Relativistic treatments of quantum plasma-immersed Li, Na, K atoms

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Abstract:

A relativistic investigation for Li, Na and K atoms immersed in a quantum plasma environment, under the influence of spherical encompassment and external electric field is carried out in this study, for the first time. Considering the closed shells of Li, Na and K atoms, the model potential approach is taken into account for the interaction of the valence electron. Due to the shielding effect of the quantum plasma environment modeled by the exponential cosine screened Coulomb (ECSC) potential, the model potential is modified, which in turn allows the consideration of plasma-immersed alkaline systems. Then, the interaction potential consists of the modified model potential, the spherical encompassment effect, and the external electric field. To obtain the bound states of the interaction potential, the decoupling of the second-order Dirac equation for the large and small components of the radial atomic wave functions is considered. The Dirac equation including the interaction potential is solved numerically within the decoupling formalism. The effects of the plasma shielding, spherical encompassment and external electric field on the relativistic energy spectrum, relativistic transition energies and relativistic oscillator strengths are probed and detailed elucidations are performed. In addition to elucidating the effects of interaction potential parameters on the aforementioned observables, detailed analyzes such as alternatives to each other, dominance, optimal ranges or critical values are also carried out.

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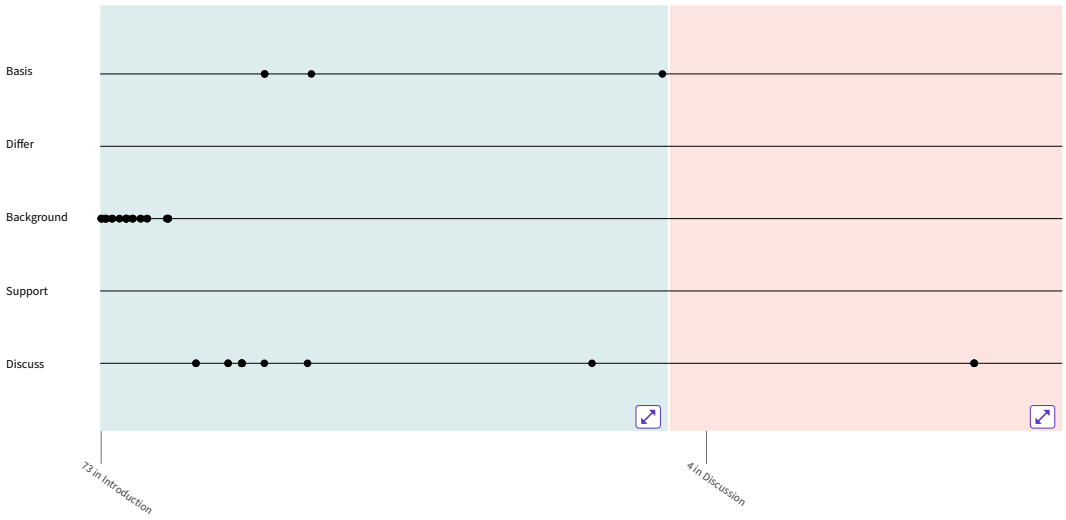

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International Symposium / 33rd Annual Sanibel Symposium on Atomic, Molecular, and Condensed Matter Theory and Computational Methods
1993 | INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY , pp.385-397

Cited in Article: 1

12 Citations
59 References
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2 NUMERICAL APPROACH TO TRANSITION-PROBABILITIES IN COULOMB APPROXIMATION - BE-II AND MG-II RYDBERG SERIES

LINDGARD, A and NIELSEN, SE
1975 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 8 (8) , pp.1183-1199

Full Text at Publisher

Cited in Article: 1

56 Citations
34 References
Related records

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YNNERMAN, A and FISCHER, CF
Mar 1995 | PHYSICAL REVIEW A 51 (3) , pp.2020-2030

Full Text at Publisher

Cited in Article: 1

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29 References
Related records

4 Weakest bound electron potential model theory

35 Citations

Zheng, NW; Wang, T; (...); Fan, J
Jun 5 2004 | INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY 98 (3) , pp.281-290

