

Dr. Pankaj S. Joshi

*Distinguished Professor of Physics and Founding Director,
International Centre of Space and Cosmology, Ahmedabad University.*

Profile Summary

Dr Pankaj Joshi is currently Distinguished Professor of Physics and Founding Director of the International Center for Space and Cosmology at the Ahmedabad University. He was earlier a Senior Professor of Astronomy and Astrophysics at the Tata Institute of Fundamental Research, Mumbai, before joining Charusat University as their Vice-Chancellor. More popularly, he is known as a Scholar, Physicist, and an expert on Cosmology.

Professor Joshi's research interests are general relativity and gravitation. He has made fundamental contributions to Blackhole Physics and Cosmology with his extensive analysis of final fate of massive collapsing stars in the universe. This work, widely recognised for providing significant insights, led to the discovery that massive stars end up in powerfully exploding fireballs, also called naked singularities, rather than blackholes. His research is reported in more than 250 research papers in International Journals of repute, and in books and monographs from OUP (Oxford), CUP (Cambridge), and others. The world-renowned *Scientific American* magazine published his work as their International cover story (2009), translated in more than 20 languages, also included in their *Special Collector's Editions (2013,17,22)*. Stanford University has placed him in their World Top 2% Scientists list for the past four years 2020-23 for his career achievement and contributions.

Joshi has won several coveted awards and fellowships to scientific academies, holding Visiting Professorships in several countries, doing research and Lectures. He has been an adjunct faculty, fellow and visiting scientist to Cambridge, Harvard, New York University (NYU), U of Pittsburgh, U of Southampton, Osaka City U, U of Basque Country (Spain), U of Natal (SA), Queen Mary and Westfield College, London, Milano Polytechnic (Italy), U of Cincinnati, to name a few reputed ones.

His prestigious awards and prizes include Gravity Research Foundation (USA) award, Prof A C Banerji Gold Medal and Memorial Lecture award (National Academy of Sciences), C V Raman lecture award by the Department of Atomic Energy, the reputed Vainu Bappu International Award (INSA), Shankar

Fellowship Award (Govt of MP), among others. He is an elected Fellow of The World Academy of Sciences (TWAS, Europe), the Indian National Science Academy (INSA, New Delhi), National Academy of Sciences, India; and has been President of the Indian Association of General Relativity & Gravitation (IAGRG; 2010-12) and Gujarat Science Academy (GSA; 2020-23), with other such distinctions. Joshi has also contributed a large number of popular articles and books towards science outreach and has given many public talks and TV shows.

Designation and Address:

Distinguished Professor of Physics and Founding Director,
International Centre of Space and Cosmology,
School of Arts and Sciences,
Ahmedabad University,
Navrangpura, Ahmedabad-380009,
Gujarat, India.

Email: pankaj.joshi@ahduni.edu.in (O), psjcosmos@gmail.com (P)

Mobile: +91-9892490083

Academic Qualifications:

M.Sc.(1975), Ph.D.(1979). Thesis: ‘A Study of Causality Principle in General Relativity’.

Positions held:

- Distinguished Professor of Physics and Founding Director, International Centre of Space and Cosmology, Ahmedabad University, Navrangpura, Ahmedabad 380009, Gujarat, India (Feb 1, 2022, onwards).
- Vice-Chancellor and Advisor, Charotar University of Science and Technology, Campus, Changa, Anand 388421 (GUJ) (1 May 2018 to 31 January 2022).
- Senior Professor (HAG scale, 2009-2018); Professor (H-scale, 2001-2009); Professor (G-scale, 1998-2001); Associate Professor (F-scale, 1993-1998); Reader (E-scale, 1988-93); Fellow (D-scale, 1983-88), all at the Department of Astronomy and Astrophysics, Tata Institute of Fundamental Research,

Mumbai, India.

- National Science Foundation (NSF, USA) Research Fellow, University of Pittsburgh, Pittsburgh, PA, U.S.A. (1981-83).
- Visiting Fellow, Tata Institute of Fundamental Research, Bombay (1979-81).
- University Grants Commission Research Fellow, worked on the project 'Gravitation Radiation and Gravitational Collapse', Saurashtra University (1975- 79), India.
- Visiting Scientist at the D.A.M.T.P., Cambridge University, Cambridge, U.K. (Sept- Octo, 1983); Held Visiting Positions over the years at many Universities in India and abroad, for Collaborations/Seminars/Discussions.
- UGC Visiting Professor at many Indian Universities to deliver courses of lectures to post-graduate students and faculty members.
- S.E.R.C. (U.K.) Visiting Scientist at the Faculty of Mathematical Studies, University of Southampton, U.K. (Feb-March 1987); Awarded a British Council Fellowship to visit Universities in U. K. (1987).
- First Long Term Visitor at the Black Hole Initiative, Harvard University (2016); Distinguished Visitor, Osaka City University, Osaka (March 2016); Visiting Professor, Dept of Theoretical Physics, University of Basque Country, Spain (Sept Octo 1998); Faculty of Math. Sciences, University of Natal, South Africa (Feb March 1999); Queen Mary and West eld College, London (1998); Milano Polytechnic, Italy (1995, 1998); Invited as Visiting Professor by the University of Cincinnati, USA, and many other top academic centers.
- Financed Research Projects: Classical and Quantum Aspects of Strong Gravitational Fields, financed by CERN, Switzerland (1997-99), collaborators: Profs Louis Witten (University of Cincinnati, USA), Canelo Vaz (Portugal); Spanish government grant at the University of Basque Country, Spain, with an international research team of some 20 members (2000); and such others.

Research Interests:

Gravitation Theory and Cosmology; Quantum Gravity; Gravitational Collapse, Cosmic Censorship, and Black Hole Physics; Spacetime Structure and the General Theory of Relativity; Relativistic Astrophysics.

Publications:

(a) Research Papers:

More than 250 research papers published in reputed international journals, conference proceedings, etc; the full list is available at:

<https://scholar.google.com/citations?user=6TnQ2m8AAAAJ&hl=en>

(b) Research Monographs, Books, and Conference Proceedings:

1. Joshi P. S. (2018, 2015), *The Story of Collapsing Stars–Black Holes, Naked Singularities and the Cosmic Play of Quantum Gravity*, Oxford University Press, Oxford, UK, 2015; paperback edition Feb 2018.
2. Joshi P. S., (2012), *Gravitational Collapse and Spacetime Singularities*, Paperback Edition; Cambridge University Press, included in their monograph series, *Cambridge Monographs on Mathematical Physics*.
3. Joshi P. S. (2011), (ed. with R. Tikekar, N. Dadhich, K. Jotania, A. M. Vaidya, M. H. Vasavada), *A Tribute to P C Vaidya*, Special issue of *Mathematics Today*, Vol 26 (2011).
4. Joshi P. S., (2008), *Gravitational Collapse and Spacetime Singularities*, Cambridge University Press, included in their monograph series, *Cambridge Monographs on Mathematical Physics*.
5. Joshi P. S. (2007), (ed. with N. Dadhich and P. Roy), *Raychaudhuri Equation at the Cross-roads*, a Special Volume in honour of A. K. Raychaudhuri, *Pramana -Journal of Physics*, Vol. 69, No. 1, Indian Academy of Sciences and Springer, Bangalore.
6. Joshi P. S., (1996), *Global Aspects in Gravitation and Cosmology*, Clarendon Press (OUP), Oxford; the paperback edition, with corrections (*The International Series of Monographs on Physics*, Vol 87).
7. Joshi P. S. (ed.), (1996), *Singularities, Black Holes and Cosmic Censorship*, Proceedings of the Raychaudhuri Session at the International Conference on Gravitation and Cosmology (ICGC95), IUCAA Publication, Pune, 1996.
8. Joshi P. S., (1993), *Global Aspects in Gravitation and Cosmology*, Clarendon Press (OUP), Oxford (*The International Series of Monographs on Physics*, Vol 87).

(c) Books Towards Science Popularization and Public Outreach:

More than 20 books published on Science and Cosmology (details in List of Publications), for children, students, and citizens, towards Science Popularization; Received excellent response: Total aggregate circulation of

about 250 Thousand copies till the date; Published by Oxford University Press (India), Gurjar Granth Ratna Publications Ahmedabad, Yagna Prakashan, Vadodara, and others; Many of these into Fourth/Fifth editions.

