Dr. M. Hemalatha

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Educational Qualifications

1. Ph.D. (Science) – Nuclear Physics, 2005 (awarded 2007), Thesis: "Study of Exotic Nuclei", Bhabha Atomic Research Centre, Mumbai; degree awarded by University of Mumbai.
2. M. Sc. (Physics) - First Class, 2000, University of Mumbai, Mumbai.
3. B. Sc. (Physics) - First Class, 1998, University of Mumbai, Mumbai.

Positions held

1. UGC Assistant Professor, Department of Physics, University of Mumbai, Mumbai, India, since 2018.
2. Visiting Faculty, UM-DAE Centre for Excellence in Basic Sciences, Mumbai, India, 2017.
3. Assistant Professor, UM-DAE Centre for Excellence in Basic Sciences, Mumbai, India, 2010-2016.
4. Visiting Scientist, Institut de Physique Nucléaire (IPN)-Orsay, France, 2009.
5. Post-Doctoral Fellow, Physics Department, Indian Institute of Technology, I.I.T. – Bombay, Mumbai, India, 2007.
6. Visiting Scientist, Atomic Physics Department, GSI, Darmstadt and Department of Chemistry, Mainz University, Mainz, Germany, 2004.
7. Department of Atomic Energy (DAE) Research Fellow, Bhabha Atomic Research Centre, Mumbai, India, 2005.

Academic Awards and Recognition

1. **UGC Faculty Recharge Program selectee**, 2017, University Grants Commission, Government of India.
2. **Young Scientist Research Award** (YSRA-2012), Department of Atomic Energy (DAE)-Board of Research in Nuclear Sciences (BRNS), Government of India.
3. **DAE Research Fellow, 2000-2005,** Department of Atomic Energy (DAE), Government of India.

Professional Training received

Course on Radiological Safety Aspects in the Research Application of Ionising Radiation, Bhabha Atomic Research Centre and Indian Association for Radiation Protection, 2011.

Research Grants

1. **UGC Start-up grant of Rs. 10,00,000,** 2019-2021, University Grants Commission, Government of India.
2. **Principal Investigator for Research grant of Rs. 17,00,000 for the project** "Laser Spectroscopy of nuclei away from stability", 2012-2015 under Young Scientist Research Award (YSRA-2012), Department of Atomic Energy (DAE) - Board of Research in Nuclear Sciences (BRNS), Government of India.
3. **Co-Principal Investigator for Research grant of Rs. 24,57,500 for the project** "Low energy photon spectroscopy and internal conversion studies", 2014-2017, Department of Atomic Energy (DAE) - Board of Research in Nuclear Sciences (BRNS), Government of India.

Member of Professional Societies

1. Indian Physics Association, Life member
2. Indian Laser Association, Life member

Conferences organized

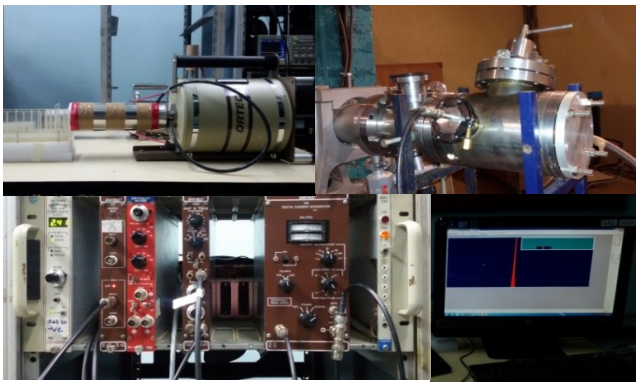
1. Co-Convenor of "Workshop on 150 years of Periodic Table of elements" at UDP, November, 2018.

My Research:

My principal area of research is the experimental and theoretical understanding of nuclei away from stability. My research interests are interdisciplinary.

(I) Experimental and Theoretical: Proton-induced reactions on Se isotopes:

Management of long-lived nuclear waste is an important aspect for any sustainable nuclear energy programme. Several strategies are being explored for the transmutation of the long-lived fission products such as ^{79}Se. Neutrons, protons and photons are being considered as suitable probes for this program. Neutrons are not suitable for the transmutation of Se isotopes. It turns out that *p*-induced reactions in particular and low energy protons (about 20 MeV) are suitable for converting ^{79}Se to short-lived ^{79}Br while transmuting the other Se isotopes to either stable or short-lived Br isotopes.

