Sergei Sharapov

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PRESENT POSITION
- **June 2008 – on Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine**
  Senior Research Associate

POSITIONS
- **August 2007 – May 2008 Department of Physics, Western Illinois University**
  Assistant Professor (nontenured)

POSTDOC EXPERIENCE
- **January 2005 – June 2007 Department of Physics, McMaster University**, Hamilton, Canada
  Postdoctoral Fellow
- **October 2003 – September 2004 Istituto Nazionale per la Fisica della Materia (INFM)** (INFM fellowship in the frameworks of the project *Transport and interference in nano-devices* in Torino, Italy) Institute for Scientific Interchange, Torino, Italy
- **October 2000 – September 2003 Institute of Physics, University of Neuchâtel**, Switzerland
  Senior Scientist (Maître-assistant)
- **June 1997 – May 1998, September 1998 – August 1999 Department of Physics, University of Pretoria**, South Africa
  Postdoctoral Research Fellow

TEACHING EXPERIENCE
- **September 2004 – December 2004**
  Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine
  students' seminar in *methods of quantum field theory in condensed matter theory (superfluidity, superconductivity, quantum Hall effect, etc.)*
- **March 2001 – June 2001, March 2002 – June 2002, March 2003 – June 2003**
  Institute of Physics, University of Neuchâtel, Switzerland
  2^{nd} year students' seminar in *mathematical physics*
- **October 2000 – December 2000**
  Institute of Physics, University of Neuchâtel, Switzerland
  4^{th} year students' seminar in *selected topic of condensed matter theory: superconductivity, magnetism, etc.*
- **January 1996 – May 1996, January 1997 – May 1997** National Taras Shevchenko University of Kiev, Lecturer in *Theory of superconductivity*
- **October 1991** Physics and Mathematics High School N 145, Kiev, Ukraine
  internship during the University study

WORK EXPERIENCE IN UKRAINE
- Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine
  September 2004 – December 2004, May 2000 – October 2002: Research Associate
  March 1996 – April 2000: Junior Research Associate

EDUCATION

◇ **1992-1995 Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine**
Ph.D. (Candidate of Science) in Theoretical Physics
Thesis (publicly defended on 4 July 1996): *Two-dimensional and Quasi two-dimensional models of superconductivity with arbitrary carrier density*
Supervisors: Profs. V.M. Loktev and P.I. Fomin

◇ **1987-1992 National Taras Shevchenko University of Kiev**
Diploma [M.Sc. Honours] in Theoretical Nuclear Physics
(specialization: theory of nucleus and quantum field theory)
Major Subjects: Physics and Mathematics Internship: high-school teaching
Master's Thesis: *Problem of inducing of non-abelian gauge fields*
Supervisor: Prof. P.I. Fomin

◇ **1987** Graduated from Physics and Mathematics High School N 145, Kiev

GRADUATE STUDENTS SUPERVISED

Rakesh Prabhat Tiwari, Summer Internship in the Institute of Physics, University of Neuchâtel, Switzerland, 2003
Title of the project: *Vortices in Superconductors of II type*

Denys Iablonskyi, National Taras Shevchenko University of Kyiv

RESEARCH INTERESTS

◇ **Carbon based materials (graphene)**, its behavior in an applied magnetic field

◇ **High-temperature superconductivity:** nodal quasiparticle excitations and their behavior in the vortex state; pseudogap phenomenon; optical conductivity and sum rule

◇ Methods of quantum field theory in strongly correlated matter

PUBLICATIONS

◇ **4** review in refereed journals; **48** papers published in refereed journals, among them **3** in Physical Review Letters; **31** conference proceedings & abstracts

My "h-index"[1] (see J.E. Hirsch, physics/0508025) is now 16. My best paper is on the quantum Hall effect in graphene (paper [34] from my *list of publications*) which was published at the end of September 2005 in Physical Review Letters has already 274 citations in ISI citation database. My total ISI citation index is $\gtrsim 954$.
See almost complete list of publications and their citation index in
`http://www.researcherid.com/rid/A-3526-2008`.

PROFESSIONAL ACTIVITIES

I am a referee for Physical Review Letters, and Physical Review B. I have also done referee work for Europhysics Letters and J. Low Temperature Physics.