Selected Awards and Honors:

- Soham Memorial Award (2023), Bharatiya Vidya Bhavan, Mumbai, for the article series 'Sage & Scientist – A Cosmic Dialogue', in *Navneet-Samarpan*.
- Gujarat Gaurav Ratna Award (2023) given to Dr. Pankaj S. Joshi; 1 May 2023
- Achala Education Foundation Trust awarded Dr. Pankaj S. Joshi their 'Saraswat Award', by the His Excellency Hon'ble Governor Acharya Devvratji vide its letter dated 16 February 2021.
- The Indian National Science Academy (INSA) nominated Dr. Pankaj S. Joshi as the Convener of the Ahmedabad Chapter (INSA) local chapter via its letter dated 24 February 2021.
- Award of Shankar Fellowship 2021-23; to Dr. Pankaj S. Joshi under the theme "Interface of Sankara's Advaita Vedanta with Modern Science by Acharya Shankar Sanskrutik Ekta Nyas, Bhopal vide letter dated 29-6-2021;
- INSA-Vainu Bappu Memorial Award (2019) has been awarded to Dr. Pankaj S. Joshi by the Indian National Science Academy (INSA), New Delhi via its letter dated 17 August 2020.
- The World Academy of Sciences, Italy, has elected Dr. Pankaj S. Joshi as a Fellow of The World Academy of Sciences (TWAS) for the advancement vide its letter dated 15 December 2020. .
- Annual Oration Award 2018, of the Society of Cancer Research and Communications (SCRAC), Mumbai.
- DAE C. V. Raman lecture award 2017, by the Indian Physics Association (IPA).
- The article 'Modern Cosmology and Ancient Traditions', published by the well-known USA magazine, Nautilus, January 2017.
- Received the First Professor A.R. Rao Research Award, and delivered the first Prof A. R. Rao Memorial Lecture, Professor A R Rao Foundation, Ahmedabad, December 2016.
- The first Long Term Visitor at the 'Black Hole Initiative' of the Center for Astrophysics and Harvard University; September 2016; Gave the Inaugural Colloquium in Physics.
- Served as Adjunct Faculty, New York University, NYU International Learning

- Program, USA, gave Course of Lectures, ‘Cosmic Frontiers I and II’, on Astrophysics and Cosmology, meant for students internationally, 2016, 2014.
- Invitation Fellowship as ‘Distinguished scholar from abroad’, Osaka City University, Osaka, Japan, March 2016.
 - Saraswat Gaurav Award, for overall academic, teaching, and research contributions, Gujarat Vishvakosh, Ahmedabad, May 2015.
 - Prof. A. C. Banerji Gold Medal and Memorial Lecture Award, by the National Academy of Sciences, India, 2013.
 - Joshi’s work on collapsing massive stars was chosen as one of the 16 frontier research articles for the ‘Collector’s Edition’ Special Issue on Physics by the ‘Scientific American’, which included our review article ‘Naked Singularities’ (May 2013).
 - Sandipani Gaurav Award (2013), by the Sandipani Sanskriti Pratishthan, Porbandar (Gujarat).
 - The Vaidya-Raychaudhuri Lecture Endowment Award (2012), by the Indian Association of General Relativity and Gravitation (IAGRG), India.
 - Elected Fellow, Indian National Science Academy (INSA), New Delhi (2012).
 - The 8th S. Chandrasekhar lecture; Nehru Center, Mumbai, on ‘Life and Death of Massive Stars’, 2012.
 - Umanga Foundation Award for Contribution to Research and Knowledge (Bharatiya Vidya Bhavan, Mumbai, October 2011).
 - President (2010-12), Indian Association of General Relativity and Gravitation (IAGRG), India.
 - ‘Scientific American’ (2009), review article on our work in Black Holes physics and the Gravitational Collapse of Massive Stars. The article on naked singularities was published in Feb 2009, as their International Cover story, and translated into more than 17 international languages.
 - The research monograph, Gravitational Collapse, and space-time singularities (2008), included in the prestigious series, ‘Cambridge Monographs on mathematical physics’; Cambridge University Press (2008); Paperback edition (2012).
 - Elected Fellow, The National Academy of Sciences (NASI), India (2006).
 - Elected Fellow, Gujarat Science Academy, Ahmedabad (2006).
 - Prize and Award by the Gravity Research Foundation, USA, for research work on the Final Fate of Gravitational Collapse (1991). Other winners that year included M. Turner (NASA/Fermi Lab), S. Coleman (Harvard), L. Krauss (Yale), J. Preskill (Caltech), and F. Wilczek (Princeton).
 - Public Service and Best Citizen Award (2001), Shishu Vihar, Gujarat, for contributions to education, students, and science popularization.

- Awarded the Nuffield Foundation Fellowship to work at the DAMTP, Cambridge University (1981).
- National Merit Scholarship holder of Govt of India (1969-73); University First in M.Sc. exams etc.
- Served on several National Committees, Member of, National Advisory Committee to the University Grants Commission, India, for Gravitation and Cosmology (1992- 1994); Member, Advisory Committee on Gravitation and Cosmology, IUCAA (1994), and others.
- Served as a Member of Scientific or Organizing Committees for very many conferences, including the ‘Physics of Black holes’ (Bangalore, 1997), the International GR15 (1997), and the International Conf. on Grav. And Cosmology (ICGC), IAGRG, and others.
- Very many citations of our research papers and books received in international journals of repute.
- Awarded Honorable Mention (1980, 85, 86, 87, 88, 92) by the Gravity Research Foundation, USA, for research in gravitation physics.
- The Oxford University Press published the monograph entitled, Global Aspects in Gravitation and Cosmology (1993), Paperback ed. (1996), published by the Clarendon Press, Oxford; included in their reputed series ‘The International Series of Monographs on Physics’; widely cited with excellent international reviews.

Teaching and Education Contributions:

1. Guided 15 students for their Ph. D.; 12 Post-Doctoral Fellows have worked under my advice.
2. Gave summer and research projects to more than 50 students over the past years.
3. Taught regular courses at the Graduate School, TIFR, and elsewhere; gave Lecture courses on Gravitation and Cosmology, at Bombay University, IUCAA, and at various Universities, at Summer/Winter Schools, and at different centers in the country (select list given in Appendix III).
4. Over the years, regularly interacted with University and College teachers, who visited to discuss/initiate new research projects; resulting in many research publications for them.
5. Developed at TIFR a research group working on gravitation theory, black hole physics, gravitational collapse, and cosmology, that included regular members, post-docs, and students.

6. Worked frequently as examiner/adviser with various Universities, contributing to teaching and education.
7. Contribution to Research at Indian Universities: Our research, and in particular the OUP and CUP monographs, was generated and inspired within the University Community in India, with more than 100 research publications in reputed international journals over the past years.

Science Refereeing Work:

Regularly worked and consulted as a referee to many National and International Research Journals such as Classical and Quantum Gravity, General Relativity, and Gravitation, Int. J. of Mod. Physics, Physics Letters B, Mod. Physics Letters, Pramana, Mathematical Reviews, Cambridge University Press, and others. Also a reviewer of International Science Proposals for many organizations.

Selected Academic Contributions:

- Research at ICSC continuing
- Research at ICC(Organized international workshop)
- Research group at TIFR; received regular visiting applications from excellent centers abroad, and from within India; distinguished visitors included R. Penrose, Ramesh Narayan, R. Wald, L. Witten, M. A.H. MacCallum, and others.
- Organized the conference, ‘Geometrical aspects of relativity’, December 1984, TIFR, Mumbai.
- Organized a Symposium ‘50 Years of Vaidya Metric’, at the Silver Jubilee Conference of the Indian Association of General Relativity and Gravitation (1994), to review the developments and applications further to the discovery of the Vaidya metric.
- Organized a three-days International Workshop on ‘Gravitational Collapse and Cosmic Censorship’ (IUCAA, Pune, 1995).
- Organized a ‘Session on The Raychaudhuri Equation’ at the International Conference on Gravitation and Cosmology (ICGC, 1995); Well-known authorities (USA, UK, Australia) participated.
- Organized an International Workshop on ‘Cosmic Censorship, Black Holes and Naked Singularities’ (Mumbai, March 3-10, 2006).
- Gave many Colloquia regularly at TIFR, which include, ‘Death of a Massive Star’, 12 July 2006; ‘Gravitational Collapse’, (DTP colloquium), 26 Sept 2006; ‘The Raychaudhuri equation in Modern Cosmology and Gravitational Collapse’, 10 Aug 2005; ‘The Black Hole Conundrum’, 19 Aug 2004; and others.

- Member, SOC, for many National and International Conferences, e.g. International Conference on Gravitation and Cosmology 4 (ICGC4), Cochi; ICGC7 (Goa, 2011); Member, IUCAA (Pune) Review Committee on Gravitation and Cosmology, to review their Research Associate Program.
- Organized the lectures by Roger Penrose (Jan. 2003) and Ramesh Narayan (2014) at TIFR.

Contributions toward public understanding of Science:

- Alongside my scientific endeavours, I have significantly contributed to society's welfare and well-being through science outreach, more than 200 popular articles, a similar number of talks in various public fora, and more than 15 popular books on Astrophysics and Cosmology many of which went into more than three editions, the latest of these being 'Tara Srushti' (4th edition), 'Brahmand-Darshan' (3rd edition), and 'Vigyan Goshti' (3rd edition). These were published by Oxford Univ. Press, India, and other publishers. science books on the universe in Gujarati, including 'Prayogo Ni Maza' and 'Tara Srushti,' my work has reached 200,000 copies in Gujarat. These books are widely utilized by children, high school, and college students.
- Some of our works attracted the excellent attention of popular science media and were reported in detail by The 'New Scientist' (2000, 2006), 'Physics World' (2006), 'The Frankfurter Allegemine' (2012), Germany, 'Nature' Asia, and many other news reports in various publications.
- I strongly believe in and uphold the philosophies of the 'Joy of Science' and 'Science for All.' To connect with people in remote areas, I have simplified complex scientific concepts and the functioning of the cosmos into easily understandable language. I have also explored ancient Indian texts, analyzing their scientific principles in light of modern science. Moreover, I have extensively taught Cosmos, Math, and Science to government school children through government and other organized seminars. I have conducted many TV and Press Interviews and Discussions, to explain recent cosmology and astrophysics developments toward public understanding of science.
- These efforts led to my election as President of the Gujarat Science Academy (GSA) from 2020 to 2022. GSA is a prominent state-level academy with strong national affiliations, promoting scientific education and research.
- The book 'Story of Collapsing Stars' (OUP), describing our work on Gravitational Collapse, Black Holes, etc at the popular level received excellent responses; reviewed by Nature (placed in 'Best Five' series), Physics Today, Choice, and others.

Some of the titles and details are as:

- 'Vigyan-Goshti', (2011), A set of Three Books, discussing topics such as the Human Body, Basic Astronomy, the Living World and such others; Trust Taral; Gujarat.
- 'Brahmand-Darshan', (2011, 4th Edition); Yagna Prakashan, Baroda, 2008.

