

National Institute of Physics

Management Team

Terminal Report for the Structure and Dynamics Research Program

Period covered: 01 January 2018 to 31 December 2018

Prepared by:

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Program Coordinator

Structure and Dynamics Research Program

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1 Executive Summary

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1.1.1 Organization

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1.1.2 Mentoring

Degree Program	Sem 2 AY 17–18 (p. 4)	Midyear 2018	Sem 1 AY 18–19 (p. 5)	Total
BS Physics	5	0	1	6
BS Applied Physics	3	0	0	3
MS Physics	2	0	0	2
Total	10	0	1	11

1.2 Research Highlights

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2 Technical Report

2.1 Activities of the Research Program

In 2018 eleven students graduated and completed their theses in SanD. This includes two graduate students (2 MS Physics). SanD membership (faculty and students) is now 45 and the research group is reaching full capacity. The group had 2 international conference presentations and 23 local conference peer-reviewed papers. One of the highlights of this calendar year is the continued activity of SanD faculty in organizing and supporting the activities of the Samahang Pisika ng Pilipinas and in strengthening the linkages with node members of the Asian Network in Condensed Matter and Complex Systems.

2.1.1 Organization

Regular Members (3)

- 1) Villagonzalo, Cristine – Professor
- 2) Banzon, Ronald – Associate Professor
- 3) Paraan, Francis – Assistant Professor

PhD Student Members (6)

- 1) Ilano, Neris – D9
- 2) Santos-Putungan, Alexandra – MSE-D6
- 3) Cortez, April – D3
- 4) dela Rosa, Rafael – D3
- 5) Itable, Gene Moses – D3
- 6) Acosta, Geronimo Allan Jerome – D2

MS Student Members (7)

- 1) Ayang-ang, Cleofe Dennielle – M1
- 2) Mangada, Mykhal – M5, University Research Associate
- 3) Guinid, Jammy Rey – M4
- 4) Masbate, Julius – M4
- 5) Elegado, Christopher Patrick – M1
- 6) Esperanza, Robertson – M2
- 7) Tan, Apolinario Miguel – M2

BS Student Members (19)

- 1) de Leon, Kryzz Joshua – B5
- 2) Dumanjog, Mignon Francis – B5
- 3) Go, Michael Nicholas – B5
- 4) Lopez, Vidal Wyatt – B5
- 5) Mactal, Gerard Antonio – B5
- 6) Medrano, Matthew – B5
- 7) Narag, Dean Von Johari – B5
- 8) Ongkiko, Mario Antonio – B5
- 9) Rivera, Vincent – B5
- 10) Urbano, Kryss – B5
- 11) Villano Jr, Celso – B5

- 12) Adelino, Joanne Mae – B4
- 13) Castro, Marc Jerrone – B4
- 14) Co, Richmond – B4
- 15) Deleon, Monica Cecilia – B4
- 16) Delima, Krishna Lyn – B4
- 17) Go, Mary Chris – B4
- 18) Gomez, Jacob – B4
- 19) Ramos, Aaron Paul – B4

Apprentices (10)

- 1) Ancheta, Sheenah – B4
- 2) Bunagan, Marc Jason – B3
- 3) Calpatura, Jairus Carlo – B3
- 4) De Guzman, Tristan – B4
- 5) Edora, Maria Alena – B3
- 6) Estrada, John Benedick – B4
- 7) Ganding, Jersey Dianne – B3
- 8) Lamsis, Trisha Rio – B3
- 9) Rodriguez, Tim Jeff – B3
- 10) Sacres, Kobe Brian – B3

2.1.2 Mentoring**Graduated Sem 2 AY 2017–2018**

BS Physics (5)

- 1) Balt, Binladin
BS Thesis: Correlation functions of an XY spin chain in a random transverse field
Adviser: Francis Paraan
- 2) Ottong, Zheina
BS Thesis: Impact of spatial constraints on the radiation-induced bystander effect
Adviser: Cristine Villagonzalo
- 3) Peria, Lean Louiel
BS Thesis: Piezomagnetic and electronic properties of MN3GAN and MN3SNN calculated using density functional theory
Adviser: Francis Paraan
- 4) Santos, Eduard Renzo
BS Thesis: Stochastic description of the radiation-induced bystander effect using fractional brownian motion
Adviser: Cristine Villagonzalo
- 5) Trinidad, Jhames Niño
BS Thesis: Periodicity of local Penna populations with migration
Adviser: Ronald Banzon

