

CONTENTS

S.NO.	CHAPTER PARTICULARS	Page No.
1.	ACCELERATOR	
1.1	15 UD PELLETRON ACCELERATOR	1
1.1.1	Operational Summary	1
1.1.2	Maintenance	2
1.1.3	Breakdown Maintenance (6 th August 2020 – 11 th August 2020)	2
1.1.4	Scheduled Maintenance (05/01/2021 – 20/02/2021)	2
1.1.5	Ion Source activities	3
1.1.6	Activities during lockdown	3
1.2	SUPERCONDUCTING LINEAR ACCELERATOR (SC LINAC)	4
1.2.1	Work done during the lock down period	4
1.2.2	Superconducting Niobium Resonator Fabrication	5
1.3	PARAS: 1.7 MV (5SDH-2) Pelletron Accelerator based Ion Beam Analysis Facility	7
1.3.1	Operation	7
1.3.2	Maintenance	7
1.3.2.1	Ion Source Maintenance	7
1.3.2.2	The 5SDH-2 Pelletron Accelerator and Endstation Maintenance	7
1.4	AMS AND GEOCHRONOLOGY FACILITIES	8
1.4.1	Accelerator Mass Spectrometry	8
1.4.1.1	Graphitization Laboratory	8
1.4.1.1.1	Optimization of background value for the graphitization of dissolved inorganic carbon (DIC) using carbonate handling system (CHS)	8
1.4.1.1.2	Graphitization of dissolved organic carbon using carbonate handling system	8

1.4.1.1.3	Graphitization of methane from atmospheric air samples	8
1.4.1.2	XCAMS facility	9
1.4.1.2.1	AMS Measurements	9
1.4.1.2.2	¹⁴ C AMS measurements of samples from industries	9
1.4.1.2.3	Maintenance activities of XCAMS	9
1.4.2	National geochronology facility	9
1.4.2.1	Quadrupole- Inductively coupled plasma mass spectrometry (Q-ICPMS)	10
1.4.2.2	Femto-second laser ablated High Resolution Inductively coupled plasma mass spectrometer	10
1.4.2.3	Field Emission Scanning Electron Microscope (FE-SEM)	10
1.4.2.4	Wave length Dispersive X-Ray fluorescence	11
1.4.2.5	X-Ray Diffraction	12
1.4.2.6	Laboratory magnetic barrier separator:	12
1.4.2.7	Jaw Crusher, Vibratory disc mill and Sieve shaker	13
1.5	LOW ENERGY ION BEAM FACILITY (LEIBF)	14
1.6	LOW ENERGY NEGATIVE ION IMPLANTER FACILITY	16
2.	ACCELERATOR AUGMENTATION	
2.1	HIGH CURRENT INJECTOR	19
2.1.1	ECR Ion Source	19
2.1.2	Beam Acceleration Test of The Radio Frequency Quadrupole (RFQ) Accelerator	22
2.1.3	Status of Drift Tube Linear Accelerator and Compact Beam Diagnostic System of HCI	23
2.2	COMMISSIONING AND TESTING OF THE SUBCOMPONENTS OF THE DELHI LIGHT SOURCE (DLS) AT IUAC	27
2.2.1	Introduction	27
2.2.2	Status of Various Subsystems of DLS	27

2.2.2.1	The Electron Gun and the High Power RF System	27
2.2.2.2	Undulator	28
2.2.2.3	Final Test of the Photocathode Deposition System	28
2.2.2.4	Fiber Laser System to Produce Electron Beam From CU as Well As Cs ₂ Te Photocathode	29
2.2.2.5	Completion of the beam line design and its Commissioning Status	29
2.2.2.6	Control Scheme for the FEL Facility	29
2.2.3	Initiative to Develop the Experimental Facilities	30
2.2.4	Conclusion	30

3. RESEARCH SUPPORT FACILITIES

3.1	SUPPORT LABORATORIES	31
3.1.1	High Vacuum Laboratory	31
3.1.2	Cryogenics Laboratory	33
3.1.3	Beam Transport System (BTS)	36
3.1.4	Detector Laboratory	39
3.1.5	Target Development Laboratory	40
3.1.6	Radio Frequency Amplifier Laboratory	44
3.1.7	Health Physics Laboratory	46
3.1.8	Data Support Laboratory	49
3.1.9	Computer and Communications	51
3.1.10	Electronics for Cryogenics, SPL, and MRI	52
3.1.11	Low Level RF & Beam Bunching Group (LLRF)	56
3.2	UTILITY SYSTEMS	58
3.2.1	Electrical Group Activities	58
3.2.2	Utility services	59
3.2.3	Mechanical Workshop (MG-III GR.)	61
3.2.4	Civil Engineering Group	66

