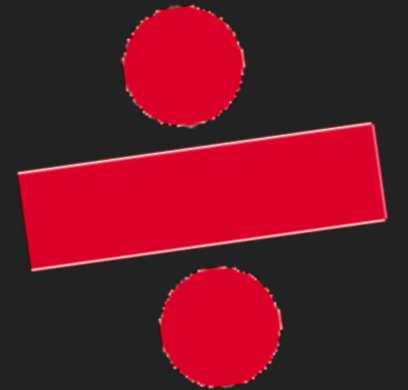
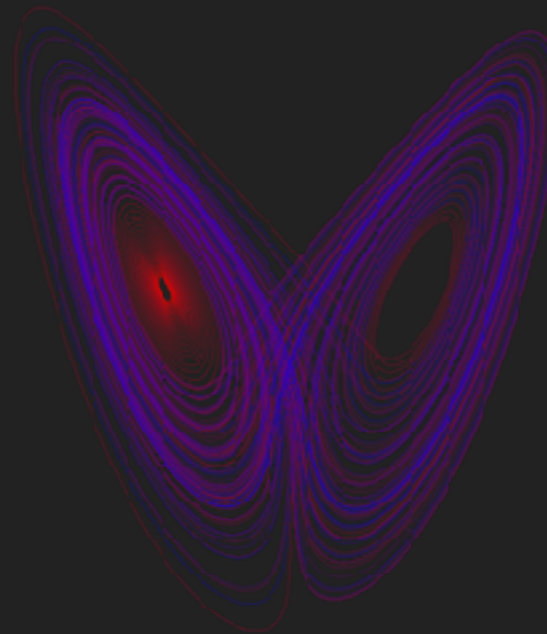




