



Constant Speed

Physics in Motion

Institute of **Physics**

RAMBERT
DANCECOMPANY



Introduction

Young Albert Einstein made three great discoveries 100 years ago – about atoms, about light and about space and time – and the Institute of Physics is marking the anniversary with many events promoting the excitement of physics.

The Institute's international publishing company, which publishes many discoveries of today's scientists, is a keen sponsor of the arts. So, three years ago when we were all chipping in ideas for Einstein Year, ours in the publishing company was to commission a dance.

With the help of Arts & Business we approached Rambert Dance Company, and to our delight they embraced the idea enthusiastically. Better still, Rambert's Artistic Director, Mark Baldwin, who had just joined the company, decided to choreograph the work himself and has created *Constant Speed*.

Dance can express and excite without having to explain. You're not getting a physics lesson, and you don't need to know any physics to enjoy it. I hope you will be thrilled by a great work of art, performed by one of the world's most talented companies. Perhaps it will also inspire you to wonder about how the world works.

I thank Arts & Business, which has continued to support the project with both advice and funding through the New Partners scheme.

Most happily, I offer my thanks, love and appreciation to Rambert's Executive Director, Susan Wyatt, to Mark Baldwin, and to all of their colleagues for the privilege and enjoyment of our collaboration.



Jerry Cowhig

Managing Director

Institute of Physics Publishing
Bristol and Philadelphia



Constant Speed

BY MARK BALDWIN

"Producing *Constant Speed* has taken me on a surprising creative journey. Prior to starting this project my knowledge of physics was basic, but creating a work dedicated to Einstein's 1905 theories has been an illuminating and rewarding experience. I am indebted to Professor Ray Rivers of Imperial College London who has demystified the theories, which have served me with choreographic devices and ideas.

What I discovered during this process is just how compatible dance and physics are. Both have the ability to fire the imagination and question the world around us, and movement is an ideal medium in which to explore abstract notions. I hope *Constant Speed* is a pleasure to watch and something that suitably celebrates the brilliance of Einstein in this centenary year."

Photo by Higo Cleandring



Mark Baldwin
Artistic Director
Rambert Dance Company

In 1905 the 26-year-old Einstein was employed in the Swiss patent office working on physics in his spare time. In a succession of remarkable papers, he contributed to three very different areas of theoretical physics – Brownian motion, the photoelectric effect and special relativity – and redefined the way in which we view the world.

For *Constant Speed*, these major theories had to be broken down into a compatible format for dance. The work evolved from the discussions between Mark Baldwin and Ray Rivers, as they studied the theories and explored the practical implications of each concept. From this came inspiration as to how Einstein's theories could trigger an idea for movement or design, which in

turn expanded to generate a full-length dance. For example, **Brownian motion** is the random movement of microscopic particles suspended in a fluid, such as pollen grains in water. Although this movement had previously been identified by the biologist Robert Brown, he couldn't ascertain what caused it. Einstein realised that the movement of pollen grains was due to molecules of water hitting them and causing them to move. The pollen grains were visible, but the water molecules weren't, so it appeared that the grains were bouncing around independently. In essence, Einstein's calculations proved that atoms and molecules exist. The observation of the pollen grain's movement provided a natural stimulus for Baldwin's choreography. He imagined the dancers' bodies moving around the

“I think this project is a fantastic route into trying to make physics part of popular culture – it’s a great way to cross the boundary.”

WENDY SADLER, SCIENCE MADE SIMPLE

stage in a similar way to the pollen grains – as if being jostled by unseen forces. This choreographic device generated a huge vocabulary of movement, creating an exciting series of unpredictable patterns, full of athletic and physical surprises.

The **photoelectric effect** is the observation that when light is shone onto a piece of metal, a small current flows through it. The light passes its energy to the charged electrons in the atoms, knocking them out of the metal and producing a current. Although the effect could be explained before Einstein, the detailed results could not. Einstein realized that the results implied that light was not a continuous wave, as previously thought, but a collection of tiny chunks of energy called photons, which behave like particles. However, the energy of a photon depends on its colour – photons of red light have less energy than those of blue. The importance of light within Einstein’s theories was the driving force behind the visual design of *Constant Speed*. Baldwin worked closely with designer Michael Howells and lighting designer Samantha McNern to create a prismatic world of colour through the lighting and costume design.

