Dr. Bharat Kumar

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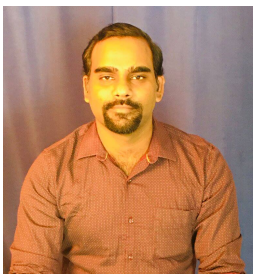

About Me

Dr. Bharat Kumar is an nuclear astrophysicist and faculty member in the Department of Physics and Astronomy at the National Institute of Technology, Rourkela, India. Currently, he is leading a research project titled "Physics of Neutron Stars: Constraints from Finite Nuclei to Gravitational Waves" (CRG/2021/000101), which is generously supported by a three-year core research grant from the SERB for the period 2022-2025. Dr. Kumar's research interests revolve around the theoretical exploration of various facets of neutron stars and dark matter, situated at the intersection of nuclear physics and astrophysics. His work establishes critical connections between multi-messenger astronomical observations and nuclear experiments.

Employment History

2020 –Present — **Assistant Professor,** NIT, Rourkela, Odisha, India.
2019 – 2020 — **Postdoctoral,** University of Tsukuba, Japan.
2018 – 2019 — **Postdoctoral** LIGO-India, IUCAA, Pune, India.

Education

2014 – 2018 — **Ph.D.** Institute of Physics, Bhubaneswar, India.
Thesis title: *Implications of nuclear interaction for nuclear structure and astrophysics within the relativistic mean-field model. [*https://arxiv.org/abs/1812.03306*]*
Supervisor: Prof. S. K. Patra

2013 – 2014 — **Post M.Sc.,** Institute of Physics, Bhubaneswar, India.
Thesis title: *Shape co-existence and parity doublet in Zr isotopes.*
Supervisor: Prof. S. K. Patra

2010 – 2012 — **M.Sc.,** Aligarh Muslim University, Aligarh, India.

2007 – 2010 — **B.Sc.(Hons),** Aligarh Muslim University, Aligarh, India.

Skills

Languages — English, Hindi
Coding — Fortran, Mathematica, Python, LaTeX, …
Misc. — Academic research, teaching, LaTeX typesetting and publishing.

List of Sponsored Projects

1. Physics of Neutron Stars: Constraints from Finite Nuclei to Gravitational Waves
   PI: Dr Bharat Kumar (NIT, Rourkela)

Co-PI: Prof B K Agrawal (SINP, Kolkata)
Sponsoring agency: SERB
Tenure of the Assignment: 2022-2025
Total Amount: 21,12,828 Rs.

Reseach Interests

- **Nuclear Physics**
  Ground state properties of finite nuclei; Nuclear energy density functionals; Relativistic mean-field and Skyrme Hartree-Fock models; Parity doublets; Nucleon density clustering; Multifragmentation fission; Density dependence of the nuclear symmetry energy; Neutron distributions and neutron skins, Equation of state of dense nuclear matter
- **Nuclear Astrophysics**
  Static and rotating neutron star structure (mass, radius, moment of inertia, quadrupole deformation, tidal deformability, Radial and Non-Radial Oscillations); Compositions in neutron stars, gravitational waves, WIMP Dark Matter

Academic Visits and Schools/Symposium/Conferences Attended

1. DST-SERC School on Nuclear Structure at High Angular Momentum and Isospin Oct. 5-25, 2014 at HBCSE, TIFR-Mumbai, India.
2. Winter School on Nuclear Astrophysics Jan. 19-31,2015 VECC, Kolkata.
3. DAE Symposium on Nuclear Physics
   Dept. of Physics, BHU, India, Dec. 8-12, (2014).
4. Nuclear Physics Meet-June 26-30, (2015)
   Institute of Physics, Bhubaneswar, India.
5. Recent development of density functional theory-July 17-19, (2015)
   Institute of Physics, Bhubaneswar, India.
6. 40^{th} Academic Year Activities of Institute of Physics
   IOP Internal Symposium, Bhubaneswar, India, August 27, (2015).
7. International workshop on "Recent Trends in Nuclear Structure and its Implication in Astrophysics" 4^{th}-8^{th} Jan., 2016, Blue Lily Puri.
8. CNT Lectures on selected topics in nuclear theory- 16-25 Feb. 2016
   Variable Energy Cyclotron Centre, Kolkata.
9. Probing the frontiers of particle physics with neutrinos and LHC
   Institute of Physics, Bhubaneswar, odisha from 17^{th}-21^{st} Oct. 2016.
10. CNT Lectures on Special Topics in Nuclear Astrophysics- 1-11 March 2017, Variable Energy Cyclotron Centre, Kolkata.
11. Summer school on gravitational-wave astronomy- 17-28 July 2017, International centre for theoretical sciences, Tata Institute of fundamental research, Bangalore.
12. Summer school on gravitational-wave astronomy- 13-24 August 2018, International centre for theoretical sciences, Tata Institute of fundamental research, Bangalore.
13. 30^{th} meeting of the Indian Association for General Relativity and Gravitation(IAGRG),3-5 January 2019, BITS-Pilani, Hyderbad Campus.

