

150th Anniversary

Nikola Tesla

The Man

Who Lit the World

International Conference

7 July 2006

Perth - Western Australia

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# 'NIKOLA TESLA THE MAN WHO LIT THE WORLD' CONFERENCE PROGRAM

Friday, 7<sup>th</sup> of July 2006

Perth Convention Exhibition Centre, Western Australia

8:00-9:00 Conference Registration

9:00-9:20 Opening Ceremony

9:20-10:30 Session A

1. Prof Dr Jasmina Vujic, University of Berkeley, California  
***Nikola Tesla: The Man Who Electrified the World***
2. His Excellency Milivoje Glisic, Ambassador of Serbia, Canberra  
***Nikola Tesla: Lonely Genius - Some Psychological Points***

10:30-11:00 Coffee Break

11:00-12:30 Session B

3. Dr R (Chandra) Chandrasekhar, University of Western Australia  
***Speculations on the Mind of Nikola Tesla***
4. Paul Pokorny, National Measurement Institute, Sydney  
***Tesla and priority in radio***
5. Luka Pravica, Department of Physics, University of Western Australia  
***Advancing Fluorescence in the modern era Tesla's legacy 150 years on***

12:30-13:30 Lunch

13:30-15:30 Session C

6. Professor David Blair, Department of Physics, University of Western Australia, Perth  
***The New Spectrum: Gravitational Waves***
7. Dr John Hartnett, Department of Physics, University of Western Australia, Perth  
***Dynamics of the universe explained without dark matter***
8. Professor Igor Bray, Physics, Murdoch University, Perth  
***Electron-atom collisions and their applications***
9. Dr John McFerran, Department of Physics, University of Western Australia, Perth  
***Sharp and Fast: The unexpected story of how ultra-fast laser pulses delivered precision optical frequency measurements***

15:30-16:00 Coffee Break

16:00-17:30 Session D

10. Dr Julian Rodrigues, Fremantle Hospital, Fremantle  
***TMS: From Magnetic Mysticism to Modern Medicine***
11. Howard Leibman, HeartWare Limited, Sydney  
***The HeartWare HVAD a life saving implantable electric motor***
12. Dr Halit Eren, Senior Lecturer, Curtin University of Technology, Perth  
***Wireless Instrumentations and Network***

17:30 Conference closing

## Session A: Paper A.1

### NIKOLA TESLA: THE MAN WHO ELECTRIFIED THE WORLD

Professor Jasmina Vujic,  
University of California in Berkeley; Tesla Memorial Society of New York Inc.

Nikola Tesla was born in 1856 in Smiljan, Lika. His father Milutin was a Serbian Orthodox priest, and mother Djuka a self-taught inventor of many household items. Tesla came to the USA in 1884 and became one of the greatest inventors in the World. Tesla was a visionary genius whose inventions established the basis for the widespread electrification and wireless communications across the Globe. In writings about Tesla, one often finds statements such as that he "invented the twentieth century" or "the twenty first century", or even that he "invented the future".

Tesla created the polyphase alternating current based system of motors and generators that remains at the heart of electric power generation to this day. Among the more than 700 of Tesla's other inventions/patents are the rotating magnetic field principle, polyphase alternating-current system, Tesla Coil, induction motor, wireless communication, fluorescent lights, use of high-frequency currents in medicine and remote control.

However, Tesla is still not recognized for many of his fundamental inventions. Such is the case of radio for which even the U.S. Supreme Court in 1943 determined Tesla as inventor. Tesla is one of only two Americans to have a unit of electrical measurement named in his honour.

In 1956, Tesla's peers at the Electro-technical Conference in Munich acknowledged his monumental contributions to science by designating his name to represent a unit of magnetic measurement: the "tesla" (T) became the Unit of Magnetic Flux Density in the MKS system. Throughout the entire history of electrical science only fifteen men worldwide have received this honour. The IEEE, which considers Tesla one of the 12 "apostles" of electrical science, continues to offer an annual prize in the field of power engineering in his name.

## Session A: Paper A.2

### LONELY GENIUS SOME PSYCHOLOGICAL POINTS

Milivoje Glisic,  
Ambassador of Serbia in Australia & New Zealand, Canberra

By documenting the particular experiences of Tesla's life, the article focuses on the different forms of his creative ("positive") misanthropy such as his sexual neutrality, solitariness, his permanent living in the hotel's room... There was only one great passion of Tesla's life the science, but also he had some transient youthful experiences with another dangerous passion gambling.

