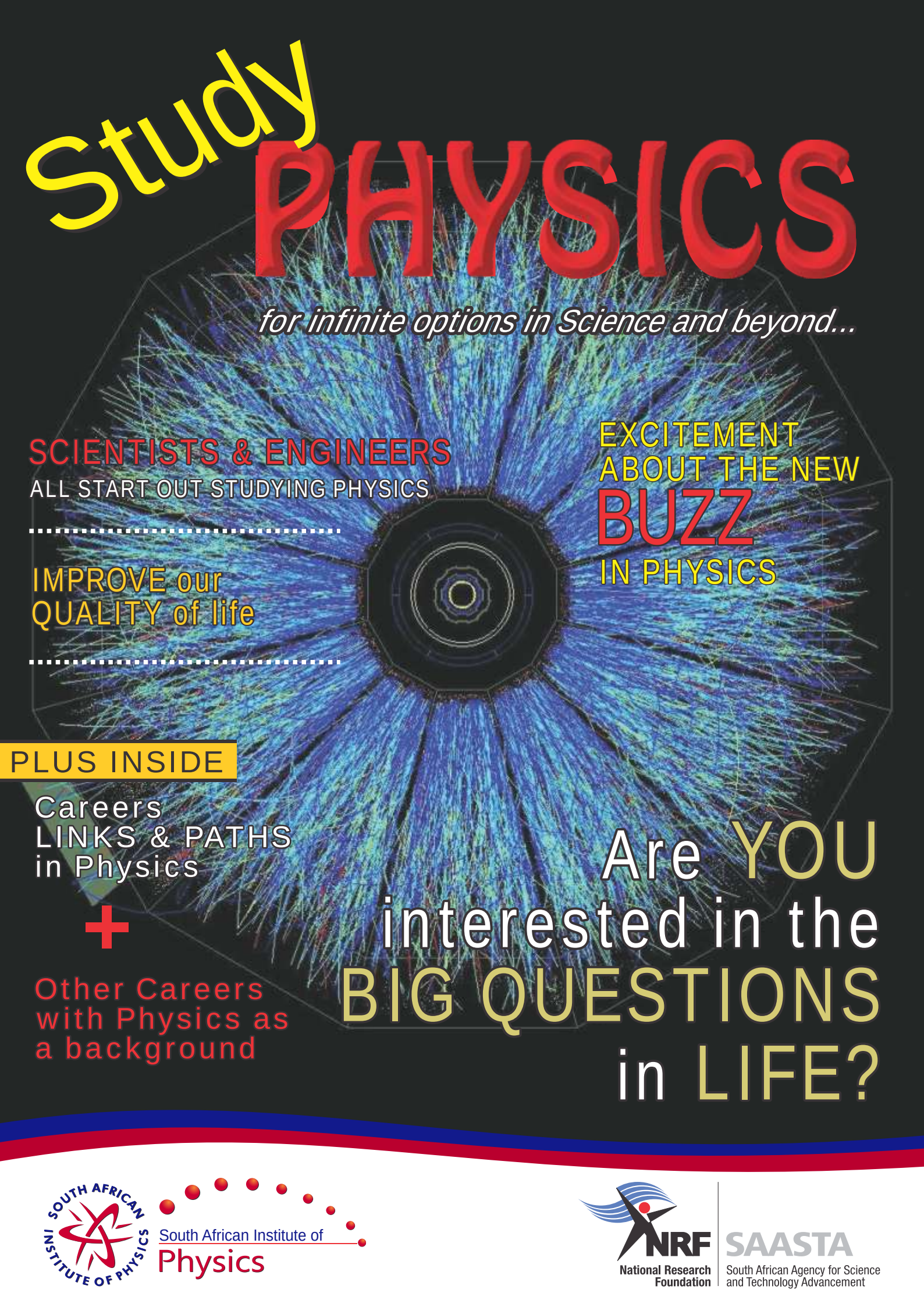
Study PHYSICS

for infinite options in Science and beyond...