14. Conference on Multi-messenger Atsronomy in the Era of LIGO-India, 15-18 January 2019, Khandala, India.
15. India-UK Entrepreneurial Workshop, 18-19 January 2019, IUCAA, Pune.
16. The 15th International Symposium on Origin of Matter and Evolution of Galaxies, 2-5 July 2019, Yukawa Institute for Theoretical Physics, Kyoto University, Japan.
17. The 18th CNS International Summer School, 21-27 August 2019, Hongo campus, University of Tokyo, Japan.
18. Academic visit to Department of Physics Education, Daegu University, South Korea, 22-25 September 2019.
19. Quarks and Compact Stars 2019, 26-28 September 2019, Haeundae, Busan, South Korea.

Presentations

Contributed Talks:

1. Analysis of parity doublet in medium mass nuclei,
   DAE Symposium on Nuclear Physics, Dept. of Physics, BHU, India, Dec. 8-12, (2014).
2. Shape co-existence and Parity doublet in Zr isotopes,
   Nuclear Physics Meet-2015, Institute of Physics, Bhubaneswar, India, June 26-30,(2015).
3. Examining the stability of thermally fissile Th and U isotopes,
   40^{th} Academic Year Activities of Institute of Physics
   IOP Internal Symposium, Bhubaneswar, India, August 27, (2015).
4. Tidal effects in equal-mass binary neutron stars
   61^{st} DAE-BRNS Symposium on Nuclear Physics,
   December 05-09, 2016, Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Kolkata -700064, India.
5. Tidal deformability of neutron stars within relativistic mean field equations of state
   CNT Lectures on Special Topics in Nuclear Astrophysics- 1-11 March 2017, Variable Energy Cyclotron Centre, Kolkata.
6. New effective interactions IOPB-I and G3; the 18^{th} CNS Summer School 2019, University of Tokyo, Japan.

Invited Talks:

1. New relativistic effective interaction for finite nuclei, infinite nuclear matter and neutron stars, ICTS-TIFR, Bangalore.
2. New relativistic effective interaction for finite nuclei infinite nuclear matter and neutron stars, Tsukuba-CCS workshop on "microscopic theories of nuclear structure and dynamics", University of Tsukuba, Japan.
3. Implications of nuclear interaction for nuclear structure and astrophysics within the relativistic mean-field model, Tsukuba-Center for Computational Sciences, University of Tsukuba, Japan.
4. Neutron star astrophysics from gravitational waves and nuclear theory, Sado2019, the 5^{th} workshop on many-body correlations in microscopic nuclear model, September 5-6, 2019 at Senkaku-sou, Niigata, Japan.
5. Relativistic models (G3 and IOPB-I) of the neutron-star matter equation of states, September 24, 2019 at Kyungpook National University, Daegu, South Korea.
6. Constraints on the moment of inertia of neutron-star/pulsars from GW170817, February 27, 2020 at Physical Research Laboratory, Ahmadabad, India.

Awards/Achievements/Memberships

2011-2012	PG Merit Scholarship at AMU, Aligarh, UP, India.
2013	BARC (OCES & DGFS)
	Joint Entrance Screening Test
2013-2014	Junior Research Fellowship (JRF), Department of Atomic Energy (DAE), India.
2014-2018	Senior Research Fellowship (SRF), Department of Atomic Energy (DAE), India.
2021	Member of Odisha Physical Society,India.
2022-2025	Associate of IUCAA Pune, India.