BS Applied Physics (Instrumentation) (2)

- 1) Ayang-ang, Cleofe Dennielle
BS Thesis: Quantum critical behavior in a long-range Kitaev chain model

Adviser: Francis Paraan

2) Ferrer, Nica Jane

BS Thesis: Ballistic Thermal transport simulations in graphene using nonequilibrium Greens function method

Adviser: Cristine Villagonzalo

BS Applied Physics (Materials Physics) (1)

1) Ang, Paul Daniel

BS Thesis: Structural, electronic, elastic and piezoelectric properties of wurtzite AlN from density functional theory

Adviser: Francis Paraan

MS Physics (2)

1) Canoy, Raymart Jay

MS Thesis: Work statistics in a quenched Kitaev chain with long range interactions

Adviser: Francis Paraan

2) Marquez, Daniel

MS Thesis: The role of magnetic orbit to orbit interaction in a twodimensional electron gas in electromagnetic fields

Adviser: Cristine Villagonzalo

Graduated Sem 1 AY 2018–2019

BS Physics (1)

1) Felismino, John Ian Kenneth

BS Thesis: Exploration of Python GRU Implementation for DMRG

Adviser: Francis Paraan

2.2 Research Highlights

2.2.1 International peer-reviewed articles (0)

2.2.2 International conference presentations (2)

1) Cortez, A & C Villagonzalo. Numerical method for solving the semiclassical Boltzmann equation on multilayer heterogeneous structures, 2018 ICTP Asian Network School and Workshop on Complex Condensed Matter Systems, P.27 (Suranaree University of Technology, Thailand, 2018).

2) Sombillo, NI, RS Banzon & C Villagonzalo. Effect of error tolerance probability to the fidelity of a 4-qubit quantum search simulation, 2018 ICTP Asian Network School and Workshop on Complex Condensed Matter Systems, P.16 (Suranaree University of Technology, Thailand, 2018).

2.2.3 Local peer-reviewed conference papers (23)

1) Ang, PD & FNC Paraan. Piezoelectric tensor of AlN calculated by the Berry phase approach implemented in Quantum ESPRESSO, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-04 (Puerto Princesa City, Philippines, 2018).

2) Ayang-ang, CD & FNC Paraan. Entanglement spectrum and entropy scaling in a Kitaev chain with variable-range interaction, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-35 (Puerto Princesa City, Philippines, 2018).

- 3) Balt, B & FNC Paraan. Ground state correlation functions of the XY spin chain in a random transverse field, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-44 (Puerto Princesa City, Philippines, 2018).
- 4) Canoy, RJ & FNC Paraan. Average work done in a ground state quantum quench of the Kitaev chain model with variable-range interactions, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-18 (Puerto Princesa City, Philippines, 2018).
- 5) Chiong, III, MR & FNC Paraan. Density functional theory-based determination of the mechanism of electrochemical reduction of CO₂ to CO by CO(salen) complex, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PA-27 (Puerto Princesa City, Philippines, 2018).
- 6) Dela Rosa, R & FNC Paraan. Ground state entanglement entropy in a coupled spin-1/2 dimer with Dzyaloshinsky-Moriya interaction, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-52 (Puerto Princesa City, Philippines, 2018).
- 7) de Leon, KJ & FNC Paraan. GPU implementation of singular value decomposition for high rank tensors, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-50 (Puerto Princesa City, Philippines, 2018).
- 8) Dumanjog, MF & FNC Paraan. Ground state entanglement entropy between harmonically confined dipoles, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-53 (Puerto Princesa City, Philippines, 2018).
- 9) Felismino, JIK & FNC Paraan. Comparison of Python GPU implementations of eigensolver, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-51 (Puerto Princesa City, Philippines, 2018).
- 10) Ferrer, NJ & C Villagonzalo. Effect of varying the atomic bond stiffness in the heat baths to the thermal conductance of a graphene junction, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-3B-04 (Puerto Princesa City, Philippines, 2018).
- 11) Guinid, JR & R Banzon. Mutation rate and genetic diversity in a Penna Model, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-13 (Puerto Princesa City, Philippines, 2018).
- 12) Itable, GM & FNC Paraan. Symmetry-protection in the deformed Affleck-Kennedy-Lieb-Tasaki state, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-18 (Puerto Princesa City, Philippines, 2018).
- 13) Lopez, VW & FNC Paraan. Evaluating the performance of a thresholding filter on handwritten images classification task, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-47 (Puerto Princesa City, Philippines, 2018).
- 14) Mactal, GA & C Villagonzalo. Investigating the diffusion of an atom on a graphene lattice, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-04 (Puerto Princesa City, Philippines, 2018).
- 15) Mangada, MG & FNC Paraan. Benchmarking a tensor network-based machine learning algorithm for supervised image classification, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-23 (Puerto Princesa City, Philippines, 2018).
- 16) Marquez, D & C Villagonzalo. Effective field analysis of magnetic orbit-to-orbit interactions in two-dimensional electron gases, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-14 (Puerto Princesa City, Philippines, 2018).
- 17) Medrano, M, M Soriano & FNC Paraan. Computational fluid dynamics analysis of lift on the Teardrop 2.0 for different angles of attack, in Proceedings of the 36th Samahang Pisika ng Pilipinas