SCIENTISTS & ENGINEERS
ALL START OUT STUDYING PHYSICS

IMPROVE our QUALITY of life

EXCITEMENT ABOUT THE NEW BUZZ IN PHYSICS

PLUS INSIDE

Careers
LINKS & PATHS
in Physics

+

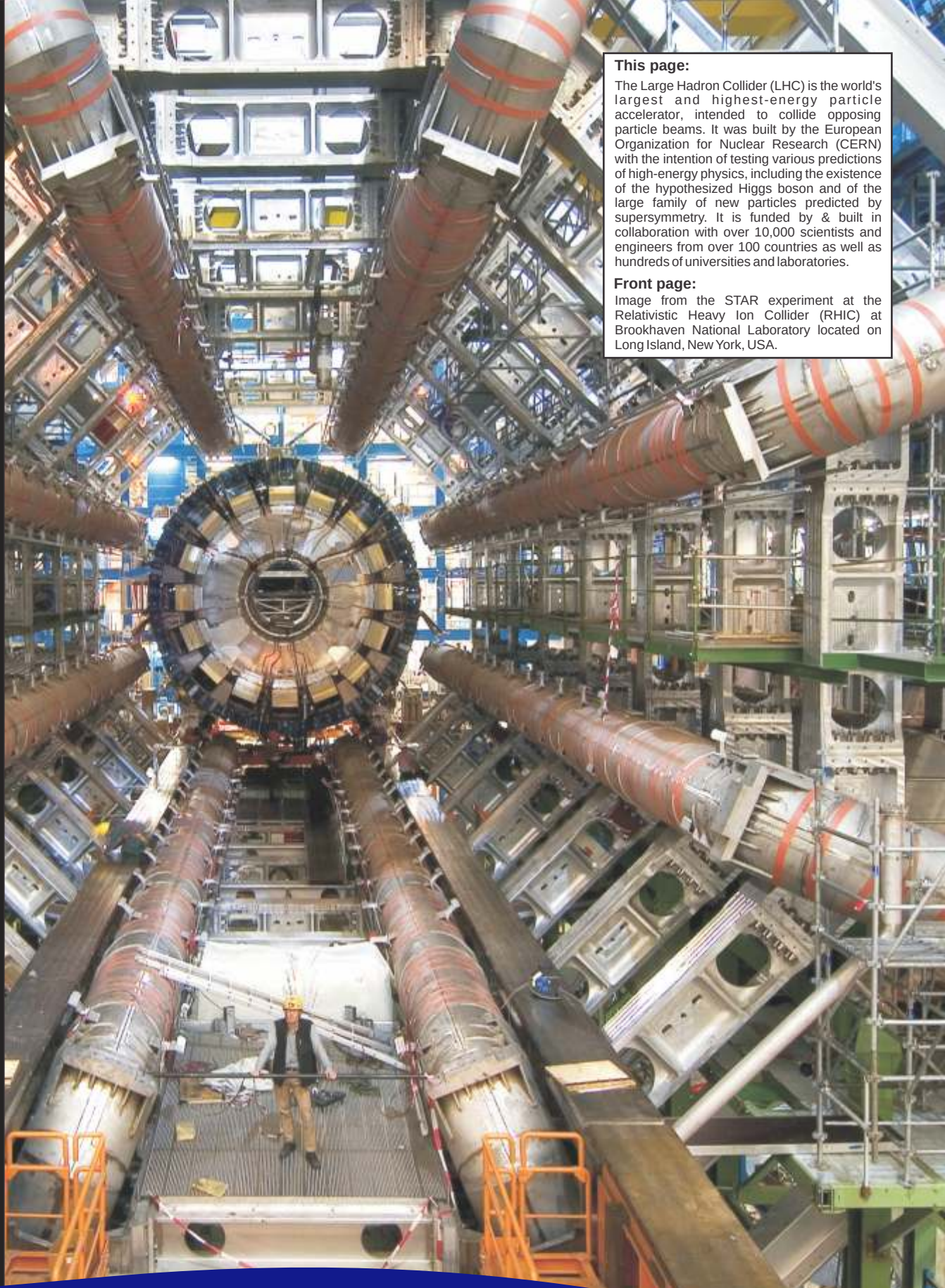
Other Careers with Physics as a background

Are YOU interested in the BIG QUESTIONS in LIFE?