Reviewer of the journals

Since 2018	Phys. Lett. B, Mod. Phys. Lett. A
Since 2019	Astrophysical Journal, Astrophysics Journal Letter
Since 2020	Physics of the Dark Universe
Since 2021	Nuclear Physics A

Courses taught

PH-1002	Physics-II (Theory)
PH-2007	Electrostatics and Magnetostatics (Theory)
PH-1070	Physics Laboratory (Laboratory)
PH-6121	Quantum Field Theory
PH-4006	Quantum Mechanics-II

PhD Students

Pinku Routray (PhD)	Nuclear Astrophysics-Ongoing 2021-Continue
Sayatan Ghosh (PhD)	Nuclear Astrophysics-Ongoing 2022-Continue
Probit Kalita (PhD)	Nuclear Astrophysics-Ongoing 2022-Continue
Sunitarani Pani (Ex-PhD)	Nuclear Astrophysics-Ongoing 2022-Continue

UG/PG Students

Sailesh Ranjan Mohanty (UG)	Impacts of Anisotropy on Neutron Star Properties: Insights from Non-adiabatic Gravitational Collapse **Publications:** • https://arxiv.org/abs/2304.02439 • https://doi.org/10.48550/arXiv.2211.12808 • https://arxiv.org/abs/2305.15724
Khokan Singha (PG)	Exploring the impact of Delta-Baryons on the Properties of Neutron Stars
Shahebaj Hasan Shaikh (PG)	Finite temperature dependent equation of state for nucleonic core of neutron stars

(continued)

Mrityunjoy Singha (PG) — Dark compect objects

Athul K P (PG) — Impact of the equation of state on f- and p- mode oscillations of neutron stars
Publications:

- **Phys. Rev. D 106 (2022) 063005**
- **Galaxies 11 (2023) 60;** [Invited Article]

Current Position: PhD in FSU

Souhardya Sen (PG) — Radial oscillations in neutron stars from unified equation of states
Publications:

- **Galaxies 11 (2023) 60;** [Invited Article]
- **Phys. Rev. D 107 (2023) 103039**

Vikram Singh Khati (PG) — Presence of dark matter in the core of Neutron star

Pritam Kumar Bishee (UG) — Treatment of quark matter in the inner core of Neutron star

Soumya Prakash Behera (UG) — Nuclear constraints on gravitational waves from deformed pulsars

Manisha (PG) — Computation of two-fluid dark matter (SIRE-project)

Arijit Maiti (PG) — Studying the Structure of Neutron Stars Through Numerical Analysis of TOV Equations (SIRE-project)

Administrative Experience

Departmental Activities

2020-Continue — Department Academic Committe UG & PG

2022-Continue — PIC-Time Table and Seminar Incharge

2021-2022 — PIC-Placement

Institute Activities

2023 — XX Convocation Dress Distribution Committee Member

Research Publications

II. Preprinted Papers

1. The Impact of Anisotropy on Neutron Star Properties: Insights from I-f-C Universal Relations, S. R. Mohanty, Sayantan Ghosh, Pinku Routaray, H. C. Das and **Bharat Kumar**, Submitted to PRD [https://arxiv.org/abs/2305.15724]

2. Unstable Anisotropic Neutron Stars: Probing the Limits of Gravitational Collapse, S. R. Mohanty, Sayantan Ghosh, and **Bharat Kumar**, Submitted to PRD [https://arxiv.org/abs/2304.02439]

3. Investigating Dark Matter-Admixed Neutron Stars with NITR Equation of State in Light of PSR J0952-0607,

Pinku Routray, Sailesh Ranjan Mohanty, H. C. Das, Sayantan Ghosh, P. J. Kalita, V. Parmar, Bharat Kumar,
Submitted to JCAP [https://doi.org/10.48550/arXiv.2211.12808]

4. Can Gravitational Waves posterior constrain the mass of a WIMP?,
Abdul Quddus, Kabir Chakravarti, and **Bharat Kumar**,
Submitted to MNRAS [https://arxiv.org/pdf/2202.04364.pdf]

5. Correlation between the curvature and various properties of the neutron star,
S K Biswal, H C Das, Ankit Kumar, **Bharat Kumar**, and S K Patra,,
[https://arxiv.org/abs/2012.13673]

6. Structure effects on fission yields,
Bharat Kumar, M. T. Senthil Kannan, M. Balasubramaniam, B. K. Agrawal, S. K. Patra,
[https://arxiv.org/abs/1701.00731]

