
Name: Dr. Ajay Kumar Rai
Nationality: Indian
Designation: Head of Department, Associate Professor
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ACADEMIC QUALIFICATIONS:

Sr No.	Examination Passed	Year of Passing	Institution	Subjects
1	Ph. D.	2006	Sardar Patel University, VVNagar, Anand, Gujarat	Particle Physics
2	M. Phil.	2002	Sardar Patel University, VVNagar, Anand, Gujarat	Particle Physics
3	M. Sc.	2000	Gujarat University, Ahmedabad	Nucl. Phys., Quantum Mech. Electronic ...
4	B. Sc.	1998	Gujarat University, Ahmedabad	Physics, Mathematics, Chemistry, English

Title of M. Phil Dissertation: **Quark-antiquark structure for the study of Mesons.**

Title of the Ph. D. Thesis: **Study of light-heavy flavor hadrons.**

Ph. D. Supervised: 05 (completed) + 08 (working)
(1). **Dr. N. B. Devlani**
(Title of the thesis 'Study of heavy-light and heavy-heavy flavored mesons')
(2). **Dr. V. H. Kher**
(Title of the thesis 'Spectroscopy study and Regge trajectories of $Q\bar{q}$ and $Q\bar{Q}$ mesons')
(3). **Dr. Z. Shah**
(Title of the thesis 'Spectroscopy of heavy flavor baryons')

(4). **Dr. D. Rathaud**

(Title of the thesis ‘Molecular Interpretation of Exotic Hadrons’)

(5) **Dr. R. Chaturvedi**

(Title of the thesis ‘Study of quarkonia using effective field theory’)

(6) **Mr. Keval M Gandhi** (Submitted)

(“Study of Open Charm and Open Bottom Mesons using Heavy Quark Effective Theory)

Projects:

(1) Properties of mesons using QCD inspired models

(funded by DST Govt. Of India SR/FTP/PS-152/2012(total cost. 12,84,000.00),
(Started 24-10-2013 Ended 30-04-2017)s

(2) Spectroscopic properties of hadrons using potential models

(funded by SVNIT-Surat (R&C)/1488/2013-14, Total cost-6,55,000.00)

Teaching Experience: **Associate Professor (since 28-01-2019)**

Assistant Professor (20-07-2007 to 27-01-2019)

Department of Applied Physics, Sardar Vallabhbhai National Institute of
Technology, Surat, Gujarat-395 007, India

International Visits:

- 1) The Abdus Salam International Centre for Theoretical Physics (ICTP), **Trieste, Italy**,
(22nd – 26th May, 2006)
- 2) Johannes Gutenberg University, **Mainz, Germany**, (1st – 6th Sept., 2008)
- 3) Florida State University. **USA**, (29th Nov. – 4th Dec, 2009).
- 4) Department of Physics, Complutense University of Madrid, **Spain** (30th Aug. – 3rd Sept., 2010)
- 5) Department of Physics, Institute of Physics, Jagellonian University Cracow, **Poland**
(10th June, 2011)
- 6) 15th International Conference on Hadron Spectroscopy (Hadron 2013); **Nara, Japan**
(4th - 8th Nov, 2013)
- 7) 3rd International Conference on New Frontiers in Physics; Kolymbari, **Crete, Greece**,
(28th July – 6th Aug., 2014)
- 8) Hadron structure and QCD (27th June – 1st July, 2016), Gatchina, St. Petersburg **Russia**.
- 9) The 3rd International Conference on Particle Physics and Astrophysics (2nd -5th Oct., 2017)
Moscow, Russia.

