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INSTITUTE OF ADVANCED STUDY IN SCIENCE AND TECHNOLOGY
KHANAPARA, GUWAHATI- 781 022, ASSAM, INDIA

Annual Report

April 1999 - March 2000

Institute of Advanced Study in Science and Technology
Khanapara, Guwahati-781022, Assam, India

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THE YEAR 1999-2000

AN OVERVIEW

This was an important year for the Institute especially in tems of initiation of Construction Works of the IASST Complex at its own site at Pashim Boragaon in Greater Guwahati with the financial assistance from the Department of Science & Technology, Government of India, creation of new facilities and initiation/ strengthening of collaboration with national and international research institutes. A few sophisticated scientific equipment have been procured during the year; the library services and financinal sector have been computerised, and action has been initiated to provide internet facility to all the Divisions of the Institute.

The Institute's effort in logical understanding of the ground realities has led to the initiation of research activities in the areas like Plasma processing of indigenous bell metal industry of Assam, management of industrial wastes, Eri & Muga-culture and biofertilizers.

We offer our sincere thanks to the Government of Assam and the Government of India for providing fund and constant help & co-operation for the growth and development of the Institute. Our sincere thanks are due to all the members of the Council of the Institute for their active co-operation and guidance.

Guwahati
27th October,2000

Prof. K. M. Pathak
Chairman-Cum-Director

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HIGHLIGHTS

The Institute of Advanced Study in Science and Technology (IASST) was set up by the Assam Science Society, the premier scientific academy of the North Eastern Region, in 1979 and got registered as a separate entity in 1991 under Societies Registration Act XXI of 1860. The major objectives of the Institute have been to carry out advanced study and research, both fundamental and applied, in frontier areas of different selected fields of science and technology as well as on interdisciplinary fields and problems concerning utilization and development of natural resources of the North Eastern Region of India.

The IASST has been conducting original research and other academic activities on the following areas :

1. Plasma Physics
2. Mathematical Sciences
3. Life Sciences
4. Resource Management and Environment
5. Computer Science and Technology

PLASMA SCIENCE & TECHNOLOGY :

The Institute has been carrying out research in Plasma Physics both theoretically and experimentally since 1984. A well equipped laboratory for studying nonlinear phenomena in Plasmas has been set up with the joint financial assistance of the Department of Science, Technology and Environment, Govt. of Assam and the Department of Science and Technology, Govt. of India and the generous donation of sophisticated scientific equipment from the Institute of Space and Astronautical Science, Japan through the international collaboration of Prof. Y. Nakamura of the said Institute.

1.1. EXPERIMENTAL RESEARCH PROGRAMMES :

The areas, where experimental investigations are being conducted, are as follows :

(a) Study of chaotic instabilities in ion-beam plasma system.

(b) Study of nonlinear phenomena like soliton and double layer in multi-component plasmas with negative ions.

(c) Study of boundary layer problem in the plasma sheath in magnetized plasma and multi component plasmas.

(d) Observation of low frequency instabilities in different plasma configurations, and

(e) Plasma processing on bell metal.

Brief accounts of the work done / in progress on P. S. T.

1.1.1. OBSERVATION OF ION-ACOUSTIC SHOCKS IN A DUSTY PLASMA :

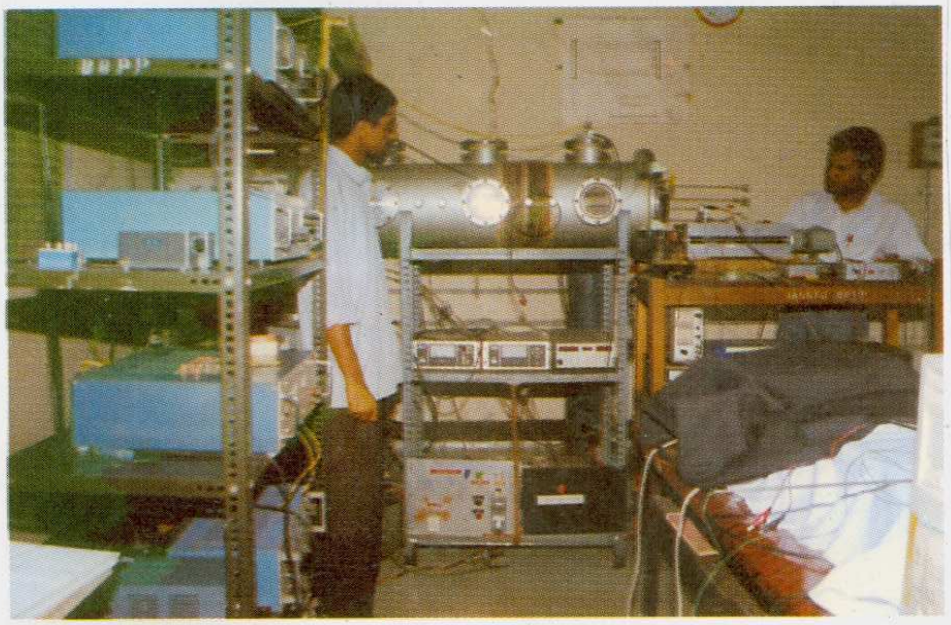
Linear and nonlinear dust ion-acoustic waves are studied experimentally in a homogeneous unmagnetized dusty plasma. In the linear regime, the phase velocity of the wave increases and the wave suffers heavy damping with increasing dust density. An oscillatory ion-acoustic shock wave in usual Ar plasma transforms into a monotonic shock front when it travels through the dusty plasma column. The korteweg-de Vries-Burgers equation is numerically integrated taking experimental parameters into account and the results are compared with the experimental findings.

1.1.2. OBLIQUE COLLISION OF MODIFIED KORTWEG-DE VRIES ION-ACOUSTIC SOLITIONS :

Two-dimensional propagation and oblique collision of modified Korteweg-de Vries (mKdV) ion-acoustic soliton in a plasma with negative ions have been investigated experimentally. At a critical concentration of negative ions, both compressive and rarefactive mKdV solitons exhibit a resonance interaction at a particular amplitude when the colliding angle is fixed. The amplitude is found to be equal for both compressive and rarefactive solitons. The collided solitons suffer a positive phase shift during the interaction. The new solitons formed during the resonant interaction are found to obey the energy and momentum conservation laws of the mKdV solitons for three-wave interaction.

1.1.3. STUDY OF SHEATH AND PLASMA PARAMETERS IN A MAGNETIZED PLASMA SYSTEM :

The variation of electron temperature and



Working in double-plasma-device Fig. 1

plasma density in a magnetized N_2 plasma is studied experimentally in presence of a grid placed at the middle of the system. Plasma leaks through the negatively biased grid from the source region into the diffused region. It is observed that the electron temperature increases with the magnetic field in the diffused region whereas in the source region of the system it decreases for a constant grid biasing voltage. Also investigation is done to see the change of electron temperature with grid biasing voltage for a constant magnetic field. This is accompanied by the study of the variation of sheath structure across the grid for different magnetic field and grid biasing voltage as well. It reveals that with increasing magnetic field and negative grid biasing voltage, the sheath thickness expands.

1.1.4. Observation of Double Layers in Multi Component Plasmas :

The double layer formation in plasma boundary sheath in multi component plasmas with negative ions has been observed experimentally. The sheath structure is observed from the potential profile, the characteristics of which are investigated in argon plasma, the

Instruments used in double-plasma device

double layers are formed showing a negative space charge region in the potential profile when negative ions are added. The characteristics of the double layers depend on the negative to positive ion ratio and biasing voltage of the plate.

1.1.5. Experimental Setup (I)

The experiments is carried out in a double plasma device of 120cm in length and 30cm in diameter equipped with multidipole magnets for surface confinement. It consists of two cylindrical cages made of stainless steel bars filled with permanent magnets. The cages, namely the source & target section respectively, are separated by a stainless steel mesh grid of 80% transparency (20 lines per cm) as shown in the Fig. 1 where the grid is negatively biased with respect to the ground. Argon plasma is produced at a pressure 3.8 to 4 x 10^{-4} Torr by d. c. discharge between the hot tungsten filaments as cathode and magnetic cages as anode, independently in each section. The base pressure is 2 x 10^{-6} Torr. Discharge voltage is kept at 60V in each side and discharge current is varied in the range of 10 - 100 mA in source side and fixed at 10 mA in target side. A movable Langmuir probe of 6mm diameter is used for the measurement of plasma parameters. The typical parameters are plasma density ~10^8 to 10^9 cm^{-3} and electron temperature *Te*~*1.5* to 2 eV. A retarding potential analyser, which is kept 4 cm away from the grid, is used to determine the ion temperature and ion beam energy. The ion temperature is Ti~ 0.1 to 0.2 eV.

