

# CONTENTS

<b>1.</b>	<b>ACCELERATOR</b>	<b>1</b>
1.1	Operational Summary	1
1.2	Maintenance And Development Activities	3
1.3	Ion Source Activities	6
1.4	Beam Pulsing System	7
1.5	Accelerator Mass Spectrometry (AMS)	8
1.5.1	Detection of $^{10}\text{Be}$ from Standard SRM 4325 Sample	8
1.5.2	$^{10}\text{Be}$ detection from Mn nodules Geological sample	9
1.5.3	Stable isotope AMS – Depth profiling of $^{63}\text{Cu}$ in Si Substrate	10
1.5.4	BeO sample preparation from Mn Nodules	11
1.5.5	Conversion of NaCl in AgCl sample	12
1.5.6	Origin of Spurious Ions in AMS Spectra	12
<b>2.</b>	<b>ACCELERATOR AUGMENTATION PROGRAMME</b>	<b>16</b>
<b>2.1</b>	<b>LINAC</b>	<b>16</b>
2.1.1	Development of New Drive Coupler	16
2.1.2	A Novel Technique of Reduction of Microphonics in Superconducting Resonators	17
2.1.3	Slow Tuner Development	17
2.1.4	Improvement in LHe Cooling in Linac Cryostat and Off Line Tests	18
2.1.5	High Pressure Rinsing Facility	20
2.1.6	Fabrication of Superconducting Niobium Resonators	21

2.1.6.1	Successful Testing of Completely Indigenously Fabricated QWR	21
2.1.6.2	Resonator Production for the 2 <sup>nd</sup> & 3 <sup>rd</sup> Linac Modules	22
2.1.6.3	Repairing of Coupling Port Bellows	22
2.1.6.4	Modification of a QWR to Study Multipactoring	22
<b>2.2</b>	<b>Cryogenics</b>	<b>23</b>
2.2.1	Cryogenic Facility	23
2.2.2	Performance Report of Cryostats	24
2.2.3	Other Experimental Studies	26
2.2.4	Other Developments	27
2.2.5	Cryogenic Instrumentation other Electronics Development	30
<b>2.3</b>	<b>RF Electronics</b>	<b>33</b>
2.3.1	Status Report of the Multi-harmonic Buncher & the High Energy Sweeper and associated jobs	33
2.3.2	Status of Resonator control Scheme	34
2.3.3	RF Power Amplifier for LINAC	34
<b>2.4</b>	<b>Beam Transport System</b>	<b>35</b>
2.4.1	Design of a large area Magnetic Scanner	35
2.4.2	Design of an Air cooled Quadrupole Magnet	36
2.4.3	High Current High Stability Power Supply (300A/100V, 10 ppm)	36
2.4.4	High Current Scanner Magnet Power Supply	37
2.4.5	Programmable 5kV/100uA Ge detector bias Power Supply (NIM based)	38
2.4.6	400Vpp High Voltage Amplifier	38

2.4.7	Local control panel for indigenously developed magnet power supply	39
2.4.8	Design of a Beta – Spectrometer	40
2.4.9	Development of Spark Counter	40
2.4.10	Beam Hall Activities	41
<b>2.5</b>	<b>Low Energy Ion Beam Facility (LEIBF)</b>	<b>42</b>
<b>2.6</b>	<b>Performance of High Temperature Superconducting ECRIS and Low Energy Beam Transport System</b>	<b>45</b>
<b>2.7</b>	<b>Beam Optical Design and Fabrication of Prototype RFQ Accelerator structure for High Current Injector</b>	<b>49</b>
<b>3.</b>	<b>RESEARCH SUPPORT FACILITIES</b>	<b>50</b>
<b>3.1</b>	<b>High Vacuum Laboratory</b>	<b>50</b>
3.1.1	Phase II Beamline Installations	50
3.1.2	Modifications in Radiation Biology Beam line:	51
3.1.3	CAMAC interfacing of phase II beam line components	51
3.1.4	Beam Line Maintenance	51
3.1.5	Installations in Ion Source Test Bench Setup	52
3.1.6	Alignment and Installation of the Soft landing Setup	52
3.1.7	Installation of Setup at GPSC for inner shell ionization experiment	52
3.1.8	Alignment of the Atomic physics experimental chamber and 90° beam line of LEIBF	53
3.1.9	Design and Fabrication of Vacuum Interlocking System for Experimental facilities	53
<b>3.2</b>	<b>Maintenance of Magnets and Power Supplies</b>	<b>54</b>

