Curriculum vitae

Dr. Udit Narayan Pal
Senior Principal Scientist (CSIR-CEERI) & Professor (AcSIR)
Vacuum Electron Devices Development Group
CSIR-Central Electronics Engineering Research Institute,
Pilani, Rajasthan, India-333031
Phone:+91-1596-252224, +91-9772975628/6375272476
Fax: +91-1596-242393/242294
E-mail: paludit@gmail.com, udit@ceeri.res.in

- **Academic Qualifications:** B.E. (2003, E&C Engg., MMMUT, Gorakhpur), M.Tech. (2006, Microwave Engg., IIT, BHU), Ph.D. (2014, Plasma Physics, BIT, Mesra).

  Title of Ph.D. thesis: Analysis and Optimization of Discharge Parameters for Efficient Dielectric Barrier Discharge (DBD) based VUV/UV Sources

- **Areas of Research Interest:**
  - Dielectric Barrier Discharge (DBD) and cold atmospheric pressure plasma devices and technologies for food, agriculture and biomedical applications.
  - Mercury free VUV/UV excimer Sources for water, food and surface modification applications.
  - High power plasma switches (cold cathode Pseudospark Switch (PSS) and hot cathode Thyratron) for fast pulsed power applications.
  - High density and energetic short pulsed electron beam generation through gaseous discharges for microwave, Material and surface modification applications.
  - Portable and tunable extreme ultraviolet (EUV)/soft X-ray sources for surface modification of biomaterials and radiography.

- **Association for development of Technologies:** DBD based mercury free plasma UV-lamps for water purification, atmospheric pressure cold plasma sources (Jets and volume discharge), High power Thyratron Switches, High power Pseudospark switch (PSS), Plasma assisted compact microwave source 'PASOTRON', High current density plasma cathode electron (PCE) guns, and PS discharge based portable and tunable EUV/X-ray sources.

- **Association for Technology Transferred:** Large volume penning discharge source for VUV-spectrometer calibration, mercury free plasma UV-lamp for water purification, and 35kV/3kA Thyratrons for line type pulse modulator applications in LINACS.

- **Project Grants:** CSIR X/XI/XII FYP; CSIR-FBR, CSIR-ILP; BRNS-DAE; DST, SERB-DST, DRDO, BRFST-DAE; CSIR-DLR collaboration (***PI: 10 Projects, Co-PI:04, Member:03***)

- **Patents:**

1. N. Kumar, **U. N. Pal**, D. K. Pal, H. Rahaman, R. Prakash, "A Novel Sheet-beam Plasma Cathode Electron (SPCE) Gun and its Beam Diagnostic using Innovative Dielectric Charging Technique" **Granted Indian Patent; Patent No.: 359771, dated 28 Feb., 2021**.
   (***Application No.: 2017/DEL/2014A; Date of filing: 17th July, 2014***)
2. Ram Prakash, Pooja Gulati, U. N. Pal, et. al, "A novel dielectric barrier discharge (DBD) based portable UV/VUV source for water disinfection" **Indian Patent, Application No.**, **797/DEL/2015 dated 23/3/2015.**
3. R. P. Lamba , B. L. Meena, H. Rahaman, Niraj Kumar, U. N. Pal and Ram Prakash, "A 20 kV/20 kA Linear Aperture Radial Multichannel Pseudospark Switch (LARM-PSS) for High Current Applications" **Indian patent, Application No.: 1220/DEL/2015 dated 1st May, 2015.**