The colourful array of costumes pick out the individual components of colour within light. The design also includes the use of a large mirror ball, which for Baldwin, not only suggests the cosmos but also highlights the



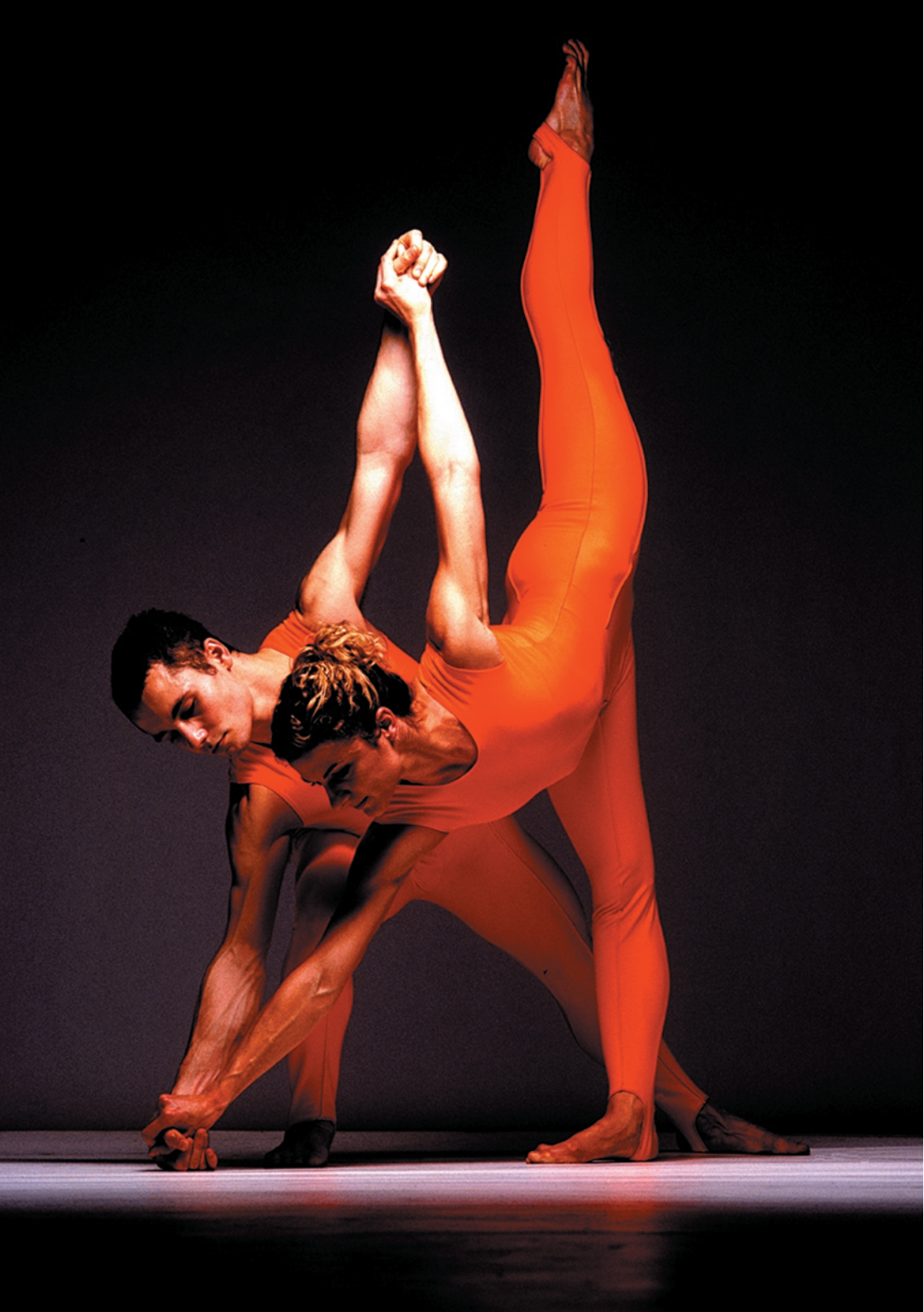
Costume design by Michael Howells

concept that light arrives in packets. The choreography also hints at this notion, through the arrival of groups of dancers simultaneously onto the stage, to perform identical phrases of movement.



