



THE UNIVERSITY OF  
NEWCASTLE  
AUSTRALIA

# RESEARCH

CONNECTING  
RESEARCH AND  
COMMUNITY

2011

INSPIRING  
INNOVATORS

Fertile minds  
Conquering cancer

Greener futures  
Solar success

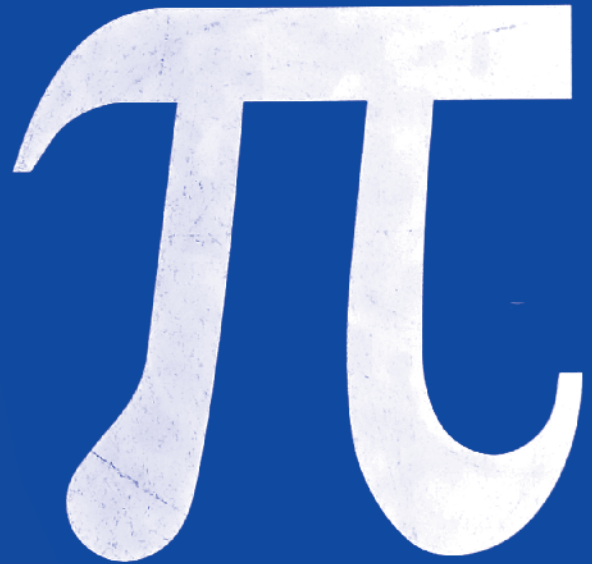
Engineering excellence  
The human dimension

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# DELVING INTO THE UNKNOWN

When people ask world-renowned mathematician Laureate Professor Jon Borwein what brought him to Newcastle, he tells them it was **CARMA**.



"It was once said that the only things a mathematician needed for research were a pad, pencil and a wastepaper basket," Laureate Professor Jon Borwein says. "That was never completely true – but it is even less so now."

Borwein has come a long way from using notepads and blackboards in the 40-plus years that he has grappled with complex mathematical equations. These days the director of the University's Priority Research Centre for Computer-Assisted Research Mathematics and its Applications (CARMA) works with vivid digital images that can portray at a glance information that would take many pages of figures to set out in written form.

"I have not found a piece of mathematics that I cannot learn more effectively and quickly with computer assistance," he says.

Mathematical visualisation through the use of graphics is one of the focuses of CARMA, which seeks to harness developments in information and communication technology to further the exploration of maths and undertake ever more challenging calculations.

Borwein is a pioneer in what is known as experimental maths, in which computers are used to run computations to look for patterns, identify sequences and gather evidence in support of specific mathematical assertions. His work at Newcastle has put the University at the cutting edge of this field.

His textbooks, papers and blogs are widely read and discussed by the international mathematics community. In recognition of his contributions to research, he was recently awarded a Fellowship of the Australian Academy of Science, the country's most elite group of scientists.

Borwein has had a lifelong fascination with Pi, the irrational number calculated by dividing a circle's circumference by its diameter. This fascination led to the development of the famous Borwein Algorithm, a formula he devised with his brother Peter for calculating the value of  $1/\text{Pi}$ .

To celebrate Pi Day on March 14 (3.14), Borwein demonstrated his mathematical prowess by teaming with several other masterminds to complete what he believes is the largest single dedicated computation ever done: calculating digits of Pi squared beginning at the 10 trillionth place.

Borwein estimates it would have taken more than 1,380 years to calculate on a single PC what he and the team achieved with exclusive access to IBM's Blue Gene/P computer system, one of the world's most powerful platforms.

Where does this sort of research lead? Borwein says there are abundant applications – from the burgeoning field of random number generation widely used in banking, to testing the integrity of computer programs. For example, a 29 million digit calculation of Pi at NASA just after the 1986 shuttle disaster uncovered hardware and software faults in the space agency's supercomputer.

But to a large extent experimental maths is an exhilarating journey towards new frontiers.

"In one minute we can now achieve calculations that would have been the subject of an applied maths PhD 40 years ago," Borwein says. "At the same time, I am conducting intensive computer-assisted research on work I once thought I had completed 15 years ago."

"One of the greatest attractions of science is that you do not know how ignorant you are until you acquire more knowledge."