<b>3.3</b>	<b>Detector Laboratory</b>	54
3.3.1	Large area position sensitive annular PPAC.	55
3.3.2	CsI + PIN photo-diode detector for particle identification and gamma detection	56
3.3.3	CdTe crystal based detectors	56
3.3.4	Pre -Amplifiers	57
3.3.5	Position Sensitive photon detector as charged particle detector.	57
3.3.6	Fast Timing Preamplifier	58
<b>3.4</b>	<b>Target Development Laboratory</b>	59
<b>3.5</b>	<b>RF &amp; Electronics Laboratory</b>	59
3.5.1	RF Power Generator for PECVD Application	59
3.5.2	Implementation of High Density Electronics Module for GDA at IUAC	59
3.5.3	Development of Pulse Shape Discrimination Module for IUAC neutron Array	60
3.5.4	Control Electronics for coarse approach mechanism for STM	60
3.5.5	Development of spare modules for multi-harmonic buncher electronics	60
3.5.6	Development of RF multiplexer unit with CAMAC control	61
<b>3.6</b>	<b>Electrical Group Activities</b>	61
3.6.1	Captive Power Arrangement	61
3.6.2	Stabilized Power Arrangement	61
3.6.3	UPS Systems	62
3.6.4	Power Factor Compensation	62

3.6.5	Minus Meter for Housing Colony	62
3.6.6	Communication Equipments	62
3.6.7	Maintenance of PHASE-I & II Electrical Installations	62
3.6.8	Energy Saving	63
3.6.9	Installation for Beam Hall-II	63
3.6.10	Development of Helium Expansion Engine Drive	63
3.6.11	LT Distribution Boards	64
3.6.12	PHASE-II Part-II Installations	64
<b>3.7</b>	<b>Computer and Communications</b>	<b>64</b>
<b>3.8</b>	<b>Air Conditioning, Water System and Cooling Equipments</b>	<b>65</b>
<b>3.9</b>	<b>Mechanical Workshop</b>	<b>67</b>
<b>3.10</b>	<b>Health Physics</b>	<b>68</b>
3.10.1	Development and study of new TLD phosphors	68
3.10.2	Radiation Shielding of PKDELIS ECR Ion Source	70
3.10.3	Natural Radioactivity in the Common Building Construction Materials	71
3.10.4	Dosimetry in the environment of 15 UD Pelletron accelerator using plastic track detectors	71
3.10.5	How Safe Is Fly Ash As Building Construction Material In Dwellings	72
3.10.6	Evaluation and Estimation of Residual radioactivity for the decontamination and decommissioning of Accelerator Components	73
<b>3.11</b>	<b>Civil Works</b>	<b>74</b>
<b>3.12</b>	<b>Compressed Air System and Material Handling Equipments</b>	<b>74</b>

<b>3.13 Data Support Laboratory</b>	75
3.13.1 Pico Ampere Current Amplifier	76
3.13.2 Variable amplitude Pulser	76
3.13.3 Micro Controller based Nuclear Radiation Monitor	76
3.13.4 Servicing and Maintenance	77
3.13.5 Multi Channel Analyzer using Embedded PC	77
<b>4. EXPERIMENTAL FACILITIES IN BEAM HALL</b>	79
<b>4.1 General Purpose Scattering Chamber (GPSC)</b>	79
4.1.1 National Array of Neutron Detectors (NAND)	80
4.1.2 Scattering Chamber for NAND	81
4.1.3 Neutron Detector Stand	83
4.1.4 Detector Characterization	83
4.1.5 Facility test of NAND	84
<b>4.2 Gamma Detector Array (GDA)</b>	85
4.2.1 Indian National Gamma Array (INGA)	86
4.2.2 INGA at Calcutta	86
4.2.3 Clover in GDA	86
4.2.4 Home made Analogue to Digital Converters - ADC814	86
4.2.5 LPCC Multirate CAMAC - DAS	87
4.2.6 NUSPE 05	87
4.2.7 GDA Electronics Module	87
4.2.8 Experiments using GDA related facilities	88
4.2.9 Polarisation Sensitivity of Clover	88
4.2.10 IUAC's INGA Clover Modules in GSI	90