- 'Tara Srushti' (The World of Stars), (3rd Edition, 2010); Gurjar Granth Ratna Publications and Trust Taral, Ahmedabad, 2006; more than 20,000 copies so far.
- 'Khagol na Mahaprashno' (The Super questions in Cosmology), 2004, Parichaya Trust, Mumbai.
- 'Saapekshvad' (Theory of relativity), 2002, Parichaya Trust, Mumbai.
- 'Tara: Sarjan ane Vilay' (Stars: Their creation and extinction), 2000, Parichaya Trust, Mumbai.
- Kutoohul' (Gujarati trans.) (Curiocities in Science), part I and II, it children series; 1981, 1983; went into three editions, Oxford Univ. Press, Mumbai.
- Kutoohul' (Gujarati trans.) (Curiocities in Science), part I and II, it teenagers series; 1982, 1984; went into three editions, Oxford Univ. Press, Mumbai.
- Prayogo ni Maza' (Gujarati) (Fun of Experiments), 1985; went into two editions, Oxford Univ. Press, Mumbai.
- 'Avnava Prayogo' (Gujarati) (Novel Experiments), 1986; went into two editions, Oxford University Press, Mumbai.
- Popular Articles on Science and Cosmology (During the period 1981-2020): More than 200 popular science articles written in reputed Magazines and News Papers, such as Navneet-Samarpan, Bhavan's Journal, Aha Zindagi (Hindi, Gujarati), Janma-Bhoomi-Pravasi, Sandesh, Divya Bhaskar, and others with wide circulation, in English, Hindi and Gujarati.

APPENDIX I:
25 Most Important Research Publications

1. Naked singularities in spherically symmetric inhomogeneous Tolman-Bondi dust cloud collapse; By P.S. Joshi, I.H. Dwivedi.
[arXiv:gr-qc/9303037](https://arxiv.org/abs/gr-qc/9303037).
[10.1103/PhysRevD.47.5357](https://doi.org/10.1103/PhysRevD.47.5357).
Phys.Rev. D47 (1993) 5357-5369.
2. Recent developments in gravitational collapse and spacetime singularities; By Pankaj S. Joshi, Daniele Malafarina.
[arXiv:1201.3660 \[gr-qc\]](https://arxiv.org/abs/1201.3660).
[10.1142/S0218271811020792](https://doi.org/10.1142/S0218271811020792).
Int.J.Mod.Phys. D20 (2011) 2641-2729.
3. The Final fate of spherical inhomogeneous dust collapse; By T.P. Singh, P.S. Joshi.
[arXiv:gr-qc/9409062](https://arxiv.org/abs/gr-qc/9409062).
[10.1088/0264-9381/13/3/019](https://doi.org/10.1088/0264-9381/13/3/019).
Class.Quant.Grav. 13 (1996) 559-572.
4. Why do naked singularities form in gravitational collapse? By Pankaj S. Joshi, Naresh Dadhich, Roy Maartens.
[arXiv:gr-qc/0109051](https://arxiv.org/abs/gr-qc/0109051).
[10.1103/PhysRevD.65.101501](https://doi.org/10.1103/PhysRevD.65.101501).
Phys.Rev. D65 (2002) 101501.
5. Gravitational Collapse: The Story so far; By P.S. Joshi.
[10.1007/s12043-000-0164-4](https://doi.org/10.1007/s12043-000-0164-4).
Pramana 55 (2000) 529-544.
6. Initial data and the end state of spherically symmetric gravitational collapse; By P.S. Joshi, I.H. Dwivedi.
[arXiv:gr-qc/9804075](https://arxiv.org/abs/gr-qc/9804075).
[10.1088/0264-9381/16/1/003](https://doi.org/10.1088/0264-9381/16/1/003).
Class.Quant.Grav. 16 (1999) 41-59.
7. The Structure of Naked Singularity in Self-Similar Gravitational Collapse; By P.S. Joshi, I.H. Dwivedi.
[10.1007/BF02102631](https://doi.org/10.1007/BF02102631).
Commun.Math.Phys. 146 (1992) 333-342.
8. Phase transition in gravitational collapse of inhomogeneous dust; By P.S. Joshi, T.P. Singh.
[arXiv:gr-qc/9405036](https://arxiv.org/abs/gr-qc/9405036).

- [10.1103/PhysRevD.51.6778.](#)
Phys.Rev. D51 (1995) 6778-6782.
9. Distinguishing black holes from naked singularities through their accretion disc properties; By Pankaj S. Joshi, Daniele Malafarina, Ramesh Narayan.
[arXiv:1304.7331 \[gr-qc\].](#)
[10.1088/0264-9381/31/1/015002.](#)
Class.Quant.Grav. 31 (2014) 015002.
10. On the occurrence of naked singularity in spherically symmetric gravitational collapse; By I.H. Dwivedi, P.S. Joshi.
[arXiv:gr-qc/9405049.](#)
[10.1007/BF02099303.](#)
Commun.Math.Phys. 166 (1994) 117-128.
11. Quantum evaporation of a naked singularity; By Rituparno Goswami, Pankaj S. Joshi, Parampreet Singh.
[arXiv:gr-qc/0506129.](#)
[10.1103/PhysRevLett.96.031302.](#)
Phys.Rev.Lett. 96 (2006) 031302.
12. Kerr Naked Singularities as Particle Accelerators; By Mandar Patil, Pankaj S. Joshi.
[arXiv:1103.1082 \[gr-qc\].](#)
[10.1088/0264-9381/28/23/235012.](#)
Class.Quant.Grav. 28 (2011) 235012.
13. Towards an observational test of black hole versus naked singularity at the galactic center; By D. Dey, P. S. Joshi, A. Joshi and P. Bambhaniya.
[arXiv: 2101.06001 \[gr-qc\].](#)
[10.1142/S0218271819300246.](#)
Int.J.Mod.Phys.D 28 (2019) 14, 1930024.
14. Shadows of spherically symmetric black holes and naked singularities; by R. Shaikh, P. Kocherlakota, R. Narayan and P. S. Joshi.
[arXiv:1802.08060 \[astro-ph.HE\].](#)
[10.1093/mnras/sty2624.](#)
Mon.Not.Roy.Astron.Soc. 482 (2019) 1, 52-64.
15. Spacetime Singularities; By P. S. Joshi.
[arXiv:1311.0449 \[gr-qc\].](#)
[10.1007/978-3-642-41992-8_20.](#)
Part of Springer Handbook of Spacetime, 409-436.

16. Distinguishing black holes from naked singularities through their accretion disc properties; By P. S. Joshi, D. Malafarina and R. Narayan.
[arXiv:1304.7331 \[gr-qc\]](#).
[10.1088/0264-9381/31/1/015002](#).
Class.Quant.Grav. 31 (2014) 015002.
17. Gamma-ray bursts as the birth cries of black holes; By P. S. Joshi, N. K. Dadhich and R. Maartens.
[arXiv:gr-qc/0005080 \[gr-qc\]](#).
[10.1016/S0217-7323\(00\)00099-2](#), [10.1142/S0217732300000992](#).
Mod.Phys.Lett.A 15 (2000) 991.
18. Timelike Geodesics in Naked Singularity and Black Hole Spacetimes; By P. Bambhaniya, Ashok B. Joshi, Dipanjan Dey, Pankaj S Joshi.
[arXiv:1908.07171 \[gr-qc\]](#).
[10.1103/PhysRevD.100.124020](#).
19. On the stability of a superspinar; By K. Nakao, P. S. Joshi, Jun-qi Guo, P. Kocherlakota, H. Tagoshi, T. Harada, M. Patil, A. Krolak.
[arXiv:1707.07242 \[gr-qc\]](#).
[10.1016/j.physletb.2018.03.014](#).
Phys.Lett.B 780 (2018) 410-413.
20. Distinguishing Kerr naked singularities and black holes using the spin precession of a test gyro in strong gravitational fields; By C. Chakraborty, P. Kocherlakota, M. Patil, S. Bhattacharyya, P. S. Joshi, and A. Królak.
[arXiv:1611.08808 \[gr-qc\]](#).
[10.1103/PhysRevD.95.084024](#).
Phys.Rev.D 95 (2017) 8, 084024.
21. Can strong gravitational lensing distinguish naked singularities from black holes? By S. Sahu, M. Patil, D. Narasimha, and P. S. Joshi.
[arXiv:1206.3077 \[gr-qc\]](#).
[10.1103/PhysRevD.86.063010](#).
Phys.Rev.D 86 (2012) 063010.
22. Equilibrium configurations from gravitational collapse; By Pankaj S Joshi, Daniele Malafarina and Ramesh Narayan.
[arXiv:1106.5438 \[gr-qc\]](#).
[10.1088/0264-9381/28/23/235018](#).
Class.Quant.Grav. 28 (2011) 235018.
23. Instability of black hole formation under small pressure perturbations; By P. S. Joshi and D. Malafarina.

[arXiv:1105.4336 \[gr-qc\]](https://arxiv.org/abs/1105.4336).
[10.1007/s10714-012-1471-z](https://doi.org/10.1007/s10714-012-1471-z).
Gen.Rel.Grav. 45 (2013) 305-317.

24. Spherical gravitational collapse in N dimensions; By Rituparno Goswami and Pankaj S. Joshi.

[arXiv:0608136 \[gr-qc\]](https://arxiv.org/abs/0608136).
[10.1103/PhysRevD.76.084026](https://doi.org/10.1103/PhysRevD.76.084026).
Phys.Rev.D 76 (2007) 084026.