At partial pressure in the range from 4.2 x 10^{-4} to 4.8 x 10^{-4} torr, a small amount of SF6

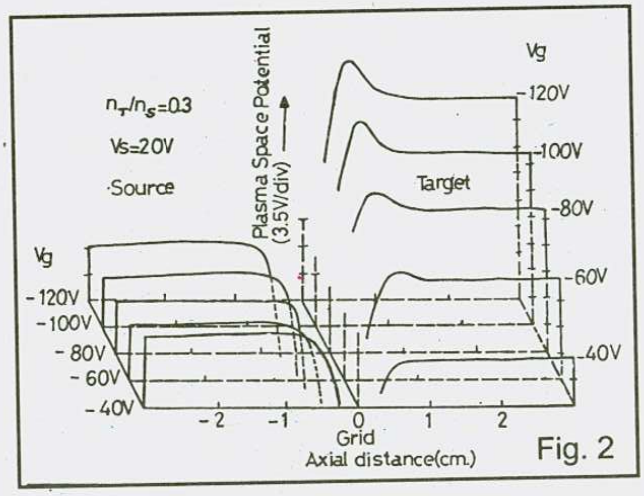


Fig. 2

gas is injected separately in to the argon plasma. The inlroduction of SF6 leads to the formation of several species of positive and negative ions due to dissociative attachment process, which reduces the electron population in the plasma and creates SF_3+, F, SF_5^- and SF_6^- etc. The negative ion concentration rat:o *'r'* defined as the ratio of negative ion to positive ion density is estimated by measuring the reduction in the electron saturation current by using the following relation.

$$r = \frac{n_-}{n_+} = 1 - \frac{I_{es}(r)}{I_{es}(o)}$$

Where les (r) and les (0) are the electron saturation current of the Langmuir probe with and without SF_6 gas respectively. An ion-rich sheath is produced around the mesh grid by biasing it negatively with respect to the ground. The structure of the sheath is determined by measuring the axial plasma potential profile as a continuous function of the distance from the grid. An emissive probe is used to measure the plasma space potential. In the limit of strong emission, floating point technique gives a

Data-analysis system

reasonable approximation to the plasma potential, because strong emission of the electrons from the probe avoids the formation of the sheath on the probe surface and hence a very small negative biasing to the probe with respect to the plasma potential leads to the saturation in ion current. Thus, the ion current abruptly increases approximately at plasma potential and crosses the floating point. Thereby the floating potential point under this condition is the measurement of plasma space potential. A test to confirm this technique was carried out by comparing the result with the inflection point measurement, which may avoid the effect of local modification created by the strong emission of the electrons and its accuracy was within 0.5V.

1.1.6 Experimental Results :

The time average potential profile drawn with the help of emissive probe in the steady state condition is shown in Fig. 2. This profile gives the clear idea about the axial potential variations on both sides of the grid in the chamber. The emissive probe can be taken up to 2mm distance from the grid and it is well within the sheath. In a plasma condition for constant Vs = 20V and for different Vg as reported earlier, the hump formation occurs at a critical density ratio n_p/n_s = 0.3 in two component Ar plasma (see Fig. 2). The space potential of the target plasma as well as the sheath thickness is found to increase with the increase of negative grid bias voltage Vg. At about -60V grid bias, a hump in the target region appears at Sheath edge. This clearly indicates that in this region much more ions are accumulated by the sheath and hence the space charge distribution over this region is much higher than the other region of the sheath on the target side. The hump increases in height with the further increase of -Vg indicating increase of potential in this region. This is similar to what Piel et al. observed in Particle in Cell simulation. They found that injected beam ions have stagnation point where positive charges accumulate. This leads to a potential maximum at that region which is termed as ''virtual anode''. Figure 3(a) shows the steepening of the hump towards the grid at the sheath edge when a small amount of negative ion ('r' = 0.26) is added to the two

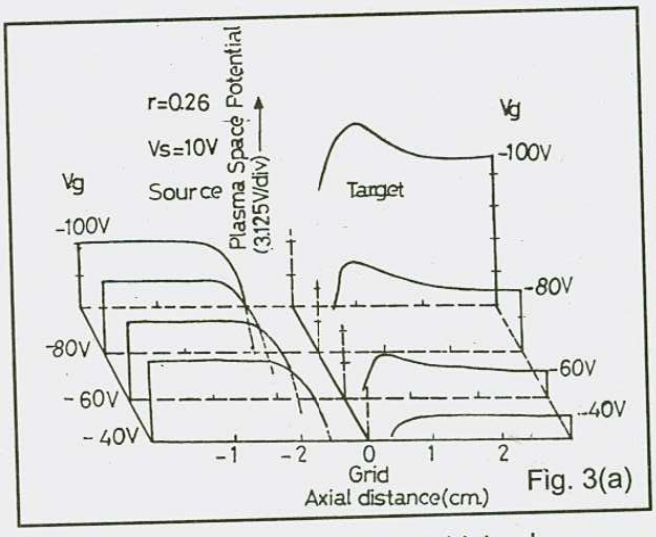


Fig. 3(a)

component plasma at Vs = loV. In the same condition itself, if Vs is increased to 14V, the energy of the ion beam increases and the ion gets more stagnant at the sheath edge, which consequently increases the height of the hump potential. Now if 'r' is increased more ('r' =

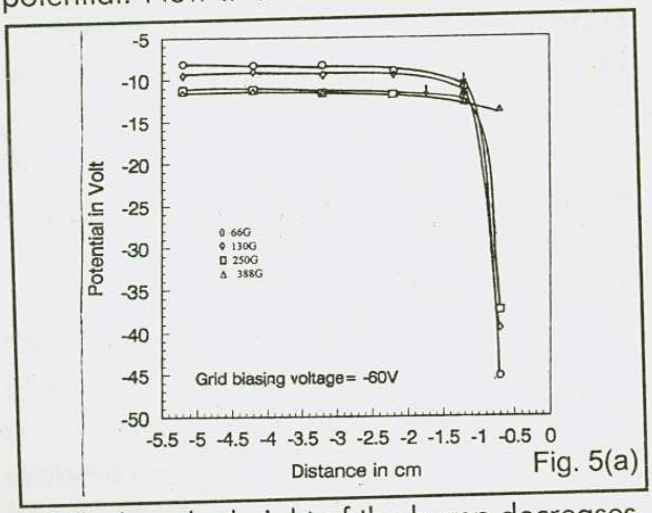


Fig. 5(a)

0.26), then the height of the hump decreases,

The sheath thickness is measured experimentally from the position of the grid to the peak of the hump. The sheath structure follows the modified Child's as Lngmuir law, which includes the negative ion concentration ratio.

This is due to the fact that the momentum transfer from the positive ions to the negative ions by Coulomb collision is greater than the momentum change due to the electrostatic force. In this case, the negative ions move in the same direction as the positive ions towards the negatively biased grid. Thus, the condition for the capture of the negative ions by the positive ions flow which is accelerated in the electric field of the plasma is 'r' < 0.26. Due to this fact, not only the positive ions, but also small amount of negative ions move together from the bulk plasma through the presheath to the sheath edge. These interpenetrating negative ions pull the beam ions coming from the source chamber due to Coulomb force and accumulation of ion charges are evident in the hump of the potential profile. When 'r' increases, then the hump height decreases while the hump width first increases then decreases and ultimately vanishes. This is due to the fact that by increasing 'r' the sheath expands initially and expansion seems to be more in the target side. The sheath thickness also increases because the electron population is now decreased by the process of attachment to the SF_6 gas to form the negative ions and thereby the shielding effect of the electron will be reduced and the sheath thickness increases consequently. Thus, if $r > r_c$ the positive ions and the negative ions move opposite directions driven by the dominant electrostatic forces and the collisions have only retarding effects, these oppositely moving negative ions pull the positive ions from the hump region by decreasing its height and ultimately the hump vanishes. The hump does not form if nT/ns>03. Thus, it can be argued by these observations

that the variation is caused solely in the ion-rich sheath potential by the ion dynamics which is modified correspondingly by increasing the ratio of negative to positive ion concentration.

