Acknowledgments

First and foremost, I would like to thank my adviser Dr. Sandhya Choubey for her able guidance and support during my Ph.D at Harish-Chandra Research Institute, Allahabad. She has constantly given me encouragement, has been very patient throughout my Ph.D years and motivated me for independent thinking. It has been a wonderful experience for me to learn physics from her and as well as to learn the technical minute details, which are essential parts of solving a research problem.

I would like to give my heartfelt thanks to Prof. Amitava Raychaudhuri and Prof. Ashoke Sen, with whom I have discussed a lot on several intricate physics issues and clarified my doubts, whenever it was required. Learning physics from them has always been an enchanting experience. I am indebted to Dr. Srubabati Goswami for her active support, suggestions and the very enjoyable physics discussions. She has provided me with her insightful advice, whenever I needed. My special thanks goes to Prof. Raj Gandhi, it has been an excellent experience for me to come across his knowledge, deep physics insight and rigorous way of thinking during the last few years. I am grateful to Prof. Biswaup Mukhopadhyaya and Dr. Asesh Krishna Datta for several intense physics discussions, which has helped me a lot to get the clarification for the different subtle physics issues. It is a great pleasure to thank Prof. V. Ravindran. I have gained a lot of knowledge from him during my coursework and project. I would also like to thank Dr. Andreas Nyffeler.

My special thanks goes to Prof. Ashoke Sen and Rajesh Gopakumar for the excellent courses they have given. I am also grateful to the other course instructors of HRI, who have taught me the basic as well as several advanced subjects during my two years coursework period at HRI. I am indebted to Prof. Pinaki Majumdar for his support, which helped me a lot during my Ph.D years. The several talks and the intense discussions of our Pheno Lunch journal club has given me the exposure to different fields of research, which has broadened my research perspective.

I would like to convey my heartfelt thanks to all those who helped and advised me to carry out my research forward. Among them, I would like to specially mention my collaborators Prof. Steve F. King from University of Southampton and Dr. Biswajoy Brahmachari. On several occasions, I have discussed with Prof. Anjan Joshipura, Dr. Sudhir Vempati, Dr. Sourav Roy, Dr. Amol Dighe, Prof. Feruglio, Prof. Borut Bajc and Prof. Francesco Vissani and have been benefitted by their knowledge and physics insight. My thanks goes to all of them. I would also like to thank all the course and tutorial instructors of SERC 2008 school, held in IIT Mumbai, from which I have learned many good physics.

It has always been an enjoyable experience to discuss physics and even non-physics with students and post-docs of HRI. I have been extremely benefitted by the physics discussions with my collaborator Dr. Priyotosh Bandyopadhyaya. I would also like to mention Ramlal Awasthi. Physics discussion has always been enjoyable with him. I
would like to thank Rajesh Kumar Gupta, Santosh Kumar Singh, Dr. Pomita Ghoshal, Anushree Ghosh, Atri Bhattacharya, Sanjoy Biswas, Satyanarayan Mukhopadhyay, Joydeep Chakraborty, Akhilesh Nautiyal, M C Kumar, Nishita Desai, Abhijit Bandyopadhyaya, Subhaditya Bhattacharya and Dr. Paramita Dey for very enjoyable physics as well as non-physics discussions. My special thanks goes to Archana S. Morye, Dr. Anupama Panigrahi and Atashi Das. Because of them, my five years stay at HRI has become much more enjoyable and meaningful. I would also like to thank all the students, post-docs and my friends of HRI with whom I have interacted, specially Shankha, Akansha, Shrobona, Swapnomoy, Nyayabanta, Arjun da, Nabamita di, Suvankar da, Arijit da, Siddhartha da, Shamik, Ushoshi, Shweta, Rachna, Sini and Bobo. A very heartful thanks goes to our music teacher Mr. Hanuman Prasad Gupta, Dr. Rukmini Dey and all the participants of our “Music and Poetry Session”. My stay at HRI has become much more colourful because of them. My special thanks goes to Seema and Archana Madam. Spires, arXiv, Google, HRI computer and cluster section helped me in a significant way to carry out my research forward.

I express my deep gratitude to my parents and acknowledge with pleasure that without their love, affection and support, it would never have been possible for me to pursue my Ph.D work. I would also like to thank my close friends and relatives for being extremely supportive during my Ph.D years. I dedicate this thesis to my parents.