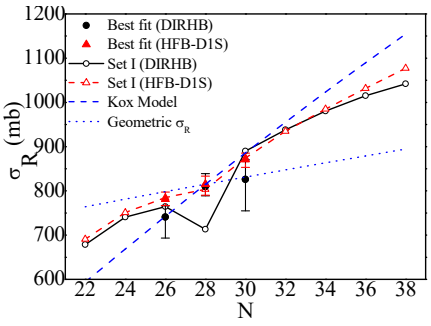


While (p,n) data exist for stable Se isotopes over a limited energy range, there are no data for the radioactive ^{79}Se. Hence, the cross sections of the (p,n) reactions on ^{76,77,78,80,82}Se using natural Se targets using stacked-foil activation technique have been measured. Se deposited on Al targets have been irradiated with proton beam of energies from threshold to 18.5 MeV using 14 UD BARC-TIFR Pelletron accelerator facility at Mumbai. Since the half-lives of the isotopes are relatively long, radioactivity of the activation products was determined via off-line gamma-counting method using high resolution HPGe detectors. The target thickness was measured using PARAS accelerator at IUAC, New Delhi and FOTIA accelerator, Mumbai. The excitation function for the ^{76,77,78,80,82}Se(p,n) obtained experimentally has been compared with statistical model codes Empire and Talys. With suitable adjustment of optical model and level density parameters, there is good agreement between experiment and calculated excitation function. Details are given in M. Hemalatha *et. al.*, Proc. DAE-BRNS Symp. on Nucl. Phys. **61**, 588 (2016).

Team: *M. Hemalatha, N. Maladkar, A. Patel, S. Kailas, S. G. Wahid, D. Negi, S.K. Tandel*, BARC and IUAC collaborators

(II) Correlation between nuclear charge radii with reaction cross sections:

Investigation of the correlation between nuclear charge radii with reaction cross sections and utilizing this correlation in predicting the reactions cross sections are being carried out. Smaller charge radii compared to neighboring isotopes are signature of magic numbers which arise due to the right number of protons or neutrons. While on the other extreme we have halo nuclei which have abnormally large radius. Observing the nuclear charge radii in isotopic chains, new shell gaps seems to appear or traditional shell gaps are found to vanish. These features give insights in to the nuclear interactions.



The behavior in nuclear charge radii and reaction cross sections has been investigated for Ti and Cr isotopic chains. Details about figure are given in M. Hemalatha *et al*., Phys. Rev. C, 92, 024611 (2015) and M. Hemalatha *et al*., European Physical Journal, 107, 08006 (2016).

Team: *M. Hemalatha,and N. Maladkar*

(IV) Theoretical Elastic scattering of halo nuclei:

Elastic scattering of light halo nuclei from a variety of heavier systems provides rich insights for understanding of both nuclear reactions and structure. Recently, there have been a number of experimental and theoretical investigations focused on this aspect. One of the interesting aspects is to understand the effect of halo structure on elastic scattering cross sections at near-Coulomb barrier energies in reactions induced by neutron halo nuclei and weakly bound radioactive beams. Nuclei such as ^{11}Be, ^{6}He and ^{11}Li, in contrast to stable nuclei, have distinct features such as extended neutron density distribution and a compact core. The unusual features of halo nuclei largely affect the interaction with light and heavy targets at low bombarding energies and have created tremendous interest in the study of nuclear reactions. Elastic scattering is sensitive to the nature of the surface of nuclei and hence it is effective in studying halo nuclei. In halo nuclei, the effects of dipole polarizability are important and it affects the elastic scattering cross section at low energies for heavy targets. I am investigating the elastic scattering cross sections of halo projectiles on different targets at near-Coulomb barrier energies using double folding optical model. Details are given in *M. Hemalatha*, European Physical Journal, 66, 03036 (2014) and *M. Hemalatha*, Pramana 82, 789 (2014).