$$(x + 3)^2 = 4$$



$$e^{i\pi} + 1 = 0$$



LUKE BENNETTS, UNI ADELAIDE

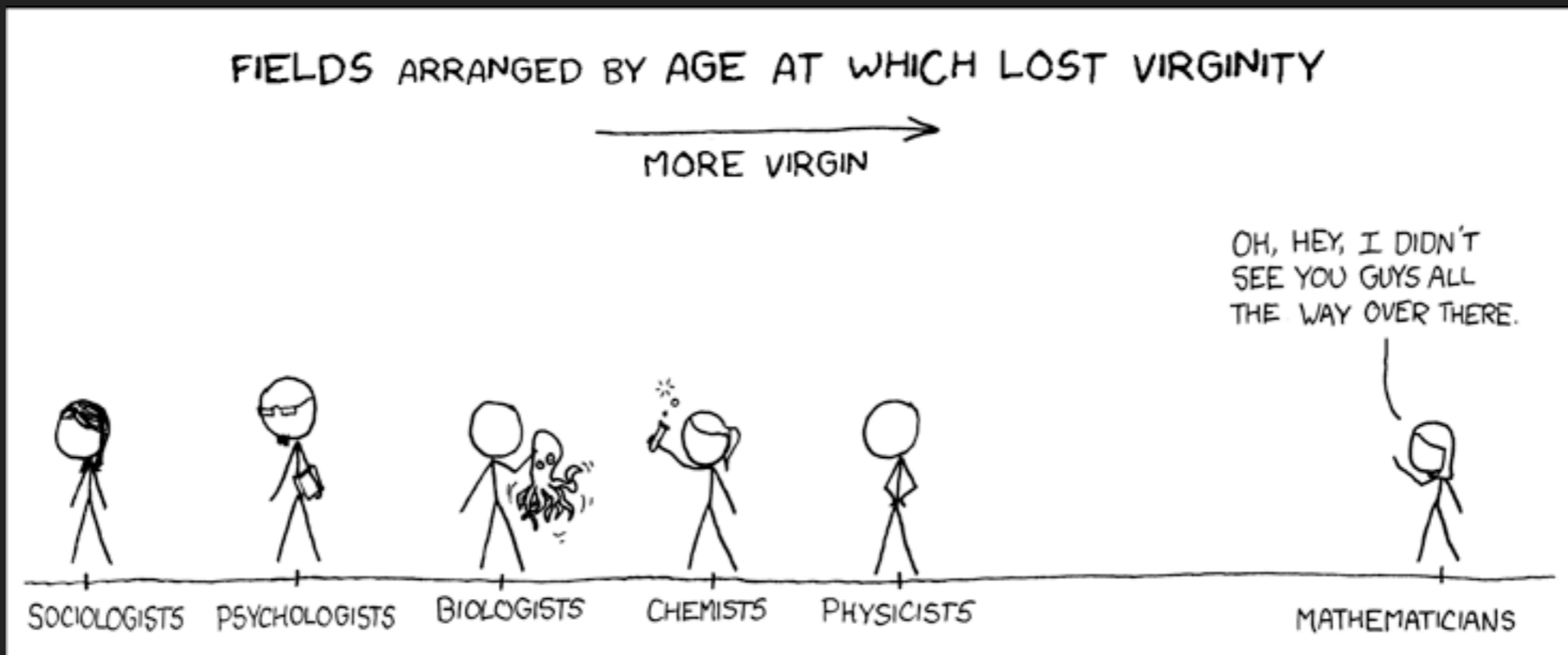
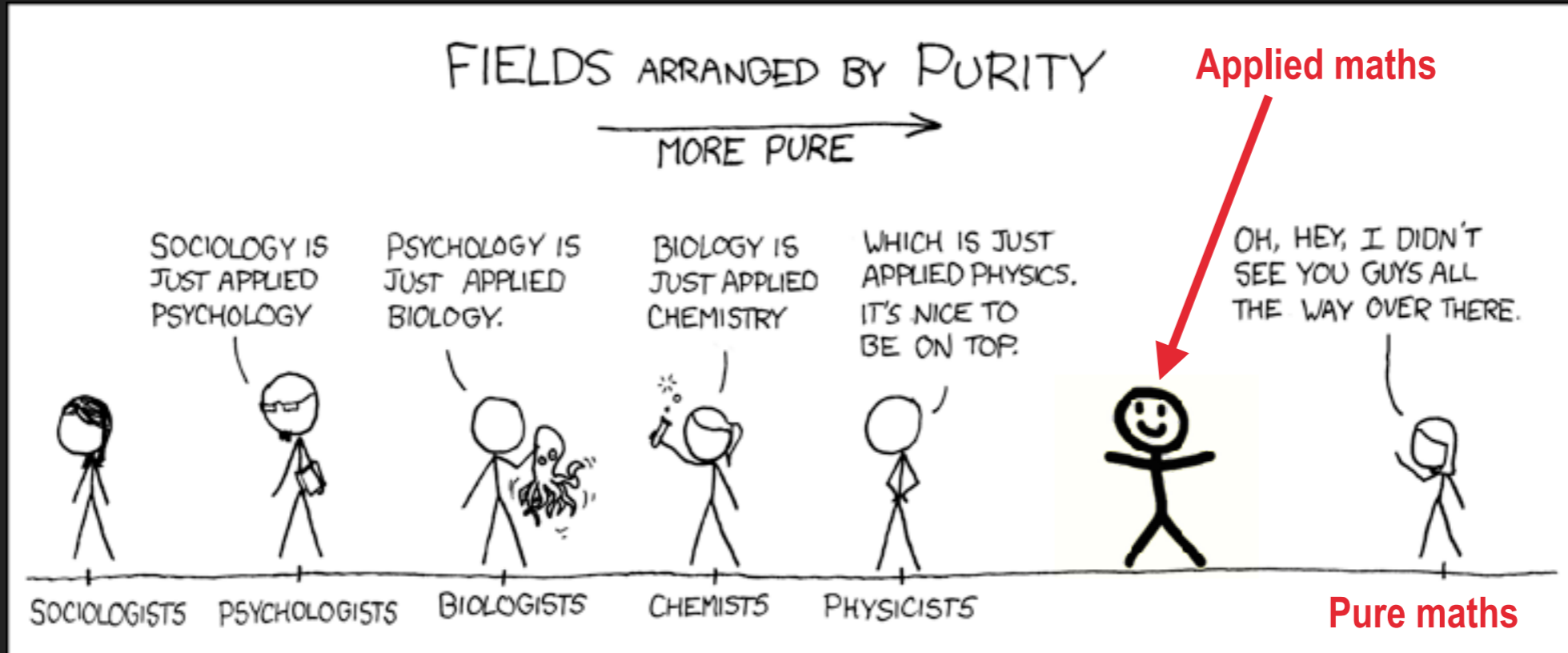
AN APPLIED MATHEMATICIAN

MY BRIEF BIO



- ▶ 1999–2007: BSc Maths, MSc+PhD **Applied Maths** in UK
- ▶ 2007–2011: Postdoc, Dept of Maths, Uni Otago, NZ
- ▶ 2011 onwards: Lecturer in Applied Maths, Uni Adelaide

SCIENCE IS A SPECTRUM...



THE APPLIED MATHS PROCESS

1. Take a problem in words: From other disciplines (physics, chemistry, biology, ...), industry, etc.
2. Turn it into a mathematical problem, using algebra, etc.
 - ▶ Typically a *differential equation*. Think Newton's 2nd law:
$$F = m a \quad \text{or} \quad \frac{d v}{d t} = \frac{F}{m}$$
 - ▶ Also, difference equations, networks, and more.
3. Perform mathematical analysis (solve and interpret).
4. Give a solution in plain English.