List of Publications:

(For more information

<https://inspirehep.net/literature?sort=mostrecent&size=25&page=1&q=find%20au%20%20K%20Rai>)

Sr No	Author (s)	Title of Paper	Name of the Journal	Vol. No	Page No	Year	Impact Factor
1.	K. Gandhi, A. K. Rai	Spectrum of strange singly charmed baryons in the constituent quark model	Eur. Phys. J. Plus	135	213	2020	2.612
2.	R. Chaturvedi,	Bottomonium spectroscopy motivated by general features of pNRQCD	J. Phys. G. https://doi.org/10.1088/1361-6471/abaa99			200	2.45

	A. K. Rai, N. R. Soni and J. N. Pandya						
3.	K. Gandhi, Z. Shah, A. K. Rai	Spectrum of Nonstrange Singly Charmed Baryons in the Constituent Quark Model	International Journal of Theoretical Physics	https://doi.org/10.1007/s10773-020-04394-4		2020	1.21
4.	Kaushal R. Purohit, Rajendrasinh H. Parmar and Ajay Kumar Rai	Eigensolution and various properties of the screened cosine Kratzer potential in D dimensions via relativistic and non-relativistic treatment	Eur. Phys. J. Plus	135	286	2020	2.612
5.	PANDA Collaboration (Dr. A. K. Rai is member of this group)	Precision resonance energy scans with PANDA experiment at FAIR: Sensitivity study for width and line-shape measurements of the X (3872)	arXiv: 1812.05132 The European Physical Journal A	55	42	2019	2.833
6.	D. P. Rathaud, A. K. Rai	Interaction and Identification of the Di-Hadronic Molecules	Few Body Systems	60	37	2019	1.134
7.	Z. Shah, K. Gandhi, A. K. Rai	Spectroscopy of light N^* baryons	Chinese Physics C	43	024106	2019	5.861
8.	K. Gandhi, Z. Shah, A. K. Rai	Decay properties of singly charmed baryons	European Physical Journal Plus	133	512	2018	2.240
9.	Z. Shah, A. K. Rai	Mass Spectra of Singly Beauty Ω_b^- Baryon	Few Body Systems	59	112	2018	1.134
10.	Z. Shah, A. K. Rai	Ground and Excited State Masses of the Ω_{bbc} Baryon	Few Body Systems	59	76	2018	1.134
11.	V. H. Kher, A. K. Rai	Spectroscopy and decay properties of charmonium	Chinese Physics C	42	083101	2018	5.861
12.	R. Chaturvedi, A. K. Rai	Mass spectra and decay properties of $c\bar{c}$ meson	European Physical Journal Plus	133	220	2018	2.240
13.	Z. Shah, A. K. Rai	Spectroscopy of the Ω_{ccb} baryon in the hypercentral constituent quark model	Chinese Physics C	42	053101	2018	5.861

14.	Z. Shah, A. K. Rai	Masses and Regge trajectories of triply heavy Ω_{ccc} and Ω_{bbb} baryons	European Physical Journal A	53	195	2017	2.833
15.	D. P. Rathaud, A. K. Rai	Dimesonic states with the heavy-light flavour mesons	European Physical Journal Plus	132	370	2017	1.753
16.	Z. Shah, A. K. Rai	Excited state mass spectra of doubly heavy Ξ baryons	European Physical Journal C	77	129	2017	5.331
17.	PANDA Collaboration paper (Dr. A. K. Rai is member of this group)	Feasibility study for the measurement of πN transition distribution amplitudes at PANDA in $p^- p \rightarrow J/\psi \pi^0$	Physical Review D	95	32003	2017	4.506
18.	V. H. Kher, N. Devlani, A. K. Rai	Spectroscopy decay properties and regge trajectories of B and Bc mesons	Chinese Physics C	41	0931015	2017	5.861
19.	V. H. Kher, N. Devlani, A. K. Rai	Excited states mass spectra decay properties and regge trajectories of charm and charm strange mesons	Chinese Physics C	41	073101	2017	5.861
20.	K. Thakkar, Z. Shah, A. K. Rai, P. C. Vinodkumar	Excited states mass spectra and regge trajectories of bottom baryons in hypercentral quark models	Nuclear Physics A	965	57	2017	1.960
21.	Z. Shah, K. Thakkar, A. K. Rai	Excited state mass spectra of doubly heavy baryons	The European Physical Journal C	76	530	2016	5.331
22.	Z. Shah, K. Thakkar, A. K. Rai, P. C. Vinodkumar	Mass spectra and Regge trajectories of, $\Lambda_{c^+}, \Sigma_{c^+}, \Xi_{c^+}, \Omega_{c^+}$ baryons	Chinese physics C	40	123102	2016	5.861
23.	Z. Shah, K. Thakkar, A. K. Rai, P. C. Vinodkumar	Excited State Mass spectra of Singly Charmed Baryons	The European Physical Journal A	52	313	2016	2.833
24.	PANDA Collaboration paper (Dr. A. K. Rai is member of this group)	Feasibility studies of time-like proton electromagnetic form factors at PANDA at FAIR	The European Physical Journal A	52	325	2016	2.833