South African Institute of Physics

NRF National Research Foundation | SAASTA South African Agency for Science and Technology Advancement

FAST FORWARD INTO THE FUTURE



This page:

The Large Hadron Collider (LHC) is the world's largest and highest-energy particle accelerator, intended to collide opposing particle beams. It was built by the European Organization for Nuclear Research (CERN) with the intention of testing various predictions of high-energy physics, including the existence of the hypothesized Higgs boson and of the large family of new particles predicted by supersymmetry. It is funded by & built in collaboration with over 10,000 scientists and engineers from over 100 countries as well as hundreds of universities and laboratories.

Front page:

Image from the STAR experiment at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory located on Long Island, New York, USA.

SOUTH AFRICAN INSTITUTE OF PHYSICS

South African Institute of Physics

NRF National Research Foundation

SAASTA South African Agency for Science and Technology Advancement

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EDITORIAL INFO

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SAASTA INFO

The South African Agency for Science and Technology Advancement (SAASTA) is an agency of the National Research Foundation (NRF) and aims to advance public awareness, appreciation and engagement of science, engineering and technology in South Africa.

The NRF is the key public entity responsible for supporting human resource capacity for research, technology and innovation development in the fields of science and technology.

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SAIP INFO

Mission: To be the voice of Physics in South Africa

The South African Institute of Physics (SAIP) is a non-profit, voluntary and professional physics society that was established in 1955. SAIP has a membership of over 600 made up of professionals, academics and students. Over 10% of the membership are in other African countries and further abroad. SAIP is dedicated to increasing the understanding, study and application of physics in South Africa.

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OVERVIEW OF PHYSICS

PHYSICS...

...is the study of the laws that govern the universe. A PHYSICIST tries to answer questions like:

- Why is the sky blue?
- Why do x-rays shine through the body?
- What keeps an aeroplane in the air?

Physics forms the basis of all physical sciences. The development of radios, computers, cars, planes, TV, electricity, x-rays & radiotherapy, space travel, lasers, telephones can all be linked to physics.

The field of physics can be divided into three types:

1. EXPERIMENTAL AND OBSERVATIONAL PHYSICS...
   ...consists of careful and exact measurements of phenomena to either test existing theories or to gather new information.

2. COMPUTATIONAL PHYSICS...
   ...is sandwiched between Experimental Physics and Theoretical Physics, and involves the practical use of computers in solving physical problems of interest. There are many problems that are not solvable analytically, and which may not be accessed or controlled experimentally - computer simulations are now an established means studying such systems.

3. THEORETICAL PHYSICS...
   ...involves the formulation of physical laws that govern nature, to try to explain the results of experimental observations and to determine a relationship between different phenomena.

Experimental and theoretical physics go hand-in-hand; without one, the other is useless. The theoreticians need the experimentalists' data and the experimentalists need the theoreticians to understand the data or to know what data to collect.

SKILLS GAINED IN PHYSICS TRAINING

Physics is about solving problems and understanding how the world works, and so physicists are brilliantly equipped to deal with all sorts of issues, from technological challenges to complex strategic planning. Studying physics gives someone a range of technical skills that relate to different areas such as astrophysics, electronics, particle physics, electromagnetism, quantum and classical mechanics, statistical physics and thermodynamics, wave phenomena and the properties of matter.

Physics courses also allow a person to develop numerous transferable skills that are valued by employers. These include:

- a practical approach to problem-solving, often using mathematical formulation and solution;
- the ability to reason clearly and to communicate complex ideas;
- IT and self-study skills;
- investigative and experimental skills.

Many employers are attracted to recruiting physics graduates because they have a good mix of technical skills, such as a high level of numeracy and mathematical modelling, together with research-related skills and good problem-solving and analytical skills, including data analysis and critical appraisal.

