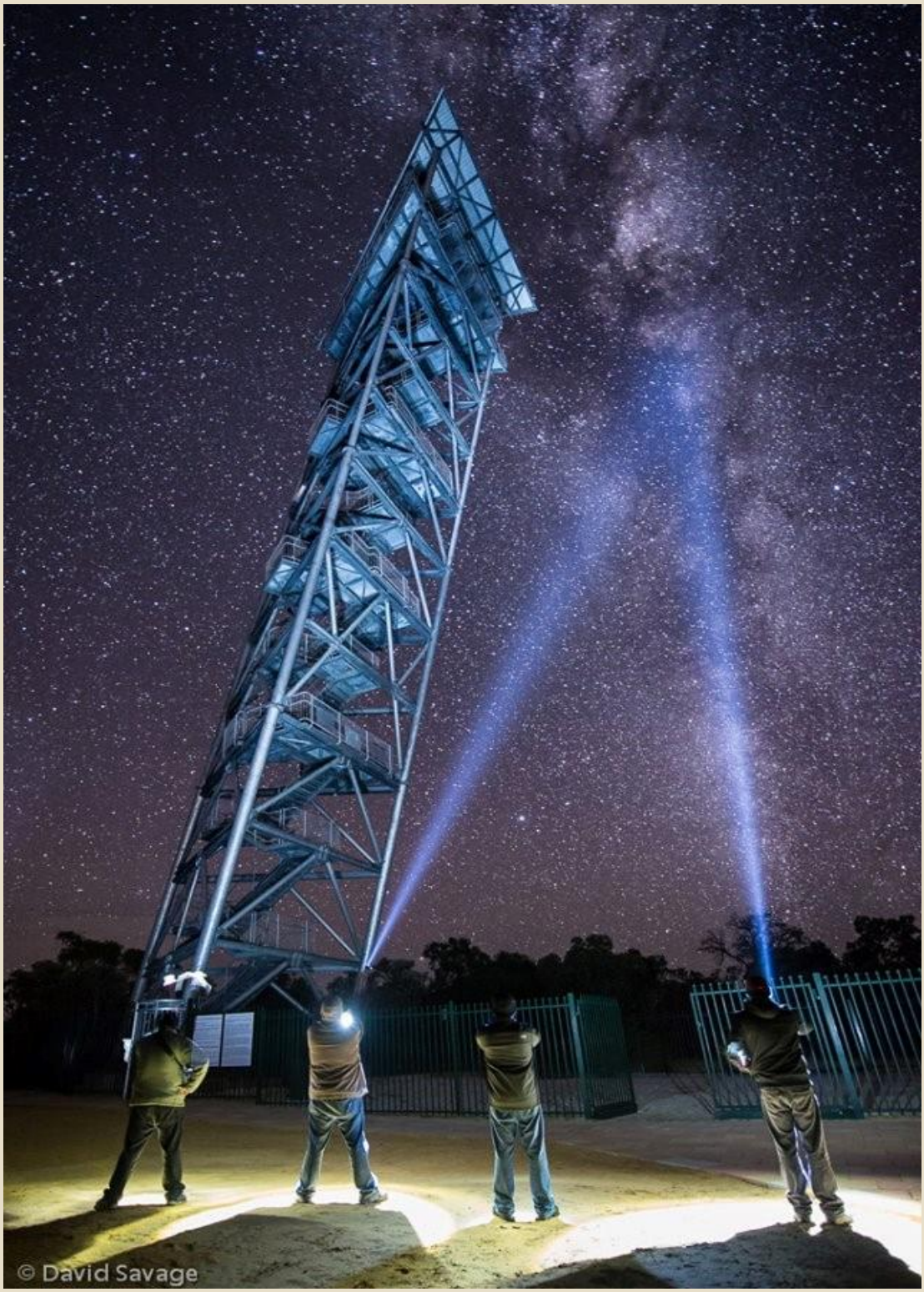
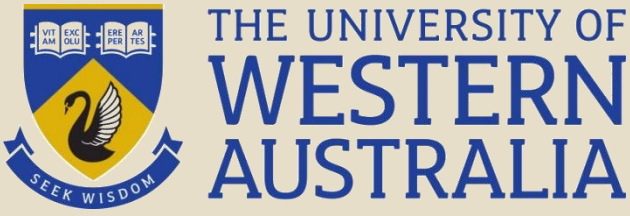
International Workshop on the Teaching and Learning of Einsteinian Physics in the Era of Gravitational Astronomy