25	PANDA Collaboration (Dr. A. K. Rai is member of this group)	Study of doubly strange systems using stored antiprotons	Nuclear Physics A	954	323	2016	1.960
26	D. P. Rathaud, A. K. Rai	Mass spectra of dimesonic states in light flavour sector	Indian Journal of Physics	90	1299	2016	1.166
27	A. K. Rai, D. P. Rathaud	The mass spectra and decay properties of dimesonic states, using the Hellmann potential	The European Physical Journal C	75	462	2015	5.331
28	PANDA Collaboration (Dr. A. K. Rai is member of this group)	Experimental access to Transition Distribution Amplitudes with the PANDA experiment at FAIR	The European Physical Journal A	51	107	2015	5.331
29	J. N. Pandya, N. R. Soni, N. Devlani, A. K. Rai	Decay rates and electromagnetic transitions of heavy quarkonia	Chinese physics C	39	123101	2015	5.861
30	N. Devlani, V. Kher, A. K. Rai	Masses and electromagnetic transitions of the Bc mesons	The European Physical Journal A	50	1	2014	2.833
31	N Devlani, A. K. Rai	Mass Spectrum and Decay Properties of D Meson	International Journal of Theoretical Physics	52	2196	2013	1.086
32	N Devlani, A. K. Rai	Spectroscopy and decay properties of B and B _s mesons	The European Physical Journal A	48	1	2012	2.833
33	N Devlani, A. K. Rai	Spectroscopy and decay properties of the D _s meson	Phys. Rev. D	84	074030	2011	4.506
34	A. K. Rai, J. N. Pandya, P. C. Vinodkumar	Decay rates of quarkonia with NRQCD formalism using spectroscopic parameters of potential	The European Physical Journal A	38	77	2008	2.833
35	A. K. Rai, B. Patel, P. C. Vinodkumar	Properties of Q anti-Q mesons in non-relativistic QCD formalism	Phys. Rev. C	78	055202	2008	3.82

36	B. Patel, A. K. Rai, P. C. Vinodkumar	Masses and magnetic moments of heavy flavour baryons in hyper central model	J. Phys. G.	35	065001	2008	2.899
37	B. Patel, A. K. Rai, P. C. Vinodkumar	Heavy Flavour Baryons in Hyper Central Model	Pramana J. Phys	70	797	2008	0.520
38	A. K. Rai, J. N. Pandya, P. C. Vinodkumar	Multiquark states as di-hadronic molecules	Nuclear Physics A	782	406	2007	1.960
39	A. K. Rai, P. C. Vinodkumar	Properties of Bc meson	Pramana J. Phys	66	953	2006	0.520
40	A. K. Rai, J. N. Pandya, P. C. Vinodkumar	Low-lying di-hadronic states in relativistic harmonic model	Indian J. Phys	80	387	2006	1.116
41	A. K. Rai, J. N. Pandya, P. C. Vinodkumar	Decay rates of quarkonia and potential models	J. Phys. G.	31	1453	2005	2.899
42	A. K. Rai, R. H. Parmar, P. C. Vinodkumar	Masses and decay constants of heavy–light flavour mesons in a variational scheme	J. Phys. G.	28	2275	2002	2.899