- **Papers Published:**

1. Varun, N. K. Sharma, **U. N. Pal**, " Design of Multi-gap Pseudospark Discharge Based Plasma Cathode Electron Source at Different Configurations of Electrode Apertures," IEEE Trans. Electron Devices vol., no., pp., 2021 (DOI: 10.1109/TED.2021.3108944).
2. N. K. Sharma, S. Misra, Varun, R. P. Lamba, Y. Choyal, and **U. N. Pal**, "Analysis of Discharge Characteristics of Cold Atmospheric Pressure Plasma Jet," IEEE Trans. Plasma Sci., vol.49 , no.9 , pp.2799-2805, 2021, (doi: 10.1109/TPS.2021.3106792).
3. A. Abhishek, N. Kumar, **U. N. Pal**, Bhim Singh, and S. A. Akbar, " Implementation of Trigger Unit for Generation of High-Current-Density Electron Beam," IEEE Trans. Electron Devices vol.68, no.7, pp.3582-3587, May 2021 (DOI: 10.1109/TED.2021.3079290).
4. A. K. Dhakar, S. K. Rai, V. K. Saini, S. K. Sharma, and **U. N. Pal**, " Simplified High Voltage Short Pulse Power Modulator for DBD Plasma Application," IEEE Trans. Plasma Sci., vol. 49, no. 4, pp.1422-1427, 2021, (doi: 10.1109/TPS.2021.3064894).
5. **U. N. Pal**, R. P. Lamba, Varun, B. L. Meena and K. Frank, "A Multigap Multiaperture Pseudospark Switch and Its Performance Analysis for High-Voltage Applications," IEEE Trans. Electron Devices vol. 67, no. 12, pp. 5600-5604, 2020 (doi:10.1109/TED.2020.3029022).
6. N. K. Sharma, Shikha Misra, Varun, and **U. N. Pal** " Experimental and simulation analysis of dielectric barrier discharge based pulsed cold atmospheric pressure plasma jet," Phys. Plasmas 27, 113502, 2020 (doi: 10.1063/5.0018901).
7. Varun, and **U. N. Pal**, "Impact of Irregular Electrode Apertures in Pseudospark Discharge Geometries for the Generation of High Density and Energetic Electron Beams", IEEE Trans. Electron Devices vol. 67, no. 5, pp. 2182-2187, 2020.
8. Varun, A. W. Cross, K. Ronald, and **U. N. Pal**, "PIC Simulation of Pseudospark Discharge Based Plasma Cathode Electron Source for the Generation of High Current Density and Energetic Electron Beam", IEEE Trans. Electron Devices vol. 67, no. 4, pp. 1793-1796, 2020.
9. Varun, H. K. Dwivedi and **U. N. Pal**, "Breakdown Characteristics of Triggered Pseudospark Discharge Based Multi-Gap Plasma Cathode Electron Source", IEEE Trans. Electron Devices, vol 65, no. 10, pp. 4607-4613, 2018.