28 November - 2 December 2016,

Gravity Discovery Centre, Yeal and Curtin University, Bentley, Western Australia.



Acknowledgements:

This conference is supported by: The Australian Research Council, The Gravity Discovery Centre Foundation, The Polly Farmer Foundation, the Science Teachers' Association of Western Australia and the Research Council of Norway

Discovering the World of Einsteinian Physics

In 1900 Lord Kelvin said "*There is nothing new to be discovered in physics now, All that remains is more and more precise measurement.*" [1] At this very time Albert Einstein had just completed his teaching diploma at Zürich Polytechnic. Within a generation the world as Lord Kelvin understood it had been demolished. No longer was the universe understood to be a mechanistic model, a world ruled by rules and laws: pull a lever, flick a switch and observe the predicted outcome. No, now the world was chaotic, uncertain and even weird. Time can slow down or speed up. Distances can be dilated and stretched. Space is curved. Matter can morph into packets of energy and back again. A thing can be in two places at the same time, and can move between two points without a pathway in between. Ultimately, the universe may not be on its own, there may be a parallel universe in a place and time we cannot possibly observe.

"Physical theories do not tell us what nature is, only what it is like." (Wolfgang Rindler)

It is now over one hundred years ago since Einstein introduced his theory of Special Relativity and his subsequent theory of General Relativity, among the most revolutionary ideas in science. The theory changed how we perceive space and time and removed the distinction between mass and energy.

Einstein's theories together with quantum mechanics are generally regarded as the greatest developments in physics over the last century. Quantum mechanics, which arose from Einstein and Planck's prediction of the photon, underpins the electronics and communications industries. General Relativity underpins our understanding of warped space-time, black holes, the big bang and gravitational waves. These subjects excite interest in students and comprise the focus both of contemporary research and of popular scientific fascination. The recent discovery of gravitational waves further enhances the importance and veracity of Einstein's theories.

It is now recognised that 300 year-old Newtonian mechanics, the backbone of the present secondary school physics curriculum, is merely an approximation of the real world. It is becoming widely accepted that our best understanding of the world is encapsulated in the topics of Special and General Relativity and quantum mechanics should be introduced early in a student's education. The introduction of such new concepts requires new resources for teachers.

With these thoughts in mind this workshop has brought together academics and teachers from around the world - Norway, Australia, Germany, Scotland, Korea, China, the USA to share ideas and learn from each other in our joint endeavour to introduce students to our best theories for describing the universe and enable and equip them to understand this world.

Our aim is to make Physics interesting and awesome … and above all, fun!

Warren Stannard - on behalf of the Einstein-First Project, University of Western Australia

[1] William Thomson (June 26, 1824 - December 17, 1907), 1st Baron Kelvin, often referred to simply as Lord Kelvin, was a Scottish physicist. Quote, reportedly from an address to the British Association for the Advancement of Science (1900) (from WikiQuotes.org)

International Workshop on the Teaching and Learning of Einsteinian Physics in the Era of Gravitational Astronomy

28 November -2 December 2016, Gravity Discovery Centre, Yeal and Curtin University, Western Australia

Monday 28 November: International Think Tank and Collaboration, GDC:

Chair Elaine Horne

The need for Einsteinian Physics – International Perspectives

9.00 – 9.15	**Welcome:** Elaine Horne, David Blair**.**
9.15 – 10.00	**Keynote Address:** Martin Hendry *Einsteinian Physics in the Age of Gravitational Waves*
10.00 – 10.55	**Introducing ourselves:** Norway, Korea, Germany, China, UK, USA and Australia.
10.55 – 11.00	**Introduction to the GDC**: Jan Devlin.
11.00 – 11.30	**Morning tea**

