Maxim Ponomarjov

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Education:

1996: PhD in Physics and Mathematics (specialty – **statistical, numerical simulations of fluid, gas and plasma flows**) from the **State St-Petersburg University, St-Petersburg,** the applications are approved by the Polar Geophysical Institute, Russian Academy of Sciences, Russian Federation

1992: MS with Honors from the **Physical Mechanics Dept., Mathematics and Mechanics Faculty, State St-Petersburg University, St-Petersburg**

1985: Diploma of Secondary Education (Honors) with Emphasis in Physics and Mathematics, **College of Physical and Mathematical Sciences attached to the Leningrad State University** (presently the State St-Petersburg University), Leningrad (presently St-Petersburg).

1982: Musical School Diploma, class accordion

Awards, Fellowships, Grants, Associations:

EURATOM Research Fellowship in Plasma Physics at the **Statistical and Plasma Physics group, Association EURATOM**, **Free University of Brussels**, Belgium (2002-2004)

Berkner Fellow, **American Geophysical Union**, 2001

Winner of the International Center for Fundamental Physics Fellowships at **Lebedev Physical Institute** (Moscow) in Plasma Physics and Astrophysics (1995)

Outstanding PhD-student Grant from the **Free University of West Berlin** (1995-1996),

Outstanding Young Researcher Grant of the **State St-Petersburg University** (1993-1994),

Outstanding Graduate Student Fellowship (1990-1992)

Member of the Division for Planetary Sciences, **American Astronomical Society**

Committee on Space Research (**COSPAR**) Associate

Present Research Interests, Professional Experience:

2002: Statistical and Plasma Physics group, Association EURATOM, Free University of Brussels, Belgium, Post-doctoral Researcher

Statistical simulations of electromagnetic fields interactions (radio frequency and microwave domain) with plasmas, heating and acceleration of charged particles:

a) Direct particle Monte Carlo simulations with developing programming codes in C++, FORTRAN 90

b) Proposed physical mechanism for acceleration of charged particles resulting from effects of crossing electromagnetic waves propagating at different angles to the external magnetic field in vacuum or in a dispersive medium.

To analyse this mechanism we propose a resonance moment method (RMM) based on the flow moments approximations via the corresponding moments-integrals calculated inside the resonance layers (RL).

Based on this mechanism and RMM we propose the most efficient launching configuration for the two wave scheme when the secondary wave should be launched in perpendicular to the external magnetic field.

Our direct statistical simulations (a) show that this configuration allow to rise the mean electron velocity up to the order of magnitude as compared to the first wave launching alone. It is a quite promising result because the amplitude of the secondary wave is ten times lower the one of the first wave. The parameters used are typical for magnetic plasma fusion experiments in electron cyclotron resonance heating (ECRH) and current drive (ECCD). The waves are considered as generated by advanced system of gyrotrons, free electron masers (FEM)

Both the direct simulations and the resonance moment method (RMM) can be developed for the following applications:

(i) **Plasma etching of materials,**
Analytical chemistry, where the HF plasma serves to break the molecule to be analysed into atoms, then to excite and ionize these atoms, which allows their detection by optical spectroscopy and mass spectrometry

(ii) Active magnetospheric experiments
Artificial auroras generation by high-power high-frequency radio waves transmitted from ground-based facilities (e.g. Arecibo, EISCAT, HAARP, HIPAS and SURA) The physics of high-frequency particle acceleration is still not enough understood and appears to be a function of magnetic field dip angle (that corresponds to our results).

(iii) ECRH, ion cyclotron heating (ICRH), whistler wave heating in electron-cyclotron resonance (ECR) thruster - electrodeless thruster in which microwave frequency electromagnetic radiation is used to ionize a gas which is then accelerated to high velocity in an external magnetic field

(iv) Charged particles heating and acceleration in space and astrophysical plasma by combinations of electromagnetic fields

c) Using TRANSP – Tokamak Core Transport And Modelling Code.
TRANSP is a time-dependent transport analysis code that first solves the magnetic field diffusion equation and then uses the particle and energy conservation equations to calculate local transport coefficients. It is tuned for data analysis and developed mainly at PPPL (Princeton Plasma Physics Laboratory), and implemented at JET (Joint European Torus) on the JAC Linux Analysis Cluster (Beowulf PC cluster).

1996 - 2001: State Academy of Aviation Technology, Physics Dept., Yaroslavl region, Russia, Lecturer and from 1999 - Assoc. Professor

Course of general physics and mathematical, computer modeling is delivered for undergraduate and graduate students including lectures, seminars and computer, laboratory practice (using Matlab, Maple).

2D/3D non-linear statistical simulations of time-dependent space plasma flows and wave propagation in electric and magnetic fields.

Dynamics of magnetoplasma disturbances due to motion of reflecting boundaries is explored in space and upper ionosphere.

The model Boltzmann equation is resolved, which describes the ion distribution in the case of reflecting vehicle motion through the space magnetoplasma. Density, mean velocities, pressure of ions and heat transfer are calculated. 3D-surfaces of constant plasma density are plotted numerically.The plots compared with those for limiting cases of rapidly moving vehicles considered asymptotically.