Team: M. Hemalatha

(IV) Experimental: Laser Spectroscopy of stable nuclei and nuclei away from stability:

Development of a high-sensitive fluorescence cell and measurement of atomic isotope shift (IS) and hyperfine structure (Hfs) of stable and radioactive isotopes using laser spectroscopic methods is being carried out. This experimental set up would be the first of its kind in India for laser based nuclear physics investigations and was built at Laser Spectroscopy for Nuclear Physics Laboratory. This research work was carried out mainly with the funding received under the Young Scientist Research Award (YSRA-2012). Presently, the design and fabrication of the fluorescence cell and development of laboratory for the laser spectroscopic set-up is in progress. The studies proposed here will have a considerable impact in the understanding of ground-state properties of nuclei away from stability using laser spectroscopic techniques. This work is interdisciplinary and involves nuclear physics, atomic spectroscopy, lasers, accelerators and reactors. Techniques that have high sensitivity and resolution would be required in the near future as new nuclei are being produced in increasing numbers at accelerated radioactive ion beam facilities. The development of fluorescence cell that enables on-line measurement of short-lived nuclei produced in small amounts at accelerators using laser spectroscopy is an important step. The highly accurate measurements of isotope shifts which are sensitive to small changes in the mean-square charge radii will provide considerable insight into these issues. Details are in **M. Hemalatha et. al., Nucl. Inst. Meth. A572, 971 (2007)**

Team: M. Hemalatha

Papers in International Peer Reviewed Journals:

1. Excitation functions of the Zn(p,xn)Ga reactions, ***M. Hemalatha***, A. Patel, and S. Kailas, **Applied Radiation and Isotopes, 156, 108968 (2020).**
2. Prediction of reaction cross section for p-Cr**,** ***M. Hemalatha***, N. Maladkar and S. Kailas, **European Physical Journal, 107, 08006 (2016).**
3. Verification of the sputter-generated 32SFn- (n=1-6) anions by accelerator mass spectrometry**,** R.G. Mane, P. Surendran, Sanjay Kumar, J.P. Nair, M.L. Yadav, ***M. Hemalatha*****,** R.G. Thomas, K. Mahata, S. Kailas, and A.K. Gupta**, Nucl. Inst. Meth. B366, 13 (2016).**
4. Correlation between nuclear charge radii of Ti and reaction cross sections for p-Ti, ***M. Hemalatha***, N. Maladkar and S. Kailas, **Phys. Rev. C, 92, 024611 (2015).**
5. Nuclear Transmutation Strategies for Management of Long Lived Fission Products, S. Kailas, ***M. Hemalatha***, and A. Saxena, **Pramana, *85, 517* (2015).**
6. Elastic scattering of the halo nucleus ^{11}Be on ^{64}Zn, ***M. Hemalatha***, **European Physical Journal, 66, 03036 (2014).**
7. Double folding model analysis of elastic scattering of halo nucleus ^{11}Be from ^{64}Zn around Coulomb barrier, ***M. Hemalatha***, **Pramana 82, 789 (2014).**
8. Evolution of octupole collectivity in ^{221}Th, S.K. Tandel, ***M. Hemalatha,*** A.Y. Deo, and S.B. Patel, R. Palit, T. Trivedi, J. Sethi, and S. Saha, D.C. Biswas and S. Mukhopadhyay, **Phys. Rev. C 87, 034319 (2013)**.
9. A study of secondary cosmic ray flux variation during the annular eclipse of 15 January 2010 at Rameswaram, India, Ankush Bhaskara, Avadhut Purohit, **M. *Hemalatha,*** Chintamani Pai, Anil Raghav, Chetan Gurada, S. Radha, Virendra Yadav, Vishal Desai, Abhishek Chitnis, Padmanabh Sarpotdar, and Anirudha Patankar, **Astroparticle Physics, *35, 223* (2011).**
10. Weakening of the spin-orbit interaction with the increase of neutron number, ***M. Hemalatha***, Y. K. Gambhir, W. Haider, and S. Kailas, **Phys. Rev. C79, 057602 (2009).**
11. Accelerator mass spectrometry programme and related developments at the BARC-TIFR Pelletron accelerator, P. Surendran, A. Shrivastava, A.K. Gupta, R.M. Kale, J. P. Nair, **M. *Hemalatha***, K. Mahata, M.L. Yadav, H. Sparrow, R.G. Thomas, P.V. Bhagwat, and S. Kailas, **Nucl. Inst. Meth. B267, 1171 (2009).**
12. Microscopic optical model potentials for p-nucleus scattering at intermediate energies, ***M. Hemalatha***, S. Kailas, W. Haider, and Y. K. Gambhir, **Phys. Rev. C75, 037602 (2007).**
13. Development of a high-sensitive fluorescence cell for measurement of atomic isotope shifts and hyperfine structures, ***M. Hemalatha***, S. Kailas, A. Venugopalan, B. N. Jagatap, and K. G. Manohar, N**ucl. Inst. Meth. A572, 971 (2007).**
14. The study of exotic nuclei, ***M. Hemalatha,*** S. Kailas and Y.K. Gambhir, **Hyperfine Interactions 162, 133 (2005).**
15. Anomaly in the nuclear charge radii of Zr isotopes, ***M. Hemalatha***, A. Bhagwat, A. Shrivastava, S. Kailas, and Y.K. Gambhir, **Phy. Rev. C70, 044320 (2004).**
16. Production of neutron-deficient nuclei ^{127}Cs and ^{129}Cs by heavy-ion fusion reaction, ***M. Hemalatha***, S. Kailas, K. Mahata, A. Shrivastava, K. Ramachandran, and A. Chatterjee **Nucl. Inst. Meth. A531, 645 (2004).**
17. Beam energy calibration for the folded ion tandem accelerator, S. Santra, K. Mahata, P. Singh, C.V. Fernandes, ***M. Hemalatha***, and S. Kailas, **Nucl. Inst. Meth. A496, 44 (2003).**