1.1.7. Experiment al set up (II) :

The experiment is carried out in a hollow stainless steel cylinder of 1 meter in length and 0.2 meter in diameter. The schematic diagram of the experimental set up is shown in Fig. 4. A

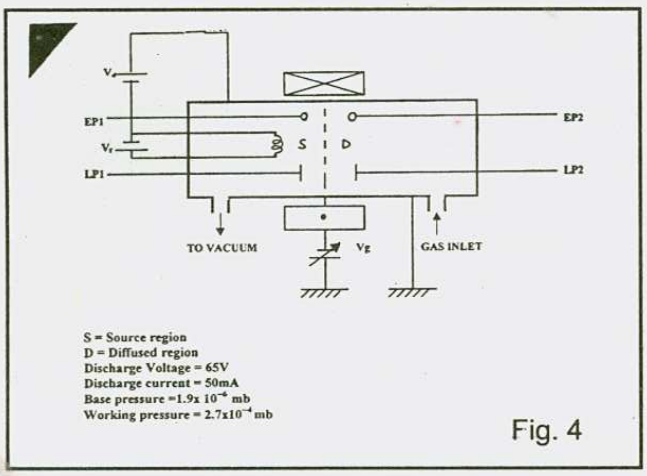


Fig. 4

mesh grid of 95% transparency is placed vertically at a distance of 46 cm apart from the right end of the chamber. It divides the system

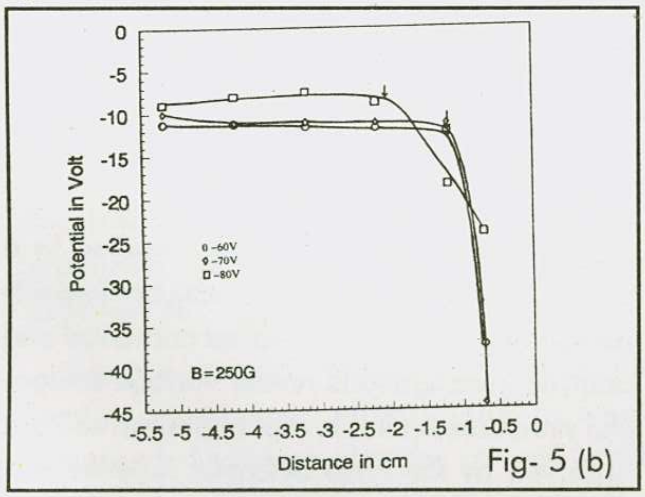
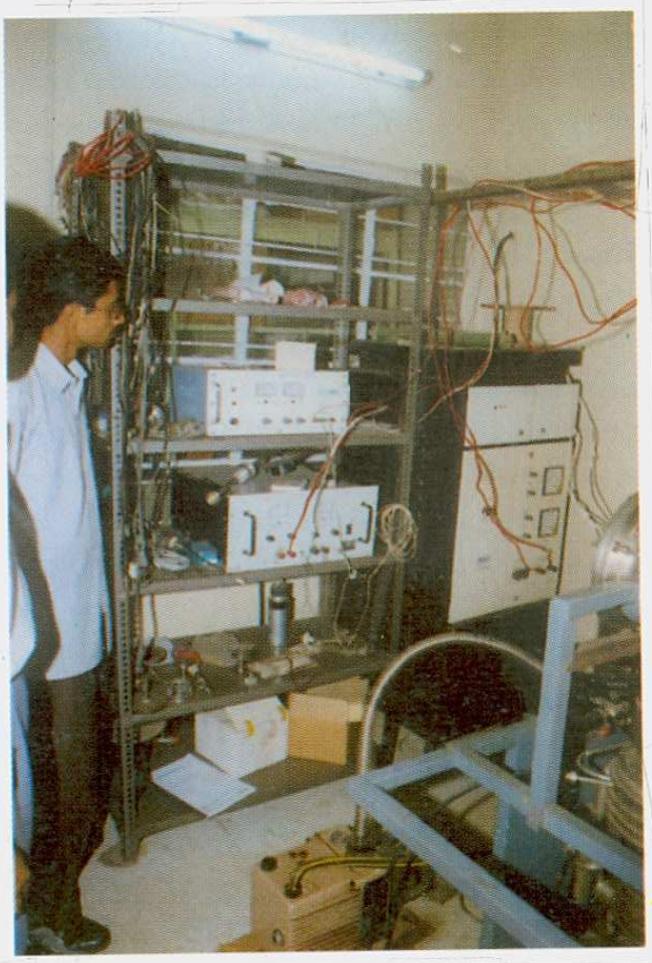


Fig- 5 (b)

into two regions named as source region (S) and the diffused region (D) as shown in Fig. 4. The chamber is evacuated by a rotary pump followed by a Diffstak pump to attain a base pressure of 1.9×10^{-6} mb. Argon gas is injected into the chamber at a working pressure of 2.7×10^{-4} mb. Plasma is produced in the source region of the chamber by hot filament discharge method. The plasma sustaining in the diffused region is controlled by its production in the source region, which penetrates across the grid. In order to produce an external magnetic field, several turns of copper coil are wounded in a region of 33cm at the middle of the chamber. The strength of the applied magnetic field ranges from 66 Gauss to 388 Gauss. An ion rich sheath is formed across the mesh grid by applying negative dc voltage into it. The plasma density at the source region (10^9 / cm^3) is found to be higher than that in the diffused region (10^8 / cm^3).

1.1.8 Results :

Characteristic behaviour of the sheath in a two component plasma across a mesh grid in presence of external magnetic field and also the influence of the grid bias voltage upon it have been investigated experimentally. Moreover, noticeable features of the electron temperature variation with the magnetic field as well as grid bias voltage in both source and diffused region have been observed. As stated, plasma is produced in the source region and it penetrates through the grid in the diffused region. The experimental observation yields that the sheath thickness is enhanced in the source region due to the external application of both magnetic field *(B)* and negative grid biasing



Instruments used in magnetised plasma system

voltage (-Vg). The measurements of the sheath thickness and the electron temperature are carried out under various conditions of magnetic fields viz. 66G, 130G, 250G and 388G and grid biasing voltages -60V, -70V and -80V. Those results are depicted in Fig. 5 (a,b). Fig. 5 (a) shows the characteristic behaviour of the sheath across the grid in the source region at a particular grid biasing voltage -60V and with various B viz. 66G, 130G, 250G and 388G (in the figure, '0' on the X-axis denotes the grid position). It has been observed that though sheath thickness increases with increasing B, it is prominent for the higher magnetic field only (the downward arrow in the profile gives the sheath edge). Potential profile gives the various sheath thickness measured at a particular B=250G with varying grid biasing voltages viz. -60V. -70V and -80V. It yields that at higher Vg, sheath thickness changes noticeably.

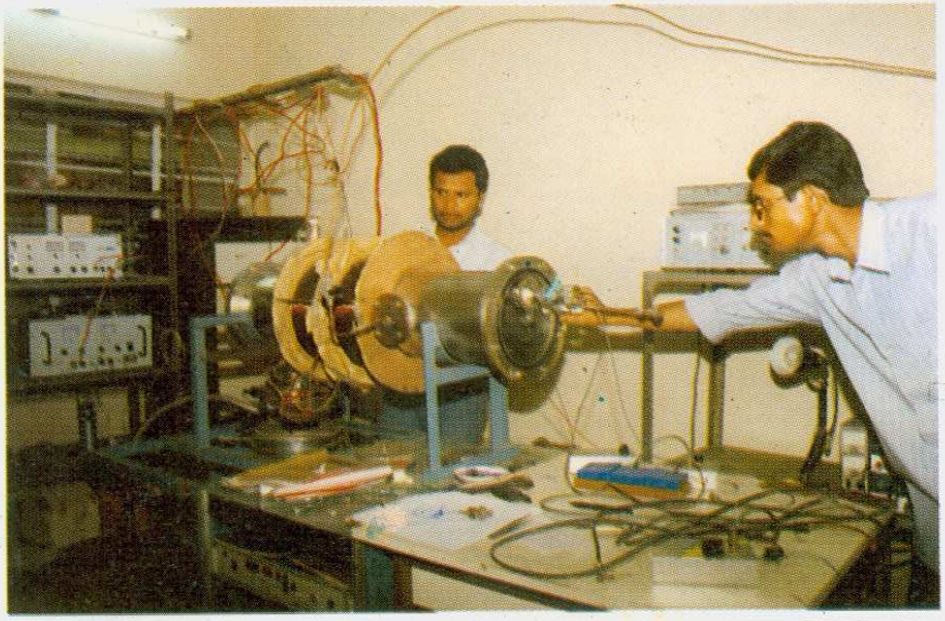
The external magnetic field applied is not homogeneous in the plasma chamber in the axial direction as well as in the radial direction. There are magnetic field gradients (∇B) on both sides of the grid on the axial direction. In addition, due to the presence of radial and axial inhomogeneity of the magnetic field, another magnetic field gradient at some particular direction making some finite angle with the direction of B also arises. The combined effect of all the magnetic field gradients causes a grad B drift of the plasma particles to occur in the source region.