10. G.D. Deepak, N. K. Joshi, Ram Prakash and **U. N. Pal**, "Electrical Characterization of Argon and Nitrogen based Cold Plasma Jet", Eur. Phys. J. Appl. Phys., vol. 83, no. 2, 20801, 2018.
11. Varun and **U. N. Pal**, "Investigation of Electron Beam Generation in Pseudospark Discharge-Based Plasma Cathode Electron Source", IEEE Trans. Plasma Sci., vol. 46, no.62, pp. 2003-2008, 2018.
12. Varun and **U. N. Pa**l, "PIC Simulation to Analyze Peak Electron Current Generation in a Triggered Pseudospark Discharge based Plasma Cathode Electron Source", IEEE Trans. Electron Devices, vol. 65, No. 4, pp. 1542-1549, 2018.
13. S. K. Rai, A. K. Dhakar and U. N. Pal, "A Compact Nanosecond Pulse Generator for DBD Tube Characterization", Rev. Sci. Instrum., 89, 033505, 2018.
14. R.P. Lamba, **U.N. Pal**, B.L. Meena, and Ram Prakash, "A sealed-off Double-gap Pseudospark Switch and Its Performance Analysis", Plasma Sources Sci. Technol., 27, 035003, 2018.
15. **U. N. Pal**, P. Shukla, A. S. Jadon, and N. Kumar, "Estimation of Beam and Plasma Parameters for Electron Beam Transport in Ion-Focused Regime", IEEE Trans. Plasma Sci., vol. 45, no.12, pp. 3195-3201, 2017.
16. R. Prakash, A. M. Hossain, **U. N. Pal**, N. Kumar, K. Khairnar and M. K. Mohan, "Dielectric Barrier Discharge based Mercury-free plasma UV-lamp for efficient water disinfection", Scientific Reports, 7, Article no.:17426, 2017.
17. N. Kumar, R. P. Lamba, A. M. Hossain, **U. N. Pal**, A.D.R. Phelps, and R. Prakash, "A tapered multi-gap multi-aperture pseudospark-sourced electron gun based X-band slow wave oscillator", Appl. Phys. Lett. 111, 213502, 2017.
18. N. Kumar, D. K. Pal, R. P. Lamba, **U. N. Pal**, and Ram Prakash. "Analysis of Geometrical Design Parameters for High Energy and High Current density Pseudospark Sourced Electron Beam Emission", IEEE Trans. Electron Devices, vol. 64, no.6, pp. 2688-2693, 2017.
19. N. Kumar, A. S. Jadon, P. Shukla, **U. N. Pal**, and Ram Prakash. "Analysis of Experimental Results on Pseudospark Discharge based Electron Beams with Simulation Model", IEEE Trans. Plasma Sci., vol. 45, no.3, pp. 405-411, 2017.
20. N. Khandelwal, **U. N. Pal**, R. Prakash and Y. Choyal, "Temporal evolution of electron beam generated Argon plasma in pasotron device", J. Phys.: Confe. Ser. 755, 012052, (4pp) 2016.
21. G.D. Deepak, N. K. Joshi, **U. N. Pal**, R. Prakash, "Electrical characterization of atmospheric pressure dielectric barrier discharge-based cold plasma jet using ring electrode configuration", Laser and Particle beams, vol 34, issue 4, pp. 615-620, 2016.
22. G. L. Vyas, Ram Prakash, **U. N. Pal**, R. Manchanda and N. Halder "Penning plasma based simultaneous light emission source of visible and VUV lights" Plasma Physics Reports, vol. 82, issue 6, pp. 601-609, 2016.
23. N. Kumar, D. K. Pal, A. S. Jadon **U. N. Pal**, H. Rahaman and R. Prakash, "A Multiple Gap Plasma Cathode Electron (MG-PCE) Gun and its electron beam analysis in self and trigger breakdown modes" Rev. Sci. Instrum., 87, 033503 (2016).
24. V. Pathania, D. K. Pal, B. L. Meena, N. Kumar, **U. N. Pal**, R. Prakash and H. Rahaman, "Switching Behavior of a Double Gap Pseudospark Discharge" IEEE Trans. on Dielectrics and Electrical Insulation, Vol. 22, Issue 6, pp. 3299-3304, December 2015.
25. R. P. Lamba, V. Pathania, B. L. Meena, H. Rahaman, **U. N. Pal**, and Ram Prakash "Investigations of a high current linear aperture radial multichannel pseudospark switch", Rev. Sci. Instrum. Vol. 86, 103508, 2015.

