Current Position:

- Professor, Departments of Physics and Astronomy, University of Maryland, College Park
- Co-director, East West Space Science Center (**EWSSC**)

Education:

- B.Sc., Physics, University of Athens, Greece (1960)
- M.Sc., Nuclear Engineering, MIT (1965)
- Ph.D., Physics, University of Maryland (1968)

Society Elections:

- Fellow, American Physical Society (**APS**, 1975)
- Fellow, The Washington Academy of Science (**WAS**, 1979)
- Corresponding Member, International Academy of Astronautics, (**IAA**, 2004)

Authorship/Presentations:

- Published over 265 refereed scientific journals (see attached)
- 7 U.S. Patents and 1 pending patent (see attached)
- Over 140 invited lectures in National and International meetings (see attached)
- Edited two books (see attached)
- h-index50 (Google)

Other Honors:

- Chairman, Gordon Conference on Space Plasmas, 1979.
- Vice Chairman, Gordon Conference on Space Plasmas, 1978.
- Co-Chairman, International URSI-IAGA, Joint Group on “Space Plasmas”, 1975-1978.
- Member, APS Fellowship Committee, (1977-1980)
- Correspondent “Comments on Plasma Physics’ (1984-2000)
- Associate Editor, Journal of Geophysical Research (1981-1984)
- Editor, Plasma Physics Series, Cambridge University Press (1989-2000)

Service and Professional Membership:

- Member, Space Earth Science Advisory Committee (SESAC), (The Senior NASA Advisory Committee for the Office of Space and Applications), 1984-1987.
- Science Advisor, Office for Fusion Energy, Applied Physics Program 1978-1979
- Member, Space Science Board, Committee on Solar and Space Physics, National Academy of Sciences, 1983-1986
- Member Committee on the role of high power, high frequency band transmitters in advancing ionospheric/thermospheric research, National Research Council, National Academy of Sciences, 2013.
- Member, Keyworth Briefing Committee on Space Physics, 1984.
- Member, Research and Analysis Review Committee, NASA, 1984.
- Member, Maxwell Prize Committee for Plasma Physics, APS, 1988.

- Member, Executive Committee Division of Plasma Physics (DPP), American Physical Society (APS), 1985-1988.
- Member, Program Committee DPP-APS, 1985, 1986, 1989.
- Member, Space Station Planning Committee on Plasma and Fusion Physics, 1985.
- Member, Space Plasma Physics and Astrophysics Panel, Physics Review Committee, National Academy of Sciences, 1983-1984.
- Chairman, Steering Committee "Assessment of the Status of Solar Terrestrial Physics", 1982-1983.
- Member, N.A.S.A., "Space Plasma Theory Panel", 1978.
- Member, Overview Committee, D.O.E., A.P.P. 5 year plan, 1980, 1985.
- Member, N.A.S.A., Advisory Panel on "Computer Simulations in Space Plasma", 1977.
- AIP Physics New Committee, 1979.
- Member, Sigma-X, Honorary.
- National Academy of Science, NRC Postgraduate Advisor
- U.S. Delegate, I.A.E.A. Fusion Conference, 1971, 1974, 1976, 1978.
- Member, Working Group "Electron Beam Experiments on the AMPS Program".
- Organizing Committee, "N.C. Christophilos International Summer School and Conference on Plasma Physics", Spetses, Greece, 1977.
- Convener, "Symposium on Wave Instabilities in Space Plasmas", URSL XIX General Assembly, Helsinki, 1978
- Member, Program Committee "Mediterranean School on Plasma Astrophysics", 1985.
- Committee on Future Direction of HAARP, Chair Tony Tether, Director of DARPA (2001)
- Chairman, Committee on Scientific Program Using HAARP
- Member, Investigator Working Group the Tether Satellite Program
- Member, Council on Foreign Relations "The Study Group on United States Space Posture for 21st Century", 2003
- Member, Committee on Terrorism and the Nuclear Question, Eisenhower Institute, 2003
- Member Committee on the role of High-Power, High-Frequency-Band Transmitters in advancing Ionospheric/Thermospheric Research. National Research Council, National Academy of Sciences, 2013.