Project Introductions

11.30 – 12.15	Magdalena Kersting, Thomas Frågåt, Ellen Henriksen, Cathrine W. Tellefsen *Introduction to ReleQuant: Developing online learning resources in modern physics*
12.15 – 13.00	David Blair, Tejinder Kaur and Warren Stannard *Introducing Einstein First: activity based resources.*
13.00 – 13.45	**Lunch**
13.45 – 14.30	Hongbin Kim, Martin Hendry, Ute Kraus, David Blair *Projects and ideas from around the world.*

Collaborative Workshop 1

14.30 – 15.30	**Workshop:** Chair: Magdalena Kersting, Rolf Steier *Learning Einsteinian Physics with Einstein First and ReleQuant Resources: Activities, models and analogies for teaching general relativity and quantum physics – part 1 - general relativity*
15.30 – 15.45	**Break**
15.45 – 17.00	**Workshop:** Chair: Ellen Henriksen, Cathrine W. Tellefsen *Learning Einsteinian Physics with Einstein First and ReleQuant Resources; Activities, models and analogies for teaching general relativity and quantum physics – part 2 - quantum physics*
17.00 – 18.30	**GDC Exhibition, Floor Talk and Refreshments**
19.00	**Dinner: Speaker** Robert French *Why Lawyers and Judges need Einsteinian Physics*

Tuesday 29 November: International Think Tank and collaboration, GDC:

Chair David Treagust

Teaching Quantum Physics

9.00 – 9.30	Tejinder Kaur *Curved Space and Quantum Weirdness: Analysis of research results with middle school students*
9.30 – 10.00	David Blair *Quantum thought experiments*
10.00 – 10.30	Francis Chun *Education and Outreach Using the Falcon Telescope Network*
10.30 – 11.00	**Morning tea**
11.00 – 11.30	Strategy session – *What is our international plan for Einsteinian Physics education?* Chair: Robin Groves

Quantum Workshop Chair: David Blair

11.30 – 12.45	*Workshop on physical experiments on quantum weirdness*
12.45 – 14.00	**Lunch and travel to the Pinnacles**
14.00 – 19.00	**Excursion to the Pinnacles Desert**
19.00 – 21.00	**Dinner, Seabird Tavern**

Wednesday 30 November: International collaboration - open day, GDC:

Chair Ellen Henriksen

Teaching Special and General Relativity

9.00 – 9.45	**Keynote Address**: Hongbin Kim *Teaching relativity for Physics teachers*
9.45 – 10.15	Warren Stannard *Is Relativity Special?*
10.15 – 11.00	Strategy session – *What is our international plan for Einsteinian Physics education?* Chair: Robin Groves
11.00 – 11.30	**Morning tea**

Professional Development

11.30 – 12.00	Thomas Frågåt *Investigating physics teachers' professional development when collaborating in a research project*
12.00 – 12.30	Elisabeth Villanger-Larsen, Henrik Raeder, Jan Bakke *What's in it for us? ReleQuant from the teachers' and students' point of view.*
12.30– 13.30	**Lunch**

Afternoon sessions, Chair: Hongbin Kim

13.30 – 14.00	Rolf Steier *Designing learning spaces: moving between schools and museums*

Teacher guides

14.00 – 14.45	Thomas Frågåt *Designing and implementing a web-based teacher guide in modern physics*
14.45 – 15.30	**Workshop**: Chair Thomas Frågåt, Elisabeth Villanger-Larsen: *Teacher guides and professional development*
15.30 – 15.45	**Break**

Collaborative Workshop 11 Chair: Rolf Steier, Magdalena Kersting

15.45 – 17.00	**Workshop**: *Bridging the gap between web-based ReleQuant resources and hands-on activities at the GDC*
17.00	**Refreshments, Floor Talk at GDC Observatory: Australia Tests Einstein.**
19.00 – 20.30	**Dinner: Speaker:** David Blair: *Einsteinian Astronomy and Gravitational waves*

