

# Dr. D. Aravinthan

Centre for Nonlinear Dynamics, School of Physics  
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## Education

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<b>Bharathidasan University</b> <i>Ph.D., Physics, Highly Commended</i>	<b>Tiruchirappalli</b> 2011–2017
<b>Bharathidasan University</b> <i>M.Phil., Physics, First Class with Distinction, 77.00%</i>	<b>Tiruchirappalli</b> 2010–2011
<b>Bharathidasan University</b> <i>M.Sc., Physics, First Class with Distinction, 80.02%</i>	<b>Tiruchirappalli</b> 2008–2010
<b>Nehru Memorial College (Autonomous) (Bharathidasan University)</b> <i>B.Sc., Physics, First Class with Distinction, 85.16%</i>	<b>Puthanampatti</b> 2005–2008
<b>Nehru Higher Secondary School (State Board, Tamil Nadu)</b> <i>H.S.C., First Class with Distinction, 83.66%</i>	<b>Puthanampatti</b> 2003–2005
<b>Government High School (State Board, Tamil Nadu)</b> <i>S.S.L.C., First Class with Distinction, 82.40%</i>	<b>Thinnanur</b> 2002–2003

## Ph.D. Work

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**Title:** *Effect of Interlayer Coupling and Biasing on Spin Transfer Torque Switching in Ferromagnetic Nanopillars*

**Supervisor:** Prof. M. Daniel

**Description:** Spin transfer torque induced magnetization switching has recently attracted much interest due to its potential applications in magnetic random access memory (MRAM), fast programmable logic, high-density magnetic storage devices, magnetic sensors and in high frequency devices for telecommunications. Magnetic storage devices and magnetic sensors based on Giant Magnetoresistance (GMR) and Tunnelling Magnetoresistance (TMR) effects require high quality multilayers constructed out of ultrathin ferromagnetic and non-magnetic films. The performance of these devices strongly depend on the morphological and structural properties of the films and their physical characteristics. Among them, the crucial factor is the interlayer coupling between the two ferromagnetic layers separated by a non-magnetic spacer. Various interlayer coupling mechanisms have been reported. Among them, pinhole coupling, orange peel coupling, biquadratic coupling and RKKY coupling are important ones. These interlayer couplings play an important role in the understanding of

magnetization switching mechanism and GMR of spin valves and TMR of magnetic tunnel junction structures. We have done a systematic and in-depth study about the effect of interlayer coupling that arises due to the interface roughness namely orange peel coupling and biquadratic coupling on spin transfer torque magnetization switching in trilayer and pentalayer nanopillar structures. Further, we have investigated the effect of biasing on spin transfer torque magnetization switching in the pentalayer structure, in order to reduce the switching time and critical current density required to initiate the magnetization switching. The magnetization switching dynamics of the free layer magnetization in nanopillar are basically nonlinear in nature and is governed by the Landau-Lifshitz-Gilbert-Slonczewski (LLGS) equation which is a highly nontrivial vector nonlinear evolution equation. By solving this LLGS equation, we can understand the underlying magnetization dynamics. For time-independent case, LLGS equation is analytically solved and the critical current density required to switch the magnetization is calculated. Then the full LLGS equation is solved numerically by using Runge-Kutta fourth order procedure for each case and from the numerical simulations study we understood the effect of interlayer coupling and biasing on spin transfer torque switching. Our important findings are both orange peel coupling and biquadratic coupling reduces the switching time. Even though biquadratic coupling reduces the switching time, the lowest switching time is obtained through orange peel coupling. Further, we found that biasing ferromagnetic layers of the nanopillars reduce the switching time considerably. Although biasing in the case of pinned layer enhances the spin transfer torque acting on the free layer and reduces the switching time, the fastest magnetization switching is achieved in the case of free layer biasing configuration.

## Awards, Grants & Honours

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- Awarded **2016 Joint MMM-Intermag Conference Student Travel Grant** for participating in the 2016 Joint MMM-Intermag Conference, held at the Hilton San Diego Bayfront Hotel in San Diego, California, United States during January 11-15, 2016.
- Awarded **DST – INSPIRE Senior Research Fellowship (SRF)** (from August 28, 2015 to September 30, 2016).
- Won the **Best Library User Award** for the year 2013 awarded by University Library, Bharathidasan University, Tiruchirappalli.
- Awarded **DST – INSPIRE Junior Research Fellowship (JRF)** (from October 01, 2011 to August 27, 2015).
- Awarded **Tmt. Rukmani Gopalan Memorial Gold Medal 2010** for the First Rank in the M.Sc., Physics (2008-2010) Examinations in Bharathidasan University, Tiruchirappalli.
- Secured the **University First Rank** in the Bharathidasan University Rank Examinations conducted for both Autonomous and Non-Autonomous colleges for M.Sc., Physics (2008-2010).