4	EXPERIMENTAL FACILITIES IN BEAM HALL	
4.1	GENERAL PURPOSE SCATTERING CHAMBER AND NATIONAL ARRAY OF NEUTRON DETECTORS	67
4.1.1	Experiments using GPSC and NAND facilities	67
4.1.2	Maintenance and servicing activities of GPSC facility	67
4.1.3	Maintenance and servicing activities of NAND facility	68
4.1.4	Testing of NAND array for the measurement of neutrons above 10 MeV	68
4.1.5	Performance results of NAND array	69
4.2	GAMMA DETECTOR ARRAYS: GDA and INGA	70
4.2.1	Indian National Gamma Array (INGA)	70
4.2.2	LN2 filling system	70
4.2.3	In-beam test of the plunger facility in INGA	70
4.3	RECOIL MASS SPECTROMETERS	71
4.3.1	Heavy Ion Reaction Analyzer (HIRA)	71
4.3.2	HYbrid Recoil mass Analyzer (HYRA)	72
4.4	MATERIALS SCIENCE FACILITY	72
4.4.1	Maintenance of Irradiation chamber in Beam Hall I	73
4.4.2	Material Synthesis and Microscopy laboratory	73
4.4.3	Status of the Facilities available in the Transport Lab	73
4.4.4	TEM Facility Activities	74
4.5	RADIATION BIOLOGY	79
4.5.1	Status of the research work done using the Radiation Biology facility	79
4.6	ATOMIC AND MOLECULAR PHYSICS FACILITIES	80
4.6.1	Status of vacuum chamber at 75 ⁰ beam line in LEIBF	80
4.6.2	Status of general-purpose atomic physics vacuum chamber (GPAC) at beam hall-II	80

4.6.3	Status of vacuum chamber at 105 ⁰ beam line in LEIBF	81
4.6.4	Development of Ion Trap Facility at IUAC	83

5 RESEARCH ACTIVITIES

5.1	NUCLEAR PHYSICS	88
5.1.1	Measurement of quasi-elastic excitation function for $^{16}\text{O}+^{142}\text{Ce}$ using a Recoil Mass Spectrometer	89
5.1.2	Spectroscopy of ^{183}Ir	90
5.1.3	Shell model calculations of $^{84,86,88}\text{Sr}$ nuclei using BIGSTICK code	91
5.1.4	Study of target deformation effect on fusion dynamics with Universal Fusion Function	92
5.1.5	Fragmentation dynamics and neutron multiplicity measurements for super-heavy nuclei	94
5.1.6	Mass dependent neutron multiplicity studies in the $^{30}\text{Si}+^{232}\text{Th}$ reaction	95
5.1.7	Nature of dissipation and shell effects in fusion-fission via neutron multiplicity measurements	96
5.1.8	The study of chiral nature in ^{128}La using lifetime measurements	97
5.1.9	GEANT4 simulations for crosstalk calculations	98
5.1.10	Forward recoil range distribution measurement for the system $^{14}\text{N} + ^{169}\text{Tm}$	99
5.1.11	Angular distribution of evaporation residues populated through complete and incomplete fusion	100
5.1.12	Coulomb excitation of ^{118}Sn	101
5.1.13	Study of anomalous light particle spectra in heavy-ion induced fusion reactions	102
5.1.14	Study of octupole deformation in neutron deficient nuclei ($A < 120$) through lifetime measurements	103
5.1.15	Systematic study of fusion-fission dynamics of ^{209}At through fission fragment mass distribution	104
5.1.16	Measurement of transfer cross sections for $^{16}\text{O}+^{144,154}\text{Sm}$ systems	105
5.1.17	Fission dynamics and neutron multiplicity measurements populating the compound nucleus ^{234}Cm through $^{28}\text{Si}+^{206}\text{Pb}$	106

