



Professor Anthony Thomas (ARC Australian Laureate Fellow and CoEPP Associate Director)

SOUTH AUSTRALIAN SCIENTIST OF THE YEAR TALKS ABOUT HIS ACADEMIC PATH

Professor Anthony Thomas (ARC Australian Laureate Fellow and CoEPP Associate Director) has been named South Australian Scientist of the Year for 2014. This award recognises and honours his outstanding scientific contributions.

Prof Thomas' work covers a very broad range of topics, from nuclear structure and forces to quark models of the structure of hadrons, nuclear modification of deep-inelastic structure functions, as well as

the origin of the spin of the proton, tests of fundamental symmetries and direct searches for dark matter.

"Both my wife and I were born in Adelaide and our families have lived here for more than 150 years. No-one in my family had ever thought of attending university before me and I appreciate very much the opportunities I was given to pursue my interest in discovering how nature works at the deepest level."

"On two occasions I have given up much better paying positions overseas (in Europe and the US) to come back home and do my best to build an internationally known and

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respected research group. The SA Science Award is a wonderful stimulus for everyone in the group."

Apart from the University of Adelaide, Prof Thomas' experience also includes being a leading member in theory groups of major international laboratories such as TRIUMF, CERN, and Jefferson Lab.

"I will never forget how, as a relatively young staff member at CERN, I had Erwin Gabathuler, Head of Experimental Physics, walk into my office (his office was just a few metres from mine) and ask if I could possibly help to explain the (as yet unpublished) data that his group had taken on the EMC effect – a fundamental modification of the structure function of a bound nucleon. That particular problem goes to the heart of how QCD leads to the atomic nuclei we know and love, and getting to the bottom of it is still one of the things that drives my work."

His recent work with Dr Ross Young (CoEPP Adelaide) and Associate Professor Joel Giedt (Rensselaer Polytechnic Institute, US) showed how to dramatically improve the predictions of neutralino-nucleon scattering cross sections, which is of fundamental importance in the direct search for dark matter.

When asked what advice he would give to young scientists today, Prof Thomas says "Pick the problems that really fascinate you the most. Listen to the wise around you but in the end it is you that must set your own path. Many times I have been told why I was wrong when it was simply that the idea was too new. Don't let them put you off if, after careful consideration, you feel you are right!"

FROM THE DIRECTOR



The past few months have given us a time for both reflection and for looking to the future. Preparations on ATLAS and the LHC are well underway, in readiness for first beam

in 2015 at the higher energy of 13 TeV; concurrent to celebrating the remarkable achievements at CERN, which celebrated its 60th anniversary in an official ceremony on 29 September. CERN truly has a lot to celebrate. Whilst it is most famous for the recent discovery of the Higgs boson, CERN's true worth lies in the global cooperation it engenders to bring about such amazing scientific discovery. CoEPP is proud to be a part of this incredible, ongoing adventure.

Collaboration is an intrinsic element in high-energy physics research. As CERN celebrated 60 years, CoEPP – along with fellow ARC Centre of Excellence CAASTRO and representatives from Italy's INFN and the Gran Sasso laboratory – met at the Great Western winery, Victoria for a dark matter workshop to discuss

the proposed dark matter experiment at Stawell Gold Mine. Excitement and support for this experiment is growing rapidly. To complete the visit by our esteemed Italian colleagues we had meetings with University of Melbourne leaders, various Commonwealth ministries and departments, the ARC, and the Victorian State government, expounding the benefits of the proposed underground facility.

Congratulations goes to our Associate- and Adelaide node Director Anthony Thomas, who was named South Australian Scientist of the year for his outstanding contribution to science.

As I write this I am on my way to the ICFA (International Committee for Future Accelerators) symposium, and the FALC (Funding Agencies for Large Colliders) meeting in Beijing. The future is bright for accelerator-based science.

Finally, I would like to acknowledge Professor Tony Gherghetta who has recently left CoEPP as a Chief Investigator to take a position at the University of Minnesota.

TEDxCERN@MONASH

For the second year in a row, Monash and CoEPP hosted TEDxCERN@Monash – an official delayed broadcast of TEDxCERN event that was held at CERN on 24 September.