26. **U. N. Pal**, J. Prajapati, N. Kumar and R. Prakash "Simulation and experimental studies of 20 kV/200 A PCE-Gun for discharge current analysis", Indian J Phys, vol. 89, issue 9, pp. 951-956, 2015.
27. **U. N. Pal**, J. Prajapati, N. Kumar and Ram Prakash "Particle-in-cell simulation study of PCE-gun for different hollow cathode aperture sizes", Indian J. Pure and Applied Physics, vol 53, pp. 225-229, 2015.
28. N. Kumar, **U. N. Pal**, D. K. Pal, R. Prajesh and Ram Prakash, "Experimental Investigation of a 1 kA/ cm^2 Sheet Beam Plasma Cathode Electron Gun", Rev. Sci. Instrum. Vol. 86, 013503, 2015.
29. J. Jain, R. Prakash, G. L. Vyas, U. N. Pal, M. B. Chowdhuri, R. Manchanda, N. Halder, Y. Choyal, "Simultaneous estimation of plasma parameters from spectroscopic data of neutral helium using least square fitting of CR-model" J. Theor. & Appl. phys., vol. 9, issue 1, pp. 25-31, 2015.
30. P. Gulati, R. Prakash, **U. N. Pal**, S. S. Geetha and V. Vyas "Plasma Parameter Estimation in Capillary Single Barrier DBD Source using Space Resolved Plasma Spectroscopy and PIC Simulation" IEEE Trans. Plasma Sci., vol. 42, no.9, pp. 2266-2272, 2014.
31. P. Gulati, R. Prakash, **U. N. Pal**, M. Kumar and V. Vyas, "Ultraviolet-B radiation enhancement in dielectric barrier discharge based Xenon chloride exciplex source by air" Appl. Phys. Lett., vol. 105, 013505, 2014.
32. N. Kumar, N. Pareek, **U. N. Pal**, D. K. Verma, J. Prajapati, M. Kumar, B. L. Meena and R. Prakash, "Performance evaluation of self-breakdown based single gap plasma cathode electron gun" Pramana- J. Phys., Vol. 82, no. 6, pp. 1075-1084, 2014.
33. **U. N. Pal,** P. Gulati, R. Prakash, M. Kumar, V. Srivastava and S. Konar, "Analysis of Power in an Argon Filled Pulsed Dielectric Barrier Discharge" Plasma Sci. and Tech. vol. 1, no.7, pp. 635-639, 2013.
34. **U. N. Pal**, P. Gulati, N. Kumar, M. Kumar, V. Srivastava and R. Prakash, "Analysis of Discharge Parameters and Optimization Study of Coaxial DBDs for Efficient Excimer Light Sources" J. Theo. & Appl. phys., 6:41,pp.1-8, 2012.
35. **U. N. Pal**, N. Kumar, D.K. Verma, J. Prajapati, M. Kumar, V. Srivastava, H. K. Dwivedi and R. Prakash, "Development of Low Pressure High Current Plasma Cathode Electron Gun and Use of Associated Techniques" J. Theo. & Appl. phys., **6**:36, pp. 1-4, 2012.
36. P. Gulati, **U. N. Pal**, M. Kumar, Ram Prakash, V. Srivastava, V. Vyas, "Diagnostic of Plasma Discharge Parameters in Helium Filled Dielectric Barrier Discharge" J. Theo. & Appl. phys., **6**:35, pp.1-8, 2012.
37. R. Prakash, G. L. Vyas, J. Jain, J. Prajapati, **U. N. Pal**, M. B. Chowdhuri and R. Manchanda, "Development of large volume double ring penning plasma discharge source for efficient light emissions" Rev. Sci. Instrum. 83, 123502, 2012.
38. N. Kumar, D. K. Verma, J. Prajapati, M. Kumar, B. L. Meena, M. S. Tyagi, V. Srivastava and **U. N. Pal**, "Experimental Investigation of Pseudospark generated electron beam" J. Phys.: Confe. Ser. 390, 012073, (5pp) 2012.
39. P. Gulati, **U. N. Pal**, N. Kumar, V. Srivastava, R. Prakash and V. Vyas, "Pulsed and RF glow discharge in helium atmosphere" J. Phys.: Confe. Ser. 390, 012072, (6pp) 2012.
40. P. Gulati, **U. N. Pal,** R. Prakash, M. Kumar, V. Srivastava, and V. Vyas "Spectroscopic Diagnostic of Volume Discharge Arrangement of a DBD Source and Comparison with PIC Simulation Code," IEEE Trans. Plasma Sci., vol. 40. no.10, pp. 2699-2705, 2012.
41. D. K. Verma, **U. N. Pal**, N. Kumar, J. Prajapati, R. Prakash and V. Srivastava, "Investigation on electron beam parameters inside the drift region of plasma cathode electron gun," J. Phys.: Confe. Ser. 365, 012048, (4pp) 2012.