25. Neutrinos of non-zero mass in Friedmann universes; By P. S. Joshi, S. M. Chitre.

[arXiv:gr-qc/0608136 \[gr-qc\]](https://arxiv.org/abs/gr-qc/0608136).
[10.1103/PhysRevD.76.084026](https://doi.org/10.1103/PhysRevD.76.084026).
Phys.Rev.D 76 (2007) 084026.

APPENDIX II:

Selected comments on research by well-known international experts

- “You and your collaborators have elucidated the nature of singularities that occur in gravitational collapse... Your papers typically demonstrate the existence of naked, strong-curvature singularities, and ‘serve to constrain the class of tenable cosmic censorship conjectures.’ The work is certainly useful in this respect...” -- Professor S. Chandrasekhar, Univ. of Chicago (letter dated 6/9/1994).
- “Professor Joshi has an excellent international reputation for his work in the field of gravitational collapse.” (Editorial comment, Camb. Univ. Press on the monograph ‘Gravitational Collapse and Spacetime Singularities’; Cambridge Monographs on Mathematical Physics; Eds: P. V. Landshoff, D. R. Nelson, S. Weinberg: “This highly acclaimed series of monographs provides introductory accounts of specialized topics in mathematical and theoretical physics.. The monographs in this series are of outstanding scholarship and written by those at the very frontiers of research...”
- “This work is significant for it adds a new signature to the list of observable predictions of quantum gravity,” said Abhay Ashtekar, director, Institute for Gravitational Physics and Geometry at Pennsylvania State University.... In general relativity, the gravitational field is coded in the very
- “geometry of space time... Loop quantum gravity elevates this coding to quantum gravity. Everything, including geometry, is quantum mechanical by birth. However, like general relativity, loop quantum gravity does not have an underlying principle leading to natural unification of all forces.” (Abhay Ashtekar, in ‘The Telegraph’, Calcutta, 20/2/2006).
- Carlo Rovelli of the Université de la Méditerranée in France thinks the new result might be important. “If it worked, it would be a major step ahead,” he says. “In addition, it is another example in a growing number of suggestions that quantum gravity observations are do-able -- contrary to what was believed only a few years ago.”(Carlo Rovelli, ‘Physics World’ March 2006).
- “The picture the authors advocate makes a lot of sense and the results are definitely encouraging...”(Giovanni Amelino-Camelia, ‘Physics World’, March 2006).
- “I found the whole subject, and your important contributions to it, very interesting indeed. From what you told me in Bombay, I am convinced that astrophysical consequences may be far-reaching.” (M. Abramowicz, well-known astrophysicist, letter dated 2/2/2005).
- “For any question on the cosmic censorship conjecture or singularity formation in gravitational collapse you are the first person I would turn to for advice. The body of work that you (and) your coworkers have turned out on these topics in the last couple of decades have established your group as world leaders in the field. Your Oxford monograph, which summarizes much of this work, is a self-contained introduction to the entire field of global spacetime structure and cosmic censorship, more up to date (and) much more pedagogical than the rather severe text by Hawking (and) Ellis, (and) its popularity is well

deserved... As far as your international reputation goes, you have no reason to fear.” (W. Israel, well-known gravitation theorist and past-President of International Gravitation and Gen. Relat. Society; letter dated 26/10/2004).

- “Joshi and others have shown that Einstein's theory of gravity allows the possibility that the horizon may not form immediately after the star collapses...there could be a brief window during which high energy particles can escape.”(New Scientist, 2000).
- “These results provide strong evidence that LQG removes naked singularities...” (Lee Smolin, 'New Scientist', 4 Feb, 2006).
- “With your works and your nice book, nobody can afford to overlook your contribution in this field...”(Professor A. K. Raychaudhuri, letter dated 4/4/1997).
- “This... covers in detail recent work on global aspects of general relativity theory and the existence of spacetime singularities..”
“..the book attains uniqueness in its specific approach, for example, through emphasis on reflecting spacetimes... and by exploring light cone cuts of infinity...
“It also achieves a specific flavour and usefulness through tackling some specific topics in depth, notably the issue of cosmic censorship. This is the question of whether gravitational collapse leads to a naked singularity that can be seen from far away and can influence what happens there, or to a black hole with an event horizon that hides the final stages of collapse and the ensuing spacetime singularity from the outside world.
“..this remains one of the most outstanding open issues in classical gravitational theory today. He discusses this issue in depth, showing how some spherically symmetric examples with inflowing radiation lead to censorship violation...
“Other sections look at the way upper limits on some cosmologically interesting parameters (the age of universe, particle masses, and the cosmological constant) can be obtained by use of these global methods, a use... that is valuable in terms of relating them to observational quantities..
“The book is readable and covers interesting material... covered not so fully in earlier texts. It can be recommended for the serious student who wishes to study these matters in some detail, particularly the material on cosmic censorship..”--G. F. R. Ellis, From 'Naked singularity', the Review of PSJ's book, in 'The Times Higher Education Supplement', (29/9/1995).
- “One of Joshi's aims is to show that global theory is not just a tool for complicated singularity theorems, but has wider applicability.”
“An excellent example is the use of global techniques to obtain upper limits in cosmology that are independent of particular cosmological model...upper bounds are found for the age of the Universe, the masses of dark-matter particles and the cosmological constant.”
“...there are still major unresolved questions about physical nature of such singularities.. One such unresolved question is Penrose's Cosmic Censorship hypothesis... Naked singularities that violate Cosmic Censorship would... seriously undermine much of the black hole physics.”

“Joshi gives an excellent survey of this major problem, including a range of apparently reasonable naked singularity examples.”

“This comprehensive survey of established and recent results in global theory is the first of its kind since the major book by Hawking and Ellis in 1973. This survey on Cosmic Censorship is particularly useful. Joshi is an active researcher in the field, and the book contains many new results and insights. It can be strongly recommended for research and for advanced courses in relativity.”--Roy Maartens, Director, Institute of Gravitation and Cosmology, Portsmouth, ‘Contemp Physics’, 1995.

- “The unifying theme of this book, which treats a wide range of subjects in general relativity is the question of nature of spacetime singularities and validity of cosmic censorship...”
“It should be very welcome to anyone wishing to learn these issues.. it should also serve as stimulus for those already working in the field.... I recommend this book to any one interested in spacetime singularities. Its subject is one which is of central interest in general relativity and there is no existing book which treats recent developments anything like as extensively... I hope it will inspire students and researchers to make their own contribution to this exciting area.”-- Gen. Relat. and Grav. Journal, Vol.26, p.845, (1994).
- “... a useful source of information for researchers interested in the global properties of the Einstein equations..” -- Mathematical Reviews, (1995)
- “This series of monographs is written by physicists on subjects to which they have made outstanding contributions...” -- ‘The International Series of Monographs on Physics’, Clarendon Press, OUP, in which PSJ's book ‘Global aspects...’ was included).
- “Indeed your work adds significantly to the evidence that one cannot hope to formulate tenable cosmic censorship hypotheses based upon strong limiting focusing conditions...” -- R. P. A. C. Newman, Univ. of Oxford, (letter dated 25/8/1992).
- “..This will be an extremely useful book and should be as successful as the ‘Classic’ by Hawking and Ellis.”-- Professor J. V. Narlikar, IUCAA, (letter dated 6/10/1992).
- “Your results on this singularity are most interesting.” -- Professor D. Eardley, Inst of Th Physics, Santa Barbara (letter dated 9/9/1991).
- “...I think that you have made a very major point in finding a solution that contradicts the cosmic censorship hypothesis.” -- Professor J. V. Narlikar, IUCAA (letter dated 4/9/1991)
- “They also show all stationary spacetimes are reflecting, and establish a number of other interesting results...part of the motivation is to give a deeper understanding on ways censorship hypothesis may be violated...”-- Mathematical Reviews, Feb. 1989.
- “...They also find that chronology violations yield singularities in a very general context.”-- John K. Beem, Mathematical Reviews (Nov. 1988).
- “...The remarkable result is that the probability measure for the set of geometries with classical singularities turns out to be zero and thus the cosmological singularity problem can be avoided from the quantum gravity

point of view.” -- Mathematical Reviews (July 1987).

APPENDIX III:
Invited Plenary Lectures at Major International Conferences (selected)

- Invited Plenary talk on ‘Gravitational Collapse and Space-time Singularities’ at the International meeting on ‘Singularities of general relativity and their quantum fate’, Banach Center, Warsaw (June 2016).
- Invited Talk on ‘Black hole physics’ at the IUPAP conference on ‘Computational Physics’, November 2015, IIT, Guwahati.
- Invited Plenary talk on ‘Gravitational Collapse and Black Hole Physics’, at the Japan Physical Society (JPS) Meeting, Osaka, September 2015.
- Invited Inaugural Talk, ‘Gravitational Collapse: Recent Perspectives’, the Shanghai Conference on ‘Collapsing Objects”, Fudan University, October 21-24, 2013, China.
- Invited Review lecture on ‘Gravitational collapse, black holes and singularities: Recent developments and astrophysical applications’, at the COST (European Cooperation in Science and Technology) Conference on, ‘Black Holes: From Quantum to Gravity’, (April 23- 25 April, 2012, Malta.
- ‘Collapsing a Massive Star’, at Chandrayana, the Chandra Centenary Symposium, Institute of Mathematical Sciences, Chennai, 3-7 January 2011.
- ‘Present Status of Cosmic Censorship’; at the ‘International Workshop on Dynamics and Thermodynamics of Black Holes and Naked Singularities’, May 13-15, 2004, Milan, Italy.
- ‘Gravitational Collapse End States’; at the conference, ‘Provocative Universe’ 30 June-2 July 2003, IUCAA, Pune.
- ‘Gravitational collapse: The Story so far’; at the ‘4th International Conference on Gravitation and Cosmology: Cosmology, Black Holes and Compact Objects’, 4-7 Jan. 2000, IIT, Kharagpur, India.
- ‘Singularities in General Relativity’ at the Moriond Conference on ‘Perspectives in Neutrinos, Atomic Physics and Gravitation’, Villars sur Ollon, Switzerland, 1993.

