

Curriculum Vitae of Alexander Pukhov.

I was born in Moscow, Russia, 1951

Education:

1969-1975: Student of Physical Department of Lomonosov Moscow State University.

1988: Ph.D. degree Moscow State University in Theoretical High Energy Physics.

Employment history:

1975 till now: research position in Skobeltsyn institute of Nuclear Physics.

Research interests

- Development of computer programs for automatic calculation of Feynman diagrams. Creating software for automatic calculation for various observables of collider and astroparticle experiments in framework of generic model of elementary particle interaction.
- Calculation of full sets of observables of astroparticle physics related to Dark Matter phenomenology. In particular DM relic density, signals of direct and indirect DM detection, neutrino telescope signal. *micrOMEGAs* project.
- Calculations of cross sections of high energy collisions of elementary particles and generation of events flow for comparison theoretical models and experiments. *CalcHEP* project.
- Study of BSM from viewpoint of DM phenomenology. Mutual study of collider and astroparticle properties of BSM models.

Collaborations

- I worked in collaboration with phenomenology group of Dr. Boos (Skobeltsyn Institute) for theoretical study of collider physics for LEP and FNAL. In framework of this collaboration I started to develop tools for automatic calculation of Feynman diagrams.
- Last 12 years I work in collaboration with scientists of LAPTH(France). During this collaboration it was written *micrOMEGAs*, a program for automatic calculation of different characteristics of DM particles. Several SM extensions were tested for their ability to obtain observed relic density and prospects of direct and indirect DM search.

- In the same time I collaborate with Alexander Belyaev (Southampton University) for development of CalcHEP package for automatic calculation of collider reactions.

Grants

- Russian Foundation for Fundamental Research: 1993-1995, 1996-1997, 1998, 2001-2002, 2008-2010, 2010-2012,2012-2014
- GDRI-ACPP:
- Royal Society International grant: 2010-2011

Invited plenary talks and lectures:

- Workshop on Advanced Computing and Analysis Techniques (ACAT) in Physics 2010
- TASSI confrence, Boulder, USA, 2011

Experience: I have experience in computing, development software for scientific community, theory of elementary particles, high energy phenomenology, astrophysics and physics related to Dark Matter.

Research results

- I was the the main author of CompHEP program for automatic calculation of Feynman diagrams, cross sections and event flows. Later on this software was developed under name CalcHEP. This software provides high energy physics community with an option to pass the way from initial Lagrangian to simulation of experimental plots taking into account experimental cuts with high level of automation [2]. Now CalcHEP is a widely used tool in HEP community including all leading theoretical groups and experimental groups.
- CompHEP/CalcHEP in the beginning used for calculation of SM signal and background cross section. In collaboration with group of Dr.Boos studied prospects of Higgs detection in γ -e collider[17], and possibility detection of anomaly Vtb coupling[18] in the same type of collider.
- Several BSM investigations were done by me in collaboration with Alexander Belyaev. In pariqular Technicolor signal [19] and new gauge boson signals[14] in Higgsless model were studied.

- Automatic calculation of Feynman diagrams was applied for calculation of DM annihilation reactions in early Universe. Such processes are responsible for formation of Dark Matter relic density. Here automatic calculations approach proved to be very convenient because of large number of processes with different initial particles which contribute to relic density formation. Indeed list of annihilation channels depends on mass spectra. It was developed a method for dynamic run-time generation of matrix elements which allows to generate matrix element codes only for needed channels depending on model parameters. This idea was realized in micrOMEGAs[9,10,11] - a public code for calculation of DM relic density which I develop in collaboration with G. Belanger, F. Boudjema (LAPTH, France) and A. Semenov (JINR, Russia). Now micrOMEGAs predicts all spectrum of astroparticle observers : relic density, direct detection and indirect detection rates in the framework of generic model of elementary particle interaction. micrOMEGAs is one of two widely used programs for calculation DM phenomenology and the only program which is able to do it in framework of generic model of particle interaction.
- Using micrOMEGAs in collaboration with LAPTH scientists several interesting results about parameter region of different BSM extensions where the model agrees with observed relic density. As well prospects of DM direct detection in this models, and collider signatures where studied were obtained . In particular were tested MSSM [12,13,14], NMSSM [15], Dirac Neutrino Dark Matter[16].