“Human beings, vegetables or cosmic dust, we all dance to a mysterious tune intoned in the distance by an invisible player.”

ALBERT EINSTEIN



Constant Speed

Special relativity, Einstein's third and final contribution in 1905, makes the counterintuitive assumption that the speed of light is the same for all observers, regardless of how fast they are travelling with respect to each other – hence the title of the dance, *Constant Speed* (of light). One of the consequences of the theory is that time moves at different rates for different observers. Later in 1905 Einstein extended special relativity to find a relationship between energy and momentum. The outcome was, in part, Einstein's most famous equation, $E=mc^2$, which shows the equivalence of mass and energy. Within *Constant Speed*, Baldwin has attempted to disrupt the external perception of space and time, by setting fast sections against slow ones. The audience is presented with contrasting speeds of movement and use of space.

As for the choice of music for *Constant Speed*, Baldwin and Paul Hoskins, Music Director of Rambert Dance Company, wanted music that had some relevance to the Einstein stimulus. Franz Lehár was one of the composers of the time, popular for a select number of works, such as *The Merry Widow*. However, Baldwin and Hoskins were drawn to his lesser-known repertoire, from which they selected a number of pieces that match the glitter, sparkle and energy of the new dance.

The success of the collaboration is that dance and physics have worked in harmony – one inspiring the other – creating an exciting fusion of ideas within a completely unique project for Einstein Year.

Choreography	Mark Baldwin
Music	Franz Lehár
Set and costume designs	Michael Howells
Lighting design	Samantha McNern



Constant Speed has already captured the imagination. Extracts were performed on London Underground as part of a series of promotional events run by Visit London in January 2005.

“For all the very big differences in the goals of scientists and dancers, we both inhabit worlds of intense commitment, high imagination and personal integrity.” RAY RIVERS, PROFESSOR OF THEORETICAL PHYSICS,

IMPERIAL COLLEGE LONDON

Education

“The enthusiasm and energy with which the workshop material was delivered was an inspiration.” GCSE DANCE TEACHER

Teaching physics through movement

A significant element of this special project is the programme of education work that will support it. In collaboration with the Institute of Physics, Rambert’s award-winning Education Department will run a range of education work, including workshops and pre-performance talks, as well as providing resource materials. These are aimed at furthering the understanding and enjoyment of *Constant Speed* and the relationship between dance and physics.

WORKSHOPS

Specially tailored to the individual needs of schools or colleges, workshops on *Constant Speed* are available for students at all levels, and any age group above Year 7.

Each workshop will include:

- an introduction to the session;
- a warm-up in which the three major Einstein theories are explored;
- students learning a section from *Constant Speed*;
- students creating their own material based on *Constant Speed*, by developing and exploring further the theory behind the section from *Constant Speed* that they have learned;
- a presentation of the movement that the students have created, alongside the professional phrase that they have learned.

PRE-PERFORMANCE TALKS

Free pre-performance talks will be given at every venue where *Constant Speed* is performed. These usually take place at 6.30pm on the evening of the second performance and are led by Rambert Archivist Jane Pritchard. She will give an introduction to all of the works being performed and a background to the company. There will also be an opportunity to ask questions.

For more information about any of these activities and to find out how we can work with you, please go to www.rambert.org.uk or e-mail education@rambert.org.uk.

“The workshop provides a unique opportunity to approach what is perceived as a very academic subject through physical involvement. Hopefully the process of exploring these theories physically will bring to life what students read about on the page.”