Educational Service:

- Supervised 17 Ph.D. theses. Currently supervising three more
- Supervised 25 post-doctoral associates.
- Member School of Computational Physics, Advisory Board, George Mason University, 2003
- Reviewer Interdisciplinary Ph.D. Program in the Physical Sciences George Mason University, 2003

Major Competitive PI Selections:

- NASA Space Plasma Physics Theory Program- $ 1.4 M (1980-1986)
- NASA International Solar Terrestrial Program – PI Theory & Simulations – $ 7.9 M (1990-2002)
- NASA Tethered Satellite Systems (TSS)- Theory and Simulations – $ 8 M (1987-1994)
- NASA CRESS – Theory and Simulations - $ 2.5 M (1989 – 1993)
- ONR – MURI on Radiation Belts - $ 7.5 M (2006-2011)
- AFOSR – MURI "Mobile HF Sources for Ionospheric Modifications" - $ 7.5 (2013-2018) [Co-PI]

Citations:
The 265 research articles published by Prof. Papadopoulos have been cited over 8000 times (Google Scholar). His h-index is 50.

Overview of Notable Research Accomplishments:
Prof. Papadopoulos research spans several decades and covers the following areas:

(i) The Physics of high Mach number collisionless shocks
(ii) Active experiments that use space as a non-linear plasma laboratory
(iii) Beam-plasma instabilities including non-linear stabilization, collapse and radiation signatures with application to type III radio-bursts and the aurora
(iv) Virtual low frequency antenna driven by modulated HF heating of the ionosphere
(v) Anomalous transport in the laboratory and space
(vi) Magnetospheric global space weather modeling and prediction
(vii) Laser plasma interactions and applications to switching, THz radiation and medical imaging
(viii) The physics of high altitude lightning

His research accomplishments include:

a) Initial prediction and demonstration of spontaneous magnetic fields (>MG) in laser produced plasmas
b) The first analysis of non-linear beam plasma interactions that includes strong Langmuir turbulence and radiation effects (Resolution of "Sturrock's dilemma")
c) First analysis of ionospheric generation of ELF/ULF waves by ionospheric heating that does not require the presence of electrojet currents
d) First self-consistent analysis of the Critical Ionization Velocity (CIV) effect
e) First resolution of the physics that allows high ($2<M_A<20$) and super-high ($M_A>20$) Mach number collisionless shock waves
f) First self consistent model of artificial ionization using high power ionospheric heaters
g) Comprehensive analysis of anomalous plasma transport effects in space plasmas
h) Introduction of 3D global MHD simulations with applications to space weather and major space missions

The Physics of High Mach Number Collisionless Shock Waves:
A critical plasma physics issue, since the discovery of the earth's bow shock in the late 50s, was the microphysics that allowed its existence in a collisionless environment. Early work focused on anomalous resistivity but this could not explain the observed shocks at Mach numbers above two. During the period 1979-1985, Prof. Papadopoulos led a group of theoretical/computational physicists and data analysts, that using satellite observation and newly developed hybrid codes provided the physics foundations of high Mach number collisionless shock waves that are currently used in magnetospheric physics and astrophysics. The work emphasized the critical role played by the ions reflected from the shock and of the ubiquitous magnetic overshoot in setting up the kinetic interactions,, necessary to produce quasi-stationary high Mach number shocks [Pub.72,82;cit.167,37]. An extension of this work was the physics of super-high Mach number shocks ($M_A>25$) such as the ones observed in supernova remnants. The model remains the standard model in astrophysics [Pub135; cit.140]. Prof. Papadopoulos overall work on collisionless shocks has been extremely influential as evidenced by the more than 1300 of citations of his work on the subject. It should be moreover noted that the use of major computations by his Space Plasma Physics group in 1978 was the first to introduce major simulation programs in space plasma physics.