Full Text at Publisher •••

Cited in Article: 1

57 References

Related records

5 MODEL POTENTIAL CALCULATIONS OF THE NA-HE SYSTEM

HANSSEN, J; MCCARROLL, R and VALIRON, P
1979 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 12 (6) , pp.899-908

Full Text at Publisher •••

Cited in Article: 1

72 Citations

22 References

Related records

6 MODEL POTENTIALS IN ATOMIC-STRUCTURE

HIBBERT, A
1982 | ADVANCES IN ATOMIC AND MOLECULAR PHYSICS 18 , pp.309-340

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Cited in Article: 1

62 Citations

104 References

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7 MODEL-POTENTIAL METHODS

LAUGHLIN, C and VICTOR, GA
1988 | ADVANCES IN ATOMIC AND MOLECULAR PHYSICS 25 , pp.163-194

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Cited in Article: 1

48 Citations

174 References

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8 Dynamic dipole polarizabilities of the Li atom and the Be+ ion

Tang, LY; Yan, ZC; (...); Mitroy, J
Apr 2010 | PHYSICAL REVIEW A 81 (4)

Free Submitted Article From Repository Full Text at Publisher •••

Cited in Article: 1

30 Citations

43 References

Related records

9 Dynamic processes and polarizability of sodium atom in Debye plasmas

Qi, YY and Ning, LN
Mar 2014 | PHYSICS OF PLASMAS 21 (3)

Full Text at Publisher •••

Cited in Article: 1

22 Citations

32 References

Related records

10 Positronium formation in collisions between positrons and alkali-metal atoms (Li, Na, K, Rb and Cs) in Debye plasma environments

Pandey, MK; Lin, YC and Ho, YK
Feb 14 2016 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 49 (3)

View full text •••

23 Citations

124 References

Cited in Article: 1

Related records

11 [Not available]

Bahar, M. K
2021 | Annalen der Physik

Cited in Article: 1

1 Citation
0 References

12 Confinement effects of magnetic field on two-dimensional hydrogen atom in plasmas

Bahar, MK and Soylu, A
May 2015 | PHYSICS OF PLASMAS 22 (5)

Full Text at Publisher •••

Cited in Article: 1

13 Citations
56 References

Related records

13 Charge currents and induced magnetic fields in a bounded two-dimensional hydrogen atom

LumbTalwar, S; Lumb, S and Prasad, V
Feb 15 2021 | EUROPEAN PHYSICAL JOURNAL D 75 (2)

Enriched Cited References

View full text •••

Cited in Article: 1

6 Citations
49 References

Related records

14 [Not available]

Estanon, C.R.; Aquino, N.; (...); Dehesa, J.S.
2020 | Int. J. Quant. Chem. 120 (11)

Cited in Article: 1

1 Citation
0 References

15 Electronic structure and dynamics of confined atoms

Deshmukh, PC; Jose, J; (...); Manson, ST
Jun 2021 | EUROPEAN PHYSICAL JOURNAL D 75 (6)

Full Text at Publisher •••

Cited in Article: 1

9 Citations
157 References

Related records

16 Shannon entropy and Fisher information for endohedral confined one-and two-electron atoms

Martinez-Flores, C
Jan 18 2021 | PHYSICS LETTERS A 386

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Cited in Article: 1

13 Citations
66 References

Related records

17 The ground state of the lithium atom in dense plasmas using variational Monte Carlo method

Doma, SB; El-Gendy, HS; (...); Hejazi, MM
Dec 2021 | Nov 2020 (Early Access) | INDIAN JOURNAL OF PHYSICS 95 (12) , pp.2847-2853

Enriched Cited References

Full Text at Publisher •••

Cited in Article: 2

2 Citations
22 References
Related records

18 Dynamics of positron scattering from lithium, sodium and potassium atoms in hot and dense plasmas

Masanta, N and Ghoshal, A
Jun 2021 | Mar 2021 (Early Access) | CHINESE JOURNAL OF PHYSICS 71 , pp.273-285