◇ Grant reviewer: the National Science Foundation (NSF) USA; the Netherlands Foundation for Fundamental Research on Matter, FOM; member of the EuroGRAPHENE (EUROCORES Programme) Review Panel, the European Science Foundation (ESF)

GRANTS AND AWARDS

◇ 2001-2003 The research grant of the Swiss National Science Foundation (SCOPES-project in collaboration with Profs. H. Beck and V.M. Loktev)

◇ 1998 The Annual Prize of the National Academy of Sciences of Ukraine for the best results obtained by young scientists

◇ 1988-1992 Special University Scholarship – National Taras Shevchenko University of Kiev

RESEARCH BIOGRAPHY

At present I work both on graphene and on various aspects of high-temperature superconductivity. I became interested in graphene or planar graphite in 2003. I investigated magnetic oscillations (de Haas – van Alphen effect (paper [30] from my list of publications), Shubnikov – de Haas effect [33]) and integer quantum Hall effect [34] in this new fascinating material. *This unconventional quantum Hall effect, and the predicted nonstandard features*

[1] A scientist with a h-index of 10, say, will have published 10 papers that have received at least 10 citations each.

of the quantum magnetic oscillations have been observed in the most recent experiments [see K.S. Novoselov, *et al.*, Nature **438**, 197 (2005); Y. Zhang, Y.-W. Tan, H.L. Stormer, P. Kim, Nature **438**, 201 (2005); A.H. Castro Neto, F. Guinea, and N.M. Peres, Physics World **19**, 33 November (2006).] I gave invited talks on the quantum Hall effect in graphene at the March 2006 Meeting of the American Physical Society, March 13-17, 2006 in Baltimore and at the annual congress of the Canadian association of physicists, in a Condensed Matter and Material Physics (DCMMP) symposium on graphene on June 17, 2007 in Saskatoon.

My work at McMaster University started in 2005 with a very interesting collaboration with the experimental group of Prof. T. Timusk (paper [36]), where my contribution was to develop an approximate formula (full derivation is given in [35]) which they could easily use to fit the data.

The main direction of my early research was the modeling of the electronic properties of high-temperature superconductors (HTSC). In particular, I have been studying the important features of HTSC based on their *low dimensionality, low carrier density* and *d-wave character of pairing*. These common properties of HTSC materials make them essentially different from ordinary superconductors. For instance, a crossover from the superconductivity of the BCS type to the superfluidity of composite bosons occurs in the corresponding models as the carrier density decreases. My early work was devoted to the description of this crossover. These and related works [1–6] formed the basis of my PhD (1996) thesis. In 1998 I was awarded the prize of the National Academy of Sciences of Ukraine for Young Scientists on the basis of these papers.

My subsequent articles [papers 7 – 21, 24] in period 1997 – 2000 were devoted to the study of the formation of the superconducting state in the 2D and quasi-2D attractive Hubbard models that is believed may describe some features of HTSC. Using the modulus-phase variables appropriate to this problem I proved the presence of a new non-superconducting, but (pseudo) gapped phase in the 2D model of a superconductor with a relatively small carrier density. In particular, I obtained analytic expressions for the Green's function and other observable quantities. I attempted to relate this phase to the pseudogap phenomenon observed in HTSC. All these results are discussed in the review published in Phys.Rep. **349**, 1-123 (2001).

From 2001 I have concentrated on studying various consequences of the d-wave character of Cooper pairing in HTSC. I have derived a finite temperature time-dependent effective action [23] for the phase of the pairing field devoting special attention to the so called *Landau damping* terms. I have also investigated the *Carlson-Goldman mode* [26] in clean d-wave superconductors using the effective "phase only" action formalism.

In 2002 I studied the dependence of the superfluid density in the HTSC on an applied magnetic field [27] (see also the latest work [37]) caused by the *Volovik effect* and investigated the collective phase excitations (*Leggett mode*) in two-band superconductors using the path integral formalism and applied these results to the recently discovered MgB_2 superconductor [28].

LANGUAGES
- ◇ Mother tongue: Russian
- ◇ Fluently spoken/written: English, Ukrainian; French - intermediate level

COMPUTER SKILLS
- ◇ DOS, Windows 98/NT/2000/XP, Linux, IRIX; Mathematica, Mathcad, LaTeX, MiKTeX, Gnuplot, basics of hypertext language (I support the research group's and my own homepages); software for managing databases of scientific articles; dictionary software; a little of FORTRAN and PASCAL

REFERENCES
- ◇ **Prof. Hans Beck** Institut de Physique, Université de Neuchâtel
  Rue A.-L.Breguet 1
  CH-2000 Neuchâtel, Switzerland
  E-mail: `Hans.Beck@unine.ch`
  `http://www.unine.ch/phys/theocond/Members/TMC_Beck.html`
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◇ **Prof. Jules P. Carbotte** Department of Physics and Astronomy,
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◇ **Prof. Igor Herbut** Department of Physics, Simon Fraser University
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