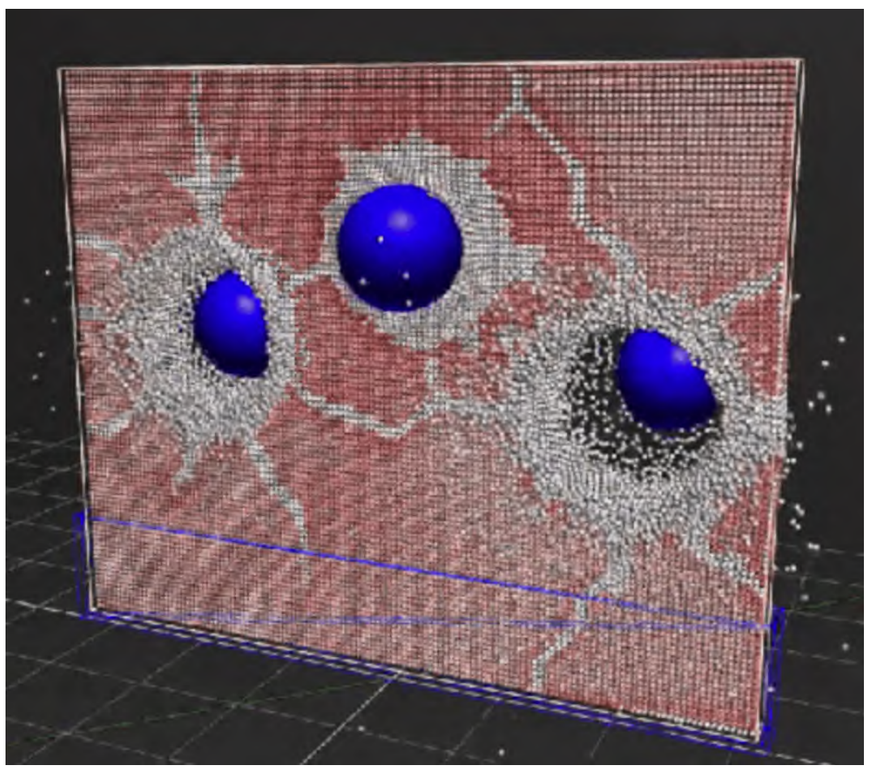
Study A-level Mathematics & Further Mathematics for

Modelling Black Panther's Suit?

Fiction!

Shuri is a masterfully fantastic scientist, engineer, and inventor with a genius level of intellect. She wears a uniform made from Vibranium (a fictional metal!) noted for its extraordinary abilities to absorb, store, and release large amounts of kinetic energy. Shuri's uniform is special because it can distribute the kinetic energy from an impact. The idea is that the kinetic energy will not be focused on one area but will move to another part of the suit where it can be absorbed.

Watching this scene took Professor Nira Chamberlain back to his postgraduate days when he was doing an MSc in Industrial Mathematical Modelling at Loughborough University. He says, *I did a dissertation titled 'Impact on an adhesive joint'. The mathematical model I had to create was to show how a material behaved in aggressive impact circumstances. … [would a] composite material … be able to take an impact by distributing the kinetic energy away from the impact zone to places where it can be absorbed. Sound familiar? But materials under impact react like* this **three ball impact** graphic – they fracture.



So, might Black Panther's suit be possible? What mathematical modellers do is get facts from the subject-matter experts and turn that into a mathematical form. Then, by solving the mathematical form, we see if that solves the real world problem. For Nira, this ended up with him needing to analyse a wave…

Fact!

After discussing the physics of the situation[stess-strain which is studied in Physics A-level] Nira used the **wave equation** to see if kinetic energy can be distibuted away from the impact zone fast enough to avoid fracturing.

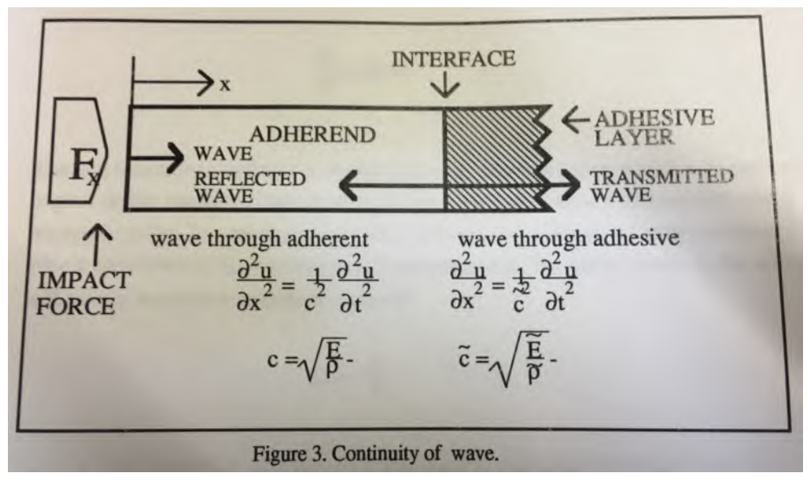


Figure 3. Continuity of wave.

Partial differential wave equations from modelling

Link to Article

You Could Do This!

By studying Maths & Further Maths A-levels you will encounter differential equations which lead on to the Partial Differential equations that Nira used.

$$\frac{dP}{dt} = kP \qquad \int \frac{dP}{P} = \int k\,dt$$

Maths A-level

$$3600v\frac{dv}{dx} = 9000 - v^2 \qquad 3600\int \frac{v}{9000-v^2}\,dv = \int dx$$

Further Maths A-level

$$\frac{\partial u}{\partial x}(0,t) = \varepsilon_1\left[\frac{t}{b}\big(H(t)-H(t-b)\big) + \left(\frac{t}{b-a}+\frac{a}{a-b}\right)\big(H(t-b)-H(t-a)\big)\right]$$

The boundary condition representing a triangular pulse (representing the impact force) forcing term of impact duration 'a'

Going back to the film, Black Panther's suit started to disintegrate when it was hit by a sufficient force, like the horn of a rhino or a point-blank grenade launcher. Nira's research identified that the point of contact is where the composite material was most likely to fail.

Professor Nira C Chamberlain OBE CMath CSci FIMA

Professor Nira Chamberlain is a Past President of Institute of Mathematics and its Applications. He is one of the top 100 UK scientists according to the Science Council and is the first black mathematician featured in the Who's Who since 1849.

Nira has over 20 years of experience at writing mathematical models/simulation algorithms that solve complex industrial problems. He has developed mathematical solutions within industries such as the defence, aerospace, automotive and energy sectors.

Nira's recommendation to any aspiring mathematician is that:
"You don't need anybody's permission to be a great mathematician!"

There is more to Mathematics than you think…. visit rhgmc-mspw.cymru to find out more.
Level 2 Additional Maths can be studied during key stage four.

In key stage five A Level Mathematics is the most popular[1] A-level and A Level Further Mathematics is the perfect accompaniment.

The Mathematics Support Programme Wales (MSPW) is here to support students, teachers and departments across Wales

in enriching and developing their Mathematical domain across all key stages.
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[1]https://www.wjec.co.uk/media/invh1fni/gce-a-level-provisional-results-june-2022.pdf