1.2 Theoretical Research Programme :

The primary focus of the theoretical research programme is to study plasma wave dynamics in relation to the laboratory and space plasmas, including nonlinear Sheath and instability.

1.2.1. Nonlinear Phenomena :

Nonlinear waves have been studied in a plasma with strong as well as weak nonlinearity using a new formalism. Detailed numerical and analytic investigations reveal various soliton-like structures similar to dip and hump solitons observed by the Freja Scientific Satellite and other spacecrafts. The observations could be related to high intensity laser irradiate



Working in the magnetised plasma system

discharge plasmas as well as astrophysical plasmas such as in the solar corona, earth auroral zone etc. The observations predict the root cause of the shock - like soliton structure in Plasma dynamics. The theoretical findings on the formation of spikes in solitons, collaped or explosive soliton and double layers have a closed relation to the satellite observations in heliosphere and its surrounding atmospheres, the overall feed back from nonlinearities generates the causes of various soliton formation and meet the eyes to think whether the soliton structure could be resulted in explaining the solar radio burst, emission or radiation etc.

Special attention has been given on the studies of plasma phenomena in weak Townsend discharge plasmas as well which might have a direct impact to the laboratory plasma problems to explain various plasma acoustic waves reported so far by in situ experiments.

Based on the fluid attroximation, the formation as well as the characteristic of sheath in a plasma contaminated with the dust charged grains has been studied. It is reported that the presence of dust charged grains might lead to play a very different behaviour of the sheath as compared to that of electron in plasma. Moreover, in the presence of an applied magnetic field, the sheath exhibits novel features. The characteristic behaviour of the sheath formation in thermal plasmas has been investigated. In the higher potential region, an improved child's law has been derived and corresponding potential variation in the sheath region shows better results in case of improved child's law in comparision to child's law.

The stability of the nonlinear wave has also been analysed through the augmentation of a duffing equation which shows distinctly the plasma variation causing nonlinear effect and the proposed method finds

1.2.2. Interinstitutional Collaborative Reserach Programme :

(i) Collaborative research activities on the studies of nonlinear waves in Plasmas

through the augmentation of multidimensional Sagdeev Potential wave equation has been carried with Prof. R. K. Roychoudhury of Physics & Applied Mathematics unit (PAMU); of Indian Statistical Institute, Calcutta.

(ii) Research programmes are being continued with Prof. C. Uberoi, Mathematics Department at I.I.Sc. Bangalore, in the fields of Alfven Waves, nonlinear solitary waves as well as low frequency waves in partially ionised plasmas in helio sphere, magneto sphere and ionosphere, under ISTEP (Govt. of India)Project.

(iii) Prof. Y. T. Gao from the Department of Applied Physics, Beijing University of Aeronautics, Beijings has been doing a collaborative research with the theory group of the Plasma Physics Division on nonlinear ionacoustic waves in relation to the nonlinear shock wave, solar radio burst, emission radiation process in astrophysical Plasmas.

(iv) Collaborative research work has been initiated with Dr. (MS) N. Devi of Deptt. of Mathematics, Cotton College, Guwahati in the area of Plasma waves through the augmentation of alfven waves and solitary Kinetic Alfven waves.

1.3 Nonlinear Sheath and Instability :

In continuation with earlier projection a serious attention has been paid to interdisciplinary approach of current scientific research trend. A critical debate has been established through national & international seminar discussions and publications about the novel discoveries of (i) plasma acoustic mode in 1989 (Dwivedi et al.) and (ii) neutral induced low frequency turbulence in the context of ionospheric plasma modes of weakly / partially ionised plasma in 1992 (Dwivedi & Das). New scientific basis has been suggested for classification & nomenclature of the impure plasmas and the associated sound modes. A more comprehensive but simplified physical model has been proposed to understand the driving mechanism of a bipolar ion-rich space charge induced low frequency instability. Efforts has been *made* to unify the suggested models for sheath driven low frequency instabilities. Moreover, a three scale analysis has been applied to characterise the static & dynamic properties of the plasma sheath structure under external gravity in colloidal plasmas. ●

2. MATHEMATICAL SCIENCES

The mathematical Sciences division was started in 1993 with the objectives as given below :

(i) To carry out and sustain high quality research in some selected areas of Mathematics and Statistics.

(ii) To develop the Division into a standard level with adequate infrastructural facilities conducive for research in Mathematical Sciences and to attract the talented scientists from the different parts of the country.

(iii) To develop the Division into a centre of excellence in Mathematical sciences to meet the aspirations of the young talents of the NE region.

At present, research activities have been carried out in the Division on the areas of function space & Harmonic Analysis; Sequences, Series & Summerbility Theory Queueing Theory and Science & Technology Management Information system.

2.1. FUNCTION SPACE AND HARMONIC ANALYSIS :

Cesaro operator of order α, defined by

$$c^{\alpha} f(z) = \frac{1+\alpha}{z^{\alpha}} \int_0^z f(\varpi) \frac{(z+\varpi)^{\alpha}}{(1-\varpi)^{\alpha+1}} d\varpi$$

has been studied and it is found to be simply a convolution $(F\ 1,1;\ 1+\alpha;\ z)^* \frac{f(z)}{(1-z)^{\alpha+1}}$

of hepergrometric function with an analytic function in the unit disc. The investigation suggests the study of natural generalization of Cesaro Operator via hypergeometric functions. Some preliminary results have also been found. For example, the Operator C^{α} does not preserve the starlikeness property and it preserves convexity for certain range of α. Attempt has been made to find out the exact range of the paramer α.

Finite (four element) Universal Korovkin Set in the convolution algebra of central measures $Z(M(G))$, where G is a compact simple Lie groups. The technique involves continuous irreducible unitay representation of these groups. Efforts have been made to construct finite Universal Korovkin set in banach algebra of radial functions on Heinsenburg group.

2.2. SEQUENCES, SERIES AND SUMMERBILITY THEORY :

Different properties of the space of statistically convergent series have been studied with the result of providing suitable examples, where there is diviation from the properties of convergent series. A result involving the equivalence of statistically monotonic sequences known as the decomposition theorem has been obtained. A sequence space E is said to be symmetric if $(X_n)\ \varepsilon E$ implies $(X_{\pi(n)})\ \varepsilon\ E$, $\pi(n)$ is the permulation over N, the set of natural numbers. It has been shown that the space of statistically convergent sequences is not symmetric on providing suitable examples and a result involving the conditions for the symmetry of the space of statistically convergent sequences has been obtained. The space of statistically convergent and statistically null sequences has been generalized in the light of paranormed sequence spaces. The

decomposition theorem for generalized bounded statistically convergent sequences m(p) is proved, which not only generalizes the earlier results of J. A. Fridey, J. S. Connon and T. Salat but also proves the equivalence of their results. It is proved that m (p) is a closed subspace of 1_α (P). Necessary and or sufficient condition on the sequence (P_k) are obtained for the inclusion as well as equality of two generalized statistically null sequence spaces. It is also established that the space of bounded statistically convergent sequences is not separable. Statistically analogue of some results of Prof. G. H. Hardy on bounded variation sequences are obtained. Some properties of the sequence space m (ϕ,p), $p>1$ have been introduced and this generalizes the BK space m (ϕ) introduced by W.L.C. sargent.

2.3. Queueing Theory :

The operating characteristic of the batch arrival Poisson input queue with a random set up time has been studied and some analytically explicit results for joint distribution of the queue size and set up period have been derived. An unified treatment has been made to study the queue size distribution for a class of N-policy queueing models of type $M^x/G/1$ with generalised vacation. The generalised vacation includes both the single as well as multiple vacations (where the server keeps on taking sequence of vacations before starting each busy period). Various techniques such as supplementary variable, renewal theoretic approach etc have been used to study and develop various aspects of the vacation models.

2.4. Application Potential :

The models, studied in queueing theory may be applicable in digital communication, data transmission system and scheduling problems. These models can also be applicable in quality control problems, production and inventory system. The sequence spaces, introduced, may have relation with Topology and Functional Analysis in studying their proportion. The sequence spaces introduced may be used in characterizing new matrix classes which, in turn, may generalise and unify existing results.

2.5. Programme for Science & Technology Management Information System :

The Institute has already completed successfully two projects on Science and Technology Management Information System funded by the DST, Govt. of India. Presently, activities under the project entitled 'Performance of S & T students of the Universities in the NE Region in selected national eligibility tests', Sanctioned by the DST, Govt. of India, are being carried out in the Institute since May, 1999.