List of main publications of Alexander Pukhov:

1. Belanger G, Boudjema F, Pukhov A, Semenov A "micrOMEGAs_3.1 : a program for calculating dark matter observables" LAPTH-023-13, e-Print: arXiv:1305.0237
2. Belyaev A, Pukhov A, Christensen N "CalcHEP 3.4 for collider physics within and beyond the Standard Model" Comput.Phys.Commun. 184 (2013) 1729-1769
3. Belanger G, Kannike K, Pukhov A, Raidal M. "Z3 Scalar Singlet Dark Matter" JCAP 1301 (2013) 022
4. Belanger G, Celine B, Cirelli M, Da Silva J, Pukhov A "PAMELA and FERMI-LAT limits on the neutralino-chargino mass degeneracy" JCAP 1211 (2012) 028
5. Belanger G, Belyaev A, Brown M, Kakizaki M, Pukhov A. "Testing Minimal Universal Extra Dimensions Using Higgs Boson Searches at the LHC" Phys.Rev. D87 (2013) 016008
6. Belanger G, Kannike K, Pukhov A, Raidal M. "Impact of semi-annihilations on dark matter phenomenology - an example of Z_N symmetric scalar dark matter" JCAP 1204 (2012) 010
7. Belanger G, Godbole R, Pukhov A, Albornoz Vasquez A. "The Higgs boson in the MSSM in light of the LHC" Phys.Rev. D85 (2012) 115013

8. Belanger G, Da Silva J, Pukhov A. "The Right-handed sneutrino as thermal dark matter in U(1) extensions of the MSSM", JCAP 1112 (2011) 014
9. Belanger G, Boudjema F, Pukhov A, et al. "Dark matter direct detection rate in a generic model with micrOMEGAs_2.2", CPC v180, p , 2009
10. Belanger G, Boudjema F, Pukhov A, et al. "micrOMEGAs 2.0: A program to calculate the relic density of dark matter in a generic model." CPC v176, p367, 2007
11. Belanger G, Boudjema F, Pukhov A, et al. "micrOMEGAs: Version 1.3." CPC v174, p577 ,2006
12. Belanger G, Boudjema F, Cottrant A, et al. "WMAP constraints on SUGRA models with non-universal gaugino masses and prospects for direct detection," NUCLEAR PHYSICS B706, p411, 2005
13. Allanach BC, Belanger G, Boudjema F, et al. "Requirements on collider data to match the precision of WMAP on supersymmetric dark matter." JOURNAL OF HIGH ENERGY PHYSICS v12, 020, 2004
14. Belanger G, Kraml S, Pukhov A. "Comparison of supersymmetric spectrum calculations and impact on the relic density constraints from WMAP." PHYSICAL REVIEW D72, 015003, 2005
15. Belanger G; Boudjema F; Hugonie C; et al. "Relic density of dark matter in the next-to-minimal supersymmetric standard model", JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS 9 , 001, 2005
16. Belanger G; Pukhov A; Servant G. "Dirac neutrino dark matter". JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS 1, 009, 2008
17. Boos E; Dubinin M; Ilyin V; et al. "Associated Higgs Boson production in gamma-e collisions." Phys. Lett. B273, p173, 1991;
18. Boos E; Pukhov A; Sachwitz M; et al. "Probing anomalous Wtb coupling via single top production at TeV energy gamma e colliders" Source: Phys. Lett B404, p119, 1997
19. Belyaev A, Foadi R, Frandsen MT, et al. "Technicolor walks at the LHC." PHYSICAL REVIEW D79, 035006, 2009
20. He HJ, Kuang YP, Qi YH, et al. "CERN LHC signatures of new gauge bosons in the minimal Higgsless model." PHYSICAL REVIEW D78, 031701, 2008
21. Skands P, Allanach BC, Baer H, et al. "SUSY Les Houches accord: interfacing SUSY spectrum calculators, decay packages, and event generators." JOURNAL OF HIGH ENERGY PHYSICS v7, 036, 2004