Advanced numeric, analytic methods are utilized: Integral transforms, Asymptotics, Approximations and expansions, Characteristics, Finite-difference and Finite-element methods, Spectral, Collocation and Statistical methods

Used computer languages: C++, FORTRAN, PASCAL.

1992-1996: State St-Petersburg University, St-Petersburg, Russia, Post-Graduate Student

The imaginary emission method is developed for the statistical simulations of waves propagation, heat transfer and disturbances in ambient medium due to moving bodies.

Stratifications of ion clouds are simulated in the magnetic fields, using both analytic and numerical approaches.

Flute structure and stratification of ion beams are modelled in space and ionosphere under the presence of the ambient magnetic fields.

Flute structure and stratification of wakes is described behind absorbing vehicles in motion through the space and ionospheric magnetoplasma using the imaginary emission method.

Ph.D.-thesis “Time-dependent charged-particle fluxes in electric and magnetic fields” is defended (the applications are approved by the Polar Geophysical Institute, Russian Academy of Sciences, Russia).

The Candidate (PhD) Examinations on the Specialty “Statistical, numerical simulations of Fluids, Gas and Plasma” have been passed with the highest grades:

Part 1 (hydrodynamics and MHD) EXCELLENT

Part 2 (statistical, kinetic descriptions of plasmas) EXCELLENT

Advanced (five years) English courses are passed with the highest grade “EXCELLENT”

Advanced (two years) **course of the psychology and teaching** is taken with the highest grade "EXCELLENT";

For teaching practice:

Delivered lectures, conducted seminars and laboratory practice in general physics for undergraduate students during one semester.

Participation in supervision for two graduate students to their MS theses in specialty entitled "Statistical, numerical simulations of Fluids, Gas and Plasmas".

Special skills:

Fundamental practical education and experience in physical problems evaluation using the high level Numerical simulations; Monte Carlo technique; Special functions, Integral transforms, Asymptotics, Numerical approximation and analysis, Ordinary and Partial differential equations, Functional equations,

Working knowledge:

MatLab-6.1, Mathematica 3.0, MCAD, Maple, IDL DSP, TRANSP
FORTRAN-77/90, C/++, PASCAL, PL-1, ALGOL
Scientific Word, TeX/LaTeX
MS DOS, Windows 95/98/NT/2000/XP-Professional, Unix/Linux

Principal Publications:

M. Ponomarjov, D.Carati, Acceleration of electrons by crossing waves in an external magnetic field, submitted to Physical Review Letters

Ponomarjov,M.G., 3D time-dependent kinetic simulation of space plasma disturbances due to moving bodies with the ambient magnetic field effect, Advances in Space Research, 29/9, 1397-1402, 2002

Ponomarjov,M.G., Acceleration and Transport of Particles in Collisionless Plasmas: Wakes due to the Interaction with Moving Bodies, Astrophys. Space Sci., 277, 39-44, 2001

Ponomarjov,M.G., Space flows and disturbances due to bodies in motion through the magnetoplasma, Astrophys. Space Sci., 274, 423-429, 2000

Ponomarjov M.G., Pressure of charged particle flows in ambient magnetic field, Astronomische Nachrichten, 318, 187-192, 1997

Ponomarjov M.G., Imaginary emission method for modeling disturbances of all magnetoplasma species: Reflecting and absorbing objects in motion through rarefied plasma at different angles to the ambient magnetic field, Physical Review E, 54, 5591-5598,1996

Ponomarjov M.G., Disturbances of the ambient magnetoplasma due to interactions with the object surfaces. Imaginary emission method. Far-wake of objects moving through rarefied plasma at different angles to the ambient magnetic field, Planetary and Space Science, 43, 1419-1427, 1995

Ponomarjov M.G., Gunko Yu.F., Kinetic modeling of charged particle cloud expansion and emission in magnetic and electric fields, Planetary and Space Science, 43, 1409-1418, 1995

Gunko Yu.F., Ponomarjov M.G., The charged particle distribution due to emission in a magnetic field, Astronomische Nachrichten, 316, 17-21, 1995

*Conferences Proceedings

Ponomarjov,M. and Carati,D., Kinetic Simulations of Relativistic Electron Flows in Time-Dependent Electromagnetic Fields, Proceedings of the 12th Joint Workshop on

Electron Cyclotron Emission and Electron Cyclotron Resonance Heating (ed. by G. Giruzzi, World Scientific, Singapore, 2003), pp. 137-142.

Carati,D. and Ponomarjov,M., Statistical Description of Currents Induced by Two Electron Cyclotron Counter-Propagating Waves, Proceedings of the 12th Joint Workshop on Electron Cyclotron Emission and Electron Cyclotron Resonance Heating (ed. by G. Giruzzi, World Scientific, Singapore, 2003), pp. 77-82.