2.5.1. Objective and Coverage :

The broad objective of the Project is to study the underlying causes for the unsatisfactory performance and suggest corrective measures. To keep the workload within manageable limit and considering the importance, three major Eligibility Tests only have been taken up for study. These tests are (i) The National Eligibility Test (NET) conducted by the UGC/CSIR, (ii) The General Aptitude test for Engineers (GATE) conducted by Selected IITs and (iii) The Agricultural Research Services (ARS-NET) conducted by the ARSSB. These tests which regulate recruitment of the teachers and the Research personnel for the Universities / Colleges of the country and / or regulate entry to P. G. Courses in Engineering and technical Institutions of the country, are

considered as specially important to the NE Region.

The study intends to cover students of all the Universities in the NE Region who appeared in these eligibility tests in past three years. Each of these tests is to be studied separately. The target is to achieve at least 30 PC response in respect of each batch of the students appearing in the tests. The broad parameters to be studied are (i) Bio-data of the students including Social and family background (ii) Academic background of the students from High School upwards which also includes information on educational environment. (iii) 'Awareness and Motivation' of the students about various tests either for merit recognition or for entrance to different courses of studies and their participation in such tests, the sources of information and inspiration etc. and (iv) various details on performances in the eligibility tests under study which include inter-alia the mode of preparation, causes for failure or success, infrastructural facilities for coaching, material and moral support from institutions / teachers / parents etc.

The data required for the Project are being collected through three prescribed questionnarie viz. Questionnaire - I : meant for the students appearing the tests, Questionnaire - 2 : meant for selected teachers of the Universities about their role in grooming the students for these tests and their general opinion and Questionnaire - 3 : meant for the part of the study on 'Career choice' through which required data are to be collected from at least 30 pc of the final year PG students grouped into three classes based on the results of the Degree Courses.

The draft questionnaire prepared for collection of field data, duly field tested, were considered and approved by the Local PAC meeting. After printing the Questionnaire, actual field survey of the parent study was launched in December 1999 and the 'Career-Choice' study was launched in phases in different Universities from January 2000. Under 'Career-Choice' study, the survey was launched during the year in all Universities except manipur, Agartala, Tezpur and Arunachal Pradesh Universitity. ●

3. Life Sciences :

Research activities on certain priority areas in the fields of Biofertilizer, Sericulture and Biochemistry are being carried out in the Life Sciences Division.

3.1. Biofertizer :

The Biofertilizer Unit of the Life Sciences Division is actively engaged in isolating efficient native Rhizobium strains to produce Rhizobium biofertilizer to improve pulse production in Assam. After characterization and efficiency test of the nine strains only six were found to have resistance to different antibiotics tested, wide host range ability to infect and nodulate six common pulses of Assam and acid tolerance upto soil pH 4.5 Further, the strains have enhanced production of the test pulses upto 24 percent and also enhanced production of rice upto 14 percent, grown after harvest of pulse cultivation both during Kharif and Rabi seasons. Organic blending during application of the Rhizobium strains enhanced production of both pulse and rice in the field. So, to evaluate the above six strains under farmer's field condition pilot trial project on "Evaluation of native Rhizobium strains for improvement of pulse production in Assam", has been prepared and submitted to the Third World Academy of Sciences (TWAS) of Italy for financial assistance.

Leonardjar experiment in the Biofertilizer Laboratory, IASST.

Further, considering the importance of Vesicular Arbuscular Mycorrhizal (VAM) Fungi for better infection, nodulation and mineral uptaking particularly for phosphate solubilization, seventeen species of VAM fungi species have been isolated and seven of them have been identified. Inoculants of these seven

species have been produced in maize plants and blended them with Rhizobium for dual inoculation experiments for their evaluation. The dual inoculation experiments on test pulses produces better results in respet of infection, nodulation, dry weight of root, shoot and nodule. It also increases uptake of higher amount of nitrogen, phosphorus, Calcium, magnesium, Sodium, Potassium, Manganeses, iron etc. in comparison to the single inoculation. So, a project proposal on "Studies on native Rhizobium and VAM fungi for improvement of pulse production in the North Eastern Region", with specific aspects of dual inoculation and search for axenic culture for VAM, was prepared and submitted to the DBT, Govt. of India for financial support.

This Unit has also been conducting research on Biocontrol aspects of three major crop diseases of Assam viz. late blight of potato, caused by *Phytophthora infestans;* Blast of rice, caused by pyricularia oryzeae and Red-rod of sugarcane caused by *Colletorichum falcatum*. Already a few native strains of *Trichoderma harzanium, Trichoderma viridi and Bacillus subtilis* have been isolated, identified and evaluated as bio-control agents against the above three diseases of Assam both in vitro and in vivo. Epidemiology of the above diseases have already been studied and now a specific project proposal on "Control of major crop diseases of Assam with native bio-control agents" is prepared to submit it to the CSIR, Govt. of India. Successful completion of the above projects will enable us to produce native Rhizobia and bio control agent strains for local farmers of the region in near future.

3.2. Sericulture :

3.2.1. Muga Culture :

After completion of the project on "Development of Muga culture with special reference to Indoor rearing technique" sponsored by the DST Govt. of India, the IASST had decided to continue the programme for rearing Muga silkworm indoors with a the co-operation and financial help from the state government of Assam with a view to producing

Production of pulses (Blackgram and Greengrant) at Gerua Field Trial Station, Hajo, Kamrup.

seed cocoons and ease the present situation regarding scarcity of seed cocoons. A project proposal has already been subimtted to the State Govt. of Assam requesting financial and other help to implement the programme.

In the meantime- batches of Muga silkworm, though in a very small scale, are being reared successfully through the application of indoor rearing technique in the Institute using seed cocoon originally procured from a village rearer. It has already completed its third generation and arrangement is being made to continue its fourth generation. It may be mentioned that the Zoology Department of Gauhati University has completed successfully the second generation using the seed produced at the IASST through indoor rearing.

3.2.2. Ericulture :

The Eri silkworm Philosamia has been reported from the prehistoric era and was scattered in the dense forest of the North Eastern Region in wild condition and gradually it became a cottage industry of the tribal folk of this region. It produces wool like fabric finished with a look of cotton and the softness of silk. The quality of silk is not upto the mark in comparison to other varieties of silk. So far, seven ecoraces of *Philosamia* have been identified in this region. However, lack of information on the genetic differences amongst the races has become hindrance in the process of breeding of this silkworm for quality improvement. Use of genetic markers in silkworm breeding process has been well documented specially in mulberry silkworm.

It is aimed to use the same technique for genetic analysis of Eri stock already available in the NE region. Easterase isozyme comparison of different ecoraces of *P. Ricini* was undertaken using the technique of polyacrylamide electrophoresis. The gut and haemolymph of larvae (5th instar) fed on castor leaves were analysed for this experiment. Three estarases (E1, E2 and E3 in order of increasing mobility) were detected in all the 7 ecoraces. Our result indicated that pattern of esterase isozyme of different organs showed different intensities.

Meanwhile other two enzymes namely Alkaline phosphatases and Amylases have been taken for characterisation of these germ plasm stocks Experiment for the same is on progress.

3.3. Biochemistry :

3.3.1. Herbal Medicine :

The North-Eastern Region is full of medicinal and economic plants. Most of these plants are used by the local indigenous people of Assam as well as other ethnic people of this region as remedy for various ailments in one or the other form to get relief of the diseases. Many such remedies practised by these people have got miraculous effects in curing some diseases. Unfortunately, this age-old knowledge is vanishing very fast from our society forever for lack of proper support and protection. Many such valuable remedies practiced by different people rolled mouth to mouth from one generation of the other and in many cases, we loose from the benefit of these remedies with the death of the practitioner. This valuable knowledge needs scientific and systematic study for validation and standardization so that people can derive the benefits of these

remedies.

Keeping in mind this aspect, we had started working on the development of herbal medicine, which are most commonly used by the people of this region.

We had undertaken a survey in some rural and tribal areas of Kamrup district to identify such practices prevalent amongst the people of these areas. We have documented some practitioners of the surveyed area for future reference and record. We had interacted with the village practitioners and patients who were the real beneficiaries. A few plants had been selected in different seasons of the year from these areas with the help of these local people. We have focused our attention on the plants of these areas, namely *Leucas lavendulaefolia, Vitex negundu, Costus specious, Sida cordifolia, Clerodemdron colebrokianum and malastoma malabathricum* which have been claimed to be effective in the treatment of liver disorder and hypertension etc.

Presently, we are concentrating on the folk remedies used for the liver ailments, like Jaundice, liver-cirrhosis etc.