Enriched Cited References

View full text •••

Cited in Article: 2

6 Citations
53 References
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19 Dynamics of Positron Scattering from Lithium, Sodium and Potassium Atoms in Quantum Plasmas

Masanta, N and Ghoshal, A
Dec 2021 | FEW-BODY SYSTEMS 62 (4)

Enriched Cited References

Full Text at Publisher •••

Cited in Article: 2

3 Citations
42 References
Related records

20 Ionization of many-electron atoms by the action of two plasma models

Martinez-Sanchez, MA; Martinez-Flores, C; (...); Sen, KD
Apr 9 2021 | PHYSICAL REVIEW E 103 (4)

View full text •••

Cited in Article: 2

6 Citations
54 References
Related records

21 Spectroscopy of Multielectron Atomic Systems in a DC Electric Field

Kuznetsova, AA; Glushkov, AV; (...); Ternovsky, VB
22nd International Workshop on Quantum Systems in Chemistry, Physics, and Biology (QSCP)
2019 | QUANTUM SYSTEMS IN PHYSICS, CHEMISTRY AND BIOLOGY - THEORY, INTERPRETATION, AND RESULTS 78 , pp.287-306

View full text •••

Cited in Article: 1

5 Citations
122 References
Related records

22 Stark effect on the low-lying excited states of the hydrogen and the lithium atoms

Sahoo, S and Ho, YK
Nov 28 2000 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 33 (22) , pp.5151-5163

Full Text at Publisher •••

Cited in Article: 1

18 Citations
28 References
Related records

19

23 9

The influence of the oscillating electric field on the recurrence spectra of a Li Rydberg atom in a strong magnetic field

Wang, DH; Ding, SL and Lin, SL
Nov 14 2003 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 36 (21) , pp.4225-4232

Full Text at Publisher •••

Cited in Article: 1

Citations 18
References
Related records

24 [Not available]

De-Hua, W.; Sheng-Lu, L.; (...); Chuan-Lu, Y
2006 | Commun. Theor. Phys. 46 , pp.545

Cited in Article: 1

1 Citation
0 References

25 [Not available]

CHEN ZB
2018 | PHYS PLASMAS 25

Cited in Article: 1

26 Citations
0 References

26 Relativistic spectroscopy of plasma-embedded Li-like systems with screening effects in two-body Debye potentials

Das, M; Sahoo, BK and Pal, S
Sep 14 2014 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 47 (17)

Free Submitted Article From Repository Full Text at Publisher •••

Cited in Article: 1

14 Citations
52 References
Related records

27 Effect of screening on spectroscopic properties of Li-like ions in a plasma environment

Mondal, PK; Dutta, NN; (...); Majumder, S
Jun 4 2013 | PHYSICAL REVIEW A 87 (6)

Free Published Article From Repository Full Text at Publisher •••

Cited in Article: 1

18 Citations
91 References
Related records

28 Screening and wake potentials of a test charge in quantum plasmas

Shukla, PK and Eliasson, B
Apr 14 2008 | PHYSICS LETTERS A 372 (16) , pp.2897-2899

Full Text at Publisher •••

Cited in Article: 1

202 Citations
14 References
Related records

29 Photoionization of Li and Na in Debye plasma environments

Sahoo, S and Ho, YK
Jun 2006 | PHYSICS OF PLASMAS 13 (6)

Full Text at Publisher •••

100 Citations
55 References

Cited in Article: 3

Related records

30 [Not available]

Poszwa, A. and Bahar, M.K.
2015 | Phys. Plasmas 22

Cited in Article: 1

1 Citation
0 References

31 SUPERSYMMETRY AND QUANTUM-MECHANICS

COOPER, F; KHARE, A and SUKHATME, U
Jan 1995 | PHYSICS REPORTS-REVIEW SECTION OF PHYSICS LETTERS 251 (5-6) , pp.268-385

Cited in Article: 1

1,296 Citations
314 References

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32 ANALYTICAL RELATIVISTIC SELF-CONSISTENT-FIELD CALCULATIONS FOR ATOMS