SOME SUB-FIELDS OF PHYSICS

Field of physics	...is the study of
Applied Physics	the application of knowledge gained in physics to other areas e.g. engineering (in the design of better power stations, cars, fridges, etc.), telecommunication, mining, etc.
Astronomy and Astrophysics	stars, planets, galaxies, etc.
Bio, medical & health Physics	the application of physics to molecular biology & diagnostics and therapy
Computational Physics	writing computer code and developing computational algorithms to efficiently solve physical problems of interest
Cosmology	the theory of the universe
Electromagnetism	magnetic forces produced by electricity
Environmental Physics	the principles of physics to problems in the natural environment
Fluid Mechanics	fluids at rest or in motion
Geophysics	• the magnetic structure of the earth • ocean currents • geo-processes • mineral exploration
Mechanics	moving bodies
Meteorology	atmospheric phenomena, especially for forecasting the weather
Nuclear, particle and radiation Physics	• the properties of atomic nuclei & elementary particles • radiation and radioactive materials
Oceanography	ocean currents
Optics	the properties of light (how light is generated, transported, reproduced and observed)
Physics Education	physics and how it is taught
Plasma and Space Physics	• nuclear fusion as a source of energy • the interaction between the solar wind and the earth's magnetosphere
Quantum Mechanics	the theory that assumes that energy exists in discrete units. It provides the key to understanding many aspects of the structure and behaviour of atoms and molecules that cannot be understood on the basis of the older theories of mechanics and electromagnetism.
Relativity	the theories of relativity. The **special theory of relativity** is based on the principle that all motion is relative and that light has a constant velocity. The **general theory of relativity** extends the theory to gravitation and accelerated motion.
Solid-state Physics and materials science	properties of solids such as metals, semiconductors, ceramics
Spectroscopy	• the properties of atoms • molecules by the analysis of light radiated or reflected by atoms • the use of spectroscopy as an analytical tool to determine trace elements
Thermodynamics and Statistical Physics	the relationship between heat and other forms of energy

CAREER PATHS IN PHYSICS

Academic Career Path - University / Major Research Facility

Nature of the work:	Lecturing and Research
Main qualities:	Good command of English and the language of instruction, research aptitude, usually also soft skills
Job opportunities:	Universities, Technikons
Career Path:	Start at the lecturer level, progress to Senior lecturer / Professor
Salary range:	R300k - R700k
Qualifications:	PhD or on track for a PhD

Business Career Path - Industry, Corporate

Nature of the work:	Contract research, process management, project management, patent law
Main qualities:	Good command of English, research aptitude, management ability, usually also soft skills
Job opportunities:	Manufacturing Industry, high level management consultancy services, financial services
Career Path:	Start at the junior level, progress to management
Salary range:	R300k - R2M
Qualifications:	Hons, MSc, PhD plus usually a business qualification (en route), Legal qualification necessary in addition for patent law

Entrepreneurship Career Path - Various

Nature of the work:	Product Development, patents
Main qualities:	Innovative, applied and ability to work cross-disciplinary
Job opportunities:	Self-employed, industry, commercial
Career Path:	Start at the junior level, progress to management, lead inventor, chief technologist
Salary range:	R200k - R700k (plus additional income from patents)
Qualifications:	Hons, MSc, PhD plus a business qualification (en route).

Research Policy and Management Career Path - Government

Nature of the work:	Policy research and development, synthesis
Main qualities:	National and global perspective, generalist, usually also soft skills
Job opportunities:	**G**overnment institutions
Career Path:	Start at the junior level, progress to management
Salary range:	R300k - R700k
Qualifications:	Hons, MSc, PhD plus policy / administration qualification (en route)

Study PHYSICS

for infinite options in Science

SPACE

astronaut
astronomer
cartographer
climatologist
instrumentation technologist
test engineer
satellite engineer
space scientist
meteorologist

Meteorology is the interdisciplinary scientific study of the atmosphere that focuses on weather processes and forecasting. Variables which are studied are temperature, air pressure, water vapor, and the gradients and interactions of each variable, and how they change in time. Meteorology has application in many diverse fields such as the military, energy production, transport, agriculture and construction.