- Physics Conference, SPP-2018-2C-04 (Puerto Princesa City, Philippines, 2018).
- 18) Narag, DVJ & C Villagonzalo. Harmonic disturbance on the topological phases of a Chern insulator, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PB-24 (Puerto Princesa City, Philippines, 2018).
 - 19) Ongkiko, MA & FNC Paraan. Band structure contribution of adsorbed H₂ on graphene calculated from molecular orbital projection, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PA-19 (Puerto Princesa City, Philippines, 2018).
 - 20) Ottong, Z & C Villagonzalo. Impact of the absorption and reflection of signals on the radiation-induced bystander effect, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-22 (Puerto Princesa City, Philippines, 2018).
 - 21) Santos, ER & C Villagonzalo. Radioactive diffusion without complete signal annihilation, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-19 (Puerto Princesa City, Philippines, 2018).
 - 22) Urbano, KC & R Banzon. Two-dimension Ising model simulation via Monte Carlo method with regions without spin, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-PC-32 (Puerto Princesa City, Philippines, 2018).
 - 23) Villano, Jr, CT & C Villagonzalo. The next-next-nearest neighbor interaction of two Fibonacci anyon, in Proceedings of the 36th Samahang Pisika ng Pilipinas Physics Conference, SPP-2018-3B-03 (Puerto Princesa City, Philippines, 2018).

2.2.4 Local conference presentations (6)

- 1) Canoy, RJE & FNC Paraan. Characterization of a ground state quantum quench of the Kitaev chain model with variable-range interactions using work statistics, ASTHRDP Graduate Scholars' Conference, F3-2 (PICC, Pasay City, 2018).
- 2) Guinid, JRC & RS Banzon. Diversity of semelparous populations in a Penna model with continuous and periodic mutations, ASTHRDP Graduate Scholars' Conference, P127 (PICC, Pasay City, 2018).
- 3) Manceras, A II & RS Banzon. Genetic diversity in asexually reproducing populations of the semelparous Penna model, ASTHRDP Graduate Scholars' Conference, P129 (PICC, Pasay City, 2018).
- 4) Mangada, MGL & FNC Paraan. Accuracy of a tensor network-based image classifier saturates with bond dimension, ASTHRDP Graduate Scholars' Conference, P126 (PICC, Pasay City, 2018).
- 5) Marquez, DF & C Villagonzalo. Magnetic orbit to orbit interaction in a two-dimensional electron gas, ASTHRDP Graduate Scholars' Conference, P130 (PICC, Pasay City, 2018).
- 6) Vilorio, JFD & FNC Paraan. Calculation of the stiffness coefficient and elastic moduli of copper silver alloy using molecular dynamics simulations, ASTHRDP Graduate Scholars' Conference, F3-5 (PICC, Pasay City, 2018).

2.2.5 NIP funded projects (3)

- 1) Project Leader: Banzon, Ronald S.
Project Title: Diversity in a Penna Model with Intermittent Mutation
Period: 01 January 2018–31 December 2018

- 2) Project Leader: Paraan, Francis Norman C.
Project Title: Features of criticality in spin chains and Kitaev chains with long-range interactions
Period: 01 January 2018–31 December 2018
- 3) Project Leader: Villagonzalo, Cristine DLR.
Project Title: Thermal Transport of Graphene: A Numerical Study
Period: 01 January 2018–31 December 2018