TED's mission is to spread ideas and believes that the power of ideas can be used to drive change in the world. With the theme "Forward - Charting the Future with Science", this free event provided a unique platform for world's leading researchers, scientists, developers, designers, and artists to share and build bold visions of the future, and was hosted at CERN by particle physicist and BBC presenter, Brian Cox. The talks were grouped into three themed sessions – "Adapt", "Change" and "Create"

according to the stance that the speakers take on confronting global challenges such as the efficient management of natural resources or extending access to healthcare to non-urban areas.

The @Monash event provided access for people to experience the CERN event. Over 200 people took part in the event on 2 October with all three sessions well attended, the first one "Adapt", proving the most popular. Registrations in 2014 increased by 30 per cent and overall attendance by 95 per cent when compared to 2013. The overall feedback was very positive with many expressing gratitude to CoEPP and Monash for organising the broadcast. We're looking forward to the next TEDxCERN@Monash in 2015.

Right: TEDxCERN@Monash, 2 October, 2014

COEPP UPDATES

ADELAIDE

Three new postdoctoral researchers-- **Dr Soumya Rao**, **Dr Pankaj Sharma** and **Dr Jinmian Li** have joined the Theory group in Adelaide node.

Dr Peter Athron transferred from CoEPP Adelaide to CoEPP Monash.

MELBOURNE

Dr Chunhua Li (Postdoctoral researcher), **Mr Luis F. Pesantez** (PhD student), **Ms Caitlin Guenther** (Masters student) and **Mr Paul Jäger** (exchange student from Germany) joined Melbourne's Belle/Belle II Group.

MONASH

Dr Doyoun Kim has moved to the Asia Pacific Center for Theoretical Physics in Pohang, South Korea.

Associate Professor Peter Skands started his lectureship. He worked at CERN before that and developed the VINCIA software

<http://vincia.hepforge.org/>

Dr Sujeet Akula (Postdoctoral researcher) and **Ms Nadine Fischer** (PhD student) joined the Theory group.

SYDNEY

Mr Ian Watson and **Mr Nikhul Patel** (PhD students) started their JSPS fellowships at the University of Tokyo and Kyoto University respectively.

Mr Gonçalo Borges has moved from Laboratório de Instrumentação em Física de Experimental de Partículas (Lisbon, Portugal) to start his role of Research Computing Systems Administrator in the CoEPP Research Computing team.





Dr Kevin Finelli (postdoc researcher, CoEPP Sydney) has recently been appointed as the ATLAS top-cross co-coordinator. Together with his co-convenor Professor Tom Schwarz (University of Michigan), he will oversee the LHC data analyses process within the group and help them get ready for LHC run-2 data.

STAFF PROFILE WITH DR KEVIN FINELLI

Why did you choose to move into particle physics and what is your main research focus at the moment?

I finished my PhD at Duke University in 2013, writing my thesis on a simultaneous measurement of top quark, W boson, and tau lepton pair production cross-sections at the LHC. I chose to get involved in particle physics because I wanted to look for answers to the biggest questions I could imagine: what are we made of; where did we come from? My research interests have generally been in the realm of Standard Model measurements; precise tests of our most sophisticated predictions of the rates of rare processes.

What made you choose CoEPP Sydney for your first postdoctoral position after completing your PhD? Are you currently involved in any collaboration work with your CoEPP colleagues?

I chose the position at CoEPP Sydney because I had collaborated with quite a few people here while working at Duke. I knew before even applying for the position

that CoEPP Sydney would be a great environment to work in. Parallel with my responsibilities as subgroup convenor, we at Sydney are continuing to work on an analysis of vector boson production in association with top quark pair events, together with others from Duke University and Argonne National Lab both in the US.

What was the most challenging part of being appointed as the ATLAS top-cross section coordinator?

Starting out as subgroup convenor has been a massive learning curve: I had to go from understanding one or two analyses to understanding around 15–20 that are currently ongoing. This means many hours reading ATLAS internal notes and asking questions. Ultimately this has been very rewarding though, as I'm learning a lot from both the techniques used and the physics results that are being obtained.