Chapters in book

1. Recent parametrization in relativistic mean-field formalism,
K C Naik, R. N. Panda, **Bharat Kumar** and S. K. Patra,
Nuclear structure physics, CRC press (2020) ISBN:9780367256104

Papers Published in International Refereed Journals

1. Radial Oscillations of Dark Matter admixed Neutron Stars,
Pinku Routray, H. C. Das, Souhardya Sen, **Bharat Kumar**, Grigoris Panotopoulos, and Tianqi Zhao,
Phys. Rev. D 107 (2023) 103039 [https://doi.org/10.48550/arXiv.2211.12808]
Impact Factor:**5.29**

2. Radial oscillations in neutron stars from unified equation of states,
Souhardya Sen, Shubham Kumar, Athul Kunjipurayil, Pinku Routaray, Sayantan Ghosh, Probit J. Kalita, Tianqi Zhao and **Bharat Kumar**,
Galaxies 11 (2023) 60; [Invited Article] [https://arxiv.org/pdf/2205.02076.pdf]
Impact Factor:**3.3**

3. Theoretical studies on structural properties and decay modes of $^{284-375}119$ isotopes,
Asloob A. Rather, M. Ikram, Ishfaq A. Rather, A. A. Usmani, **Bharat Kumar**, K. P. Santhosh, S. K. Patra,
Eur. Phys. J. Plus 138 (2023) 467 [https://arxiv.org/abs/1709.07311]
Impact Factor:**3.75**

4. Impact of the equation of state on f- and p- mode oscillations of neutron stars,
Athul Kunjipurayil, Tianqi Zhao, **Bharat Kumar**, Bijay K. Agrawal, and Madappa Prakash,
Phys. Rev. D 106 (2022) 063005 [https://arxiv.org/abs/2205.02081]
Impact Factor:**5.29**

5. Dark Matter Effects on the Compact Star Properties,
H C Das, Ankit Kumar, **Bharat Kumar**, and S K Patra,
Galaxies 10 (2022) 14; [Invited Review Article]
Impact Factor:**3.17**

6. Universal relations between the quasinormal modes of neutron star and tidal deformability,
Hajime Sotani, and **Bharat Kumar**,
Phys. Rev. D 104 (2021) 123002; [https://arxiv.org/pdf/2109.08145.pdf]
Impact Factor:**5.29**

7. The BigApple force and it's implications to finite nuclei and astrophysical objects,
H C Das, Ankit Kumar, **Bharat Kumar**, S K Biswal, and S K Patra,
IJMP E 30 (2021) 2150088; [https://arxiv.org/abs/2009.10690]

Impact Factor:**1.174**

8. Impacts of dark matter on the curvature of the neutron star,
H C Das, Ankit Kumar, **Bharat Kumar**, S K Biswal, and S K Patra,
JCAP 01 (2021) 007; [https://arxiv.org/abs/2007.05382]
Impact Factor:**5.21**

9. Warm dense matter and cooling of supernovae remnants,
Ankit Kumar, H C Das, S K Biswal,**Bharat Kumar**, and S K Patra,
Eur. Phys. J C 80 (2020) 775; [https://doi.org/10.1140/epjc/s10052-020-8353-4]
Impact Factor:**4.39**

10. *GW170817 constraints on the properties of a neutron star in the presence of WIMP dark matter,
Abdul Quddus, Grigorios Panotopoulos, **Bharat Kumar**, Shakeb Ahmad, and S. K. Patra,
J. Phys. G 47 (2020) 095202; [https://doi.org/10.1088/1361-6471/ab9d36]
Impact Factor:**2.41**

11. Effects of dark matter on the nuclear and neutron star matter,
H C Das, Ankit Kumar, **Bharat Kumar**, S K Biswal, Takashi Nakatsukasa, Ang Li, and S K Patra,
MNRAS 495 (2020) 4893; [https://doi.org/10.1093/mnras/staa1435]
Impact Factor:**5.54**

12. *Inferring Neutron Star Properties from GW170817 with Universal Relations
Bharat Kumar, and Philippe Landry,
Phys. Rev. D 99 (2019) 123026; [https://doi.org/10.1103/PhysRevD.99.123026]
Impact Factor:**4.83**