APPENDIX IV: Other Talks (selected)

- Lecture on "At the Heart of Our Galaxy; Shadows and Singularity", Ahmedabad University, March, 2023
- Talk on "Exploring our Neighborhood beyond Planet Earth" on Azadi ka Amrit Mahotsav organized by SAC-ISRO with Gujarat Council on Science and Technology, September, 2021
- Talk on "If this were my last lecture", Bhavan's Cultural Centre, Andheri, August, 2021
- Talk "Science, Future and Gandhi" in State Level Workshop organized by GUJCOST, Gandhibharati and Lokbharati Community Science Center, February, 2021
- Inaugural Lecture on Black Hole Science at National Seminar, Nagarjuna University
- PRL Colloquium, "Beyond Penrose - Black holes and Spacetime Singularities", December, 2020,
- TIFR, NSF Colloquium, "Gandhi and Science", October, 2020.
- A Talk in National Webinar "Century of Quantum Mechanics and still going strong", jointly organized by M.S. University, Gujarat Science Academy, IAPT, IPA, June, 2020
- Talk on "Joy of Science- How to do good research" in a webinar on "Research Methodology and Frontiers in Science" organized by Saurashtra University and Gujarat Science Academy, April, 2020
- Talk on "Stories of Black Hole and Cosmos" jointly organized by IITE and GUJCOST, April, 2020
- Talk on "Frontiers in Black Hole Physics" in Indian National Science Academy, AGM Symposium at NIO, Goa, December, 2019
- Public Lecture on "Our Universe; Through the window of Gravitational Waves" at Sardar Patel University, January, 2019
- VV Narlikar Memorial Lecture "Black Holes, Quantum Stars and Gravitational Wave", Centre for Theoretical Physics, Jamia Millia Islamia, Delhi, November, 2018

- Talk on "Our Universe; Through the window of Gravitational Waves" at CSMCRI, BVN September, 2018
- Talk on "Gandhi and Science" as First Kakasaheb Kalelkar Lecture at Gujarat Sahitya Parishad, Ahmedabad, September, 2018
- AC Banerji Memorial Award Lecture on "Can we see a Black Hole", R.R. College and National Academy of Sciences, March, 2018
- DAE-CV Raman Lecture on "Black Holes and Quantum Stars" jointly organized by TIFR, IPA, K.C. College, February, 2018
- The Story of Black Hole, TEDxICTMumbai, August, 2017.
- 'Gravitational collapse, Black Holes and Naked singularities', Inaugural Colloquium in Physics, Black Hole Initiative, Harvard University, USA, September, 2016.
- Talk on "Gravitational Collapse, Black Hole and Naked Singularities" at Kavli Institute of Theoretical Physics, University of California, Santa Barbara, May, 2016
- 'Gravitational collapse', at the 'International conference on High Frequency Gravity Waves', Austin, USA (2010).
- Plenary review talk 'the formation of black holes vs naked singularities in gravitational collapse: The state of the arts', International Workshop on 'Thermodynamics of black holes and naked singularities', Milan, Italy, May, 2007.
- 'In-formation: Thoughts on Science-Spirituality Interface', Conference on 'Information as Science and Spirituality', India Habitat Center, New Delhi, 19 March 2007.
- 'Students and the World of Science': Taral Memorial Lecture, 7 October 06, Bhavnagar.
- 'Cosmic mysteries', Invited talk at the SCRAC monsoon Conference on 'Inuence of Science on Literature and Films', Sept 06, Mumbai.
- 'Gravitational Death of a Massive Star', July 2006, Nat. Inst. of Advanced Studies (NIAS), Bangalore.
- 'Cosmology Today', a Lecture given at the M S University of Baroda, Vadodara, 7 Jan 2006.

- ‘Black holes, Singularities and Hawking Radiation’, Lecture at Department of Physics, South Gujarat University, 1 Octo 2005.
- ‘Black hole theory and Universe’, lecture at the Science and Technology Fair, Bhavnagar, 28 Dec 2004.
- ‘Sciences in Ancient India’, Ananthacharya Indological Institute, Mumbai, April, 2004, at the Meeting: "National Seminar on Sciences in Ancient India".
- ‘The puzzle of black holes’ at the ‘Einstein’s Theories Centenary Conference’, Ind.Planetary Soc., Mumbai, 7-9 Jan 05.
- Invited to Chair the session, ‘Global aspects, singularities and cosmic censorship’ at MG10, Rio, Brazil, July 2003.
- ‘Visibility of a Spacetime Singularity’, IAGRG24 conference, Jamia Milia Islamia, New Delhi, 8 Feb 2007.
- ‘Gravitational Collapse End State’, Colloquium at the Harishchandra Institute, Allahabad, Nov 8, 2004.
- ‘The Puzzle of Black Hole’ CSMCRI, Bhavnagar, Octo 2004.
- ‘Gravitational Collapse and Gravitational Radiation’, Silver Jubilee Conference, "Recent Trends in Natural Sciences", Feb 04, Bhavnagar University.
- ‘Recent exciting developments in Physics and Mathematics’, Feb 04, Bhavnagar University.
- Theoretical Physics Seminar Circuit (TPSC) invited speaker at important physics centers in India (1996-98).
- ‘Final fate of Gravitationally Collapsing Massive Stars’ at the ‘Visitors Program’, Platinum Jubilee Session, Delhi University, 1997.
- Invited for talk at conference ‘Mathematical theories of gravitation’, International Banach Center, Warsaw, 1996.
- ‘Singularities, Gravitational Collapse and the Raychaudhuri Equation’ at the Raychaudhuri Session, International Conference on Gravitation and Cosmology (ICGC95), Pune, Dec. 1995.
- ‘The Nature of Singularities in Gravitational Collapse’ at the International Workshop on Gravitational Collapse and Cosmic Censorship, IUCAA, Pune,

Dec. 1995.

- ‘Recent Developments in Gravitational Collapse’ at the ‘Symposium on Early Universe 94’, Indian Institute of Technology, Madras, Dec. 1994.
- ‘Gravitational Collapse and Cosmic Censorship’ at the Indian Association for General Relativity and Gravitation (IAGRG) Silver Jubilee Conference, Pune Feb.1994.
- Invited for a talk at the conference on ‘Quantum aspects of black holes’, (Inst. for Th. Physics, Santa Barbara), USA, 1993.
- Invited to give a talk at the Aspen Workshop on ‘Cosmic Censorship’, USA, 1992.
- ‘The Structure of Naked Singularities and Cosmic Censorship Hypothesis’ at the Sixth Annual Conference of the Ramanujan Mathematical Society, Rajkot, 1991.
- ‘Quantum Effects near Spacetime Singularities’, Workshop on ‘Early Universe’, Pune, 1989.
- ‘Structure of Spacetime Manifolds’ at the Mathematics Research Seminar, Sardar Patel Univ. Vallabh Vidyanagar, 1989.
- ‘Singularity Avoidance in Quantum Gravity’, 5th Marcel Grossmann Meeting, Perth, Australia, 1988.
- ‘General Relativity and Spacetime Topology’, Frontier Symposium at the Platinum Jubilee Session of Indian Science Congress, Pune, 1988.
- ‘The Cosmic Censorship Problem’ at the Indian Association for General Relativity and Gravitation (IAGRG) Conference, Vishakhapatnam, 1987.
- Paper presented on ‘Axions and Dark Matter’ at the IAU Symposium No. (1986).
- ‘Conformal Quantization in Singular Spacetimes’, Summer School on Topological Properties and Global Structure of Spacetime’, Erice, Italy, 1985.
- ‘Light Cone Cuts of Schwarzschild Geometry’, GRG10, Padova, Italy, 1983.
- ‘Gravitational Collapse and Singularities’, IAGRG Conference, Bangalore, 1980.

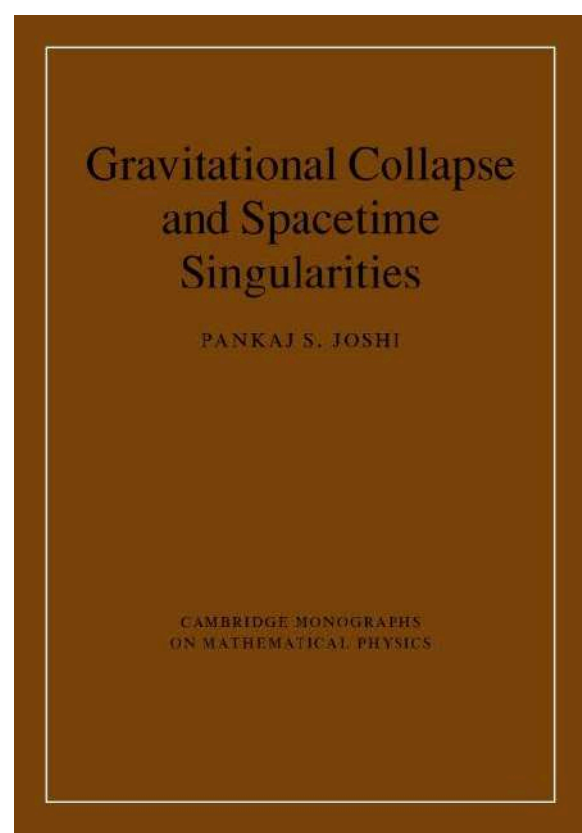
- Paper presented on 'Causality Violations in Spacetimes' at the Einstein Centenary Symposium, Ahmedabad, 1979.
- 'Spacetime Topology', IAGRG Conference, Bhavnagar, 1977.
- 'Complex Periodic Functions' at Gujarat Mathematical Society Conference, Visnagar, 1975.