42. J. Prajapati, **U. N. Pal**, N. Kumar, D. K. Verma, R. Prakash and V. Srivastava "Comparative simulation studies of plasma cathode electron (PCE) gun," J. Phys.: Confe. Ser. 365, 012051, (5pp) 2012.
43. **U. N. Pal,** P. Gulati, N. Kumar, V. Srivastava and R. Prakash, "Multi-Switch Equivalent Electrical Model to Characterize Coaxial DBD Tube," IEEE Trans. Plasma Sci., vol. 40. no.5, pp. 1356-1361, 2012.
44. N. Kumar, **U. N. Pal**, D. K. Verma, J. Prajapati, M. Kumar, B. L. Meena, M. S. Tyagi and V. Srivastava, "Experimental Analysis of Pseudospark sourced Electron Beam," J Infrared Milli Terahz Waves, vol. 32, pp. 1415-1423, Sep. 2011.
45. **U. N. Pal**, P. Gulati, N. Kumar, M. Kumar, M. S. Tyagi, B. L. Meena, A. K. Sharma and R. Prakash, "Analysis of Discharge Parameters in Xenon Filled Coaxial DBD Tube," IEEE Trans. Plasma Sci .vol. 39. no.6, pp. 1475-1481, 2011.
46. **U. N. Pal,** M. Kumar, M. S. Tyagi, B. L. Meena, H. Khatun and A. K. Sharma, "Discharge analysis and electrical modeling for the development of efficient dielectric barrier discharge," J. Phys.: Confe. Ser.208, 012142, 2010.
47. B. L. Meena, S. K. Rai, M. S. Tyagi, **U. N. Pal**, M. Kumar and A. K. Sharma, "Characterization of high power Pseudospark Plasma Switch (PSS)," J. Phys.: Confe. Ser.208, 012110, 2010.
48. **U. N. Pal,** A. K. Sharma, J. S. Soni, Sonu Kr, H. Khatun, M. Kumar, B. L. Meena, M. S. Tyagi, B-J Lee, M. Iberler, J. Jacoby and K. Frank, "Electrical modeling approach for discharge analysis of a coaxial DBD tube filled with argon," J. Phys. D: Appl. Phys. vol. 42, 045213 (8pp) 2009.
49. H. Khatun, A. Mishra, M. Kumar, **U. N. Pal**, A. K. Sharma and P. K. Barhai, "Study of filamentary behavior in a coaxial dielectric barrier discharge lamp," Indian J. Pure and Applied Physics, vol 46, pp. 889- 892, 2008.
50. **U. N. Pal**, M. Kumar, H. Khatun and A. K. Sharma, "Discharge characteristics of dielectric barrier discharge (DBD) based VUV/UV sources," J. Phys.: Confe. Ser. 114, 012065, (7pp) 2008.
51. B. L. Meena, M. S. Tyagi, S. S. P. Rao, A. Mishra, H. Khatun, A. Jakhar, M. Kumar, **U. N. Pal** and A. K. Sharma, "Pseudospark Switch Development for Pulse Power Modulators," J. Phys.: Confe. Ser. 114, 012057, (7pp) 2008.
52. M. S. Tyagi, M. Kumar, B. L. Meena, A. Jakhar, A. Mishra, H. Khatun and **U. N. Pal**, "Development and characterisation of hydrogen reservoirs for thyratrons and copper vapour laser," J. Phys.: Confe. Ser. 114, 012033, (6pp) 2008.

- **Papers presented in International and National Conferences** :143

  (International Conferences: 46; National Conferences: 97)

- **Books Chapters:** Two book chapters have been published in New India Publishing Agency, New Delhi (ISBN: 978-93-83305-33-9) and Applied Academic Press, USA (ISBN: 9781771881272), respectively.