## Session B: Paper B.1

### SPECULATIONS ON THE MIND OF NIKOLA TESLA

Dr R (Chandra) Chandrasekhar, Adjunct Senior Lecturer School of Electrical,  
Electronic and Computer Engineering, The University of Western Australia

Nikola Tesla was a complex genius whose prolific mind produced many electrical marvels. In this paper, we focus on only four of his documented mental characteristics: (1) an extremely acute sense of hearing and sight; (2) a visualization so vivid as to mimic reality; (3) eccentricities of habit and behaviour; and (4) making grandiose scientific claims like the possibility of free energy that remain open until today. Each of these is examined in some detail, especially with respect to his creativity, and questions worthy of further investigation are posed. Finally, the idea of mental evolution, as proposed by R M Bucke, is put forward as a possible explanation for Tesla's prodigious and rare mind.

## Session B: Paper B.2

### TESLA AND THE ORIGIN OF RADIO

Paul Pokorny

National Measurement Institute, Sydney

Priority in radio is often taken to be 'proven' by the U.S. Supreme Court ruling of 1943, in favour of Nikola Tesla, over Marconi. Strictly speaking, the ruling is because of 'prior art', not only of Tesla, but also of others such as Lodge, Stone, Braun, Fessenden and Pupin. However, it should be noted that the question was never who invented radio, but whether the U.S. Government had infringed particular Marconi Co. patents.

The legal case, known as 'Marconi Wireless Telegraph Company of America v. United States, 320 U.S. 1 (1943)', ruled on alleged infringement of four Marconi Co. patents by the U.S. Government, for radio equipment built during the First World War and was the result of an appeal of an earlier (1935 - 81 Ct.Cl. 671) decision by the U.S. Court of Claims. Of the four patents, only two originated from Marconi, the other two were purchased, one from Oliver Lodge and the other from Fleming.

The lower court did find that one patent claim of one Marconi patent was infringed and ruled in Marconi's favour and damages were awarded, but after the later Supreme Court ruling, the company settled for a smaller amount, after a further appeal was disallowed. The Lodge patent was also found to be infringed by the lower court. The history of radio is littered with patent litigation.

The 1943 majority opinion, although upholding the earlier decision, was not unanimous and further analysis would be useful. The Supreme Court's ruling is long, complex, technically detailed and subtle in terms of the wireless principles and illustrates perhaps the limitations of at least some non-technical judges considering highly technical issues. The Court regarded useful, long-distance 'radio' as arising from four tuned circuits, i.e. two at the transmitter and two at the receiver, but if priority in radio was to be argued today, that definition alone may be contestable. That Marconi used 'Hertzian' waves and Tesla allegedly did not, was immaterial to the case. Tesla's patent No. 645,576, applied for September 2, 1897 and allowed March 20, 1900 was primarily intended for transmission and reception of significant amounts of energy, and it was stated that without modification, the equipment could be used for wireless communication.

It is a fact that Marconi, with his commercial drive and engineering tenacity, made communication, an affordable practical reality, but it is also a fact that he created such a radio-system, based on applying much work of others, including Tesla, which necessarily required invention or refinement in crucial engineering details for success. Many others were just behind Marconi. However, since 1891, and in much published form, in lectures, articles, the essential elements have been shown to be recorded and disseminated by Tesla, for the benefit of other workers in the field. Few workers publicised their work, for the benefit of others, more than Nikola Tesla.

Apart from the above-mentioned, many talented inventors, scientists, engineers and technicians developed what we now call radio, including Armstrong, Popov, Hertz, Maxwell, Slaby, von Arco, Zenneck, etc. The resolution of the priority debate may never be resolved for some who feel that this question needs to be answered, but the 1943 ruling remains an impartial argument in favour of the prime significance of Nikola Tesla and his place in this most competitive field of endeavour, an argument which is hard to refute.

## Session B: Paper B.3

### ADVANCING FLUORESCENCE IN THE MODERN ERA - TESLA'S LEGACY 150 YEARS ON

Luka Pravica,

CAMSP, Department of Physics, University of Western Australia, Perth

Less known Tesla's inventions of phosphorescent lights and his improvements to the fluorescent lights have become everyday reality. For example TV and computer CRT displays use synthetic fluorescent minerals to produce the phosphor colour dots that we see and neon lights brighten up our lives every day and night.