Ponomarjov,M.G., Kinetic modeling magnetic field effect on ion flows, disturbances and wakes in space plasma, Proceedings of the Sixth International School/Symposium for Space Plasma Simulations (ISSS-6), Max-Planck-Institut fuer extraterrestrische Physik, Garching, Germany, 328-331, 2001, (can be viewed at http://www.copernicus.org/ISSS-6/ISSS-6..cont.htm).

Ponomarjov,M.G., Anticipatory simulation of charged particle flows in electric and magnetic fields. Image method for anticipatory modeling disturbances due to bodies in motion through a magnetoplasma, International Journal of Computing Anticipatory Systems, v.5, 117-131, 2000.

*Conferences attended and papers presented:

12th Joint Workshop on Electron Cyclotron Emission and Electron Cyclotron Resonance Heating, Aix-en-Provence (FRANCE) May 13-16, 2002, http://wshop.free.fr/ec12/ two presentations with Professor D. Carati

Euroconference on Hypersonic and aerothermic flows and shocks, plasma-radiation-surface interactions and lasers, April 23-27, 2001, Observatoire de Paris-Meudon, Invited oral presentation: "Kinetic Simulation of Stratifications and Flute Structures of Hypersonic Plasma Flows and Wakes in External Magnetic Fields"

The Sixth International School/Symposium for Space Plasma Simulations (ISSS-6), Max-Planck-Institut fuer extraterrestrische Physik, Garching, Germany, September 3-8, 2001, Kinetic modeling magnetic field effect on ion flows, disturbances and wakes in space plasma (http://www.copernicus.org/ISSS-6/ISSS-6..cont.htm)

Meteoroids 2001, Conference at the Swedish Institute of Space Physics (IRF), Kiruna, Sweden, 6-10 August, 2001. Oral presentation: "Kinetic Simulation of Magnetic Field Effects on the Wakes of Meteoroids. Imaginary Emission Method".

AGU Spring Meeting, May 29 - June 2, 2001, Boston, Massachusetts. U.S.A. Presentation by the AGU Berkner Fellow entitled: "Kinetic Simulation of Magnetic Field Effects on Stratifications and Flute Structures of Space Plasma Flows and Wakes of Bodies".

The 42nd Annual Meeting of the DPP (APS) and the 10th ICPP, October 2000, Quebec, Canada. Oral presentation:"3D time-dependent kinetic simulation of turbulent plasma flows under the effects of external magnetic field", Bulletin of the APS, v.45, No7, 2000, p.261.

32nd IUVSTA Workshop on Gas-Surface Interaction, St-Petersburg, Russia, 25-29 September 2000, Oral presentation: "Simulation of plasma flows interacted with body surfaces and external magnetic fields"

International Workshop and Seminar on Nonequilibrium Physics at Short Time Scales, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, May-June, 2000. Oral presentation: "Time-dependent charged particle fluxes in ambient electric and magnetic fields, Kinetic simulation of plasma flows in the ambient magnetic field at short time scales. Imaginary emission method for simulations of disturbances and wakes"

33rd COSPAR Scientific Assembly, Warsaw, Poland, 16-23 July, 2000. Oral presentations at Scientific Commissions:
D (Space Plasmas in the Solar System, including Planetary Magnetospheres),
B (Space Studies of the Earth-Moon System, Planets, and Small Bodies of the Solar System)

International Conference on Physics of Space: Growth Points and Problems, Jan.10-14, 2000, Observatoire de Paris-Meudon, Acceleration and transport of particles in collisionless plasmas in the ambient magnetic field, wakes due to interactions with moving bodies, Book of Abstracts, p.22
(http://despa.obspm.fr/OBS2000/Proceedings/node4.html)

31st Meeting of the AAS Division for Planetary Sciences, Padova, Italy, October 10-15, 1999, Kinetic simulation of stratification and flute structures of charged particle jets and wakes in the ambient magnetic field, Abstracts of Presented Papers in the Bulletin of the AAS, v.31, No 4, p.1157, 1999

International Conference on Progress in Cosmic Gas Dynamics, Moscow, September 13-17, 1999, Kinetic simulations of space magnetoplasma flows and disturbances due to bodies in motion through the magnetoplasma, Book of Abstracts, p.42

IUGG XXII General Assembly, Birmingham, July 19-30, 1999, Symposium JSP39, Dynamics of stratified, flute structured charged particle jets and wakes in the ionosphere under the geomagnetic field effect, Abstract Book, Part B, p.108

Outer atmosphere and wake of space objects, kinetic simulation, Abstract Book for NASA Laboratory Space Science Workshop, Harvard-Smithsonian Center for Astrophysics, p.217, April 1-3, 1998

Personal
Born: Jan.24, 1968, Arkhangelsk reg., Russia
Martial Status: Married. Wife, Ponomarjova Irina is a qualified Computer Programmer (MS in Software Engineering, Diploma with Honors from the Computer Science Department, Faculty of Mathematics and Mechanics, State St-Petersburg University, 1992), speaking French, English.
Son, Ponomarjov Andrei, was born 1994, attending third class of the primary school in Brussels, speaking French, Dutch, starting English