Active plasma experiments in space:
Prof. Papadopoulos work has been extremely influential in the area of active plasma physics experiments, in which electron, ion and neutral beams, as well as high power radio waves were injected in space to study their interaction with the space plasma. In addition to participating in the experiments he developed key theoretical models that explored the physics of neutral gas-plasma interaction, including an understanding of Alfven's Critical Ionization Velocity (CIV) hypothesis [Pub.110], the theory of the Beam Plasma Discharge (BPD), the propagation of energetic ion beams in space and the physics controlling collisionless coupling of neutral gas with the magnetospheric plasma. He was selected as PI and participated in the design and analysis of NASA's Tethered Satellite System (TSS) mission, in which a 20 km conducting tether was released from the space shuttle upwards to study the interaction of high VxB driven voltage (5 kV) with the ionospheric magneto-plasma and determine its I/V characteristics (Classic Langmuir problem). More recently he focused on active experiments using high-power ionospheric heaters and he was instrumental in promoting the HAARP facility in Alaska that is currently the premier heater in the world. HAARP has been the first facility to produce artificial plasmas at altitudes between 150-280 km, with densities exceeding the plasma density of its natural ionosphere [Pub.261]. The new development has important implications in trans-ionospheric VHF/UHF and ground-to-ground HF communications and Over the Horizon Radar (OTH) applications.

Strong turbulence theory of beam-plasma interactions with applications to type III radio-bursts and the aurora:
Prof. Papadopoulos conducted numerous groundbreaking investigations in the area of electron beam-plasma interactions and their radiative manifestations. The original work was motivated by the so-called "Sturock's dilemma" related to Solar type III type radio bursts. Observations indicated that electron beams generated near the Sun were causing radiation in the plasma frequency and its harmonic while propagating over distances of 1 AU. Conventional quasi-linear beam-plasma instability theory predicted that will form a plateau and stop radiating within 20-50 km. To address the paradox he reformulated the basic weak turbulence beam-plasma theory [Pub.21, 27; cit.137, 108] introducing strong Langmuir turbulence effects and demonstrating that they would replace the exponential loss of energy due to instabilities by a low loss friction-like effect that allowed the beams to propagate over large distance while emitting the observed type III radiation. In addition to type III bursts the theory was applied and explained the reasons that relativistic beam heating of plasmas was extremely inefficient [Publ.II.15] and predicted that similar interaction will produce super-thermal tails in the auroral zone. The theoretical predictions were instrumental in guiding mission measurements such as the NASA ULYSSES and STEREO missions. The in situ measurements [Pub.203, 259] confirmed the theoretical model expanded in [Pub. 21,27]. A corollary of the analysis [Pub. 20] predicted that that strong Langmuir turbulence should be observed in the auroral regions and was the cause of auroral power law electron tails. These predictions were confirmed in a recent PRL [Isham et al., PRL, 2012] almost 50 years later. Prof. Papadopoulos papers in this area were cited over 1300 times.

Virtual Antenna (VA) at ULF/ELF/VLF frequencies Using HF Heating of the Ionosphere: At ULF/ELF/VLF (.01Hz-20 kHz) frequencies, traditional dipole antennas are extremely inefficient and require very long wires. Since the early 70s Prof. Papadopoulos has been exploring the possibility of taking advantage of the active properties of the ionospheric plasma (that supports currents systems known as electrojets and inverted density gradients) and using HF (3-10 MHz) heating to down-covert the HF waves to the ULF/ELF/VLF frequencies by linear or nonlinear plasma processes. The low frequency waves can then be injected in the earth-ionosphere waveguide and used for applications such as underwater communications [Patents 1,4,6] and underground imaging [Patent 2] or in the Radiation Belts (RB) where they can as whistler or Alfven waves where their can be used the physics of wave-particle interactions and possibly provide techniques that can reduce the flux of trapped energetic particles that are deleterious to lifetime of satellites. His work has been instrumental to the development of the HAARP facility in Alaska, the premier ionospheric heater in the world. The experiments verified the old concept, known as Polar Electrojet Antenna (PEJ) (refs) of modulating electrojet currents flowing in the plasma at 80-100 km altitudes. He, furthermore, developed and successfully tested a new technique, known as Ionospheric Current Drive (ICD) that does not rely currents, but drives a diamagnetic current by periodic heating the F-region. As a result Virtual Antenna using ICD can be placed anywhere is needed for RB or other applications. The success of these experiments led to a new MURI program initiated this year to construct small portable antennas with the University of Maryland as the leading institution. Novel techniques to explore the physics of wave-particle interactions in the RB are now possible using Virtual Antennas to inject whistler or Alfven waves in the RB and study the interaction physics using instruments on the numerous overflying satellites. The widespread interest in this new and innovative technique is evidenced by the 7 invited talks in international meeting he presented during the past year [Presentations 1,3,4,7-9]. His research in the area resulted in improved concepts on submarine communications and underground imaging for oil and mineral resources. Prof. Papadopoulos papers on the subject were cited more than 600 times.