- **Invite Talks:** Delivered 23 invited talks/colloquium talks (Indian:18 and Abroad:5)

- **Visit Abroad:** Visited to University of Erlangen, Germany; University of Frankfurt, Germany; GSI, Darmstadt, Germany; University of Karlsruhe, Germany, University of Strathclyde, Glasgow, UK, and Orlando, Florida, USA.

- **Event Organizing Capacity:** Convener of one-day scientific meet on Plasma Assisted Devices (SMPAD-2010) on 22 October 2010 and Co-Convener of 2nd PSSI-Plasma Scholars' Colloquium (PSC-2013) & National Workshop on Plasma Devices Technology, July 22-24, 2013.

- **As Ph.D. Guide:** Currently supervising four PhD researchers and supervised two Ph.D. scholars.
- **As a Dissertation Guide:** Guided 11 M. Tech./MS students and 32 B. Tech./M. Sc. students for their project works.
- **GATE Exam:** Qualified with 98.62 percentile (AIR: 432) in 2003 and completed M. Tech. through GATE scholarship from IIT, BHU, Varanasi.
- **Management Capacity:**

  a) Manager of CEERI Vidya Mandir (CVM) Pilani**,** one of the best co- educational Sr. Sec. School affiliated to CBSE in Pilani.
  b) Playing different roles in national professional societies, chapters and institutional societies.
  c) Vice President, CSIR-CEERI Staff Club.
  d) Member Executive Committee of IEEE Rajasthan Sub-Section from Dec 2017.

- **International collaboration:**

  - Visited two times to University of Frankfurt/Erlangen, Germany to participate in the experimental programme on DBD based VUV/UV sources under CSIR-DLR Collaborative Program. Plays significant role in exploring the scientific collaboration between CSIR-CEERI and University of Strathclyde, Glasgow, UK on high power plasma filled microwave sources.

- **R&D Experience: 16** Years

  Working as scientist in various capacities at CSIR-CEERI, Pilani since January, 2005.

- **Awards and Honours:**
  1. Awarded **Raman Research Fellowship-2019-20** to work at University of Strathclyde, Glasgow, UK.
  2. Received **Foundation Day Award for the Recognition of Excellence in Research** at CSIR-CEERI for the **Year 2018** for the project work entitled "Pseudospark Discharged Electron Beam Driven Compact Plasma Assisted Slow Wave Oscillator" on 21st Sept. 2018**.**
  3. Awarded **INSA, India – RSE, Scotland, Exchange of Scientists Programme**, fellowship to Visit University of Strathclyde, Glasgow, Scotland during 7-22, July 2018.
  4. Received **CSIR Young Scientist Award-2015** in Physical Sciences (including instrumentation).
  5. Received **Buti Young Scientist award 2012.**
  6. Received **best paper award (2nd Prize)** in the theme Strategic Applications of Young Scientist' Conclave in "India International Science Festival" Dec. 2016.
  7. Received **3rd Prize** for paper presentation "First International Conference on Plasma Processing of Organic Materials and Polymers" Nov. 25-27, 2011, Kottayam Kerala.
  8. Received "**Bharat Jyoti Award**" India International Friendship Society in 2011.
  9. In addition to above awards, I have also contributed in the **9 research papers** which have been ***awarded best contributions*** in National and International conferences.

- **Membership of Professional Body/Academies:**

SN	Name of the Body	Membership Type
1.	Institute of Electrical and Electronics Engineers (IEEE)	Senior Member
2.	The institution of Electronics and Telecommunication Engineering , (IETE)	Life Fellow
3.	Vacuum Electron Devices and Applications (VEDA)	Life Fellow
4.	The National Academy of Sciences, India (NASI)	Life Member
5.	Plasma Science Society of India (PSSI)	Life Member
6.	Indian Vacuum Society (IVS)	Life Member
7.	The Indian Physical Society (IPS)	Life Member
8.	Vijnana Bharati (Vibha)	Life Member

(Udit Narayan Pal)