13. [1]Constraints on the moment of inertia of PSR J0737-3039 from GW170817,
Philippe Landry, and **Bharat Kumar**,
ApJL 868 (2018) L22; [https://doi.org/10.3847/2041-8213/aaee76]
Impact Factor:**8.20**

14. *GW170817: Constraining the nuclear matter equation of state from the neutron star tidal deformability,
Tuhin Malik, N. Alam, M. Fortin, C. Providência, B. K. Agrawal, T. K. Jha, **Bharat Kumar**, and S. K. Patra,
Phys. Rev. C 98 (2018) 034005; [https://doi.org/10.1103/PhysRevC.98.035804]
Impact Factor: **3.29**

15. Decay properties and reaction dynamics of zirconium isotopes in the relativistic mean-field model,
M. Panigrahi, R. N. Panda, **Bharat Kumar** and S. K. Patra,
IJMP E 27 (2018) 1850012; [[https://doi.org/10.1142/S021830131850012X]
Impact Factor:**1.174**

16. *New relativistic effective interaction for finite nuclei, infinite nuclear matter and neutron stars,
Bharat Kumar, S. K. Patra, and B. K. Agrawal,
Phys. Rev. C 97 (2018) 045806; [https://doi.org/10.1103/PhysRevC.97.045806]
Impact Factor: **3.29**

17. A Study of Multi-Λ Hypernuclei within Spherical Relativistic Mean-field Approach,
Asloob A. Rather, M. Ikram, A. A. Usmani, **Bharat Kumar**, S. K. Patra,
Braz. J. Phys. 47 (2017) 628; [https://doi.org/10.1007/s13538-017-0525-9]

18. *New parameterization of the effective field theory motivated relativistic mean field model,
Bharat Kumar, S. K. Singh, B. K. Agrawal, S. K. Patra,
Nucl. Phys. A 966 (2017) 197; [https://doi.org/10.1016/j.nuclphysa.2017.07.001]
Impact Factor: **1.70**

[1]Important papers which are related to the GW170817 and nuclear fission.

19. *Relative mass distributions of neutron-rich thermally fissile nuclei within statistical model,
Bharat Kumar, M. T. Senthil Kannan, M. Balasubramaniam, B. K. Agrawal, S. K. Patra,
Phys. Rev. C 96 (2017) 034623; [https://doi.org/10.1103/PhysRevC.96.034623]
Impact Factor: **3.29**

20. Relative fragmentation in ternary systems within the temperature-dependent relativistic mean-field approach,
M. T. Senthil Kannan, **Bharat Kumar**, M. Balasubramaniam, B. K. Agrawal, S. K. Patra,
Phys. Rev. C 95 (2017) 064613; [https://doi.org/10.1103/PhysRevC.95.064613]
Impact Factor: **3.29**

21. *Tidal deformability of neutron and hyperon star with relativistic mean field equations of state,
Bharat Kumar, S. K. Biswal and S. K. Patra,
Phys. Rev. C 95 (2017) 015801; [https://doi.org/10.1103/PhysRevC.95.015801]
Impact Factor: **3.29**

22. Structural and decay properties of Z=132,138 superheavy nuclei,
Asloob A. Rather, M. Ikram, A. A. Usmani, **Bharat Kumar**, S. K. Patra,
Eur. Phys. J. A 52 (2016) 372; [https://doi.org/10.1140/epja/i2016-16372-x]
Impact Factor:**2.80**

23. Quest for magicity in hypernuclei,
M. Ikram, **Bharat Kumar**, S. K. Biswal and S. K. Patra,
IJMP E 25 (2016) 1650103; [https://doi.org/10.1142/S0218301316501032]
Impact Factor:**1.174**

24. Effects of isovector scalar meson on neutron star both with and without hyperon,
S. K. Biswal, **Bharat Kumar** and S. K. Patra,
IJMP E 25 (2016) 1650090; [https://doi.org/10.1142/S0218301316500907]
Impact Factor:**1.174**

25. Nuclear structure and decay properties of even–even nuclei in Z = 70-80 drip-line region,
S. Mahapatro, C. Lahiri, **Bharat Kumar**, R. N. Mishra and S. K. Patra,
IJMP E 25 (2016) 1650062; [https://doi.org/10.1142/S0218301316500622]
Impact Factor:**1.174**

