National Academy of Sciences of Ukraine
Bogolyubov Institute for Theoretical Physics
Young Scientists Council

VIII International Young Scientists Conference

Problems of Theoretical Physics

December 12 – 14, 2017

Kyiv, Ukraine

Program & Abstracts

Kyiv 2017

Chair:
Acad. of the NAS of Ukraine, Director of BITP,
Prof. Dr. Sci. Anatoly G. Zagorodny

Organizing Committee

Deputy Director of BITP, Dr. Sci. Volodymyr I. Zasenko,
Dr. Ivan Starodub (Head),
Dr. Kostiantyn Yershov, Dr. Sergiy Perepelytsya,
Dr. Dmytro Piatnytskyi, Dr. Oleksii Ivanytskyi, Dr. Volodymyr Shapoval,
Denys Savchenko, Oleksiy Zdorevski, Oleksandr Cherniak

Editorial Group

Dr. Ivan Starodub, Dr. Sergiy Perepelytsya, Dr. Yulia Bezvershenko,
Dr. Anastasiia Rebesh, Dr. Oleksii Ivanytskyi, Denys Savchenko,
Oleksiy Zdorevski, Oleksandr Cherniak

13-25	**A.I. Korniienko, O.V. Pylypovskyi, V.P. Kravchuk, D.D. Sheka, Yu. Gaididei**	
O.21	"Magnetic metamaterials: curvature induced magnonic crystals in nanowires" *Taras Shevchenko National University of Kyiv*	
13-45	**C.M. Scherbakov, A.N. Morozovska, Yu. M. Vysochanskii**	
O.22	"Spatially modulated incommensurate phases induced by flexoelectric coupling in ferroelectrics" *Taras Shevchenko National University of Kyiv*	
14-05	**LUNCH**	

Afternoon Session

15-15	**O. Boliasova, V. Krivoruchko**
O.23	"Longitudinal spin dynamics in antiferromagnets: Diagrammatic approach" *A.A. Galkin Donetsk Institute for Physics and Engineering, NAS of Ukraine, Kyiv*
15-35	**O.R. Sulymenko, , O.V. Prokopenko**
O.24	"THz-frequency AC signal source based on antiferromagnetic spin-Hall oscillator" *Taras Shevchenko National University of Kyiv*
15-55	**L.Yu. Kharkhalis, O.O. Korolevych, O.V. Dulkai**
O.25	"Electronic structure of the InSe diluted magnetic semiconductors" *Uzhhorod National University, Institute of Physics and Chemistry of Solid State*
16-15	**E.A. Eliseev, I.S. Vorotiahin, Y.M. Fomichov, M.D. Glinchuk, S.V. Kalinin, Y.A. Genenko, A.N. Morozovska**
O.26	"Flexo-chemical coupling in ferroelectric thin films with defect layer" *Institute for Problems of Materials Science, NAS of Ukraine, Kyiv* *Charles University, Prague, Czech Republic*
16-35	**S.E. Reschikoff**
O.27	"The bias error of flicker noise spectral exponent estimation" *Ulyanovsk State Technical University, Ulyanovsk , Russia*
16-55	**O.A. Hrebnov, V.F. Korolovych, L.A. Bulavin, L.Yu. Matsuy**
O.28	"Dielectric properties of nanocellulose aqueous suspension" *Taras Shevchenko National University of Kyiv*
16-55	**A.V. Bezvershenko, A.K. Kolezhuk, B.I. Ivanov**
O.29	"Stabilization of magnetic skyrmions by RKKY interactions" *Taras Shevchenko National University of Kyiv*

Magnetic metamaterials: curvature induced magnonic crystals in nanowires

A.I. Korniienko[1], O.V. Pylypovskyi[1], V.P. Kravchuk[2], D.D. Sheka[1], Yu. Gaididei[2]

[1] *Taras Shevchenko National University of Kyiv, Volodymyrska Str 64/13, 01601 Kyiv, Ukraine*
[2] *Bogolyubov Institute for Theoretical Physics, Metrolohichna Str 14-b, 03680 Kyiv, Ukraine*
E-mail: korniyenko.nastya@gmail.com

Metamaterials, artificial periodic structures with promising advantages for control of wave propagation, are of great importance for modern nanotechnology. Metamaterials for optics (photonic crystals) are used for manipulation electromagnetic waves at optical frequencies at the nanometer scale. Nowadays, the concept of nanopatterned structure is encapsulated in different fields of physics, like as physics of phonons or plasmons. In magnetism magnonic crystals construct media for the control of magnons propagation. Magnonic crystals are the artificial magnetic structures with periodic distribution of the constituent materials or periodic modulation of magnetic parameters [1]. They are promising for all-magnon data processing [2] and used for the realization of logic operations [3].

In current study we propose the concept of curvature induced magnonic crystals with periodic spatio-inhomogeneous curvature distribution. We consider a planar ferromagnetic meander-like nanowire with strong easy-tangential anisotropy, composed of periodically arranged semi-circle segments. We describe statics and dynamics of the magnetization using the recently developed approach [4] for arbitrary shaped wires. The curvature of the system leads to appearance of geometrically induced Dzyaloshinskii-Moriya interaction and an additional anisotropy in plane of the sample, which results in a deviation of the magnetization from the strictly tangential distribution. The ground state magnetization distribution is derived analytically for the curved wire with the periodic spatial dependent curvature.

Ground state of the magnetization has periodic structure and plays a role of periodic potential for magnon excitations. The spin-wave spectrum of this structure is calculated analytically in the empty lattice approximation, which corresponds to the weak curvature case. Bandgaps in magnon spectrum are determined by the curvature. The minimal size of the gap corresponds to zero wave-vector and it decreases with the curvature amplitude increasing. There is a critical value of the curvature when the gap vanishes.

[1] S. O. Demokritov and A. N. Slavin (eds.), *Magnonics: From Fundamentals to Applications (Topics in Applied Physics)*, Springer Berlin Heidelberg, Berlin New

York (2013).
[2] A. V. Chumak, A. A. Serga, and B. Hillebrands, Nat. Commun., **5**, 4700 (2014).
[3] T. Schneider, A. A. Serga, B. Leven, B. Hillebrands, R. Stamps, and M. Kostylev, Appl. Phys. Lett., **92**, 022505 (2008).
[4] D. D. Sheka, V. P. Kravchuk and Y.Gaididei, J. of Phys. A: Math. and Theor., **48**, 125202 (2015).

II
Author index