RESEARCH

laser scientist
astrophysicist
space geodesist
astromoner
material scientist
nuclear scientist
partical physicist
theoretical physicst

Laser Scientists can work on many levels and usually are involved in inter-disciplinary projects. Research can be done on new laser material, laser development, as well as the applications and research in which we utilise lasers: from probing how certain chemical reactions occur, measuring the distance to the Moon to developing new treatments for cancer.

Role Model

Jeetesh Keshaw

Qualifications

In 2008, M.Sc., from Department of Nuclear Science and Engineering at UNW
In 2004, M.Sc., from Nuclear Physics at WITS

Career

Started 2005 at Pebble Bed Modular Reactor in Nuclear Engineering Analysis - RDFM as "Senior Fission Product Release Analyst"
Started 1999 at South African Nuclear Energy Corporation in Radiation Utilisation - Nuclear Technology as "Scientist - Small Angle Neutron Scattering"

Survey

Why did you originally choose to study physics at university?
I loved physics and the answers it provided to many questions people often ponder about.

What made you choose a career in industry rather than a career in academia?
Industry provides the opportunity to solve problems that would yield immediate application to the world, as well as a better salary.

Is there a particular contribution in industry that you are especially proud of and that you attribute to your training in physics?
Yes, my position sensitive neutron detector built from machined components, which is still in use today.

How does your physics training help with your career?
It helps mainly from a problem solving perspective. Much of the concepts I currently develop have long surpassed the scope of studies presented during my training.

What advice do you have for physics students thinking of embarking on a similar career?
Try to remain in the technical domain and focus on experimental work, as this is where there is a large and growing shortage of physicists.





CAREERS WITH PHYSICS AS A BACKGROUND

If you feel that a career IN physics is not for you then you should still consider taking physics as a subject at school and during your first year at university.

What Careers are open to you if you study PHYSICS?

These are some examples of where physics can enhance your career:

SECTOR	CAREER	POSSIBLE EMPLOYER
Basic Research	Universities, Technikons, National Laboratories, Industrial & Private Laboratories	HMO, iThemba LABS, CSIR, NECSA, De Beers, Element Six, Eskom, Universities
Engineering	Electronic, Biomedical, Mechanical, Computer, Civil, Chemical, Environmental, Aerospace	Industry, CSIR, Samsung, AEG, Philips
Communication	Telecommunications, Television, Image Analysis, Video Recording, Photography, Laser Technology	Telkom, SABC, newspapers, MTN, magazines, Vodacom, MWeb
Medical & Biological	Biophysicist, Radiation Oncology, Magnetic Resonance Imaging, Radiation Protection, Nuclear Medicine, Diagnostic Instrumentation, Medical Physicist	Hospitals, iThemba LABS, MRC, CSIR, ESKOM, SABS
Computer Science	Graphics, Software, Design, Peripherals, Modelling, Programming, Artificial Intelligence, Data Processing, Computer Games	Universities, Industry, Games Programming, Simulator, Development, HP, Microsoft
Industry	Metallurgy, Laser Technology, Textile & Clothing, Food, Semiconductors, Energy, Computers, Electrical, Materials, Agriculture Construction, Fuel, Transportation	Industry, NECSA, CSIR, ESKOM, ARC, De Beers, Element Six
Environmental Science	Noise Control, Pollution Control, Conservation, Radiation Protection, Environmental Monitoring	CSIR, ESKOM, South African National Parks, mining industry, chemical industry, local government
Education	Lecturer, Teacher, Policy Maker	Colleges, Universities, Technikons, High Schools, Primary Schools
Military	Lecturer, Researcher, Technician, Scientific Advisor	South African Department of Defence
Space & Earth Sciences	Astronomy, Space Technology, Geophysics, Geology, Meteorology, Atmospheric Sciences, Energy & Resources, Ocean Sciences	SAAO, HartRAO, SAWB, IMT, ESKOM, Universities, De Beers, Anglo
Consulting	Industry, Government, Military	Andersen Consulting, Deloitte and Touche, Financial Institutions
Non-technical	Law, Administration, Business, Journalism, Museums, Sports, Accounting, stock exchange, Marketing, Art, Financial services, Actuarial science	Museums, newspapers, magazines