This talk will give a short historical and technical overview of fluorescent and phosphorescent lighting sources from Tesla's days until present. A brief introduction into quantum world of creation of light by the atomic transitions will be given. Moreover, the talk will highlight the advances into the next generation fluorescent lighting which replaces mercury with zinc. This is an important step which will lead to a reduced impact on the environment as mercury has toxic properties on life. This new development is strongly dependent on good theoretical models of discharges and the guidance and testing of the theory by experiments, as for example done at University of Western Australia (experimental) and Murdoch University (theoretical). In experimental studies spin-polarised electrons were used to unmask spin-dependent interactions (electron exchange and the spin-orbit interaction) from the usually much stronger Coulomb interactions. Improved measurement techniques have enabled unprecedented statistical accuracy in this type of experiments and allowed observation of very small spin-dependent resonant effects.

## Session C: Paper C.1

### THE NEW SPECTRUM: GRAVITATIONAL WAVES

Professor David Blair

Department of Physics, University of Western Australia, Perth

Gravitational waves were predicted less than 30 years after electromagnetic waves were first harnessed by Heinrich Hertz. Today the spectrum of gravitational waves has been explored theoretically, but direct detection has still not occurred. A new generation of detectors has been observing for more than half a year, but these can only detect large rare signals. The next generation of gravitational wave detectors, dubbed Advanced detectors will go into operation in the next decade. These detectors are almost certain to detect frequent events and allow the first exploration of the universe in this new spectrum. A large scale detector is planned for Western Australia.

## Session C: Paper C.2

### DYNAMICS OF THE UNIVERSE EXPLAINED WITHOUT DARK MATTER

Dr John Hartnett

Department of Physics, University of Western Australia, Perth

The problem in explaining the dynamics of sources in the cosmos is not new to physics and has often led to the claim of the existence of dark matter and now dark energy. The cosmology of Prof. Moshe Carmeli has been applied to the expanding universe and it has been found that the distance-redshift relation will fit the data of the high-z supernova teams, from which it was first discovered that the universe is accelerating, without the need for either dark matter or dark energy. Also when applied to the observed speeds of gases and stars in the arms of spiral galaxies it is no longer necessary to invoke dark matter to explain their apparent anomalous dynamics. An analysis is presented showing the new theory can indeed describe the observed motions in the Universe based on the properties of the metric alone.

## Session C: Paper C.3

### ELECTRON-ATOM COLLISIONS AND THEIR APPLICATIONS

Igor Bray,

Professor of Physics, Murdoch University, Perth

Tesla's main contributions were in areas associated with electricity. This is mediated by electrons moving through space. As they do so they collide with atoms. Sometimes these atoms are parts of wires or surfaces, and sometimes they are parts of molecules or individual atoms in the gaseous phase. To understand electron-atom collisions requires the knowledge of quantum mechanics when applied to few-body systems. The simplest prototype, electron-hydrogen collision system, involves just three particles, two electrons and a proton. Yet this apparently simple system defied quantitative understanding until the early 1990s. We were at the forefront of developing a new computational theory for electron-atom collisions, now known as the convergent close-coupling (CCC) theory. It has proved to be the most general approach to electron-atom collisions that is valid for scattering and ionising collisions at low through to high electron energies. The talk will give a brief historical overview of the field and show how a solution of a small fundamental problem has resulted in enormous number of applications in diverse fields such as astrophysics, fusion, lighting, matter-antimatter interactions, plasma processing and displays.

## Session C: Paper C.4

### THE RAINBOW COLOURED COMB: BRIGHTENING UP THE LIFE OF A FREQUENCY METROLOGIST

Dr John McFerran

Department of Physics, University of Western Australia, Perth

A dramatic breakthrough occurred at the turn of this century when ultrashort pulsed lasers combined with spectral enhancement techniques that permitted the counting of light-cycles anywhere in the visible range of the electromagnetic spectrum. The attributes of this so-called *frequency comb* extend beyond making frequency measurements: one can manufacture spectrally pure signals for use in atomic spectroscopy, either in the optical or microwave frequency domains. In optical atomic clocks, where such pure signals are employed, the frequency comb also acts as a means of disseminating the clock signal. Furthermore, the combs are used as means of comparing the performance of state-of-the-art clocks that lie in the visible, as well as comparing optical clocks to microwave clocks.

This talk will give an overview of the recent revolution that has occurred in frequency metrology, as well as discuss further afield applications of the frequency comb, including the probing of electron dynamics in atoms. I will also address future trends of frequency combs: will they become more user friendly and versatile?