2.2.6 Non-NIP funded projects (2)

- 1) Project Leader: Villagonzalo, Cristine DLR.
Type: OVPAA Enhanced Creative Writing and Research Grant/ECWRG 2014-12
Project Title: Specific heat capacity studies in a two-dimensional electron system with Rashba spin-orbit coupling in tilted magnetic fields
Period: 02 February 2015– 29 June 2018
Amount: P600 000
- 2) Project Leader: Paraan, Francis Norman C.
Type: OVPAA ECWRG 2018-1-009
Project Title: Computational and theoretical studies of small molecule binding on nanoclusters and surfaces
Period: 17 September 2018 – 16 March 2020
Amount: P500 000

2.2.7 Other invited lectures/talks (0)

- 1) Name: Villagonzalo, Cristine
Title: Quantum Size Effect in Phonon Thermal Transport in Graphene
Activity: International Workshop "Disordered Systems: From Localization to Thermalization and Topology"
Place: Center for Theoretical Physics of Complex Systems, Institute for Basic Science (PCS-IBS), Daejeon, South Korea
Dates: 3-7 September 2018
Mode of exchange: ICTP Asian Network of Condensed Matter and Complex Systems
- 2) Name: Francis Paraan
Title: Quantum Criticality and scaling in a model with long-range interactions
Activity: Physics Society of Mapua Seminar
Place: Mapua University, Intramuros, Manila
Date: 10 December 2018
Mode of exchange: Research dissemination

2.2.8 Outbound travel abroad (3)

- 1) Name: Santos-Putungan, Alexandra
Activity: ICTP-OFID Sandwich Training Educational Programme (STEP)
Purpose: Sandwich training program
Place: International Centre for Theoretical Physics, Trieste, Italy
Dates: 15 Feb – 14 July 2018
Mode of exchange: Postgraduate fellowship, ICTP-OFID

- 2) Name: Villagonzalo, Cristine
Activity: The 30th Board of Trustees Meeting & The 20th General Council Meeting of the Asia Pacific Center for Theoretical Physics (APCTP)
Purpose: International Representation for NRCP in APCTP
Place: APCTP, Pohang, South Korea
Dates: 08-10 March 2018
Mode of exchange: Asia Pacific Center for Theoretical Physics (APCTP)
- 3) Name: Villagonzalo, Cristine and Cortez, April and Sombillo, Neris and Santos-Putungan, Alexandra
Activity: ICTP Asian Network School and Workshop on Complex Condensed Matter Systems 2018
Purpose: Research dissemination and international representation
Place: Suranaree University of Technology (SUT), Nakhon Ratchasima, Thailand
Dates: 5-9 November 2018
Mode of exchange: ICTP Asian Network on Condensed Matter and Complex Systems and SUT

2.2.9 Inbound visiting researchers (4)

- 1) Visitor: Eliezer Estrecho
Affiliation: Australian National University
Purpose: Invited Seminar Talk
Title of Talk: *Exciton-polariton Condensation in Single-shot Regime and Thomas-Fermi Limit*
Duration: 15 January 2018
NIP Contact: Francis Paraan
- 2) Visitor: Kazuhiro Tanaka
Affiliation: KEK High Energy Accelerator Research Organization and Asian Nuclear Physics Association
Purpose: Invited Seminar Talk
Title of Talk: *Major Accelerator Facilities for Nuclear Physics Experiments in the Asia Pacific Region*
Duration: 22 February 2018
NIP Contact: Cristine Villagonzalo
- 3) Visitor: Atsushi Hosaka
Affiliation: Osaka University
Purpose: Invited Seminar Talk
Title of Talk: *Introduction to Recent Achievements of Hadron Physics*
Duration: 22 February 2018
NIP Contact: Cristine Villagonzalo
- 4) Visitor: Peter Robinson
Affiliation: University of Sydney
Purpose: Invited Seminar Talk
Title of Talk: *The Physical Brain*
Duration: 13 June 2018
NIP Contact: Francis Paraan

2.3 Extension Work Highlights

2.3.1 Extension Work Activities¹ (7)

- 1) Name: Francis Paraan
Extension work: Invited Speaker
Organization: Philippine Science High School Ilocos Region Campus
Event: A Day with a Scientist, 09 February 2018
- 2) Name: Cristine Villagonzalo
Extension work: Referee for Chinese Journal of Physics (Elsevier)
- 3) Name: Francis Paraan
Extension work: Referee for American Physical Society (Physical Review Journals: A, B, E & Letters)
- 4) Name: Francis Paraan
Extension work: Editor in Chief and Online Journal Manager
Organization: Samahang Pisika ng Pilipinas
- 5) Name: Cristine Villagonzalo
Extension work: Topical Editor
Organization: Samahang Pisika ng Pilipinas
- 6) Name: Francis Paraan
Extension work: Web Administration of <http://www.spp-online.org> and sub-domains
Organization: Samahang Pisika ng Pilipinas
- 7) Name: Cristine Villagonzalo
Position: Network Node Coordinator for the Philippines
Organization: ICTP Asian Network on Condensed Matter and Complex Systems