Astronomy, Star gazing

Thursday 1 December: Special International researchers' / STEM teacher' day, GDC:

Chair Marjan Zadnik

Teaching Einsteinian Physics

9.00 – 9.45	**Guest Speaker**: Ling-An Wu *Quantum properties of light*
9.45 – 10.30	**Keynote Address:** Martin Hendry *Teaching Einsteinian Physics within the Curriculum for Excellence in Scotland*
10.30 – 11.00	**Morning tea**

Spacetime

11.00 – 11.45	Magdalena Kersting *Curved space and warped time: Students' understanding of gravity*
11.45 – 12.30	Ute Kraus, Corvin Zahn: *Models for curved space and spacetime*
12.30 – 13.15	**Lunch**

Paradigms and Motivation

13.15 – 14.00	David Treagust *Changing Paradigms in Teaching*
14.00 – 14.45	Cathrine W. Tellefsen: *Modern Physics on the Curriculum - Challenges to Teachers and Students*

Quantum Interactions

14.30 – 15.15	Igor Bray *Quantum scattering in the world around us*
15.15 – 15.30	**Break**

Gravity and General Relativity:

15.30– 16.15	Ute Kraus, Corvin Zahn *Sector Models – Visualizations and Model Experiments in General Relativity*
16.15 – 17.00	Marina Pitts, Grady Venville *The Impact of Conducting Experiments at the Leaning Tower of Gingin on High School Students' Understanding of Gravity*
17.00 – 17.45	**Climbing the Time Gradient (Leaning Tower of Gingin) or Solar System Walk. Refreshments.**
17.45 – 18.45	**Dinner**
19.00	**International delegates leave for UWA accommodation.**

Friday 2 December: FUTURE SCIENCE, Curtin University, Bentley.

Einsteinian Physics Stream

7.30	Pick-up for international delegates from Trinity College.
8.00 – 8.20	**Registration**
8.20 – 8.30	***Welcome and STAWA* Awards**
8.35 – 9.20	**Keynote 1** Future of Agriculture
9.30 – 10.15	***Keynote 2 A4:*** Ellen K. Henriksen and David Blair *Einsteinian Physics; no longer optional.*
10.15 – 10.45	**Morning tea**

Workshop BC6: General Relativity in Schools Chair: David Blair

10.45 – 12.45	Magdalena Kersting *Educational Reconstruction of General Relativity in High Schools - Making Einstein's Theory Teachable*
	Rolf Steier Conceptual Understanding and Embodied Learning in General Relativity
	Warren Stannard *New ideas in teaching relativity!*
12.45 – 13.45	**Lunch**

Workshop DE6: Quantum Physics and Gravity Chair David Blair

13.45 – 15.45	Ellen Henriksen *Pupils' learning and understanding in quantum physics: the nature of light and the concept of quantization*
	Yohanes Dua *Videos on Teaching Einsteinian Physics*
	John Moschilla *Gold: Einstein's Metal: a special topic for Einsteinian Physics*
	Collaborative Workshop (all participants present): *Future Cooperation in Einsteinian Physics in the Gravitational Wave Era (20 minutes).*
16.00 – 16.20	Plenary
16.20 – 17.30	**Sundowner**

Introduction to our speakers:

Special Guest: Ling-An Wu

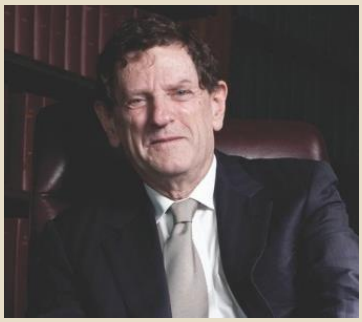
The Institute of Physics, Chinese Academy of Sciences, China

Research interests: experimental and theoretical quantum optics and nonlinear optics, including the generation and application of entangled states; applications of single photons; squeezed states. She is currently organizing an extracurricular class on hands-on optics for secondary school students.