I would like to have claimed that the research here involves electromagnetic frequencies several 100 million times greater than in Tesla's time. But, Tesla had his finger in many research pies, including light. Whatever the differences, science is just as much fun now as it was 100 years ago, and hopefully some of the current excitement will be portrayed in this talk.

## Session D: Paper D.1

### TMS: FROM MAGNETIC MYSTICISM TO MODERN MEDICINE

Dr Julian Rodrigues,  
Fremantle Hospital, Fremantle

Magnetic brain stimulation has its origins in the late 19<sup>th</sup> century when French physicist and physician D'Arsonval began using technology developed by Tesla to study the effects of high frequency currents on the nervous system. It was not until 1985 that the technology matured, and Transcranial Magnetic Stimulation arrived, allowing painless activation of the motor area of the brain for the first time. It immediately became an indispensable tool in studying how the central nervous system controls normal movement, and gave new insights into diseases such as epilepsy, stroke and Parkinson's disease. Over 3000 papers have now been published on aspects of TMS, and its use has widened to the study of diseases as varied as schizophrenia, tinnitus, depression and chronic pain.

As well as exploring brain function, TMS can *alter* brain function if trains of low or high frequency stimulation are applied. Its potential as a therapy is only beginning to be explored, and though the field is evolving rapidly there are still no definitive clinical applications of the technique.

The talk will cover historical aspects of TMS, highlight how TMS has improved our understanding of cerebral function, and present data on its therapeutic successes and failures to date.

## Session D: Paper D.2

### THE HEARTWARE HVAD A LIFE SAVING IMPLANTABLE ELECTRIC MOTOR

Howard Leibman,  
HeartWare Limited, Sydney

Magnetic induction is at the core of a vast array of medical technologies, widely used in both diagnostic and therapeutic applications. One such application is the emerging use of permanently implantable rotary blood pumps for treating patients with advanced heart failure. The latest generation of these Ventricular Assist Devices (or "VAD's") represent the cutting edge of medical technology and the culmination of many years of refinement in induction motor design.

HeartWare has recently begun a clinical trial for its lead device, the HeartWare Ventricular Assist Device (or "HVAD"), the smallest full-output blood pump in the world today. The HVAD is a centrifugal pump implanted directly into the apex of the patient's left ventricle. The pump is powered via a driveline that is tunnelled through the patient's abdominal wall and connected to a belt-worn battery pack and controller. Motor stators within the pump housing induce a magnetic field which interacts with a series of permanent rare-earth magnets in the pump's impeller, causing it to rotate and producing a forward flow of up to ten litres of blood per minute. The impeller, which is the only moving part within the device, is completely suspended within the pump housing through a combination of magnetic and hydrodynamic forces. The absence of internal mechanical bearings results in the device being largely "wearless", giving rise to long term expected durability and eliminating any mechanical damage to the blood.

Some ten million people around the world suffer heart failure, with approximately one million at the "end stage" of the condition. With only 3,000 donor hearts available each year and with no effective medical therapy, heart failure is today one of the major unmet medical needs of the western world. With the introduction of technologies such as the HeartWare HVAD, the implant of a mechanical circulatory assist device may soon become the "gold standard" treatment for this debilitating and ultimately fatal condition.

## Session D: Paper D.3

### WIRELESS INSTRUMENT NETWORKS DESIGN AND APPLICATIONS

Dr. Halit Eren  
Curtin University of Technology, Perth

Wireless technology is making revolutionary contribution to our better standards of living. For the industrial applications of this technology, the presenter will highlight some of the important issues in the design and application of wireless instrumentation systems. It is very likely that wireless technology will be replacing their wired counterparts in the very near future.

The presenter will show that single-chip IC sensors, System-on-Chips (SoCs), built-in-tests (BITs), and Programmable System-on-Chips (PSoCs) are changing conventional instruments and instrumentation systems into modern devices with characteristics of small features, compact in signal processing, flexible in design and applications, and easily networkable. Coupled with the recent technological progress in RF communications, these devices are finding wider applications rapidly replacing traditional instruments and instrumentation systems. Apart from the conventional telemetry, the new wireless instruments can be configured to operate for short distance, medium distance and long distance applications by using conventional networking techniques, including the use of internet technology. The immense market potential of wireless instruments is well understood by many companies and they are concentrating on their products for better interoperability features. Nevertheless, there is a war taking place for the dominance of protocols and communication standards as applied to wireless instruments. Despite, the early setbacks, the Bluetooth and Wi-Fi technologies appear to be finding wider acceptance among the consumers. In addition, the academia is concentrating more on the advanced design and implications of this technology.

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