26. Modes of decay in neutron-rich nuclei,
Bharat Kumar, S. K. Biswal, S. K. Singh, Chirashree Lahiri, and S. K. Patra,
IJMP E 25 (2016) 1650020; [https://doi.org/10.1142/S0218301316500208]
Impact Factor:**1.174**

27. Examining the stability of thermally fissile Th and U isotopes,
Bharat Kumar, S. K. Biswal, S. K. Singh and S. K. Patra,
Phys. Rev. C 92 (2015) 054314; [https://doi.org/10.1103/PhysRevC.92.054314]
Impact Factor: **3.29**

28. Properties of superheavy nuclei: Z = 124,
M. S. Mehta, Harvinder Kaur, **Bharat Kumar** and S. K. Patra,
Phys. Rev. C 92 (2015) 054305; [https://doi.org/10.1103/PhysRevC.92.054305]
Impact Factor: **3.29**

29. Shape co-existence and parity doublet in Zr isotopes,
Bharat Kumar, S. K. Singh and S. K. Patra,
IJMP E 24(2015)1550017; [https://doi.org/10.1142/S0218301315500172]
Impact Factor:**1.174**

Papers Published in in National Symposium and Conferences

1. Analysis of parity doublet in medium mass nuclei,
   Bharat Kumar, S. K. Singh and S. K. Patra,
   Proceedings of the DAE Symp. on Nucl. Phys. **59**, 96 (2014).

2. β-decay half-life of Th and U isotopes,
   Bharat Kumar, S. K. Biswal, S. K. Singh and S. K. Patra,
   Proceedings of the DAE Symp. on Nucl. Phys. **60**, 406 (2015).

3. Nucleus and its application: Neutron-rich thermally fissile nuclei,
   Bharat Kumar, S. K. Biswal and S. K. Patra,
   National seminar on recent trends in physics & 33^{rd} convention of Orissa Physical Society.

4. Evolution of N = 32,34 shell closure in relativistic mean field theory,
   Bharat Kumar, S. K. Biswal and S. K. Patra,
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 196 (2016).

5. Tidal effects in equal-mass binary neutron stars,
   Bharat Kumar,S. K. Biswal and S. K. Patra,
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 868 (2016).

6. Curvature of a neutron star,
   Bharat Kumar, S. K. Biswal and S. K. Patra,
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 916 (2016).

7. Search For Λ Shell Closures in Multi-Λ Hypernuclei,
   Asloob A. Rather, M. Ikram, M. Imran, **Bharat Kumar**, S. K. Biswal, S. K. Patra,
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 178 (2016).

8. Competition between α, β decay and Spontaneous Fission in Z=132 Superheavy Nuclei,
   Asloob A. Rather, M. Ikram, **Bharat Kumar**, S. K. Biswal,S. K. Patra
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 202 (2016).

9. Effects of δ-meson on the maximum mass of the hyperon star,
   S. K. Biswal, **Bharat Kumar**, S. K. Patra,
   Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **61**, 912 (2016).

10. I-Love relation in low-mass neutron stars **...Accepted** (2016).
    Bharat Kumar, S. K. Biswal and S. K. Patra,
    National Conference On Nuclear and Accelerator Physics (NCNAP-2016) October 4-6, 2016, Centre for Applied Physics Central University of Jharkhand, Brambe, Ranchi, India.

11. Effective relativistic mean field model for finite nuclei and neutron stars,
    Bharat Kumar, B. K. Agrawal and S. K. Patra,
    Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **62**, 716 (2017).

12. Tidal deformability of neutrons and hyperon star,
    Bharat Kumar and S. K. Patra,
    Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **62**, 37 (2017).

13. Determination of the nuclear incompressibility and symmetry energy from neutron star tides,
    Tuhin Malik, N. Alam, M. Fortin, C. Providência, B. K. Agrawal, T. K. Jha, **Bharat Kumar**, and S. K. Patra,
    Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **63**, 816 (2018).

14. Properties of a neutron star in the presence of dark matter,
    Abdul Quddus, Grigorios Panotopoulos, **Bharat Kumar**, Shakeb Ahmad, and S. K. Patra,
    Proceedings of the DAE-BRNS Symp. on Nucl. Phys. **63**, 810 (2018).

15. Neutron skins of heavy nuclei and tidal deformability of neutron star, **Bharat Kumar**, OMEG15 at Kyoto University, Japan; https://arxiv.org/abs/1908.02909

References

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Sincerely,