International/ National Conference Proceedings

1. Mass spectra of triply heavy charm-beauty baryons ; Z. Shah, and A. K. Rai: **EPJ Web Conf. 202 (2019) 06001**
2. Regge trajectories in the B meson; N. Devlani, V. H. Kher and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 910 (2018)
3. Simulation of $f_0(1710)$ state using PANDARoot; K. Gandhi *et al.*; Proceedings of the DAE Symp. on Nucl Phys. **63**, 906 (2018)
4. $B^+ \rightarrow K^+ \ell^+ \ell^-$ to probe physics beyond standard model; A. Parmar, S. Dabhani and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 896 (2018)
5. Regge trajectories in the B_C meson; V. H. Kher, N. B. Devlani, and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 884 (2018)
6. N- Δ and Δ - Δ Di-baryonic Molecular Systems; R. Tiwari, D. P. Rathaud and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 860 (2018)
7. $\gamma\gamma$ and ggg decay width of S-wave Charmonia; R. Chaturvedi, N. R. Soni, J. N. Pandya and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 834 (2018)
8. Magnetic properties of $D^*(2007)^0$ and $D^*(2010)^\pm$ meson in the constitute quark model; K. Gandhi, V. Patel, V. Kher and A. K. Rai; Proceedings of the DAE Symp. on Nucl Phys. **63**, 824 (2018)
9. Mass spectra of di-baryonic systems in charm sector; Z. Shah, D. P. Rathaud and A. K. Rai; Pos Hadron2017 (2018) 244
10. Mass spectra of triply beauty Ω_{bbb} baryon; Z. Shah and A.K. Rai; Pos Hadron2017 (2018) 068

11. Insights to $N(\text{udd})$ baryon spectra; A. K. Rai, Z. Shah and K. Gandhi; AIP Conf. Proc. **1953** (2018), 140091
12. Orbitally excited spectra and decay of $c\bar{c}$ meson; R. Chaturvedi and A. K. Rai; AIP Conf. Proc. **1953** (2018), 140062
13. $\Sigma_s - \Sigma_s$ as a di-baryonic molecule; D. P. Rathaud and A. K. Rai; AIP Conf. Proc. **1953** (2018), 030100
14. Regge Trajectories of triply heavy baryons; A. K. Rai and Z. Shah; J. Phys. Conf. Ser. **934**, 012035 (2017)
15. Mass spectra of bottomonia using relativistic corrections to the potential; A. K. Rai, R. Chaturvedi, J. Phys. Conf. Ser. **934**, 012033 (2017)
16. Radiative transitions and the mixing parameters of the D meson; V. H. Kher, A. K. Rai; J. Phys. Conf. Ser. **934**, 012036 (2017)
17. $\gamma\gamma$ and Light Hadron decay widths of S wave charmonia, R. Chaturvedi and A. K. Rai; Proceedings of the DAE Symp. on Nucl. Phys. **62**, 772 (2017)
18. $\Omega_c - \Omega_c$ Possible di-baryonic molecule; D. P. Rathaud and A. K. Rai; Proceedings of the DAE Symp. on Nucl. Phys. **62**, 784 (2017)
19. Radiative dipole transitions of the D meson; N. B. Devlani, V. H. Kher and A. K. Rai; Proceedings of the DAE Symp. on Nucl. Phys. **62**, 796(2017)
20. Excited mass spectra of Ω_c^0 Baryon; Z. Shah, K. Thakkar, A. K. Rai and P. C. Vinodkumar; J. Phys. Conf. Ser. **759**, (2016) 012076.
21. Deuteron as a di-baryonic molecule; D. P. Rathaud and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 696 (2016).
22. Regge Trajectories of Ξ_{bb} baryon in (n, M^2) and (J, M^2) planes; Z. Shah, K. Thakkar, A. K. Rai and P. C. Vinodkumar, Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 674 (2016).
23. D wave mass spectra and triple gluon decay of charmonia; R. Chaturvedi and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 668 (2016).
24. Excited state mass spectra of Λ_c^+ baryon; Z. Shah, K. Thakkar, A. K. Rai and P. C. Vinodkumar; AIP Conf. Proc. **1728**, (2016) 020096.
25. Spectra and decay rates of bb meson Gaussian wave function; A. K. Rai, N. Devlani, V. H. Kher; EPJ Web of Conferences **95**, 04054 (2015)
26. Masses of di-mesonic molecular states; D. P. Rathaud and A. K. Rai; EPJ Web of Conferences **95**, 05013 (2015)
27. Spectroscopic properties of the B meson; N. Devlani, V. H. Kher and A. K. Rai; EPJ Web of Conferences **95**, 05006 (2015)
28. Study of various spectroscopic properties of the Ds meson; V. H. Kher, N. Devlani and A. K. Rai; EPJ Web of Conferences **95**, 05005 (2015)
29. Orbitally excited mass spectra of Charmonium; Z. Shah, R. Chaturvedi and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **59**, 655 (2015)
30. Excited mass spectra of Σ_c^+ Baryon; Z. Shah, K. Thakkar, A. K. Rai and P. C. Vinodkumar; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **60**, 688 (2015).
31. Radially excited state masses and decay constants of $c\bar{c}$; V. H. Kher, N. B. Devlani and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **60**, 702 (2015).
32. Molecular-like states in the bottomonium sector; D. P. Rathaud and A. K. Rai, Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **60**, 680 (2015).
33. Masses and decay rates of Charmonium; Z. Marfatia and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **59**, 654 (2014)
34. S-Wave Masses of the Ds Meson, V. Kher, N. Devlani and A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **59**, 670 (2014)
35. Molecular like states in charmonium sector, D. P. Rathaud, A. K. Rai; Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **59**, 630 (2014)