Papers in International Conferences:

1. Unusual behaviour of nuclear charge radii and reaction cross sections in N=28 region, ***M. Hemalatha***, N. Maladkar and S. Kailas, Proc. International Nuclear Physics Conference (INPC2016), *Adelaide, Australia, S*eptember 11-16, 2016.
2. Prediction of reaction cross-section for *p*-Cr, ***M. Hemalatha***, N. Maladkar and S. Kailas, Proc. International Conference on Nuclear Structure and Related Topics, *Dubna, Russia*, **41**, 2015.
3. Nuclear Transmutation Strategies for Management of Long Lived Fission Products, S. Kailas, ***M. Hemalatha***, and A. Saxena, Proc. 75 years of Nuclear Fission: Present status and future perspectives, *Mumbai, India*, **47** (2014).
4. Elastic scattering of halo nucleus ^{11}Li in the vicinity of Coulomb barrier, ***M. Hemalatha***, and S. Kailas, Proc. VI International Conference FUSION14, *New Delhi, India*, **6**, 28 (2014).
5. Elastic scattering of the halo nucleus ^{11}Be on ^{64}Zn, ***M. Hemalatha***, International Nuclear Physics Conference (INPC2013), *Firenze, Italy,* **NR76** (2013).
6. Evidence of subshell gap at *N=72* in neutron-rich nuclei, ***M. Hemalatha***, Nuclear Structure with Advanced Gamma-detector Arrays (NSP13), *Padova, Italy*, (2013).
7. Evolution of octupole collectivity in ^{221}Th, S.K. Tandel , ***M. Hemalatha***, A.Y. Deo, S.B. Patel, R. Palit, T. Trivedi, J. Sethi, S. Saha, D.C. Biswas, S. Mukhopadhyay, International Nuclear Physics Conference (INPC2013), *Firenze, Italy,* C1 (2013).
8. Design of fluorescence cell for isotope shift measurements by atomic-beam laser spectroscopy, ***M. Hemalatha***, Proc. International DAE Symp Nuc. Phy., *Mumbai, India*, **58**, 978 (2013).
9. Elastic scattering of halo nucleus ^{11}Li with near-barrier energies, ***M. Hemalatha***, Proc. International DAE Symp Nuc. Phy., *Mumbai, India*, **58**, 546 (2013).

Papers in National Conferences:

1. Reaction cross section for p-Fe, N. Maladkar, ***M. Hemalatha*** and S. Kewat, Proc. DAE Symp. on Nucl. Phys 64, 567 (2019).
2. Exploration of Effects of Nuclear Structure and Reaction Mechanism on the Threshold Behaviour in Nuclear Reactions with Weakly Bound Projectiles: the ^{7}Li + ^{74}Se System, U. K. Pal, V. V. Parkar, S. Santra, A. Pal, H. Kumawat, K. Ramachandran, D. Chattopadhyay, A. Kundu, C. Joshi, T.N. Nag, G. Mahanto, A. Parihari, S. De, A. Patel, ***M. Hemalatha***, B. K. Nayak, Proc. DAE Symp. on Nucl. Phys 63, 660 (2018).
3. Single-particle states and isomers in ^{202}Tl and ^{203}Pb, S.G. Wahid, S.K. Tandel, A. Patel, S. Suman, P. Roy, ***M. Hemalatha***, A.Y. Deo, Pragati, S. Rai, A. Sharma, S.S. Bhattacharjee, R.P. Singh, S. Muralithar, and P.C. Srivastava, Proc. DAE Symp. on Nucl. Phys 63, 228 (2018).
4. Isomers and intrinsic excitations at high spin in ^{201}Tl, Poulomi Roy, S.K. Tandel, S.G. Wahid, S. Suman, A. Patel, ***M. Hemalatha***, A.Y. Deo, Pragati, S. Rai, A. Sharma, S.S. Bhattacharjee, S. Muralithar, R.P. Singh, and P.C. Srivastava, Proc. DAE Symp. on Nucl. Phys 63, 238 (2018).
5. Total reaction cross section for p-Sm at Ep= 65 MeV, R Gala, ***M. Hemalatha***, Proc. DAE-BRNS Symp. on Nucl. Phys. **61**, 590 (2016).
6. Cross sections of 79Se(p,n) reaction for nuclear transmutation, ***M Hemalatha***, BK Nayak, SV Suryanarayana, G Mahanto, A Patel, SG Wahid, S Santra, H Naik, SK Tandel, D Negi, S Kailas, N Maladkar, A Saxena, Proc. DAE-BRNS Symp. on Nucl. Phys. **61**, 588 (2016).
7. Charge radius of doubly magic ^{56}Ni and reaction cross section for p-Ni, N Maladkar, ***M Hemalatha***, S Kailas, Proc. DAE-BRNS Symp. on Nucl. Phys **60**, 618 (2015).
8. Excitation function of (p, n) reaction on ^{67}Zn, A Patel, ***M Hemalatha***, S Kailas, Proc. DAE-BRNS Symp. on Nucl. Phys 60, 500 (2015).

9. 129I measurement at BARC-TIFR Pelletron accelerator facility, P. Surendran, J.P.Nair, R.G.Mane, ***M. Hemalatha***, M.L. Yadav, H. Sparrow, R. G. Thomas, S. Kailas, Indian Particle Accelerator Conference, (2015).
10. Proton-induced reactions on Se isotopes, ***M Hemalatha***, A Saxena, S Kailas, Proc. DAE Symp. on Nucl. Phys 59, 582 (2014).
11. Identification of Polyatomic Anions by Accelerator based Mass Spectrometry at Pelletron-LINAC Facility, R.G Mane, P. Surendran, ***M. Hemalatha***, K. Mahata, J.P.Nair, R.M.Kale, A.K.Gupta Proc. SPARC, 2014.
12. Double folding model analysis of elastic scattering of halo nucleus ^{11}Be from ^{64}Zn around Coulomb barrier, ***M. Hemalatha***, Proc. National conference on nuclear physics (NCNP2013), Sambalpur University, Odisha, 30 (2013).
13. Study of subshell gap around *N*=70 for neutron-rich nuclei, ***M. Hemalatha***, Proc. DAE Symp. Nuc. Phy. 56, 686 (2011).
14. Study of Spin Rotation Function for Polarised Proton Incident on Zr and Sn Isotopes, ***M. Hemalatha***, S. Kailas, W. Haider, and Y. K. Gambhir, Proc. DAE Symp Nuc. Phy. **54**, 270 (2009).
15. Determination of ^{36} Cl/ Cl ratio in ground water using the Accelerator Mass Spectrometry Technique, Suman Sharma, A.S. Deodhar , U. Saravana Kumar, P. Surendran, A. Shrivastava, A.K. Gupta, J.P.Nair, M.L. Yadav, ***M. Hemalatha***, H. Sparrow, K. Mahata, R.G. Thomas, P. V. Bhagwat, S. Kailas, R.M. Kale, Conference Proceedings , InPAC-2009.
16. Accelerator Mass Spectrometry programme at Mumbai Pelletron Accelerator Facility, P. Surendran, A. Shrivastava, A. K. Gupta, J. P.Nair, M. L. Yadav, ***M. Hemalatha***, H. Sparrow, K. Mahata, R. G. Thomas, P. V. Bhagwat, S. Kailas, Suman Sharma, A. S. Deodhar, U. Saravana Kumar, R. M. Kale. International Topical Meeting on Research Application and Utilization of Accelerators, Vienna, Austria, 4-8 May 2009.
17. Mass and energy dependence of the second moments of microscopic optical potentials**,** ***M. Hemalatha***, S. Kailas, W. Haider, and Y. K. Gambhir, Proc. DAE Symp Nuc. Phy. **52**, 355 (2007).
18. Microscopic optical potential for polarised proton nuclear scattering**,** ***M. Hemalatha***, S. Kailas, W. Haider, and Y. K. Gambhir, Proc. DAE Symp Nuc. Phy. **51**, 331 (2006).
19. Segmented Gas Detector for Identification of AMS Radionuclide ^{36}Cl, A. Shrivastava, P.V. Bhagwat, A.K.Gupta, ***M. Hemalatha***, S.Kailas, K.Mahata, K.Ramachandran, P.Surendran, S.K. Aggarwal, D. Alamelu, Proceedings of ISMAS-2006,
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21. Testing of the High Sensitive Fluorescence Cell for Measurement of Atomic Isotope Shifts and Hyperfine Structures using Laser Spectroscopy, ***M. Hemalatha***, S. Kailas, A. Venugopalan, B. N. Jagatap, and K. G. Manohar Proc. Fourth DAE National Laser Symposium, **NLS-4**, 277 (2005).
22. The Isotope Shift and Hyperfine Structure of ^{85,87}Rb Isotopes using Laser Spectroscopy**,** ***M. Hemalatha***, P. Schumann, C. Geppert, and K. Wendt, Biennial Report, Nuclear Physics Division, BARC/2003/P/001, (2005).
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24. Anamoly in the nuclear charge radii of Zr isotopes, ***M. Hemalatha***, A. Bhagwat, A. Shrivastava, S. Kailas, and Y.K. Gambhir, Proc. DAE Symp Nuc. Phy. **46B**, 306 (2003).
25. Production and study of doubly magic nucleus ^{146}Gd, ***M. Hemalatha***, S. Kailas, A. Shrivastava, A. Bhagwat, and Y.K. Gambhir, Proc. DAE Symp Nuc. Phy. **46B**, 46 (2003).
26. Lasers in nuclear physics, B.N. Jagatap, ***M. Hemalatha***, A. Marathe, Proc. DAE Symp Nuc. Phy. **46A**, 46 (2003).