Left: Dr Kevin Finelli (postdoc researcher, University of Sydney)

SYMMETRIES AND NATURALNESS



To paraphrase Lord Rutherford, we don't call it physics if a hundred principles are required to explain a hundred phenomena; that is merely stamp collecting. It is hard to imagine that the quest to comprehend the physical world could have been so successful as it has been, had it not been driven by the desire to describe as much as possible using as few ingredients as possible.

To reproduce the figure of a butterfly, we need to describe only either the left or the right side. Likewise, physicists have sought the simplicity of nature using the language of symmetry. Throughout the 20th century symmetry has been a powerful guiding principle in physics, from Maxwell's completion of electromagnetism and Einstein's relativity onward. Symmetries

lie at the heart of all observed physical phenomena. The Higgs boson is also predicted by such a symmetry, explaining the origin of all elementary particle's masses; but its own mass is highly mysterious, since no symmetry is known to prevent it becoming extremely heavy due to quantum corrections, yet we measure it to be quite light; only 126 times a proton mass according to a recent measurement.

Why is gravity ten thousand trillion times weaker than electromagnetism? This big hierarchy between two interaction strengths, without any deeper principle to explain it, defines the 'naturalness' problem. Physicists translate this puzzle into a question regarding the mysterious lightness of the Higgs particle. Supersymmetry is one candidate

explanation for this, and solves the puzzle by suppressing the large quantum corrections. Unfortunately, the LHC has so far been depressing for physicists supporting supersymmetry, and have led them into increasingly complicated modified scenarios.

Is nature natural? Or a divine conspiracy? Physicists generally believe the former, and so search for models with minimal fine-tuning. As such, it is intriguing to study how to sensibly define and measure this fine-tuning, and to compare various models on this basis.

Link to recent paper here:
<http://arxiv.org/abs/1312.4150>

About Doyoun Kim

Doyoun is now at the Asia Pacific Center for Theoretical Physics, Pohang in Korea. As a member of the Junior Research Group for particle physics, he is concentrating on LHC collider physics targeting some interesting final state signals and continues to work in collaboration with CoEPP on the topic of the fine-tuning of the Next to Minimal Supersymmetric Standard Model, or NMSSM.

Left: Dr Doyoun Kim

DARK DEVELOPMENTS, DEEP IN THE HEART

Late September saw CoEPP join forces with leading representatives from the Italian National Institute of Nuclear and Particle Physics (INFN) and fellow Centre of Excellence, CAASTRO, to discuss the latest developments in dark matter.

The workshop was held at the heart of Victoria in Great Western, close to where the proposed direct-detection dark matter experiment will be located.

Sponsored by The Office of the Scientific Attaché in Canberra, the workshop provided a platform to discuss developments in cosmology, direct dark-matter searches and particle candidates. Delegates included Antonio Masiero, INFN Vice President and Stefano Ragazzi, Director of the Gran Sasso National laboratory.

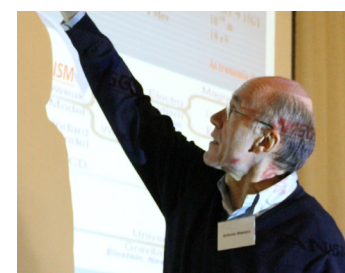
The workshop culminated in discussion about the next stages of development in the Stawell Gold Mine dark matter project. The experiment is rapidly gaining support on many levels and is being championed by the Northern Grampians Shire Council

as well as mine operators Crocodile Gold Corp. To say that the room was abuzz with excitement about the project is an understatement.

Australian project leader, Professor Elisabetta Barberio from CoEPP believes an experiment of this significance could ultimately lead to the discovery of dark matter.

Presenter talks can be viewed here:

<http://indico.cern.ch/e/CoEPP-CAASTRO-2014>



Above: CoEPP-CAASTRO Workshop attendees.

Left: INFN delegates perform an inspection of Stawell Gold Mine.

Right (from top to bottom): Prof Manoj Kaplinghat (University of California, Irvine); Prof Antonio Masiero (Vice President, INFN); Dr Robert Foot (CoEPP, University of Melbourne)



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