36. Two photon decays of charmonia; N. Devlani and A. K. Rai; Proceedings of the DAE Symp. on Nucl. Phys. **58** (2013)646
37. Masses of di-mesonic molecular states; A. K. Rai, H. R. Shah, and A. Toshniwal; Proceedings of the DAE Symp. on Nucl. Phys. **58** (2013) 634
38. Mass spectra and Radiative transitions of heavy quarkonia and bc^- mesons; J. N. Pandya, A. K. Rai and P. C. Vinodkumar; PoS Hadron2013, 082
39. Mass Spectrum and decay properties of the B_c meson; A K Rai and N Devlani; PoS Hadron 2013, 045

Research Information:

Our group is active in the field of hadron spectroscopy with quark degree of freedom. We have been able to study the heavy-light flavoured mesons within the framework of the Coulomb plus power potential model by variational method with the inter quark potential of the form $V(r) = -\alpha_c/r + A r^\nu$ for the different value of index ν for ground state [1-2]. We found that the mass spectra is in better agreement with the experimental values for $\nu = 1$ for the light-heavy and heavy-heavy flavor system [1-4]. Thus it is important to study the hadronic properties including various decays based on these observations. Recently, we studied the spectroscopy of the D_s meson as well as the decay constant, branching ratios, and E1 and M1 transitions in this scheme at $\nu = 1$ which is also suggested by the lattice calculations. Results are close to the experimental observations and we would like to extend our calculations for the D , B , B_s , B_c , charmonia and bottomonia mesons[1-4].

Heavy quarkonia are the mesons made of heavy quarks (c and b) and its anti-quarks (\bar{c} and \bar{b}). These systems have been good laboratory to test our theoretical ideas since the early days of QCD. The mass spectra of these mesons are also studied in the CPP_ν model and decay rates are studied in the conventional as well gauge invariant approach including higher order correction terms [5-6].

Apart from these we have also studied exotic states which do not fit in the mesonic and baryonic quark combinations including gluon mixing with quark anti quark and quark gluon systems . The baryon spectroscopy and magnetic moments are studied within the quark model using the hyper central description of the three body system [7-8].

1. N Devlani A. K. Rai; Phys. Rev. D **84** 074030 (2011)
2. N Devlani A. K. Rai; The European Physical Journal A **48** **1**(2012)
3. N Devlani A. K. Rai; International Journal of Theoretical Physics **52** 2196 (2013)
4. N Devlani, V H Kher A. K. Rai; The European Physical Journal A **50** **1**(2014)
5. V H Kher A. K. Rai; Chinese physics C **42** (2018); arxiv:1805.02534 (2018)
6. RaghavChaturvedi, Ajay Kumar Rai; **Eur. Phys. J. P** 133, 220 (2018)
7. Zalak Shah and Ajay Kumar Rai **Chin. Phys. C.** 42, 053101 (2018).

8. Zalak Shah and Ajay Kumar Rai; **Few-Body Syst.** 59, 76(2018) .