4.2.11	HPGe detector Service / Annealing	90
4.2.12	LN2 Filling system Controller	90
4.2.13	LPCC with local boot disc based DAS	91
4.2.14	New RDD for lifetime measurements	92
4.2.15	Incomplete Fusion experiment with CPDA	92
<b>4.3</b>	<b>Recoil Mass Spectrometers</b>	92
4.3.1	Heavy Ion Reaction Analyzer (HIRA)	92
4.3.2	Hybrid Recoil mass Analyzer (HYRA)	94
<b>4.4</b>	<b>Materials Science Facility</b>	97
4.4.1	Irradiation Chamber in BH II	98
4.4.2	Swift Heavy Ions in Materials Engineering and Characterization (SHIMEC)	99
4.4.2.1	Scanning Probe Microscope	100
4.4.2.2	In-situ XRD set up	102
4.4.2.2.1	Facility test of the In-situ X-ray Diffractometer	103
4.4.3	Systems for synthesis of materials.	104
<b>4.5</b>	<b>Radiation Biology Beam Line</b>	105
4.5.1	Status of the Radiation Biology Beam line	105
4.5.2	Status of the Molecular Radiation Biology Laboratory	106
<b>4.6</b>	<b>Atomic Physics Beam Line</b>	106
4.6.1	Status of Atomic Physics Beam Line	106
<b>5.</b>	<b>RESEARCH ACTIVITIES</b>	107
<b>5.1</b>	<b>Nuclear Physics</b>	107
5.1.1	New shell structure at $N \gg Z$ - Lifetime measurement of the first excited $2^+$ state in $^{52}\text{Ti}$	108

5.1.2	High Spin States in $^{52}\text{Cr}$	110
5.1.3	Study of High Spin States in $^{85}\text{Sr}$	112
5.1.4	Collective band structures of the $^{125}\text{Cs}$ nucleus	115
5.1.5	Study of high-spin structure of the nuclei around $A \sim 120$ near proton-drip line	118
5.1.6	Lifetime Measurements in $^{81}\text{Rb}$	121
5.1.7	Observation of anti-magnetic rotation in $^{108}\text{Cd}$	123
5.1.8	Spectroscopic Study of $^{126}\text{I}$ via Incomplete Fusion Reaction	126
5.1.9	Nuclear g-Factor Measurements of the $K^\pi = 5/2^-$ and $9/2^-$ Isomers in $^{169}\text{Ta}$	128
5.1.10	Electric Quadrupole Moment of the $K^\pi = 8^-$ and $23/2^-$ Isomeric States in $^{170,171,172}\text{Hf}$	130
5.1.11	Electric Quadrupole Moment of the $K^\pi = 9/2^-$ and $21/2^-$ isomeric States in $^{175}\text{Ta}$	132
5.1.12	Investigation of scattering and reaction with loosely bound nuclei $^{6,7}\text{Li}$	134
5.1.13	Elastic scattering and fusion measurement of $^7\text{Li} + ^9\text{Be}$ system	137
5.1.14	Neutron multiplicity from $^{16}\text{O} + ^{181}\text{Ta}$ at $E_{\text{lab}} = 105$ MeV	139
5.1.15	Study of incomplete fusion reaction dynamics: Observation of fast alpha particles in forward cone	141
5.1.16	Study of fission hindrance in $^{200}\text{Pb}$	143
5.1.17	Elastic scattering and fusion cross sections for $^7\text{Li}$ , $^7\text{Be} + ^{27}\text{Al}$ systems	146
<b>5.2</b>	<b>Swift Heavy Ions in Materials Science</b>	<b>149</b>
5.2.1	Size Effect on Electronic Sputtering of LiF Thin Films	150



5.2.2	Au ion irradiation study on Mo/Si surface	152
5.2.3	Effect of irradiation on In/Se systems	153
5.2.4	Swift heavy ion induced surface restructuring of the thin film	155
5.2.5	Formation of nanostructures of TiO <sub>2</sub>	156
5.2.6	Irradiation induced effects on the optical and magnetic properties of transition metal doped ZnS nanoparticles	157
5.2.7	Investigation of swift heavy ion effects on metallic nanoparticles embedded in silica	159
5.2.8	Optical properties in the Cu-fused silica system irradiated with swift heavy ions	161
5.2.9	Modification of magnetic anisotropy in metallic glasses using high-energy ion irradiation	162
5.2.10	Ion Beam Analysis of Defects and Strain in Heavy Ion Irradiated InGaAs/GaAs Heterostructures	164
5.2.11	High Resolution XRD Study of Swift Heavy Ion Irradiated InGaAs/GaAs Heterostructures	166
5.2.12	Raman Studies of SHI Irradiated InGaAs/GaAs Heterostructures	168
5.2.13	Effect of Ion Beam Irradiation on the Properties of Cadmium Telluride (CdTe) Thin Films	170
5.2.14	Studies of swift iron ( <sup>56</sup> Fe <sup>7+</sup> ) ion irradiated n-InP surfaces	171
5.2.15	Effect of High energy Oxygen ion Irradiation on CdTe Polycrystalline Thin films prepared by Chemical Spray Pyrolysis.	173
5.2.16	Zinc Sulfide nano particles in a matrix and their ion induced modifications	174
5.2.17	Investigations on the influence of 100 MeV Au <sup>8+</sup> ion and 40 MeV Li <sup>3+</sup> ion irradiation on MOCVD grown Gallium nitride epilayers	176