Title of talk: Quantum properties of light.

Abstract: Since the birth of mankind, light has been our most important means of cognition and communication. I will briefly summarize some of our recent endeavours to introduce hands-on optics to young children, and experimental quantum optics to graduate students. The contributions of Mo Zi to optics in ancient China will be described, followed by an account of the development of quantum optics in recent years that led up to the "Mo Zi" quantum experiment satellite launched in China this year.

Special Guest: Robert French AC



Robert French was appointed Chief Justice of the High Court of Australia in September 2008. He graduated from the University of Western Australia in science and law. He was admitted in 1972 and practised as a barrister and solicitor in Western Australia until 1983 when he went to the Western Australian Bar. Chief Justice French was appointed a Companion in the General Division of the Order of Australia in 2010.

Title of talk:
Why Lawyers and Judges need Einsteinian Physics

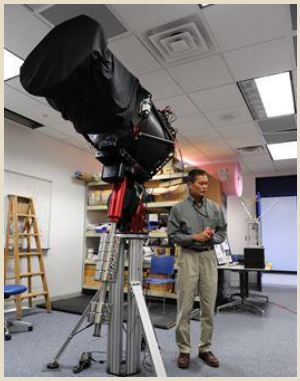
Igor Bray

Curtin University, Western Australia

Title of talk: Quantum scattering in the world around us

Abstract: Quantum scattering is the primary mechanism we all use to learn about everything around us. Our eyes are light detectors that are able to count how many photons (brightness) and the frequency (colour) of the light that happens to enter our eyes. In the talk we will discuss what is Quantum Mechanics and how it has profoundly changed the way we look at the world. We'll also discuss some everyday phenomena that can only be understood utilising the ideas of Quantum Mechanics. We'll also consider why Einstein never found Quantum Mechanics to be fully satisfying and that there are still aspects that remain a puzzle today.

Francis Chun



Francis is Professor in the Department of Physics, United States Air Force Academy (USAFA), Director, Center for Space Situation Awareness Research. He performs research on non-resolvable space object identification using small telescopes and is the principal investigator of the USAFA Falcon Telescope Network.

Abstract: Education and Outreach Using the Falcon Telescope Network (FTN). The FTN is a global network of 0.5-meter Ritchey-Chrétien telescopes developed by the USAFA to provide capabilities to its cadets for the purposes of satellite characterization and astronomy research while supporting STEM outreach to local communities. Students and teachers from FTN partner education institutes will also have the ability to request observations from any of the FTN sites and will have access to any raw image data collected by anyone on the FTN.

Martin Hendry

Head of School of Physics and Astronomy, University of Glasgow

Research Interests: Bayesian methods for gravitational wave data analysis, particularly "standard sirens" (i.e. binary neutron star and black hole mergers) and their use as precision probes of cosmology; multi-messenger astronomy; gravitational lensing and its impact on standard candles and standard sirens; statistical analysis of galaxy redshift and peculiar velocity surveys and calibration of the extragalactic distance scale.

Title of talk:
Einsteinian Physics in the Age of Gravitational Waves

Teaching Einsteinian Physics within the Curriculum for Excellence in Scotland

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Hongbin Kim

Seoul National University, Department of Physics Education, South Korea

Title of talk:
Teaching Relativity for Physics Teachers

Abstract: I will present the current situation on teaching Einsteinian physics in South Korea as well as teachers' difficulties in teaching the subject. And three questions are asked : Why should we teach relativity? What should we teach in the content knowledge of relativity? And how should we teach relativity? By analyzing a book written by Einstein, we found the relevant ideas which I will present. Thereafter, I will introduce 'the framework of relativity' as an exemplar to display a big picture of the theory and intertwined relationship between concepts in it. Finally, we suggest a guideline for teaching relativity for physics teachers.

Ute Kraus

Institute of Physics, Hildesheim University, Germany

Title of talk:
Models for curved spaces and spacetime.