ABBREVIATION	DETAILS
ARC	Agricultural Research Council
HartRAO	Hartebeesthoek Radio Astronomy Observatory
HMO	Hermanus Magnetic Observatory
IMT	Institute for Maritime Technology
iThemba LABS	iThemba Laboratory for Accelerator Based Sciences
MRC	Medical Research Council
NECSA	South African Nuclear Energy Corporation
SAAO	South African Astronomical Observatory
SABS	South African Bureau of Standards
SAWB	South African Weather Bureau

Industry / Wealth

aeronautical engineer
patent engineer
biotechnologist
brewing technologist
building technologist
agricultural engineer
colour technologist
computer-aided designer
cyberneticist
design engineer
factory inspector
financial analyst
food scientist
industrial designer
investment banker
mechanical engineer
research scientist
chemical engineer

A **patent engineer** or **patent scientist** is a patent law professional that is typically involved in preparing and prosecuting patent applications. In general, the position involves many of the technical aspects of patent prosecution, including doing background and prior art searches, drafting the specifications and preparing reference figures for patent applications, and giving technical expertise during invention evaluation. Patent scientists and engineers often pursue either patent agent qualification and/or attend law school to become patent attorneys.

Medicine

audiology technician
biochemist
biomedical engineer
orthoptist
dentist
dietician
dispensing optician
medical doctor
environmental health officer
forensic scientist
medical physicist
optometrist
veterinary surgeon
osteopath
pharmacist
physiotherapist
radiographer
speech therapist
biophysicist

Biophysics is an interdisciplinary science that uses the methods of physics and physical chemistry to study biological systems. Studies included under the branches of biophysics span all levels of biological organization, from the molecular scale to whole organisms and ecosystems. Biophysical research shares significant overlap with biochemistry, nanotechnology, bioengineering, agrophysics and systems biology. By drawing knowledge and experimental techniques from a wide variety of disciplines, biophysicists are often able to directly observe, model or even manipulate the structures and interactions of individual molecules or complexes of molecules.

Mike Alport - Entrepreneur

Role Model

Qualifications

In 1981, **Ph.D.**, from **Applied Physics** at **UKZN**

Career

Started 2004 at **Advanced Imaging Technologies** in **R&D** as **"MD" (http://ait-sa.com/)**
Started 1981 at **University of KwaZulu-Natal** in **Physics** as **"Assoc Prof"**

Survey

Why did you originally choose to study physics at university?
To understand how the world works.

When did your industrial career really take off?
After gaining consulting experience whilst an academic for about 15 years, I switched to a full time career in R&D during 2004, which involved commercializing IP.

If you consider yourself no longer a physicist, what made you give up physics to pursue your career?
I still function as a physicist - in addition to being a financial/business/admin/personnel manager!

Is there a particular contribution in industry that you are especially proud of and that you attribute to your training in physics?
Developing a product which grew out of a physics phenomena - examples have included sizing of sugar crystals, X-ray imaging and more successfully magnetic imaging applied to the conveyor industry.

How does your physics training help with your career?
It gives me full mastery and understanding of the technical aspects.

What advice do you have for physics students thinking of embarking on a similar career?
Gain as much experience in industry (i.e. outside of the laboratory) as possible. Learn about Intellectual property Rights and somehow gain commercial experience as well. Legal insight also helps! If you are lacking in any of these areas, then recruit/access suitable experts to fill in the holes.

What are your perceptions about the importance of physics in present-day society?
Very important - but with a changing emphasis towards nano, bio and medical topics.