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28. Breakup coupling effects on elastic scattering of ^{7}Li + ^{90}Zr, V. Jha, P. Shukla, B.J. Roy, A. Chatterjee, K. Ramachandran, A. Navin, K. Mahata, S. Kailas, ***M. Hemalatha***, A. Shrivastava, V. Tripathi, S. Rathi, R.G. Thomas, and P.K. Sahu, Proc. DAE Symp Nuc. Phy. **46B**, 206 (2003).
29. Direct reaction and fusion cross-section for ^{7}Li + ^{12}C at energies near the coulomb barrier, V.V. Parkar, S. Santra, K. Mahata, S. Kailas, K. Ramachandran, V. Tripathi, A. Chatterjee, and ***M. Hemalatha,*** Proc. DAE Symp Nuc. Phy. **46B**, 282 (2003).
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31. Status of AMS program at Mumbai Pelletron Accelerator facility, S. Kailas, A. Shrivastava, K. Mahata, P.V. Bhagwat, A.K. Gupta, P. Surendran, ***M. Hemalatha***, and K. Ramachandran, Indian Particle Accelerator Conference (INPAC) 692 (2003).
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33. Isotope shifts and isotonic systematics of nuclear radii, ***M. Hemalatha***, S. Kailas, A. Bhagwat, and Y.K. Gambhir, Proc. DAE Symp Nuc. Phy. **45B**, 264 (2002).
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35. Pre-Fission Charged Particle Multiplicities for ^{10}B+^{232}Th, K. Ramachandran, A. Chatterjee, A. Navin, K. Mahata, Vandana Tripathi, ***M. Hemalatha***, S. Kailas, R.G. Thomas, L. M. Pant, and A. Saxena, Proc. DAE Symp Nuc. Phy. **44B**, 162 (2001).
36. A calibration experiment for FOTIA, S. Santra, K. Mahata, P. Singh, S. Kailas***,*** and ***M. Hemalatha,*** International Conference on Heavy Ion Accelerator Technology (2001).