- Got **First Rank in First and Second Year of B.Sc Academic Examinations** in Nehru Memorial College (Autonomous), Puthanampatti.

## Research Experience

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### *Ph.D. Work*

2011–Now

Working in the emerging field of Spintronics and my research topic for Ph.D. Degree is “Effect of Interlayer Coupling and Biasing on Spin Transfer Torque Switching in Ferromagnetic Nanopillars”.

### *M.Phil. Project*

2010–2011

Carried out a project on the topic of “Soliton Spin Excitations in Ferromagnetic Spin Systems” during a period of two semesters in the M.Phil Programme.

### *M.Sc. Project*

2009–2010

Carried out a project on the topic of “Soliton in Ferromagnets” during a period of two semesters in the final year of the M.Sc Programme.

## Publications

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[1] D. Aravinthan, P. Sabareesan, and M. Daniel, Current induced magnetization switching in Co/Cu/Ni-Fe nanopillar with orange peel coupling, *AIP Advances* **5**, 077166 (2015).

[2] D. Aravinthan, P. Sabareesan, and M. Daniel, Impact of biquadratic coupling on critical current density in Co/Cu/Ni-Fe nanopillar, *AIP Conf. Proc.* **1728**, 020443 (2016).

[3] D. Aravinthan, P. Sabareesan, and M. Daniel, Effect of biquadratic coupling on current induced magnetization switching in Co/Cu/Ni-Fe nanopillar, *AIP Conf. Proc.* **1731**, 130032 (2016).

[4] D. Aravinthan, P. Sabareesan, and M. Daniel, Reduction of switching time in pentalayer nanopillar device with different biasing configurations, *J. Magn. Magn. Mater.* **421**, 409 (2017).

[5] D. Aravinthan, P. Sabareesan, and M. Daniel, Spin transfer torque switching in pentalayer nanopillar with biquadratic coupling, *J. Magn. Magn. Mater.* (Under Review).

[6] D. Aravinthan, P. Sabareesan, and M. Daniel, On the effect of orange peel coupling on spin torque magnetization switching in pentalayer nanopillar (Under Preparation).

## Papers Presented in Seminars / Conferences / Workshops

1. Presented a poster entitled "Impact of Biquadratic Coupling on Current Induced Magnetization Switching in Co/Cu/Ni-Fe Nanopillar" in the **2016 Joint MMM - InterMag Conference** held at the Hilton San Diego Bayfront Hotel in San Diego, California, United States during January 11-15, 2016, jointly sponsored by AIP Publishing and IEEE Magnetics Society.
2. Presented a poster entitled "Effect of Biquadratic Coupling on Current Induced Magnetization Switching in Co/Cu/Ni-Fe Nanopillar" in the **60<sup>th</sup> DAE Solid State Physics Symposium** held at Amity University U.P., Noida, Uttar Pradesh, India during December 21-25, 2015.
3. Presented a poster entitled "Impact of Biquadratic Coupling on Critical Current Density in Co/Cu/Ni-Fe Nanopillar" in the **International Conference on Condensed Matter and Applied Physics (ICC 2015)** organized by Govt. Engineering College, Bikaner, Rajasthan, India during October 30-31, 2015.
4. Presented a poster entitled "Spin Transfer Torque Switching in Pentalayer Nanopillar Having Two Pinned Layers with Biasing" in the **Physics and Applied Mathematics Researchers' Meet – 2015** held at Indian Statistical Institute, Kolkata, India during March 18-20, 2015.
5. Presented a poster entitled "Spin Transfer Torque Switching in Pentalayer Nanopillar" in the **Indo-Japan Workshop on Magnetism at Nanoscale (IJWMN-2015)** Organized by National Institute of Science Education and Research (NISER), Bhubaneswar, India during January 09-12, 2015.
6. Presented a poster entitled "Impact of orange peel coupling on magnetization switching in nanopillar" in the eighth **Conference on Nonlinear Systems and Dynamics (CNSD 2013)** Organized by Indian Institute of Technology(IIT), Indore, India during December 11-14, 2013.

## Participations in Seminars / Conferences / Workshop / Training Programmes

1. January 20, 2015: **International Workshop on Strongly Correlated Materials** Organized by Centre for High Pressure Research, School of Physics, Bharathidasan University, Tiruchirappalli, Tamilnadu.
2. December 08 - 20, 2014: **Science Academies' Refresher Course on Classical Mechanics and Electromagnetism** Organized by Department of Physics, Sri Dharmasthala Manjunatheswara College (Autonomous), Ujire , Karnataka.
3. September 15 - 17, 2014: **International Conference on Magnetic Materials and Applications (ICMAGMA 2014)** Organized by Department of Physics, Pondicherry

University, Puducherry.