Anomalous Transport:
Prof. Papadopoulos was a pioneer in using a combination of theory and simulations to develop anomalous transport coefficients for use in global models in space plasma physics settings, such as the auroral zones, reconnection, solar flares and shocks. Starting with extensive studies and particle simulations of various key instabilities, such as the Buneman, counter-streaming ion and lower hybrid instability he developed algorithms that allowed their effects to be modeled as transport coefficients in numerical and semi-analytic models. Anomalous transport has been shown to be an extremely important effect in understanding the resistivity and acceleration processes in the aurora [Pub.42; cit. 260] while his work on the lower hybrid turbulence [Pub. 37,49; it.165,174] has been critical in understanding and modeling reconnection and substorm physics. His papers in the area of anomalous transport and their applications have been cited over 1100 times.

Magnetospheric and Space Weather Modeling and Prediction:

In a competitive NASA procurement Prof. Papadopoulos was selected as the PI in charge of the Theory Investigation (> $8M) of the International Solar Terrestrial Program (ISTP), an over $2B multi-satellite mission (12 satellites), whose objective was to develop and test the first dynamic, self-consistent, quantitative, testable, global magnetospheric models, capable of cause and effect prediction. Under the direction of Prof. Papadopoulos the UMD/SPP group responded to the challenge by creating a sequence of data driven, dynamic models, from "Global MHD" to local hybrid that, using the satellite data as dynamic input, provided the first global 3D view of geospace, under dynamic substorm conditions with diagnostics capable of testing the models [Pub. 175]. The success of the dynamic models along the new visualization tools, led to the creation of the Center for Integrated Space Weather Modeling (CISM), an over $10M NSF initiative, to transition the models to Space Weather. Furthermore the "Global MHD" computational models form the cornerstone of the theory/modeling effort of to "Leaving With a Star" (LWS) the NASA multi-billion $ initiative following ISTP. The NASA administrator recognized Prof. Papadopoulos' technical leadership awarding him NASA's Group Achievement Award. Within the context of predictive Space Weather modeling Prof. Papadopoulos was the first to recognize that the magnetosphere behaves as far from equilibrium dynamical system and thus its behavior can be predicted by analyzing time series of magnetic indices measured on the ground or space [Pub. 146,163; cit.143,96]. The SPP group pioneered these techniques that are widely used today for Space Weather prediction. It should be further noted that the five students trained under the UMD/ISTP program are currently among the leaders of Space Weather and LWS effort.

Laser-Plasma Interactions and their applications:

Prof. Papadopoulos along with Dr. Stamper are considered the discoverers of spontaneously created MGauss magnetic fields in laser produced plasmas [Publ. 9; Cit. 433]. The discovery was sparked from his theoretical analysis indicating that the observed in the laboratory anomalous plasma coupling could be explained only by the presence of such fields. He then proceeded to develop a theoretical understanding of the process and participate in the experimental demonstration of the effect (Phys. Rev. Let, 26, 2012, 1971). This discovery has serious implications in laser fusion as well as in overall applications of laser-plasma interactions including recent proton acceleration studies. Hundreds of papers have subsequently demonstrated the effect and his original paper and considered the major impact it played in laser fusion and other laser-plasma applications. During the 90s Prof. Papadopoulos developed a number of fast switching [Patent 3] and THz generation applications based on the interaction of laser with semiconductor plasmas and the remote generation of controlled broadband radiation sources by using dual femtosecond/nanosecond sources. [Pubs]. He is currently working on the development of novel, table-top, single dose Positron Emission Tomography [PET] radio-pharmaceutical generators based on laser proton accelerators as replacement of the currently used cyclotrons [Patent 8].