2.3.2 Research Interns and Trainees (9)

- 1) Intern/Trainee: Sevilla, Patricia Ann
School: Philippine Normal University
NIP Contact: Francis Paraan
Dates: 7 May – 1 June 2018
Remarks: DOST-SEI Summer Practical Training Program
- 2) Intern/Trainee: Dancel, Tomy Rose
School: PSHS Central Mindanao Campus
NIP Contact: Cristine Villagonzalo/ Francis Paraan / Ronald Banzon
Dates: 13 June – 4 July 2018
Remarks: NIP PSHS Science Immersion Program (MOU)
- 3) Intern/Trainee: Pampanga, Gavrill Aiman
School: PSHS Eastern Visayas Campus
NIP Contact: Cristine Villagonzalo/ Francis Paraan / Ronald Banzon
Dates: 13 June - 4 July 2018
Remarks: NIP PSHS Science Immersion Program (MOU)

¹From the 2003 UP Diliman Faculty Manual 2003 Section 4.3.4: Extension includes services utilizing expertise and talent related to one's discipline, outside instruction and research, such as nondegree training, seminars, workshops, conferences, review classes [except UP College Admission Test (UPCAT)], advisory/technical/information services, exhibits, performances, consultancies (without professional fee), networking, advocacy, and volunteer/community work.

- 4) Intern/Trainee: Jimenez, Dave Angelo
School: PSHS Western Visayas Campus
NIP Contact: Cristine Villagonzalo/ Francis Paraan / Ronald Banzon
Dates: 13 June - 4 July 2018
Remarks: NIP PSHS Science Immersion Program (MOU)
- 5) Intern/Trainee: Annaguey, King Philip
School: University of Northern Philippines
NIP Contact: Francis Paraan
Dates: 2 July – 3 August 2018
Remarks: DOST-SEI Summer Practical Training Program
- 6) Intern/Trainee: Sotto, Jeannib
School: Central Mindanao University
NIP Contact: Francis Paraan
Dates: 18 June – 30 July 2018
Remarks: DOST-SEI Summer Practical Training Program
- 7) Intern/Trainee: de Leon, Kryzz Joshua
School: University of the Philippines Diliman
NIP Contact: Francis Paraan
Dates: 13 June – 31 July 2018
Remarks: DOST-SEI Summer Practical Training Program
- 8) Intern/Trainee: Narag, Dean Von Johari
School: University of the Philippines Diliman
NIP Contact: Cristine Villagonzalo
Dates: 13 June – 31 July 2018
Remarks: DOST-SEI Summer Practical Training Program
- 9) Intern/Trainee: Villano, Celso Jr.
School: University of the Philippines Diliman
NIP Contact: Cristine Villagonzalo
Dates: 18 June – 31 July 2018
Remarks: DOST-SEI Summer Practical Training Program

2.4 Challenges Encountered

- 1) Repair of the floor-type airconditioning unit did not push through. The Commission on Audit did not approve the repair through a service center as the cost exceeded 30% of the original purchase price of the unit.
Proposed solution: To request the purchase of a new airconditioning unit which will be up to standard of the 2020 new refrigerant regulations using no freon (HCFC-22) in the unit.

2.5 Awards, Accreditations, and Positions of Responsibilities Held

2.5.1 National awards and positions held (3)

- 1) Name: Marquez, Daniel
Award: Best Technical Poster
Event: DOST-SEI ASTHRDP Graduate Scholars' Conference, 18-19 June 2018
Award-giving body: Science Education Institute, Department of Science and Technology

2) Name: Cristine Villagonzalo

Position: General Council Member (up to 19 March 2018)

Organization: Asia Pacific Center for Theoretical Physics (through the National Research Council of the Philippines)

3) Name: Francis Paraan

Position: Secretary General

Organization: Samahang Pisika ng Pilipinas

3 Appendices

3.1 Photographs



SanD members and alumni (December 2018).