BARTHELAT, JC; PELISSIER, M and DURAND, P
1980 | PHYSICAL REVIEW A 21 (6) , pp.1773-1785

Full Text at Publisher

Cited in Article: 1

92 Citations
22 References

Related records

33 BASIS SET EXPANSION OF THE DIRAC OPERATOR WITHOUT VARIATIONAL COLLAPSE

KUTZELNIGG, W
1984 | INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY 25 (1) , pp.107-129

Full Text at Publisher

Cited in Article: 1

292 Citations
37 References

Related records

34 QUASIRELATIVISTIC METHODS

KARWOWSKI, J and KOBUS, J
1985 | INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY 28 (6) , pp.741-756

Full Text at Publisher

Cited in Article: 1

25 Citations
29 References

Related records

35 THE SOMMERFELD PUZZLE REVISITED AND RESOLVED

BIEDENHARN, LC
1983 | FOUNDATIONS OF PHYSICS 13 (1) , pp.13-34

Full Text at Publisher

Cited in Article: 1

34 Citations
22 References

Related records

36 REMARKS ON RELATIVISTIC KEPLER PROBLEM

BIEDENHARN, LC
1962 | PHYSICAL REVIEW 126 (2) , pp.845-&
AMERICAN PHYSICAL SOC, ONE PHYSICS ELLIPSE, COLLEGE PK, MD 20740-3844 USA

Cited in Article: 1

135 Citations
0 References

37 RELATIVISTIC THEORY OF RADIATIVE ORBITAL ELECTRON CAPTURE

MARTIN, PC and GLAUBER, RJ
1958 | PHYSICAL REVIEW 109 (4) , pp.1307-1325
AMERICAN PHYSICAL SOC, ONE PHYSICS ELLIPSE, COLLEGE PK, MD 20740-3844 USA

Cited in Article: 1

241 Citations
0 References

38 ATOMIC DATA FOR OPACITY CALCULATIONS .9. THE LITHIUM ISOELECTRONIC SEQUENCE

PEACH, G; SARAPH, HE and SEATON, MJ
Nov 28 1988 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 21 (22) , pp.3669-3683

Full Text at Publisher •••

Cited in Article: 2

146 Citations
34 References
Related records

39 The complex absorbing potential method (CAP) to study the Stark effect in hydrogen and lithium

Sahoo, S and Ho, YK
Jun 28 2000 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 33 (12) , pp.2195-2206

Full Text at Publisher •••

Cited in Article: 1

44 Citations
37 References
Related records

40 Resonance of hydrogen and lithium atoms in parallel magnetic and electric fields

Sahoo, S and Ho, YK
Jan 2002 | PHYSICAL REVIEW A 65 (1)

Full Text at Publisher •••

Cited in Article: 1

13 Citations
29 References
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41 Field induced energy shifts and widths for low-lying states of Na atom in parallel electric and magnetic fields

Sahoo, S and Ho, YK
Feb 2005 | CHINESE JOURNAL OF PHYSICS 43 (1) , pp.58-69

•••

Cited in Article: 1

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42 NATURAL STATES OF INTERACTING SYSTEMS AND THEIR USE FOR THE CALCULATION OF INTER-MOLECULAR FORCES .4. CALCULATION OF VANDERWAALS COEFFICIENTS

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BETWEEN ONE-VALENCE-ELECTRON AND 2-VALENCE-ELECTRON ATOMS IN THEIR GROUND-STATES, AS WELL AS OF POLARIZABILITIES, OSCILLATOR STRENGTH SUMS AND RELATED QUANTITIES, INCLUDING CORRELATION EFFECTSL

MAEDER, F and KUTZELNIGG, W

1979 | CHEMICAL PHYSICS 42 (1-2) , pp.95-112

Full Text at Publisher •••

Cited in Article: 3

52 References

Related records

43 Optical response of plasma processed quantum dot under the external fields

Kilic, K and Bahar, MK

Apr 5 2021 | Nov 2020 (Early Access) | INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY 121 (7)

View full text •••

Cited in Article: 1

5 Citations

38 References

Related records

44 [Not available]

Sobelman, I. I.