The notion of curved spacetime is central to the geometric concepts underlying the general theory of relativity. Any approach to teaching general relativity with little or no algebra needs to provide an intuitive understanding of the intrinsic geometry of curved spaces and spacetimes. This talk describes a novel type of model that we call sector model that can provide this type of insight. Several examples of sector models are discussed including models of a black hole, a neutron star and a gravitational wave. The associated workshop "sector models - visualizations and model experiments in GR" offers hands-on experience in the use of sector models for explaining gravitational light deflection and redshift.

David Treagust

Curtin University, Western Australia

David Treagust is Professor of Science Education in the Science and Mathematics Education Centre at Curtin University in Perth, Western Australia. He taught secondary science for 10 years prior to working in universities in the USA and Australia. Research interests are related to understanding students' ideas about science concepts, especially chemistry concepts, how they contribute to conceptual change and can be used to enhance the design of curricula and teachers' classroom practice.

Title of Talk: Changing Paradigms in Teaching

Corvin Zahn

Hildesheim University, Germany

Title of talk:
Sector models - visualizations and model experiments in GR.

Sector models visualize curved spaces and spacetimes providing an intuitive understanding of their intrinsic geometry. The models can be used to determine geodesics and hence to study the motion of particles and light. The participants will use sector models to construct geodesics close to a black hole. This hands-on technique directly leads to the phenomena of light-deflection and gravitational redshift.

The delegates from the University of Oslo, Norway

Leader: Ellen Karoline Henriksen

Professor of Physics education, Department of Physics, University of Oslo

Ellen leads the ReleQuant project and the Research section for Physics education at the Department of Physics. Her research focuses on teaching and learning physics (mainly at upper secondary level) and on students' motivation and educational choice. She teaches in the science teacher education programme at the University of Oslo and also in a range of in-service courses for teachers.
http://www.mn.uio.no/fysikk/english/people/aca/ekarolin/

Jan Aleksander Olsen Bakke

Teacher student and research assistant, University of Oslo

Aleksander is a future physics teacher for high school students. He takes a major in applied mathematics at the University of Oslo, and has been working for two years as a research assistant for ReleQuant. Aleksander is interested in how to make education important and interesting for the students.

Thomas Frågåt

PhD Candidate at the Department of Physics, University of Oslo

Thomas worked as a physics teacher in upper secondary school before he became a PhD candidate. He graduated in particle physics in 2000 and has also worked as a software developer and researcher. Currently, he is working on a web-based teacher guide for the ReleQuant learning resources. His research interests are science student teachers' and physics teachers' professional development, and their professional identity.

http://www.mn.uio.no/fysikk/english/people/aca/thomasf/

Magdalena Kersting

PhD candidate at the Department of Physics, University of Oslo.

Magdalena is a mathematical physicist and science communicator. In her PhD project, she combines both of those backgrounds and develops an online learning resource in general relativity. When not designing learning environments, she studies the educational reconstruction of general relativity. In particular, she is interested in conceptual development and how students make sense of abstract concepts such as four-dimensional spacetime.
http://www.mn.uio.no/fysikk/english/people/aca/magdak/

Henrik Galligani Ræder

Teacher student and research assistant, University of Oslo

Henrik studies to become a teacher and works as a research assistant with the ReleQuant project, where he transcribes student interviews and observes implementation of the ReleQuant teaching modules. Currently, he investigates student understanding of wave properties of particles and writes his master's thesis on TIMSS Advanced results for physics.

Rolf Steier

Post-doctoral fellow

Rolf is a postdoctoral research fellow in the Faculty of Educational Sciences at the University of Oslo. He received his PhD from the University of Oslo in 2014 and has a master's degree in Learning Design and Technology from Stanford University. His interest is in researching and designing for collaborative learning processes in a variety of contexts and disciplines, including current projects in high school physics classrooms, an architecture museum and university student spaces. He is currently focusing on the relationship between imagination and bodily practices in the context of collaborative meaning making.