APPENDIX V:
Teaching, Invited Lecture Courses etc. (selected)

- ‘Special Topics in Gravitation and Cosmology: Gravitational collapse, blackholes and spacetime singularities’ (26 lectures), Doctoral course given at Ahmedabad University, January to April 2022.
- ‘General Relativity, Black holes & Cosmology’ (26 lectures), Graduate level course given at Ahmedabad University, August to November 2022.
- ‘Gravitational Collapse’ (3 lectures), Lecture Course given at the ‘IUCAA School on Gravitation and Astrophysics’, March 15-18, 2011, Jamia Millia Islamia, New Delhi.
- A Topical course, ‘Gravitation and Cosmology, TIFR Graduate School, 2006-07. Graduate course, ‘Statistical Mechanics’ at the TIFR Graduate School, 2004-05. Graduate course, ‘Classical Mechanics’ at the TIFR Graduate School, 2001.
- A course of 3 lectures on ‘Collapse and Cosmic Censorship’ (26-29 March 03), at ‘Workshop on gravitational collapse and recent developments’, CIRI, Nagpur.
- A course of 6 lectures on ‘Cosmology’ at IUCAA, Pune in the ‘Summer School on Astronomy and Astrophysics’, May 1995.
- Graduate course, ‘Mathematical Methods in Physics’ at the Graduate School, TIFR. Bombay, Sept.1993-Jan.1994.
- UGC Visiting Professor at the Sardar Patel University, Vallabh Vidya Nagar, ‘Gravitation and Cosmology’ (4 lectures), 1993.
- A Course of 8 lectures on "Gravitational Collapse and Naked Singularities" at IUCAA, Pune (1991).
- Graduate course, ‘Classical Mechanics’ at Graduate School, TIFR, Bombay, 1990.
- A one-year graduate course on ‘General Relativity and Cosmology’ at Bombay University, 1988-89.
- A course on ‘Cosmic Censorship’ (5 lectures) at UGC All India School on ‘Advanced topics in General Relativity’, Jadavpur University and Indian Association of Cultivation of Science, Calcutta, 1988.

- A course (20 lectures) on ‘Relativity Theory’ given at the Nehru Science Center and Planetarium, Bombay, 1987.
- UGC Visiting Professor at the Saurashtra University, Rajkot (10 lectures) ‘Spacetime Structure’, 1986.
- A course on ‘Singularities’ (10 lectures), UGC Conference on ‘Differential Geometric Methods in Relativity’, Aligarh, 1986.
- A course on ‘Penrose Diagrams and Killing Vectors’ (3 lectures) at UGC School on ‘Gravitation, Gauge Theories and Early Universe’, Bangalore, 1985.
- UGC Visiting Professor at the Shivaji University, Kolhapur, (10 lectures) ‘Gravitational Collapse and Spacetime Singularities’, 1985.
- Gave a two-semester advanced course (non-credit) covering ‘Topological and Differential Geometric Methods in Physics’, at the School of Physics, TIFR, attended by many faculty members and students here (1984-85).
- A course on ‘Global Aspects in Gravitation’ (10 lectures), at the UGC Winter School, Saurashtra University, 1979.
- A course (6 lectures) given at Raman Research Institute, Bangalore, on ‘Causality in Spacetimes’, 1979.
- Gave graduate courses on ‘Real Analysis’, ‘Differential Geometry’ and ‘Differentiable Manifolds’ at Saurashtra University during 1975-78.

APPENDIX VI: Pictorial Highlights



Book description:

Physical phenomena in astrophysics and cosmology involve gravitational collapse in a fundamental way. The final fate of a massive star when it collapses under its own gravity at the end of its life cycle is one of the most important questions in gravitation theory and relativistic astrophysics, and is the foundation of black hole physics. General relativity predicts that continual gravitational collapse gives rise to a space-time singularity. Quantum gravity may take over in such regimes to resolve the classical space-time singularity. This book investigates these issues, and shows how the visible ultra-dense regions arise naturally and generically as an outcome of dynamical gravitational collapse. It will be of interest to graduate students and academic researchers in gravitation physics, fundamental physics, astrophysics, and cosmology. It includes a detailed review of research into gravitational collapse, and several examples of collapse models are investigated in detail.

Reviews:

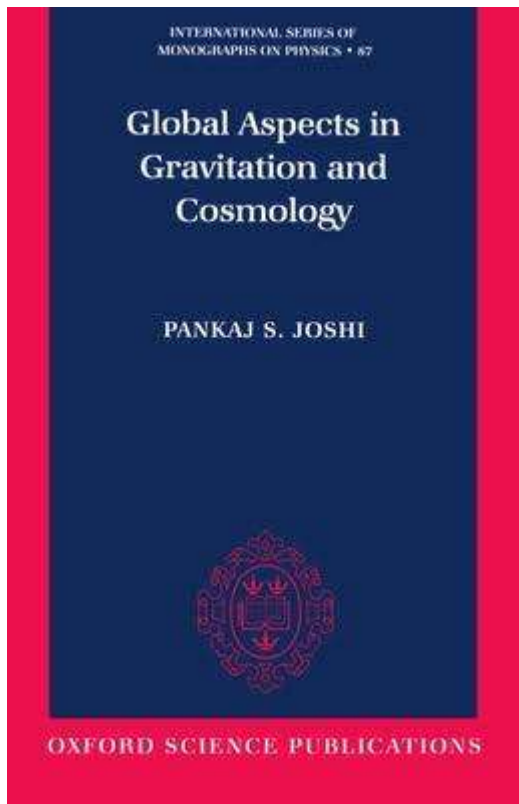
'... beautifully produced ...'--The Observatory

'... provides a useful introduction to aspects of gravitational collapse and the development of singularities. It would provide a useful starting point to either a graduate student already familiar with general relativity, or an already active researcher in a different area of relativity, who wishes to investigate recent work on gravitational collapse.'--Mathematical Reviews

'This monograph ... should be useful to students and mature researchers alike. It focuses especially on the issue of 'cosmic censorship': what conditions, in mathematical models of collapse, can lead to naked singularities, what are the singularities' properties, and how might the laws of loop quantum gravity modify singularity formation ... rich insights flow from this book's analyses, and its summaries of the relevant literature are particularly useful. Anyone interested in gravitational collapse will find this book's insights and literature summaries of great value.'--Kip S. Thorne - Feynman Professor of Theoretical Physics, Emeritus, California Institute of Technology

'Gravitational collapse of massive objects is still a major unsolved problem in general relativity at the present time. Collapse of massive objects may lead to a black hole, but may also lead to a naked singularity. Both are possible, as the conjectured 'cosmic censorship' that would cloak naked singularities does not always hold; it is an important topic in gravitational physics to determine which will occur under what circumstances. In this well-reasoned book, Dr Joshi gives a careful

survey of the general relativity aspects of this problem, emphasizing how it remains unsolved to the present day. The book will provide a good springboard for those wishing to tackle this important problem.' --George Ellis - University of Cape Town



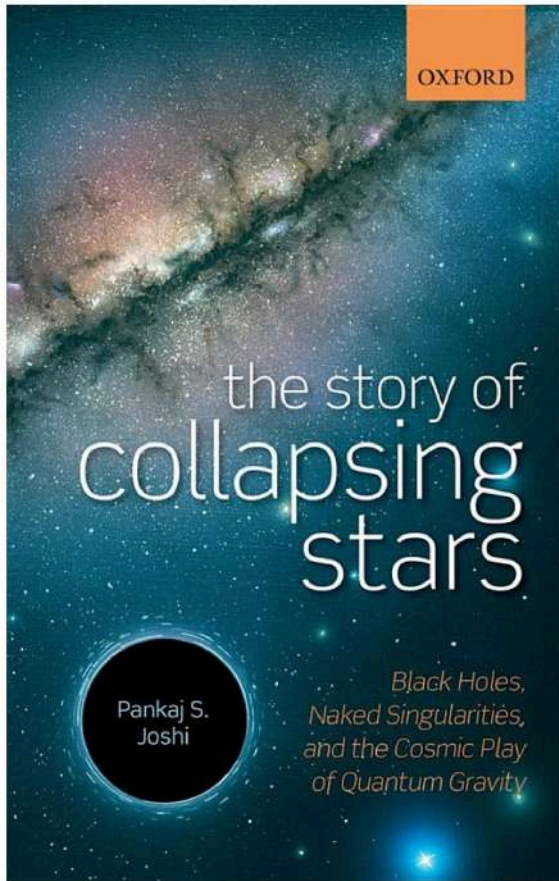
Book Description:

This book describes global aspects in gravitation theory and cosmology within the framework of Einstein's theory of gravity. Topics include results on the structure and topology of space-time, exact solutions to Einstein equations and singularities, the status of quantum gravity, and quantum effects near space-time singularities in strong curvature fields. The author also discusses the nature and structure of space-time singularities, the cosmic censorship problem in black hole physics, and the issue of quantum effects in strong gravity fields. Students and mathematicians, astrophysicists, and physicists will find this theoretically rich book a landmark in relativity theory.