The major plant of the project, *Leucas lavendulaefolia* has shown hepatoprotective activities if the damage of the liver is not severe. We had tried with experimental animal models, like paracetamol, Carbon tetra-chloride and D-galactosamine. Wister-albino rats were used for this entire investigation. It has been found from the experiment that the paracetamol and galactosamine treated model showed positive results but the carbon tetra-chloride treated animals did not recover from the damage. Other plants taken up for study during this period are Costus specious and Sida cortifolia. These plants are also showing promising results, which are to be confirmed further histopathology.

Ethnophannacological reports indicate that Clerodendron colebrookianum (C. C.) is widely used as a home remedy against hypertension and in other medical problems in North Eastern region of India. The present study attempts to investigate the hypolidaemic potentiality of the fresh juice and extract (s) in ethylacetate (EE) and methanol (ME) of the aerial part of the C. C. in male Sprague Dawely rats for a period of 28 days. Significant lowering of lipid profile has been observed both in nomolipidaemic rats after oral administration of the juice and extract (s). Enhanced level of high density lipoprotein (In)L) and depleted value of low density lipoprotein (LDL) has been noted in the rat group received ethylacetate and methanol extract (s). The PJ have been found to be in lowering the lipid profile in the rat group received 11% fat with diet Thus, the present findings advocate for the consideration with as given below. ●

4. Resource Management and Environment :

The Resource Management & Environment Division was started in 1991, the objectives of which are as follows :

(i) To study the plant and animal resources of the NE region of the country and to manage the resources for future use.

(ii) To study the sustainable developmental strategies of these resources in the context of the NE region.

(iii) To study the environmental pollution caused due to industrilization in the NE region and to evolve remedial measures to mitigate the environmental pollution through appropriate technologies etc.

The Resource Management and Environment division, IASST has been carrying out research on the management of industrial wastes for beneficial use of agriculture as well as control of environmental pollution.

4.1 Studies on Biodegradation of refinery Sludge :

Various types of sludges have been generated by the refinery. These are (i) old untreated sludge (ii) ETP sludge (iii) API separator sludge and (iv) Treated Tank Bottom Studge.

Sludges are black, semi solid and sticky heterogeneous mixture of oil, water and inorganic substances. These sludges have been creating disposal problem due to space limitation and stringent environmental norms. This instrinsic problem has stood as a challenge to us and as such our serious attention has been drawn for solution of the problem. Keeping this point in view sludges are first characterized with respect to a number of physico-chemical

Experiment on degradation of refinery sludge by hydrocarbon degradating bacteria strains

Efficient hydrocarbon degrading bacteria strands

parameters. It contains 25 to 59% oil content depending upon the sludges. Heavy metals viz. Lead. Manganese, Copper, Nickel are found to be present in all the sludge samples collected from the Guwahati Refinery.

In the next phase, attempt has been made to examine the efficiency of the natural biodegradation, ETP sludge, API separator sludge and Treated tank bottom sludge (as these three types of sludges are the main sources of sludge) are mixed separately with soil in different concentration (minimum 10% and maximum 100%). Natural biodegradation was observed for all the three categories of sludges. However, maximum degradation was observed in case of API sludge.

The biodegradation study of these sludges were also made by including three types of bacterial strains (Pseudomonas aeroginosa, pseudomonas stutzeri and Serratia marcescence) isolated from upper Assam oil fields. Though all the strains were found to be degraders of refinery sludges, the strain P. aeroginosa was observed as the most efficient degrader.

4.2 Agropotentialy Study of Jagiroad Paper Mill Wastes :

Both solid and liquid wastes have been generated by the paper mill. These wastes have always been creating a problem of environmental pollution. So, a study has been conducted to investigate the wastes for use of agriculture. Both the wastes have been analysed in respect to their physico-chemical properties along with certain toxic heavy metals content before applying into the field. In the first phase of the investigation, wastes were mixed with agricultural field soils in different concentration in pots and rice seedlings were raised in the pots. Growth parameters of the plants were recorded. After harvesting the crops, the physico-chemical characteristics of the soil of the pots were analysed. The experiment on germination of certain cereal and legume seeds are also on progress. The overall growth and development of the rice plant grown on soil mixed with liquid waste of Jagiroad paper mill are found to be significant at 50% level of concentration of waste. ●

5. Manpower Development Programme :

5.1. Computer Science & Technology :

During the year 1999-2000, the Computer Science Division has generated another batch of trained personnel in Computer Science & Technology through various courses. The Division has also been extending inhouse facilities to the researchers of the Institute by way of providing computer time and consultancy services whenever needed.

The number of students trained up during the year, 1999-2000 through different courses are as follows :

Name of Courses	No. of students trained up
1. Post graduate Diploma in Computer Application (Recognised by the State Council for Technical Education, Assam)	30
2. Advanced Diploma (DOEACC 'A' Level) (Accredited by the DOEACC Society, Deptt. Of Electronics, GOI)	30

6. On Going Projects :

6.1. 'Development of Plasma Physics Division, IASST' - Sponsored by the Department of Science & Technology, Govt. of India.

Research Group :

1. Dr. (Ms) Joyanti Chutia, *Principal Investigator*
2. Dr. G. C. Das, *Co-investigator*
3. Dr. H. Bailung, *Co-investigator*
4. Dr. A. Sarma, *Research Associate*
5. Dr. A. B. Hazarika, *Research Associate*
6. Sri Ram Prakash Lavania, *JRF*
7. Sri Utpal Deka, *JRF*
8. Sri Barnali Singha, *JRF*

6.2 'Development of Mathematical and Statistical Sciences Division, IASST' - sponsored by the Department of Science & Technology, Govt. of India.

Resarch Group :

1. Dr. B. C. Tripathy, *Associate Professor*
2. Dr. (Ms) M. R. Agrawal, *Assistant Professor*
3. Dr. G. Choudhury, *Assistant Professor*
4. Ms. Barnali Dutta, *JRF*
5. Ms. Sangeeta Kalita, *JRF*
6. Ms. Mousumi Sen, *JRF*

6.3. 'Developing isozyme marker for different stocks of Eri Silkworm' - sponsored by the Department of Biotechnology, Govt. of India.

Research Group :

1. Dr. (Ms) Dipali Devi, *Principal Investigator*
2. Dr. D. K. Sharma, *Co-investigator*
3. Ms. Swapna Sikha Choudhury, *JRF*
4. Mr. Jayanta Deka, *Field Assistant*

6.5. 'Low Frequency waves in magnetized partially ionised plasmas' (Application to Heliopause & Interplanetary space plasmas)

Research Group :

1. Prof. G. C. Das, *Principal Investigator*
2. Prof. C. Uberoi, *Co-Investigaor*
3. Sri Manoj Kr. Sarma, *Research Assistant*
4. Ms. Ajanta Dutta, *Research Assistant*

6.4. 'Preformance of S & T students of the Universiti's in the NE Region in selected national eligibility tests' - Sponsored by the Department of Science & Technology, Govt. of India.

Research Group :

1. Prof. J. Medhi, *Principal Investigator*
2. Sri D. N. Das, *Co-investigator*
3. Sri Bhaswat Kr. Das
4. Sri Rupam Kr. Bordoloi ●

7. PUBLICATIONS :

7.1 RESEARCH PAPERS (PUBLICATION IN SCIENTIFIC JOURNALS)

7.1.1. PLASMA PHYSICS :

Dwivedi C. B., Ram Prakash & Bannur V. M., 'Theoretical model for ion-rich sheath driven low frequency instability', phys. Scr. 60, 166 (1999)

Das G. C. & J. Sarma, 'Comments on : 'A new mathematical approach for equation finding the solitary waves in dusty Plasmas; 6,4392 (1999) Phys of Plasmas.

Das G. C., Talukdar M., Uberoi C. & Srefshylan N., 'Characteristic behaviour of kadomstev-Petviashvili Solitary waves and their stability in Plasma,' Indian J. Pure & Applied Physics 37,798 (1999)

Das G. C., Singha Barnali and Chutia Joyanti, 'Characteristic behaviour of the sheath formation in thermal plasmas' Physics of Plasmas 6,3685 (1999).

Roychoudhury Rajkumar, Das G. C. & Sarma J., 'Quasipotential analysis for derving the multidimensional Sagdeev potential equation in multicomponent Plasma," Physics of Plasmas 6,2721 (1999).

Tagare S. G. and Chutia Joyanti, 'Dust acoustic solitons in two ion temperature Plasma' J. Plasma Physics 61,723 (1999).

Baishya S. K., Das G. C., Chutia Joyanti & Sarma J., 'Electrostatic Sheath at the boumdary of a magnetized dusty Plasma.'' Physics of Plasmas 6,3678 (1999).

Nakamura Y., Bailung H. & Shukla P. K., 'Observation of ion acoustic shocks in a dusty Plasma', Physical Review Letters 83 (5), 1602 (1999).