4. February 24 - March 01, 2014: **NMI Workshop on Nonlinear Integrable Systems and their Applications** Organized by the Centre for Nonlinear Dynamics, School of Physics, Bharathidasan University, Tiruchirappalli, Tamilnadu.
5. January 27 - 31, 2014: **Training Programme on Research Writing** Organized by Centre for Technical Writing and Academic Writing, Bharathidasan University, Tiruchirappalli, Tamilnadu.
6. January 10 - 11, 2014: **National Educational Summit 2014 – Towards Educating Young India** Organized by Education Department, Government of Gujarat held at Mahatma Mandir, Gandhinagar, Gujarat.
7. January 11 - 14, 2013: **Conference on Condensed Matter and Biological Systems (CCMB13)** Organized by Department of Physics, Banaras Hindu University, Varanasi, Uttar Pradesh.
8. July 12-15, 2012: **Seventh National Conference on Nonlinear Systems and Dynamics (NCNSD2012)** Organized by Indian Institute of Science Education and Research (IISER), Pune, Maharashtra.
9. December 19-22, 2011: **Workshop on Theoretical Physics** Organized by the Department of Physics, Bharathiyar University, Coimbatore, Tamilnadu.
10. January 04 - 26, 2011: **DST-SERC School on Nonlinear Dynamics** Organized by the Centre for Nonlinear Dynamics, School of Physics, Bharathidasan University, Tiruchirappalli, Tamilnadu.
11. August 12 - 17, 2010: **ICM 2010 Satellite Conference on Integrable Systems and Geometry** Conducted by Dept of Mathematics, Pondicherry University, Puducherry.
12. December 08-14, 2009: **Second Science Conclave: A Congregation of Nobel Laureates** Conducted by Indian Institute of Information Technology, Allahabad, Uttar Pradesh.
13. May 25 – June 19, 2009: **Summer Training Programme in Physics** Organized by Department of Nuclear Physics, University of Madras, Chennai, Tamilnadu.

## Computer Skills

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**Operating System:** Linux (Ubuntu, Fedora), Windows

**Programming Languages:** FORTRAN

**Applications:** L<sup>A</sup>T<sub>E</sub>X, BibT<sub>E</sub>X, Gnuplot, GIMP, MS Office, OpenOffice, LibreOffice

**Specialized Software:** OOMMF, Matlab

## Languages

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**Tamil:** Read, Write & Speak

*Mother Tongue*

**English:** Read, Write & Speak

*Fluent*

## Co-Curricular Activities

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- Reviewer in Applied Physics Letters (AIP Publication).
- Served as a Treasurer of Physics Association for Creativity and Excellence (PACE) (2012-2013) in Bharathidasan University, Tiruchirappalli.
- Organized Teacher's Day Celebrations 2012, National Science Day celebrations 2013 & 2015 in School of Physics, Bharathidasan University with two other colleagues.
- Served as a Accounts Committee Member (2008-2009) in Post Graduation Hostel for Men in Bharathidasan University.
- Served as a Member in Accounts Committee (2012-2013) & (2015-2016), Hostel Rules and Regulations formation Committee (2015) & Web-maintenance Committee (2015-2016).
- Designed a Website for Physics Association for Creativity and Excellence (PACE) & for National Science Day Celebrations with Online Registration, Comments / Feedback facility.
- Served as the Class Representative in Under-Graduate, Post-Graduate & M.Phil Programme.

## Interests

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**Reading:** Reading Literature Books especially Novels, Biographies, and Political Essays

**Blogging:** Maintaining Educational Related Information Blog for the past 7 years and it crosses more than 4 lakh visits

## References

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### Supervisor

**Prof. M. Daniel**

Professor in Physics (Retd.)  
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Tiruchirappalli – 620 024,  
Tamilnadu, India.

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### Collaborator

**Prof. M. Lakshmanan**

Professor of Eminence &  
SERB Distinguished Fellow  
Centre for Nonlinear Dynamics  
School of Physics  
Bharathidasan University  
Tiruchirappalli – 620024  
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## Dept. Head

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### **Prof. K. Thamilmaran**

Professor & Head

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## Personal Details

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Father's Name	<b>Mr. P. Devarasu</b>
Mother's Name	<b>Mrs. D.Vijayalaxmi</b>
Date of Birth	<b>29.07.1987</b>
Age	<b>30</b>
Marital status	<b>Single</b>
Nationality	<b>Indian</b>
Permanent Address	<b>87, Mariyamman Kovil Street Iluppaiyur (Village) Thinnanur-Post Tiruchirappalli-Dt Pin- 621 006 Tamilnadu, India</b>


## Declaration

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I **D. Aravinthan** hereby declare that the above furnished details are true, complete and correct to the best of my knowledge and belief.

**Date:** October 30, 2017

**Place:** Tiruchirappalli



**(D. ARAVINTHAN)**