Reviews:

"The variety of subjects discussed is wide and this...make[s] this book a useful source of information for researchers interested in the global properties of solutions of the Einstein equations." --Mathematical Reviews

- This research monograph is widely cited by the international community of Cosmologists, and received excellent international reviews, such as by Times Higher Education Supplement, and others, as displayed on the back cover above.
- The Cambridge University Press, Cambridge, published my research monograph, Gravitational Collapse and spacetime singularities (2008), included in their prestigious series, Cambridge Monographs on mathematical physics; the Paperback edition was in (2012). Earlier well-known authors in this series include Stephan Hawking, George Ellis, and many other reputed names.



Book Description:

This book journeys into one of the most fascinating intellectual adventures of recent decades - understanding and exploring the final fate of massive collapsing stars in the universe. The issue is of great interest in fundamental physics and cosmology today, from both the perspective of gravitation theory and of modern astrophysical observations. This is a revolution in the making and may be intimately connected to our search for a unified understanding of the basic forces of nature, namely gravity that governs the cosmological universe, and the microscopic forces that include quantum phenomena. According to the general theory of relativity, a massive star that collapses catastrophically under its own gravity when it runs out of its internal nuclear fuel must give rise to a space-time singularity. Such singularities are regions in the universe where all physical quantities take their extreme values and become arbitrarily large. The singularities may be covered within a black hole, or visible to faraway observers in the universe. Thus, the final fate of a collapsing massive star is either a black hole or a visible naked singularity. We discuss here recent results and developments on the gravitational collapse of massive stars and possible observational implications when naked singularities happen in the universe. Large collapsing massive stars and the resulting space-time singularities may even provide a laboratory in the cosmos where one could test the unification possibilities of basic forces of nature.

Reviews:

"Being written at the level of popular literature on physics and astronomy, this book leads the reader to the current frontier of research in gravitation theory without hiding the yet-unsolved problems and differences of opinion among specialists. In this respect it is unique, and will be extremely valuable reading." --Andrzej Krasinski, Nicolaus Copernicus Astronomical Center

"Pankaj Joshi has written a wonderful book, full of challenges for the reader and also for all physicists! Only in 1998 did dark energy become established, subverting common thought. Joshi takes it all in and he teaches us to 'listen to nature' to figure out how to progress and make the leap to quantum gravity, the final unification of the fundamental forces in nature." --Peter L. Biermann,

Max Planck Institute for Radio Astronomy, Germany

"In this lucid overview, theoretical astrophysicist Pankaj Joshi corrals the research on collapsing massive stars and space-time singularities, including the idea that the event horizon might be a firewall of fierce radiation. Joshi sees work in these areas as a lab for testing the pressing problems in fundamental physics and beyond." --Nature

"Joshi's book will inspire graduate students... Recommended." --Choice

"Although meant for a popular audience, The Story of Collapsing Stars presents the open research questions so clearly that it can also serve as a valuable starting point for scientists and students considering research in the area of gravitational collapse." --Physics Today

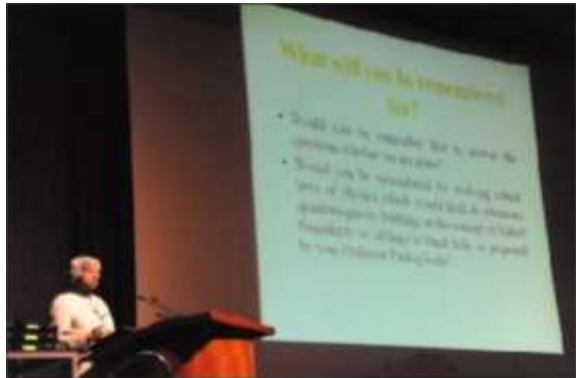
"Most of what is written in this book is very high level as can be expected from the title. Nevertheless, initiated readers would find it a good and an enjoyable read. ... The engaging narrative makes the read more like a story, especially since there are no equations at all other than the very few embedded in the text that the readers should already know or at least be familiar with."

--Contemporary Physics

Books in Gujarati



Engagement With Former President Hon. Dr. A.P.J. Kalam



Dr. A.P.J. Kalam was so happy that an Indian Scientist did a work that featured as a Cover in the famous Scientific American. Not only we discussed this in detail, but he even mentioned our work in glorious terms in his public lecture.



डा. आर. चिदम्बरम्

सर्वोच्च सलाहकार के अग्रणी वैज्ञानिक समिति
का अध्यक्ष

अध्यक्ष, सौभाग्यदत्त श्री वैज्ञानिक समिति
(पूर्व अध्यक्ष, परमाणु ऊर्जा आयोग)

Dr. R. Chidambaram

Principal Scientific Advisor to the Govt. of India
&
Chairman, Scientific Advisory Committee to the Cabinet
(Former Chairman, Atomic Energy Commission)



सत्यमेव जयते

विज्ञान भवन एक्सटेंड

मौलाना आज़ाद रोड, नई दिल्ली - 110011

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rajchid@nic.in

Ref: RC/HBC/PSA/47/13

July 26, 2013

Dear Prof. Pankaj Joshi,

Thank you very much for sending the special issue of Scientific American which is indeed a collector's edition with exceptionally well written articles; in particular I enjoyed reading (though I can't say I understood it fully) your article on 'Naked Singularities' and your comments on the event horizon of the black hole. It will be a great pleasure to spend some time with you when you are free. I shall be looking forward to our meeting.

With warm regards,

Yours sincerely,

(R. Chidambaram)

Prof. Pankaj S. Joshi,
Senior Professor
Department of Astronomy and Astrophysics,
TIFR,
Homi Bhabha Road,
Mumbai 400006

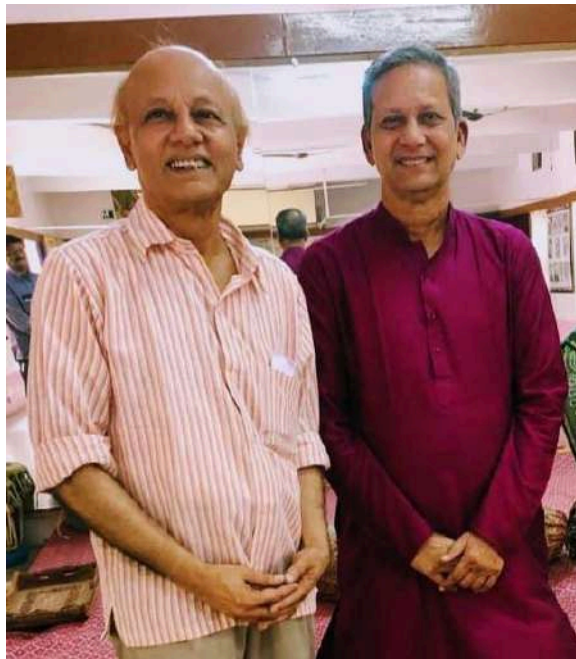
With Other eminent Scholars



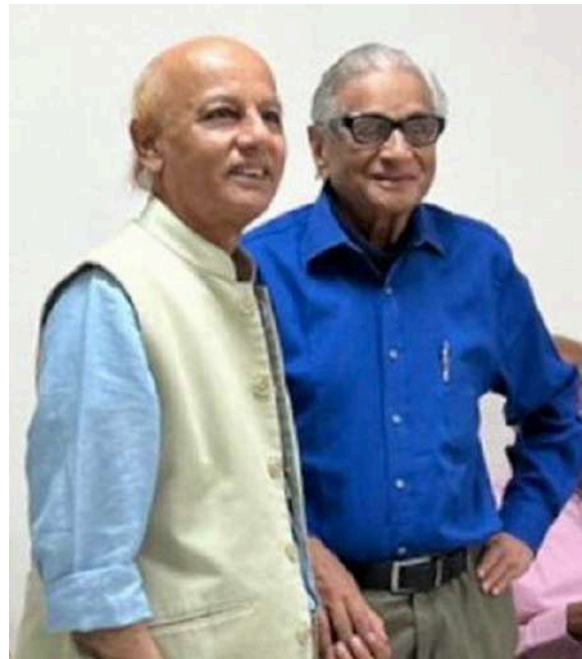
In the company of two great Joshis... respected Dr. Padmanabh Joshi, who worked with Dr. Vikram Sarabhai, and our renowned poet Shri Anil Joshi. We of course discussed the inner as well as the outer Universe!!



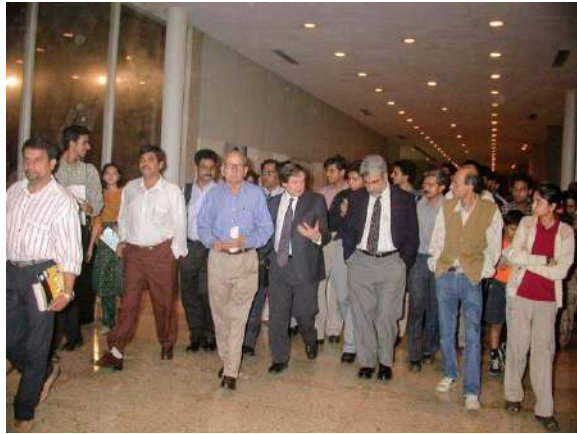
great meeting Nagindas Sanghavi ji, Shri Bhagyesh Jaha, and many other experts, at the GANDHI meeting at Sandipani, Porbandar (the birthplace of Mahatma), on 2 October



We were truly blessed to have my Guru Pandit Vikas Kashalkar ji



With Shri Rajnikumar Pandey ji.