Nakamura Y., H. Bailung and Lonngren K. E., 'Oblique Collision of modified Korteweg-de Vries ion acoustic solitons'. Physics of Plasmas 6,3466 (1999).

7.1.2. MATHEMATICAL SCIENCES :

Tripathy B. C., 'A note on statistical convergence, far East Jour. Math. Sci., 2 (I) 87 (2000)

Tripathy B. C., 'On statistically Convergent Series' Punjab Univ. Jour. Math. xxxii, 1 (1999)

Choudhury G., A. Borthakur and Kalita S., 'Some aspects of N-policy queueing system of type M^x / G / 1 with generalised vacation, 'Far East. Jour. theoretical statistics, 3(1),11(1999).

Choudhury G., 'Analysis of batch arrival Poission queue with a single vacation and N-Policy - a probabilistic study', Far. East. Jour. Theoretical statistics, 3 (2), 349 (1999)

Choudhury G., 'A note on operating characteristic of M^x/M/I queue with a random set up time. Jour. Assam Sci. Soc., 39 (4), 213 (1999)

7.1.3. LIFE SCIENCES :

Saikia R. and Azad P., 'In vivo effect of some Trichoderma species and Dithame M-45 against lata blight of potato,' Jour, Neo, Botanica. 17 (1999).

Saikia R., Deka A. K., Kalita R. & Azad P.,

'In vitro effect of some bio-control effects on the growth of colleto-trichum falcatum Went, causing red-rot of sugarcane, New Agriculturist, 10 (1999).

7.2. Research Papers (Presented in Conferences / Seminars)

7.2.1. Plasma Physics :

Hazarika A. B., Das G. C. & Chutia J., "Bohm chodura criterion for magnetised collisional sheath" 14th National Symposium on Plasma S & T (1999), GND University, Amritsar.

Sarma A., Ram Prakash, Dwivedi C. B., Singha B. and Deka U., 'Comprehensive Physical model for positive space charge region' 14th National Symposium on Plasma S & T, (1999), G.N.D. University, Amritsar.

Sarma A., Singha B., Chutia Joyanti, 'Study of sheath & Plasma parameters in : magnetised Plasma, 14th national symposium on Plasma S & T (1999), G.N.D. University, Amritsar.

Sen A. K., Dwivedi C. B., Bujarbarua S. & Borah A. C., 'Neutral drag effects on pulsational mode of gravitational collapse' National symposium on Plasma S & T (1999) G.N.D. University, Amritsar.

Mishra A. K., Dwivedi C. B. & Bujarbarua S., 'Controversial ideas about basic physics of plasma phenomena & scientific ideas for nomenclature scheme, 2nd, International conference, on "Physics of dusty plasmas," 24-28 May, 1999, Hakone, Japan.

Mishra A. K., Dwivedi C. B. & Bujarbarua S., 'Coulomb charge variation, due to plasma turbulence & its effect on the parametrlc excitation of the so-called acoustlC mode', 2nd international conference on "Phys. of Dusty plasmas" 24-28 May, 1999, Hakone, Japan.

Dwivedi C. B., Rajkhowa K. R. & Bujarbarua S., 'Three scale analysis of a steady state plasma sheath model under external gravity' 2nd International conference on the 'Phys of Dusty Plasmas' 24-28 May, 1999, Hakone, Japan.

Dwivedi C. B., Sarma A. & Ramprakash "Development of audio-visual diagnostics for acoustic wave experiments in colloidal plasmas", 14th National symposium on Plasma S & T (1999), G.N.D. university, Amritsar.

Dwivedi C. B., 'Non-neutral gravitational instability in a collisionless magneto-plasma", 14th National symposium on Plasma S & T (1999), G.N.D. University Amritsar.

Das G. C. & Sarma Manoj Kumar, 'Dynamics of dust charge grains in a Sheath formed in astrophysical plasmas,' 14th National Symposium on Plasma S & T (1999), G.N.D. University, Amritsar.

Das G. C. & Sarma J., 'Some aspects of shock like nonlinear ion acoustic waves in magnetized dusty Plasma, 14th National Symposium on Plasma S & T, (1999) G.N.D. University, Amritsar.

Chutia J. & Bailung H., Double layer formation in Plasma Boundary Sheath by reflection of negative ions', 14th National Symposium on Plasma S & T (1999) G.N.D UNiversity, Amritsar.

Ram Prakash, Dwivedi C. B., Sarma A. & Deka U., Nonlinear normal behaviour of a modified ion acoustic wave', 14th National Sympsium on Plasma S & T, (1999) G.N.D. University, Amritsar.

Baishya S. K., Chutia J. & Das G. C., Electrostatics Sheath at the boundary of a collisional sheath' 14th National Symposium on Plasma S & T (1999), G.N.D. University, Amritsar.

Nakamura Y. and Bailung H., 'Shock wave in dusty Plasma,' 2nd International conference on the Physics of dusty plasma (1999) Hakone, Japan.

7.2.2. Mathematical Sciences :

Tripathy B. C.,' On sequence spaces and full classes of subsets of natural number's Annual Conf. BHU, (1999)

Choudhury G., Some results of Poission input queues with first exceptional vacation Indian Society for Pobability and Statistics conference, Andhra University (1999).

Choudhury G., Operating characteristic of an M/M/I queue system under N-Policy with exceptional set up time', International conference on Stochastic process and its applications, (1999) Cochin University.

Choudhury G., 'Analysis of the M/G/I queueing system, with a random set up time under single vacation policy', 15th Annual Conference of BHU, (1999)

Agrawal M. R., 'Finite universal Korovkin sets in the center of group algebra', proeceedings of the 5th Ramanujam symposium on Harmonic Analysis (1999).

7.2.3. Life Sciences ;

Kotoky J., 'Investigation of trace elements in plant' : its relation of certain diseases, Annual Session of the Indian Science Congress Association, Pune University (1999)

Saikia R., Deka A. K., Kalita R. & Azad P., In vitro response of colletotrichum falcatum went to different carbon and nitrogen sources, National Seminar on RMSRAE of NE region, 2000.

7.2.4. Resource Management and Environment :

Sharma P. K., Deka S. and Bhattacharjee K. G., Studies on biodegradation of refinery sludge and its impact on plant growth, national conference on Industry and Environment, Karad, Maharastra (1999).

Sharma P. K., Physico-chemical characterization of Studge, 'Seminar on role of quality control laboratory in profile maximization under deregularisd scenario, organised by IOC Ltd. Mathura refinery (1999).

Deka S. & Azad P., Impact of petroleum production operation on eco-system of NE India, Dudhnoi College, Assam (1999).

Deka S., 'Terrestrial biomass- a conventional source of energy', 'workshop on the role of coupling proceses between earth near earth parameter and bio sphere, Department of Physics G.U., (1999).

7.2.5. Computer Science and Technology :

1. Mahanta L. B. 'Extended Pearsoniam system of Curves', Annual Conference of Assam Science Society, Gauhati University (2000) ●

8. Seminar / Symposium / Meeting Attended :

1. Dr. C. B. Dwivedi delivered an invited talk on ''Dynamic transformation of the colloidal R. T. in a weakly ionised Plasma in the international workshop of interdisciplinery nature on 'Co-ordinated study on very low frequency (VLF) phenomena : Global approach', organised at the Barkatullah University, Bhopal in Nov. 1999.
2. Dr. C. B. Dwivedi delivered an invited talk on 'Physics of colloidel Plasmas' in the 14th National Symposium on Plasma S & T at G.N.D. University, Amritsar in Dec. 1999.
3. Dr. C. B. Dwivedi, Dr. Arun Sarma, Ms. Barnali Singha and Mr. U. Deka attended the 14th National Symposium on Plasma science & Technology at G.N.D. University, Amritsar in December, 1999.
4. Dr. G. C. Das and Manoj Kumar Sarma visited Indian Institute of Science, Bangalore in January, 2000 to have academic interaction with the scientists of the I.I.Sc. working in the field.
5. Dr. H. Bailung attended 2nd international conference on the physics of Dusty Plasmas, Hakora, Japan, 1999.
6. Dr. H. Bailung visited ISAS, Japan under the extension programme of 'Boyscast Fellowship' in April, (1999) to work on experimental dusty Plasmas.
7. Dr. Joyanti Chutia visited FCIPT, IPR, Ahmedabad to attend target group meeting on Plasma chemical Processes in July 1999.
8. Dr. B. C. Tripathy delivered an invited talk 'On sequence space' in the 13th Annual Conference of Assam Academy of Mathematics, held at Gauhati University in July, 1999.
9. Dr. B. C. Tripathy delivered a talk 'on statistical limits' in the Silver Jubilee international conference held at Lucknow University held in Dec. 1999.\
10. Dr. B. C. Tripathy delivered a talk 'On the Algebra of Tringular Conservative Matrices and its maximal groups inthe 7th Ramanujan Symposium on Potentialtheory and function theory and chaired a session at the said symposium held at Ramnijam Institute for Advanced Study in Mathematics, Madras in January 2000.
11. Dr.M. R.Agrawal, delivered an invited talk on "Univerdal Kovovkin Sets in commutative Branch Alzebra" in the turn of the millennium Lectures in Mathematics held at IIT, Guwahati in Dec. 1999.
12. Dr. M. R. Agrawal participated in the 7th Discussion Meeting on Harmonic Analysis', held at IIT, Kanpur in January, 2000.
13. Dr. P. Azad delivered a talk on "Transfer of Biotechnology fromLab toLand" at the rfresher course tothe State Level officers of the Directorate of Agriculture, Asssam, held in Febrary,2000.