Role Model

Daniel Mojalefa Moeketsi

Qualifications

In 2008, **Ph.D.**, from **Physics and Electronics** at **Rhodes**

Career

Started 2008 at **CSIR** in **CHPC, Meraka Institute** as
Research Scientist

Survey

Why did you originally choose to study physics at university?
My interest in Physics started when I was still at primary school. I used to be puzzled by bar magnets. How did the magnet operate? Why did one pole attract and the other repel? I used to play with this toy (bar magnet) to try to understand its secret. The other question I used to ask myself is what the SUN is, and how it affect life on Earth? I used to be worried that one day the SUN may fall on Earth and what would happen to life on Earth? Through my effort to consult with my father, educators, and doing extensive reading in the libraries during my secondary school concerning the above mentioned questions, I was advised to consider a career in physical sciences.

What made you choose a career in industry rather than a career in academia?
The CHPC provides the same opportunity as a University to grow as a researcher. I work very closely with researchers from both industry and academia. This is also very exciting to learn how physics is applied in other disciplines in the country. I am also involved in promoting computational physics in all SA universities. In a nutshell, my career bounces between industry and academia, which I find very interesting!

When did your industrial career really take off?
I joined the CHPC on 02 January 2008. During my PhD studies, I spent three years at HartRAO on the Space Geodesy Programme as a research assistant student.

Is there a particular contribution in industry that you are especially proud of and that you attribute to your training in physics?

I am currently in a process of establishing a research group. I am confident that my research experience and contributions during my training in physics will play an exponential role in this initiative. The advice and support I receive from local and international colleagues is quiet amazing! Furthermore, the intensive knowledge and understanding of Physics I have acquired during my training in physics helps me a lot to manage the highly specialised space science and astrophysics projects funded by CHPC. A person would not easily manage this project without a sound background in related physics.

How does your physics training help with your career?
It has opened windows to many local and international career opportunities. In fact, it has provided me with unique spectacles, to look into the future with passion, honesty, beauty and curiosity.

What advice do you have for physics students thinking of embarking on a similar career?
A career in Physics is challenging and rewarding. It requires hard work, passion and curiosity. There are so many career opportunities to choose after successful completion of your Physics training. Physicists are found working in all different disciplines. Remember, that a high level training in Physics is very important for both local and international society. Physics plays a crucial role in new discoveries and technology innovations which are fundamental pillars of economic growth of the country. Do not delay, choose Physics as career now, you will never regret in the next 10 years to come!

What are your perceptions about the importance of physics in present-day society?
Physics plays a leading role in everyday life. Everything technological we use (e.g. transport, lights, computers, communication, navigation, etc.) is based on the principles of physics. In a way, physics plays a very important role in creation of wealth for the society. The society that practices and supports physics will forever embrace its power!