With Dr. R Chidambaram, Nuclear Man of India...



with Nobel laureate Roger Penrose and eminent scientist S.M.Chitre



The Nobel winner (2017), Prof Kip Thorne strongly endorsed our work, contained in the monograph, appearing on the back cover of the paperback edition, as below “This monograph on gravitational collapse to form black holes and singularities should be useful to students and mature researchers alike. It focuses especially on the issue of "cosmic censorship": What conditions, in mathematical models of collapse, can lead to naked singularities, what are the singularities' properties, and how might the laws of loop quantum gravity modify singularity formation.... rich insights flow from this book's analyses, and its summaries of the relevant literature are particularly useful. Anyone interested in gravitational collapse will find this book's insights and literature summaries of great value

Some of the Posters for the Talks and Cover Stories

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PANKAJ JOSHI
Theoretical Physicist



lucid
/ˈluːsɪd/ adjective,
luminous, suffused with light.

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INDIAN PHYSICS ASSOCIATION,
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cordially invites you to the
Department of Atomic Energy -
C. V. Raman Lecture
on
"Black Holes and Quantum Stars:
An Observer's Paradise"

to be delivered by
Prof. Pankaj S. Joshi
(Dept of Astronomy & Astrophysics,
Tata Institute of Fundamental Research,
Homi Bhabha Road, Colaba, Mumbai 400 005)

on
Saturday,
February 10,
2018 at 11 am

Venue
Rama And Sundri
Watumull Auditorium,
Kishinchand
Chellaram College 124,
Dinshaw Wachha Road,
Churchgate,
Mumbai - 400 020.



Abstract :
Einstein's theory of gravity predicts the existence of Black Holes and Space-time Singularities. We discuss the current efforts to make a direct observational detection of these entities. The Black Holes and visible or Naked Singularities arise from the gravitational collapse of massive stars. Quantum gravity effects dominate near the visible singularities, which may also be called long or short lived 'Quantum Stars'. These offer an opportunity to test the quantum theories of gravity, or the Unification of Physics. The connection to new observational missions such as Gravitational Waves, the Event Horizon Telescope, and other exciting theoretical developments is discussed.

Black Holes
The Life and Death of Massive Stars
Pankaj S. Joshi
TIFR

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What happens to a massive star when it exhausts its internal fuel that kept it shining and hot? The star would collapse continually under the force of its own gravity, creating a singularity in the universe which is ruled by the quantum gravity regime. There begins the journey into the fascinating worlds of **Black Holes and Fireballs... Welcome to this amazing arena of the cosmos !!**


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The National Academy of Sciences, India, Mumbai Chapter



Prof. A.C. Banerji Memorial Award Lecture
Ramnarain Ruia College
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at 4:00 PM Saturday
March 18, 2017 by
Prof. Pankaj Joshi




Can we see a Black Hole?
-The Story of Massive Collapsing Stars in the Universe-

ABSTRACT: The Einstein's theory of gravity that just completed 100 years, made three major predictions, namely the Black Hole, Space-time Singularity, and Gravitational Waves. We review these, and current efforts to detect black holes directly. The Big Bang marks origin of observed Universe, and other Singularities are those inside black holes, and visible or Naked Singularities. The later arise from gravitational collapse of massive stars and offer an opportunity to test Quantum Theories of Gravity or Unification of Physics, as we shall discuss.

ABOUT THE SPEAKER: Dr Pankaj S. Joshi is a Senior Professor at the Tata Institute of Fundamental Research (TIFR), Mumbai. His research is in gravitation and cosmology; he published more than 170 research papers, and monographs and books on the subject. He held visiting positions in several countries, and won many awards and Fellowships to scientific academies. Professor Joshi has made fundamental contributions in black hole physics and gravitation theory. His extensive analysis of general relativistic gravitational collapse has been widely recognized as providing significant insights into the final fate of massive collapsing stars in the universe, formation of space-time singularities, and cosmic censorship.

At the Heart of Our Galaxy: Shadows and the Singularity



Pankaj Joshi
 Director, International Centre for Space and Cosmology
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
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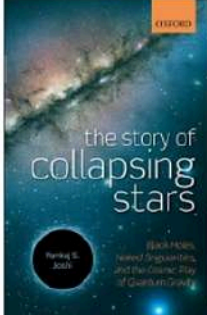


Speaker: Prof. Pankaj Joshi,
 Vice-Chancellor (Provost) & Founding Director, International Center for Cosmology (ICC),
 CHARUSAT University, Anand.

Title of the Colloquium:
 "Beyond Penrose - Blackholes and Spacetime Singularities"

Date: Wednesday, 09 December 2020
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 By Dr. Pankaj S. Joshi

Dr. Pankaj S. Joshi works as a Senior Professor with the Tata Institute of Fundamental Research, Mumbai. His research is in the fields of gravitation and cosmology and he has published more than 150 research papers as well as monographs and books on the subject. Professor Joshi has made fundamental contributions in black hole physics and gravitation theory. He has also contributed a large number of books and articles towards science outreach and has given many public lectures.

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નિમંત્રણ

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વિદ્યાવિશ્વ સ ટ્રસ્ટ દ્વારા સારસ્વત ગૌરવ એવોર્ડ પ્રદાન સમારોહનું આયોજન કરવામાં આવ્યું છે.

આ સારસ્વત ગૌરવ એવોર્ડ જાણીતા ખગોળવિદ અને સંશોધક **શ્રી પંકજ જોષી**ને તથા જાણીતા શિક્ષણવિદ અને પ્રતિનિધીય શિક્ષણના તંત્રી **શ્રી પી. ડુ. પટેલ**ને એનાયત કરવામાં આવશે.

આ એવોર્ડ-સમારોહ જાણીતા શિક્ષણવિદ **શ્રી હાઉસબાઈ ઘાંસોયા** પ્રમુખપદે યોજાશે.

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નિમંત્રક

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APPENDIX VII: Important Research Publications

1. M. Azreg-A'inou, K. Acharya and P. S. Joshi, [arXiv:2310.08022 [gr-qc]].
2. A. B. Joshi, K. Mosani and P. S. Joshi, [arXiv:2310.01222 [gr-qc]].
3. O. Trivedi, S. K. Saggi and P. S. Joshi, Phys. Dark Univ. 42, 101366 (2023) doi:10.1016/j.dark.2023.101366 [arXiv:2310.00452 [gr-qc]].
4. Saurabh, P. Bambhaniya and P. S. Joshi, [arXiv:2308.14519 [astro-ph.HE]].
5. D. Dey, Koushiki and P. S. Joshi, Phys. Rev. D 108, no.10, 104045 (2023) doi:10.1103/PhysRevD.108.104045 [arXiv:2308.03603 [gr-qc]].
6. K. Mosani and P. S. Joshi, Regular black hole from regular initial data, [arXiv:2306.04298 [gr-qc]].
7. D. Arora, P. Bambhaniya, D. Dey and P. S. Joshi, Tidal forces in the Simpson-Visser black-bounce and wormhole spacetimes, [arXiv:2305.08082 [gr-qc]].
8. K. Acharya, K. Pandey, P. Bambhaniya, P. S. Joshi and V. Patel, Naked Singularity as a Possible Source of Ultra-High Energy Cosmic Rays, [arXiv:2303.16590 [gr-qc]].
9. D. Dey, N. T. Layden, A. A. Coley and P. S. Joshi, The equilibrium condition in gravitational collapse and its application to a cosmological scenario, [arXiv:2303.16789 [gr-qc]].
10. V. Patel, K. Acharya, P. Bambhaniya and P. S. Joshi, Energy extraction from Janis-Newman-Winicour naked singularity, Phys. Rev. D **107**, no.6, 064036 (2023) doi:10.1103/PhysRevD.107.064036 [arXiv:2301.11052 [gr-qc]].
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12. A. B. Joshi, D. Tahelyani, D. Dey and P. S. Joshi, Observational aspects of a class of Dark matter spacetimes, [arXiv:2212.03042 [gr-qc]].
13. K. P. Kaur and P. S. Joshi, Fundamentals of Stellar Parameters Estimation through CMD of Star Clusters: Open (NGC 2360) and Globular (NGC 5272), Bulg. Astron. J. **38**, 2022 [arXiv:2209.03019 [astro-ph.GA]].
14. V. Patel, D. Tahelyani, A. B. Joshi, D. Dey and P. S. Joshi, Light trajectory and shadow shape in the rotating naked singularity, Eur. Phys. J. C **82**, no.9, 798 (2022) doi:10.1140/epjc/s10052-022-10638-w [arXiv:2206.06750 [gr-qc]].
15. V. Patel, K. Acharya, P. Bambhaniya and P. S. Joshi, Rotational Energy Extraction from the Kerr Black Hole's Mimickers, Universe **8**, no.11, 571 (2022) doi:10.3390/universe8110571 [arXiv:2206.00428 [gr-qc]].
16. S. Vagnozzi, R. Roy, Y. D. Tsai, L. Visinelli, M. Afrin, A. Allahyari, P. Bambhaniya, D. Dey, S. G. Ghosh and P. S. Joshi, *et al.* Horizon-scale tests of gravity theories and fundamental physics from the Event Horizon Telescope image of Sagittarius A^{*}, doi:10.1088/1361-6382/acd97b [arXiv:2205.07787 [gr-qc]].
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21. P. Bambhaniya, J. S. Verma, D. Dey, P. S. Joshi and A. B. Joshi, LenseThirring effect and precession of timelike geodesics in slowly rotating black hole and naked singularity spacetimes, *Phys. Dark Univ.* **40**, 101215 (2023) doi:10.1016/j.dark.2023.101215 [arXiv:2109.11137 [gr-qc]].
22. K. P. Kaur, P. S. Joshi, D. Dey, A. B. Joshi and R. P. Desai, Comparing Shadows of Blackhole and Naked Singularity, [arXiv:2106.13175 [gr-qc]].
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