5.1.18	Breakup study of weakly bounded projectile ${}^7\text{Li}$ with ${}^{92,100}\text{Mo}$	106
5.1.19	Measurement of evaporation residue excitation functions for the reactions ${}^{12}\text{C}+{}^{182,184,186}\text{W}$	107
5.2	MATERIALS SCIENCE	109
5.2.1	Ion irradiation effects on GaN and TiO_2 substrates for optoelectronic devices applications	110
5.2.2	Structural Response of Ce & Y-doped Zirconolite upon Swift Heavy Ion Irradiation	111
5.2.3	Swift heavy ion induced damage recovery in pre-damaged 4H-SiC	112
5.2.4	Unary doping effect of A^{2+} ($\text{A} = \text{Zn}, \text{Co}, \text{Ni}$) on the structural, electrical and magnetic properties of substituted iron oxide nanostructures	113
5.2.5	Fabrication of the porous polymeric membrane using Accelerator for fuel cell and radionuclide sensing	114
5.2.6	Determination of accurate depth distribution of Au ions in silicon substrates	114
5.2.7	Anisotropic Magnetoelectric and Magnetotransport Properties of Manganite Based Thin Films	115
5.2.8	Gamma-ray induced modifications on CdS nanorod mesh: Structural, optical, and electrical properties	116
5.2.9	Nitrogen implantation effects on CdS thin films	116
5.2.10	Metal Nanoparticles implanted TiO_2 nanofibers based mesoscopic solar cells	117
5.2.11	Ni^{+7} and Si^{+9} ion irradiation effect on structural and optical properties of PVA-Ni $(\text{NO}_3)_2$ Polymeric film	117
5.2.12	RBS Investigations on Si and Ge bombarded with 100KeV Ar Ion Beam	118
5.2.13	Defects Assisted Structural and Electrical Properties of Ar Irradiated $\text{TiO}_2/\text{SrTiO}_3$ Bilayer	120
5.2.14	Magnetic and electronic structures of N Implanted Iron Oxide Thin Films	121
5.2.15	Swift Heavy Ion Irradiation Studies on Manganite Based Thin Film Devices	122
5.2.16	Swift heavy ion irradiation-induced modifications in the electrical and surface properties of $\beta\text{-Ga}_2\text{O}_3$	123

5.2.17	Study of Resistive Switching of Ion Beam Irradiated Films with Spectroscopic Correlations	125
5.2.18	Origin of intense blue-green emission and bandgap engineering in SrTiO ₃ thin films using ion-beam techniques: An synchrotron-based spectroscopic study	126
5.2.19	Swift Heavy Ion (SHI) Irradiation Studies on doped YMnO ₃ Thin Film Device	127
5.2.20	Electrical transport study and band gap estimation of Ge implanted CoSb ₃ Skutterudite thin films	128
5.3	RADIATION BIOLOGY	130
5.3.1	Cellular response to high LET radiation exposure in human embryonic kidney (HEK293 T) cells with reference to mitochondria	130
5.3.2	Studies on effect of chloroquine, LiCl and NH ₄ Cl induced autophagy in different cell type	131
5.4	ACCELERATOR MASS SPECTROMETRY AND GEOCHRONOLOGY	132
5.4.1	Role of human environment interaction in tracing the urbanization in different sectors of Ganga Plain: A geochemical and metagenomics approach	132
5.4.2	AMS radiocarbon dating of core sediment samples from Rann of Kachchh, Gujarat, western India	132
5.4.3	Response of Harappan coastal sites in Gujarat to Middle-Late Holocene palaeo-environmental changes: A multiple proxy approach	133
5.4.4	Appraisal of regional and local groundwater-surface water dynamics and residence time using ages determined by carbon-14 dating in parts of North-Western India	134
5.4.5	Foraminiferal distribution and paleoclimatic reconstruction from the northeastern Indian Ocean	135
5.5	ATOMIC AND MOLECULAR PHYSICS	136
5.5.1	Addressing three-body dissociation of molecular ions: Extracting lifetimes and dissociation mechanisms	136
5.5.2	Investigating inner-shell processes in quasiadiabatic collisions	137
5.5.3	Formation of quasi-molecules in slow heavy ion-heavy atom collisions	138

6.	ACADEMIC ACTIVITIES	
6.1	BEAM UTILIZATION BY USERS	139
6.1.1	Low Energy Ion Beam Facility and Low Energy Negative Ion Implanter Facility Beam Time Utilization and Experiments performed (April, 2020 to March, 2021)	139
6.1.2	Pelletron Beam Time Utilization and Experiments performed (April, 2020 to March, 2021)	140
6.1.3	List of Users Family	141
6.2	STUDENT PROGRAMME	151
6.2.1	B.Sc. (Physics) Students Summer Programme	151
6.2.2	M. Sc. Orientation Programme	151
6.2.3	PhD Teaching Programme	151
6.2.4	Teaching lab Activities	151
6.3	LIBRARY	154
6.4	ACADEMIC ACTIVITIES HELD IN 2020 - 2021	155
6.5	FORTHCOMING EVENTS: 2021	157
6.6	LIST OF Ph.D AWARDEE	159
6.7	LIST OF PUBLICATIONS IN THE YEAR 2020-21	159
6.8	LIST OF SEMINARS CONDUCTED IN THE YEAR 2020-21	180
6.9	LIST OF TECHNICAL MEMOS/REPORTS (2020 – 2021)	180
6.10	SCHOOLS, WORKSHOPS, ACQUAINTANCE PROGRAMMES, FOUNDATION DAY & NATIONAL SCIENCE DAY CELEBRATIONS	183
APPENDIX - I		191
APPENDIX-II		195
APPENDIX - III		200
APPENDIX - IV		200