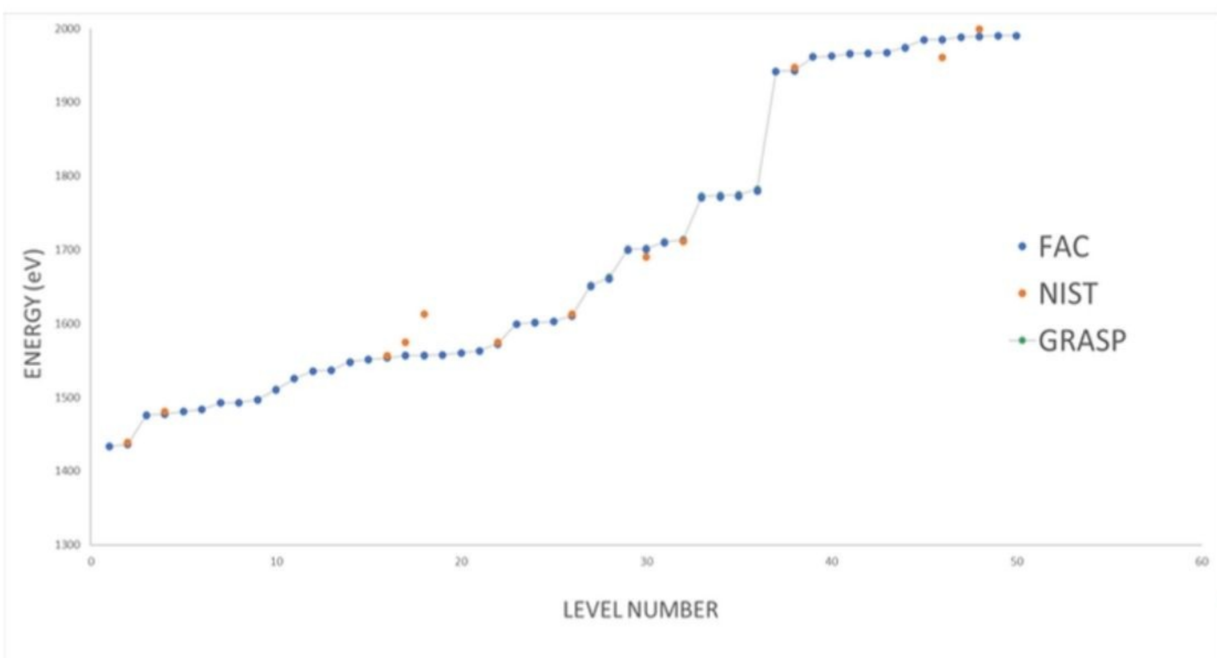

Figure 1: Calculated Energy using FAC and GRASP compared with the NIST values

RESULT

Transition wavelength, transition rates, oscillator strength, line strength, and radiative rates such as electric dipole (E1) and electric quadrupole (E2) as well as magnetic dipole (M1) and magnetic quadrupole (M2) transitions of highly ionized Ne-like Se (Se XXV) have all been calculated for the lowest 50 levels.

The NIST data and other available data are in good agreement with our measured excitation energies, wavelengths, oscillator strengths, and line strengths for Se XXV.

We have also calculated Einstein Coefficients for the spontaneous emission, stimulated emission, transition dipole moment, emission, and absorption oscillator strength of E1 transitions for Se XXV.

Additionally, we have computed life times for the lower Se XXV levels.

Table 1:Transition Wavelengths (Å), Transition rates $A_{ij}(s^{-1})$, Oscillator Strengths (f_{ji}), Line strengths (S_{ij} in a.u.)

S.No.	Final level J	Initial level I	Wavelength (Å)	Aij	Fji	Sij
1	0	2	8.632	4.08E+12	1.37E-01	3.89E-03
2	0	4	8.3916	2.77E+12	8.78E-02	2.42E-03
3	1	5	261.65	7.00E+09	4.31E-02	1.86E-01
4	2	5	278.79	2.77E+07	3.22E-04	8.87E-04
5	3	5	2559.4	2.06E+04	6.08E-05	5.12E-04
6	4	5	3741.3	9.27E+03	1.94E-05	7.19E-04
7	1	6	244.77	4.41E+09	3.96E-02	1.60E-01
8	2	6	259.71	3.94E+09	6.64E-02	1.70E-01
9	4	6	1884.1	3.69E+02	3.28E-07	6.10E-06
10	1	7	209.8	1.45E+10	1.34E-01	4.64E-01
11	1	8	207.39	1.79E+07	6.94E-05	2.37E-04
12	2	8	218.02	1.27E+10	9.04E-02	1.95E-01
13	3	8	719.14	3.72E+03	8.64E-07	2.05E-06
14	4	8	789.19	3.15E+05	2.94E-05	2.29E-04
15	1	9	195.04	9.67E+09	5.51E-02	1.77E-01
16	2	9	204.41	7.75E+09	8.09E-02	1.63E-01
17	4	9	635.97	8.92E+05	9.02E-05	5.66E-04
18	2	10	166.44	2.63E+10	3.64E-02	5.98E-02
19	4	10	371.93	4.06E+08	2.81E-03	1.03E-02

CONCLUSION

Calculations have been done for the oscillator, line strength, transition probabilities, and lower energy levels. They are determined to be fairly accurate when compared to some of the results that are currently available. The calculated Einstein Coefficients for Spontaneous emission and Stimulated emission, Transition dipole moment, Emission and Absorption oscillator strength of E1 transitions, showing the most probable transitions. The ratio of Einstein Coefficients for Stimulated emission and Spontaneous emission, helps to check which transition is suitable for LASER. The identification and assessment of spectral lines from different fusion plasma, solar, plasma modelling, and astrophysical investigations should benefit from our recently calculated atomic and radiative data of Ne-like Se.

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