GENERAL INFORMATION

Name	Web	Physics Dept No	Contact Person	E-mail
Cape Peninsula University of Technology	www.cput.ac.za	021 959 6224	John Farmer	farmerj@cput.ac.za
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Durban University of Technology	www.dut.ac.za	031 373 5361	Ms S Chetty	Singhd@dut.ac.za
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University of KwaZulu Natal	www.ukzn.ac.za	031 260 7663	Mrs Pam. Singh	singhde@ukzn.ac.za
University of Limpopo: Turfloop Campus	www.ul.ac.za	015 268 3492	Miss Pinky Mawasha	pthopom@ul.ac.za
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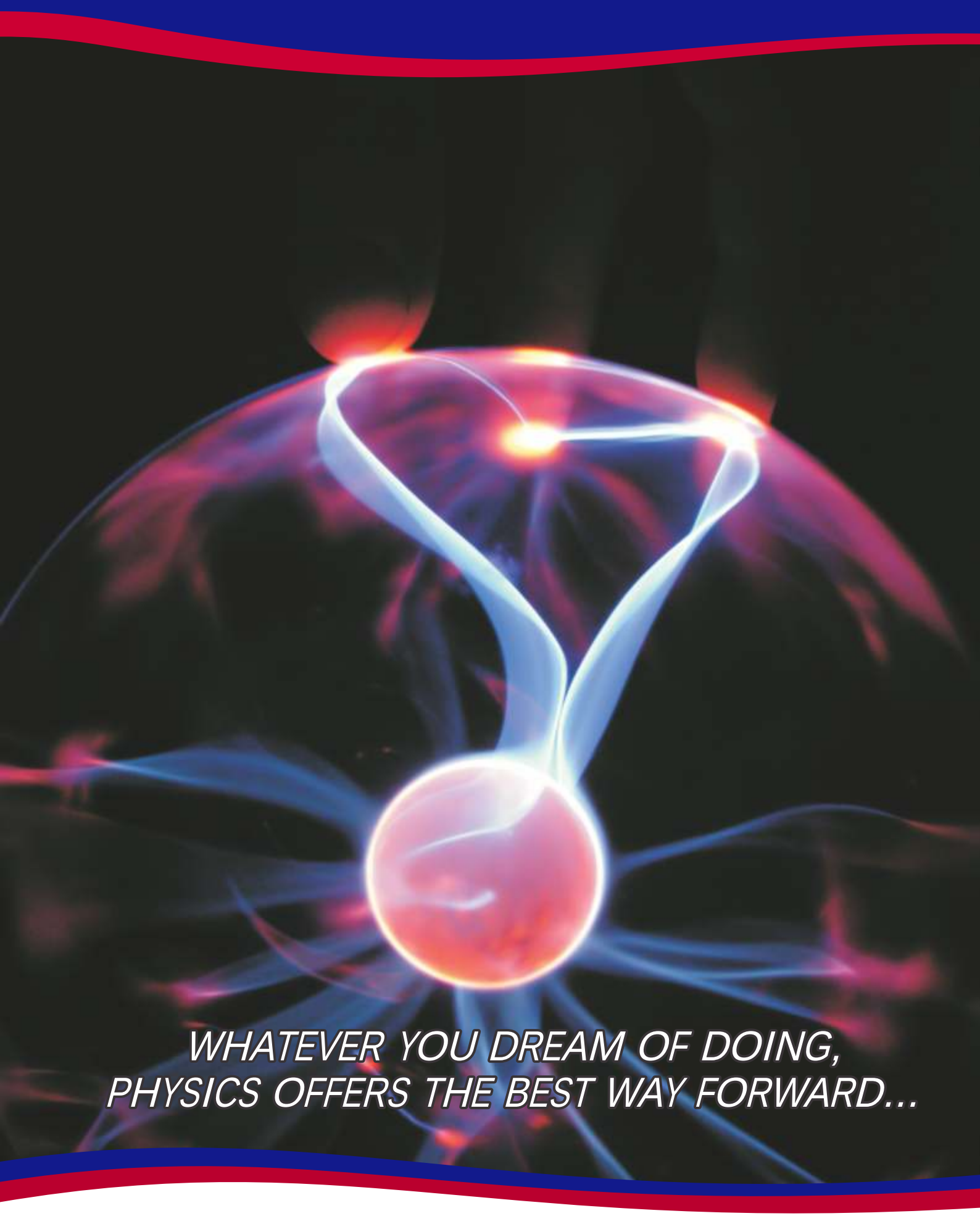
Vaal University of Technology	www.vut.ac.za	016 950 9249		
Walter Sisulu University	www.wsu.ac.za	073 496 2669	Mr Thembinkosi Dyeyi	tdyeyi@wsu.ac.za

CAREER LINKS

Links to websites containing information on careers in physics:

- First Step - South Africa's online youth consultancy. Launched in 2005 FirstStep.co.za provides a breakdown of higher education options, gap year opportunities, companies to work for, finance insight and information about various careers. http://www.firststep.co.za/
- Institute of Physics (UK) - Careers with Physics: http://careers.iop.org/
- Careers Using Physics: http://www.spsnational.org/cup/
- American Physical Society - Careers in Physics: http://www.aps.org/jobs/
- The American Institute of Physics: http://www.aip.org/careers/
- The Internet Pilot to Physics (TIPTOP) job listings: http://physicsweb.org/TIPTOP/FORUM/JOBS
- The Phds.Org science career library contains information for scientists and would-be scientists at all levels: http://www.phds.org/
- The Next Wave -- resources for the next generation of scientists: http://nextwave.sciencemag.org/
- Physlink has many useful links related to physics studies and employment: http://www.physlink.com/



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