KATIE GRAHAM, RAMBERT ANIMATEUR



Rambert workshop photos by Nils Stanni

A black and white photograph showing Marie Rambert, an older woman with short, light-colored hair, wearing a white blouse and a dark skirt. She is standing in the center, looking towards the right. To her left, a younger woman in a dark, sleeveless dress is partially visible, looking towards Marie. In the background, another woman in a dark dress is visible, and the setting appears to be a rehearsal space or a stage with some equipment.

Rambert Dance Company

Founded by Marie Rambert in 1926, Rambert Dance Company is the oldest dance company in Britain. It is committed to presenting the broadest possible range of contemporary repertoire, programming established works from choreographers of international stature alongside the new and challenging, thus offering audiences quality and innovation in equal measure.

Rambert Dance Company aspires to be one of the world's most versatile and exciting dance companies, and is committed to increasing the audience for contemporary dance by pursuing a policy of innovation, excellence and access across all of its performance and education work.

Marie Rambert with her dancers. Photo by Derek Allen c.1955

Institute of Physics

The Institute of Physics is a leading international professional body and learned society promoting pure and applied physics. This is achieved through publishing; by setting professional standards; and through conferences, education and science policy programmes. It has a worldwide membership of over 37,000. In Great Britain and Ireland the Institute is active in providing support for physicists in all professions and careers, encouraging physics research and its applications; providing support for physics in schools, colleges and universities; influencing government; and informing public debate. For more information about the Institute's activities, go to www.iop.org.

Constant Speed was commissioned as part of Einstein Year – a celebration of physics and its relevance to all of our lives. Marking the centenary of Einstein's three ground-breaking ideas, the Year communicates the vital role that physics plays in developing new technologies, such as cancer screening equipment and mobile phones, while attempting to answer big questions like how the universe was created and how climate change can be addressed. Einstein Year will inspire and inform the next generation of physicists as well as those who are just curious about the world around them. Einstein Year is the UK and Ireland's contribution to International Year of Physics, a UN-sponsored project to promote physics in 2005. Go to www.einsteinyear.org for more information on the Year and events across the country.

Tour Diary

Constant Speed is touring theatres throughout the UK in 2005 and 2006. It will form part of a mixed programme of dance. For information about the full programme, please visit www.rambert.org.uk, where you can also join Rambert's free mailing list and keep up to date with all future performances.

2005

21 – 24 September	The Lowry, Salford	0870 787 5790 www.thelowry.com
28 September – 1 October	Wycombe Swan, High Wycombe	01494 512000 www.wycombeswan.co.uk
5 – 8 October	Bristol Hippodrome	0870 607 7500 www.getlive.co.uk/bristol
12 – 14 October	Norwich Theatre Royal	01603 630000 www.theatreroyalnorwich.co.uk
2 – 5 November	Milton Keynes Theatre	01908 606090 www.theambassadors.com/miltonkeynes
23 – 25 November	Edinburgh Festival Theatre	0131 529 6000 www.eft.co.uk
30 November – 3 December	Theatre Royal, Plymouth	01752 267222 www.theatreroyal.com

2006

Constant Speed will also tour to His Majesty's Theatre, Aberdeen; Theatre Royal, Newcastle; Hall for Cornwall, Truro; The Marlowe Theatre, Canterbury; Clwyd Theatr, Cymru Mold; Theatre Royal, Brighton; and Birmingham Hippodrome. At the time of going to print, not all venues had been confirmed. For up-to-date information, please go to www.rambert.org.uk.

Constant Speed photos by Anthony Crickmay

“I see Constant Speed in the first instance as a celebratory work, the dance equivalent of a fanfare for Einstein Year, informed by Einstein’s ideas of 1905, but definitely not attempting a literal representation.”

RAY RIVERS, PROFESSOR OF THEORETICAL PHYSICS,
IMPERIAL COLLEGE LONDON

“As well as enlightening me about ideas I never knew existed, it has given me a new awareness of how far physics reaches into our daily lives.”

MARK BALDWIN, ARTISTIC DIRECTOR,
RAMBERT DANCE COMPANY

“Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.”

ALBERT EINSTEIN



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