Cathrine Wahlstrøm Tellfsen

Responsible for science teacher education at the University of Oslo

Cathrine has extensive experience from teaching physics and developing physics textbooks for high school. She has taught in-service courses for teachers as well as the physics course for non-physicists at the University of Oslo. She now works with the ReleQuant project in addition to being responsible for science teacher education.

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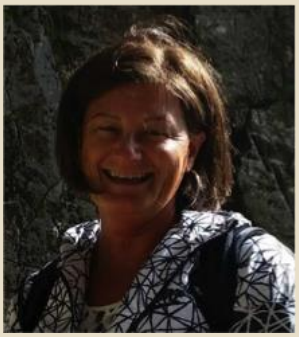
Elisabeth Villanger-Larsen



Physics and mathematics teacher at Asker Upper secondary school

Elisabeth has taught physics and mathematics in upper secondary school for many years. She has a Master´s in reservoir physics from the University of Bergen, 1994. She has participated in the ReleQuant project since the beginning, and has integrated this in her classes for the last three years. Students from the science teacher program at the Universities of Oslo and Trondheim have followed her both in her classes and in developing the project. Together with Thomas Fraagaat, she is currently one of the contributors to the web-based teacher guide for the ReleQuant learning resources.

The delegates from the University of Western Australia

Leader: David Blair

University of Western Australia

David is director of the Australian International Gravitational Research Centre and has spent decades investigating the existence of gravitational waves. Dedicated to bestowing an interest in the wonders of science upon future generations, he also co-founded the Gravity Discovery Centre in Gingin for the promotion of science in the State.

Yohanes Dua

University of Western Australia

Title of Talk:
Videos on Teaching Einsteinian Physics

Tejinder Kaur

The University of Western Australia

Title of talk: Evaluation of 14 -15 Year Old Students' Understanding and Attitude towards Learning Einsteinian Physics

Abstract: There is an increasing recognition of the importance of introducing modern Einsteinian concepts early in science education. I will present an analysis of 14 -15 year old students' conceptualization of Einsteinian physics, and their attitudes towards the program. We investigated students' understanding of concepts of modern physics after a term of 20 lessons incorporating appropriate hands-on activities.

John Moschilla

University of Western Australia

Title of Talk:
Gold: Einstein's Metal: a special topic for Einsteinian Physics

Securing the interest of students is as important, and often more challenging, than delivering quality educational content. Einsteinian physics, commonly dismissed as overly abstract, can be an intimidating topic for school age students. Gold, the most treasured of the metals, fits this description. Using Gold as a Trojan Horse to capture student interest, we can then delve into Einsteinian concepts in meaningful and engaging ways. In my presentation, I describe a short course on Einsteinian physics motivated by unravelling the secrets of gold's remarkable properties.

Warren Stannard

University of Western Australia

Title of talk:
Is Relativity Special?

New ideas in teaching relativity!

Abstract: Einstein's two theories of relativity were introduced over 100 years ago. In his 1905 work on the Special Theory of Relativity he introduced the concept of time dilation (or warping) in a moving reference frame. Emanating from his General Theory of 1916 is the idea that time is warped in a gravitational potential. These two effects have traditionally been treated as separate. This presentation proposes that these two effects are indeed intrinsically connected. The traditional propositions of special relativity are challenged and an alternative model is proposed.

Grady Venville

University of Western Australia

Title of talk:
The impact of experiments from the leaning tower on students' understanding of gravity.

with Marina Pitts

Abstract:
The aim of this research was to investigate the impact of experiments conducted from the 45m Leaning Tower of Gingin exhibit at the Gravity Discovery Centre on students' conceptual understandings of gravity. The case study involved 75 Year 8 (12 - 13 years old) students from one school. Data collection included pre- and post- excursion workbooks that qualitatively evaluated students' conceptions of gravity. Quantitative analysis indicated a statistically significant improvement in students' understanding of gravity. However, a range of scientific and non-scientific conceptions was observed amongst the students. Students frequently justified their misconception that a heavier water balloon would hit the ground before a lighter balloon when dropped from the Leaning Tower.