14. Dr. P. Azad delivered a talk on "Eco friendly living with Biofertilizer' held at the Govt. Ayurvedic College, Assam, inFebrary, 2000.
15. Dr. J. Kotoky participated in the National workshop on patent information, processing & prospect, sponsored by the DST, GOI and WWW, Guwahati, held at Guwahati in September, 1999.
16. Dr. J. Kotoky had undergone a short term training during June toJuly, 1999 on the study of toxicity offood, drugs andherbal formulations on the human body and food and Nutrition, held at the Food and Drug toxicological Research Centre, NIN, Hyderabad.
17. Sri A. Barman attended the "National Seminar on Y2K, held at New Delhi, in March 1999.
18. Sri B. Bhuyan attended the workshop on 'Introductory Image Processing at Astronomical Application', held at Tezpur university in August, 1999. ●

10. Distiguished Visitors :

Prof. N. N. Rao, Physyical Research Laboratory, Ahmedabad, gave a series of lectures on waves & instablities in Dusty Plasmas and the recent development in Dusty Plasmas.

Prof. D. N. Verma, Retired Professor, TIFR,Mumbai delivered a talkon "From the game of NIM tothe Fibonacci Quasi - crytal, and the Archimedes - Brahma Gupta - Pell's Equation."

Prof. N. R. Das,Gauhati University, delivered two lectures on "Vector valued sequence spaces."

Prof. Robin Pal of SINP, Calcutta, delivered a talk on "Anomalous ion heating in SINP Tokamak." ●

11. Academic Achievement :

Mr. Arun Sarma was awarded Ph. D. degree by the Gauhati University forhis thesis entitled 'Study of Sheath instabilities in Plasma under the supervision of Prof. Joyanti Chutia, Plasma Physics Division.

Dr. C. B. Dwivedi was awarded 'PRL Associationship' fora period of twoyears by PRL, Ahmedabad for collaborative works on interdisciplinary inter institutional character with a S. C. Tripathy at Udaipur Solar observatory, Udaipur.

Dr. M. R. Agrawal was awarded INSA visiting Fellowship.

Dr. G. Choudhury was nominated as one of thes editors of the periodical 'Far east Journal of the theoretical Statistics' published from

Dr. G.Choudhury was nominated as on editorial collaboration for the journal 'Sankhy' for the year, 1999.

Dr. B. C. Tripathy was nominated as on editorial Board Member of the periodical 'For East journal of Mathematical Sciences. published from ●

12. Library and Informatin Centre :

Infomation facilities were provided tothe Scientific clientele, both on demand and in anticipation, utilizing the modern IT gadgets. Attempt has been undertaken to computerise the library services with the use of a special library oriented software,namely 'SOUL' designed by INFLIBNET, Ahmedabad and Computer System for the purpose have already been procured, Action has also beeninitiated to introduce INTERNET based information services to the Library of the Institute.

The library and Information Centre of the IASST has provided different types of the ifnromation services to the users as follows :

- Selective Disemination of Information Services
- Current Awareness Services (CAS)
- Circulation Services (Charging & discharging)
- Current contents,Abstracts and Photostat Services (CAPS)

Total Library Collection :

Books	: 3225
Journals (Bound Volumes)	: 578
Journals subscribed during the year, 1999-2000	: 48
Thesis and Dissertations	: 122
Reports, News letters, House bulletins etc.	: 125

13. Construction of IASST Complex

The Government of Assam has allotted to the Institute a plot of land measuring 20 acres at Pashim Boragaon in Greater Guwahati to set up its complex. The Government of India is kind enough to sanction in 1999 a sum of Rs. 9.55 Crore (Rupees nine Crore and fifty five lakh) only for the ninth plan under a Scheme 'Upgrading the Institute of Advanced Study in Science and Technology' in order to generate infrastructure for research including laboratories, buildings, sophisticated Scientific equipment etc. Out of the sanctioned amount, Rs. 6.50 Crore (Rupees Six Crore & fifty lakh) only has been earmarked for building and other components.

The Construction Workof the IASST Complex has been initiated since January, 2000.

14. Council of the Institute of advanced study in Science and Technology (1999-2000) :

1. Dr. N. K. Chaudhury, *Former V. C., Gauhati University, Chairman*
2. Dr. K. C. Barua, *Director of IASST, Member*
3. Dr. J. Medhi, *Emeritus Professor, G. U., Silpukhuri, Guwahati, Member.*
4. Dr. B. K. Tamuli, *Former Professor, Deptt. of Mathematics, G. U., Gotanagar, Maligaon, Guwahati, Member.*
5. Sri B. P. Chetiya, *Professor, Deptt. of Mathematics, Gauhati University, Guwahati, Member.*
6. Sri P. C. Sarma, *IAS, Commissioner & Secretary, Deptt. of Science, Technology and Environment, GOA, Dispur, Guwahati, Member.*
7. Prof. P. Sen, *Saha. Institute of Nuclear Physics, Bidhan Nagar, Calcutta-64, Member.*
8. Dr. C. M. Sarma, *President, Assam Science Society, Latasil, Guwahati, Member.*
9. Dr. M. C. Kalita, *General Secretary, Assam Science Society, Latasil, Guwahati, Member.*
10. The Director, *Regional Research Laboratory, Jorhat - 785006, Member.*
11. Dr. R. C. Srivastava, *Scientist 'G', Ministry of Science & Technology, DST, Govt of India, Technology Bhavan, New Mehruali Road, New Delhi-110016, Member.*
12. The Director, *ASTEC, City Co-operative Bank Building, 3rd Floor, U. N. Bezbaruah Road, Silpukhuri, Guwahati, Member.*
13. Dr. N. N. Dass, *Professor, Deptt. of Chemistry, Dibrugarh University, Dibrugarh-786004, Member.*
14. Dr. G. Barua, *Professor & Head, C. S. E., I. I. T., Guwahati, Member.*
15. Dr. B. K. Sarma, *Reader, Deptt. of Physics, Gauhati University, Guwahati, Member.*
16. Dr. J. Chutia, *Professor, Plasma Physics Division, IASST, Guwahati, Member.*
17. Dr. P. Azad, *Asstt. Professor, Life sciences Division, IASST, Guwahati, Member.*
18. Dr. M. K. Kalita, *Registrar, IASST, Guwahati, Secretary.*

CONSOLIDATED RECEIPT & PAYMENT ACCOUNTS OF IASST FOR THE YEAR 1999-2000

Sl. No.	Head of Accounts	Receipt (in Rupees)	Payment (in Rupees)
1.	Opening balance	22,73,522.66	--
2.	Development of Mathematical Sciences Division	--	5,88,072.00
3.	Development of Plasma Physics Division	14,80,000.00	13,99,494.00
4.	Development of Muga Culture with special reference to indoor rearing technique	34,580.00	---
5.	Development of isozyme markers for different stock to Eri Silkworm	1,86,000.00	1,76,650.00
6.	Education & Library	4,00,000.00	4,00,067.00
7.	Study on the perormance of S & T students of the universities in the NE region in selected NET	3,00,000.00	2,23,414.00
8.	Low Frequency Waves in Magnetized partially Ionised Plasmas	3,70,000.00	2,71,038.00
9.	Land development & Building Construction of IASST Complex	---	20,000.00
10.	Up-grading of IASST	3,20,00,000.00	69,85,671.00
11.	General Office Management	30,00,000.00	41,95,724.00
12.	IASST. General fund	6,61,869.38	1,20,134.00
13.	Survey, Collection of Fungi	---	9,840.00
14.	Closing balance	---	2,63,15,868.04
	Total Rupees	**4,07,05,972.04**	**4,07,05,972.04**