1979 | Atomic Spectra and Radiative Transitions

Springer, Berlin

Cited in Article: 2

422 Citations

0 References

45 GENERAL MULTI-CONFIGURATION HARTREE-FOCK PROGRAM

FROESEFISCHER, C

1978 | COMPUTER PHYSICS COMMUNICATIONS 14 (1-2) , pp.145-153

Full Text at Publisher •••

Cited in Article: 1

261 Citations

13 References

Related records

46 SCF HARTREE-FOCK CALCULATIONS OF GROUND-STATE WAVEFUNCTIONS OF COMPRESSED ATOMS

LUDENA, EV

1978 | JOURNAL OF CHEMICAL PHYSICS 69 (4) , pp.1770-1775

Full Text at Publisher •••

Cited in Article: 1

132 Citations

51 References

Related records

47 RELATIVISTIC CALCULATIONS ON THE ALKALI ATOMS BY A MODIFIED HARTREE-FOCK METHOD

KARWOWSKI, J and SZULKIN, M

1981 | JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS 14 (12) , pp.1915-1927

Full Text at Publisher •••

Cited in Article: 1

34 Citations

39 References

Related records

48 RELATIVISTIC EFFECTS ON TRANSITION-PROBABILITIES IN LI AND BE ISOELECTRONIC-SEQUENCES

ARMSTRONG, L; FIELDER, WR and LIN, DL

1976 | PHYSICAL REVIEW A 14 (3) , pp.1114-1128

112 Citations

37 References

Full Text at Publisher •••

Cited in Article: 1

Related records

49 MEASUREMENT OF RADIATIVE LIFETIMES OF FIRST EXCITED STATES OF NA K RB AND CS BY MEANS OF PHASE-SHIFT METHOD

172 Citations

0 References

LINK, JK
1966 | JOURNAL OF THE OPTICAL SOCIETY OF AMERICA 56 (9) , pp.1195-&
AMER INST PHYSICS, CIRCULATION FULFILLMENT DIV, 500 SUNNYSIDE BLVD, WOODBURY, NY 11797-2999

Cited in Article: 1

50 [Not available]

1 Citation

0 References

Wu, L.; Zhang, S. and Li, B
2020 | Phys. Lett. A 384

51 [Not available]

1 Citation

0 References

Mondal, S.; Nayek, S.K. and Saha, J.K
Contrib. Plasma Phys. 61 (5)

52 [Not available]

1 Citation

0 References

Martinez-Flores, C.
2020 | Chem. Phys. 535

53 [Not available]

1 Citation

0 References

Meng, H.-Y.; Zhang, Y.-X.; (...); Zhan, M.-S.
2008 | J. Phys. B: At. Mol. Opt. Phys. 41

54 [Not available]

1 Citation

0 References

Chen, Z.-B. and Ma, K.
2019 | Phys. Plasmas 26

55 [Not available]

Baym, G.
1969 | LECT QUANTUM MECH
Benjamin, New York

1 Citation
0 References

56 [Not available]

Li, H.W. and Kar, S.
2012 | Phys. Plasmas 19

1 Citation
0 References

57 [Not available]

Martinez-Flores, C. and Cabrera-Trujillo, R
2020 | Matter Radiat. Ext. 5

1 Citation
0 References

58 [Not available]

Ralchenko, Y
2008 | NIST atomic spectra database (version 3.1. 5)
National Institute of Standards and Technology, Gaithersburg, MD

2 Citations
0 References

59 [Not available]

Cakir, B.; Yakar, Y.; (...); Ozmen, A
2021 | Int. J. Quant. Chem. 121

1 Citation
0 References

60 [Not available]

Saha, J. K.; Bhattacharyya, S. and Ahmed, Sk. F
2021 | Int. J. Quant. Chem. 121

1 Citation
0 References