Chair, Gravity Discovery Centre (GDC) Foundation, Don Pridmore

Don Pridmore has been chairperson of the GDC Foundation for 2 years. He has been Managing Director of early stage technology companies servicing the global mining industry for over 20 years and is currently Executive Chairman of HiSeis, a startup company incubated at Curtin University.

He was a founding director of the Finding Sydney Foundation, the volunteer organisation that raised $5M and successfully located HMAS Sydney in deep water off the WA coast. He is passionate about science outreach in the holistic context practised at the GDC.

Mon 28 Nov GDC	Tues 29 Nov GDC	Wed 30 Nov GDC	Thurs 1 Dec GDC	Fri 2 Dec: Future Science, Curtin Uni
The Need for EP – International Perspectives	Teaching Quantum Physics	Teaching Special and General Relativity	Teaching Einsteinian Physics	Einsteinian Physics Stream at Future Science
Welcome: Keynote: Hendry: *Einsteinian Physics in the Age of Gravitational Waves* Introducing participants **Break**	Kaur: *Research results* Blair: *Quantum thought expts* Francis Chun: *Falcon Telescope Outreach* **Break**	Hongbin Kim: *Relativity for Physics teachers* Stannard: *Is Relativity Special?* Strategy session **Break**	Guest Speaker Ling-an Wu: *Quantum Properties of Light* Keynote: Hendry: *Einsteinian Physics within the Scottish Curriculum.* **Break**	Welcome. First Keynote **Keynote A4** Henriksen, Blair: '*Einsteinian Physics; no longer optional*' **Break**
Project Introductions I	Quantum Workshop	Professional Development	Spacetime	**BC6** General Relativity in Schools
Kersting, Frågåt, Henriksen, Tellefsen: *Intro to ReleQuant* Blair, Kaur, Stannard: *Into Einstein First* **Lunch**	Strategy session Workshop: *Physical experiments on quantum weirdness* **Sandwich lunch**	Frågåt: *Teachers' PD* Villanger-Larsen, Ræder, Bakke: *Teacher and student involvement in ReleQuant* **Lunch**	Kersting: *Curved space and warped time* Kraus, Zahn: *Models for curved space and space-time* **Lunch**	Kersting: *Educational reconstruction of GR in high schools* Steier: *Conceptual understanding and embodied learning in GR* Stannard: *New ideas in teaching relativity* **Lunch**
Project Introductions II	Pinnacles trip /	Teacher Guides Workshop	Paradigms and Motivation	**DE6** Quantum Physics and Gravity
Hongbin Kim, Hendry, Kraus, Blair: *Projects around the world.* Workshop: *Activities, models and analogies for teaching GR* **Break**		Steier: *Learning Spaces* Frågåt: *Designing web-based teacher guide in modern physics* Workshop: *Teacher guides and PD* **Break**	Treagust: *Changing paradigms in teaching* Tellefsen: *Modern physics on the curriculum – challenges.* Bray: *Quantum Scattering* **Break**	Henriksen: *Learning quantum physics - the nature of light and quantization* Dua: *Videos on teaching EP* Moschilla: *Gold: Einstein's metal.* *Workshop: Future cooperation in Einsteinian Physics*
Collaborative Workshop I		Collaborative Workshop II	Spacetime Workshop	
Workshop: *Activities, models and analogies for teaching QP*		Workshop: *Bridging web-based ReleQuant resources and hands-on activities at the GDC*	Workshop (chair: Kraus, Zahn): *Visualizations and model experiments in GR* Pitts, Venville, *Impact of Expts at Leaning Tower*	Plenary
Refreshments, GDC floor talk Dinner. Robert French: *Why Lawyers and Judges need EP*	Dinner, Seabird Tavern	Refreshments, Wallal talk Dinner. Blair *Einsteinian Astronomy*. Astronomy, star-gazing	Refreshments, solar system walk or tower climb. Dinner. Internationals leave for UWA	Sundowner