5.2.18	Study of Li ion irradiation on Si and GaAs solar cells	177
5.2.19	Nano magnetism in swift heavy ion irradiated ferromagnetic metal/silicon interface	179
5.2.20	Silicon Ion Induced Structural and Surface Modifications on InAs, InSb and GaSb Single Crystals	181
5.2.21	Effect of SHI irradiation on dielectric behaviour of $Ti^{4+}$ -substituted $Li_{0.5}Al_{0.1}Fe_{2.4}O_4$ spinel	183
5.2.22	Effect of swift heavy $Au^{8+}$ ions on Indium doped Tin Oxide (ITO) thin film	184
5.2.23	160 MeV $Ni^{12+}$ ion irradiation effects on HCl doped polyaniline conducting polymer	185
5.2.24	Swift Heavy Ion Induced structural and Chemical Changes in BOPP Film	187
5.2.25	Effect of swift heavy ion irradiation on the optical properties of semi organic non-linear optical crystal-K $[CS(NH_2)_2]_4Br$	189
5.2.26	Effect of $Li^{3+}$ irradiation on the structural and transport properties of La-Bi-Mn-O type CMR material	191
5.2.27	Effect of SHI on RF plasma polymerized thin films	193
5.2.28	Structural and mechanical properties of ion irradiated polycarbonate membranes	194
5.2.29	Spintronic materials synthesis using SWIFT heavy ion irradiation	195
5.2.30	Swift heavy ion irradiation induced effects on $MgB_2$ thin films	196
5.2.31	Photoluminescence properties of SHI induced $F_2$ and $F_3^+$ color centers in LiF thin films having nano grains	198
5.2.32	Ferromagnetism induced by swift heavy ion irradiation in fullerene films	200
5.2.33	SHI induced modifications in magnetite thin films	201

5.2.34	Characterization of Conducting Polymers and their Structural, Electrical, Optical Properties by using Swift Heavy Ions	203
5.2.35	Investigations on the effect of Shift Heavy Ion (SHI) on the optical and structural properties of organic nonlinear optical Benzimidazole (BMZ) Crystals	205
<b>5.3</b>	<b>Status of Radiation Biology research</b>	<b>209</b>
5.3.1	Simulated heavy ion effect on growth and protein pattern in Brassica juncea	209
<b>5.4</b>	<b>Atomic Physics Research</b>	<b>215</b>
5.4.1	Studies on ion induced molecular dissociation	215
5.4.2	Effect of foil thickness on excited states in the beam-foil interactions	217
5.4.3	Effect of hyperfine splitting on K X-ray production cross sections	219
<b>6.</b>	<b>ACADEMIC ACTIVITIES</b>	<b>223</b>
<b>6.1</b>	<b>Pelletron Beam Utilization by Users</b>	<b>223</b>
6.1.1	Pelletron Beam Time Utilization and Experiments performed (April 2005-March 2006)	223
6.1.2	List of Users Family	225
<b>6.2</b>	<b>M.Sc. Orientation Programme</b>	<b>230</b>
<b>6.3</b>	<b>Library</b>	<b>231</b>
<b>6.4</b>	<b>The PHD Teaching Programme</b>	<b>232</b>
<b>6.5</b>	<b>Academic Activities Held in 2005-2006</b>	<b>233</b>
<b>6.6</b>	<b>Calendar of Forthcoming Events: 2006</b>	<b>234</b>
<b>6.7</b>	<b>List of Seminars Conducted in the Year 2005-2006</b>	<b>235</b>
<b>6.8</b>	<b>List of Publications (2005-2006)</b>	<b>239</b>

<b>6.9 List of Technical Reports/Technical Memos (2005-06)</b>	252
<b>6.10 Teaching Lab Activities</b>	258
<b>Appendix - I — Committees</b>	260
<b>Appendix - II — IUAC Personnel</b>	267
<b>Appendix - III — List of Users</b>	270