HISTORY OF APPLIED MATHS AT UNI ADELAIDE



Sir Horace Lamb

1849–1934

- ▶ UoA's 1st Professor of Maths (1876–85).
- ▶ Groundbreaking contributions to acoustics, seismology & fluid mechanics.
- ▶ Seminal book *Hydrodynamics*.
- ▶ Coined term *vorticity*.

HISTORY OF APPLIED MATHS AT UNI ADELAIDE



Ernie Tuck (1939-2009)

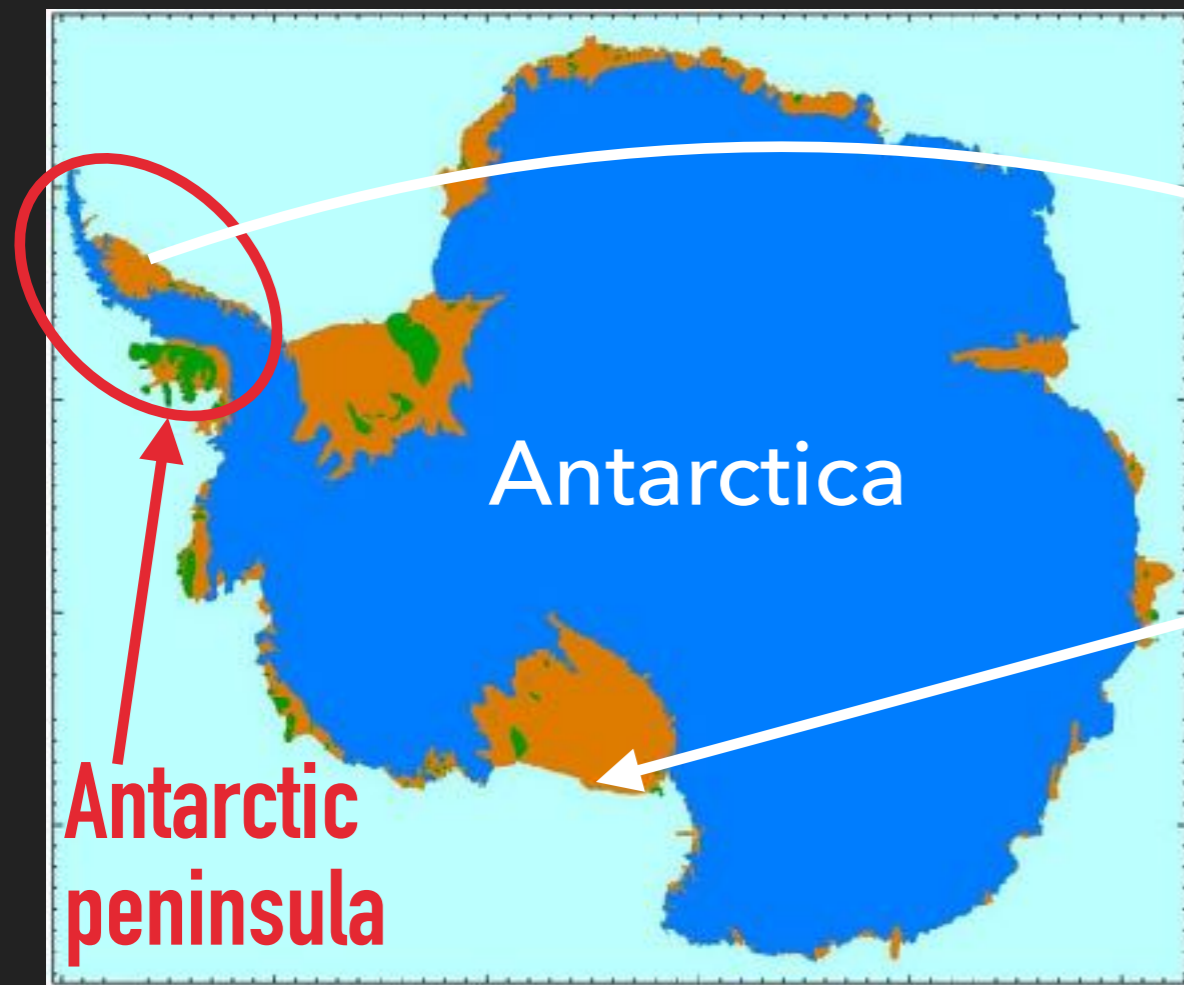
- ▶ Best known for work on ship hydrodynamics
- ▶ Studied at Cambridge and Visiting Prof at CalTech, Stanford and MIT.



Ren Potts (1925-2005)

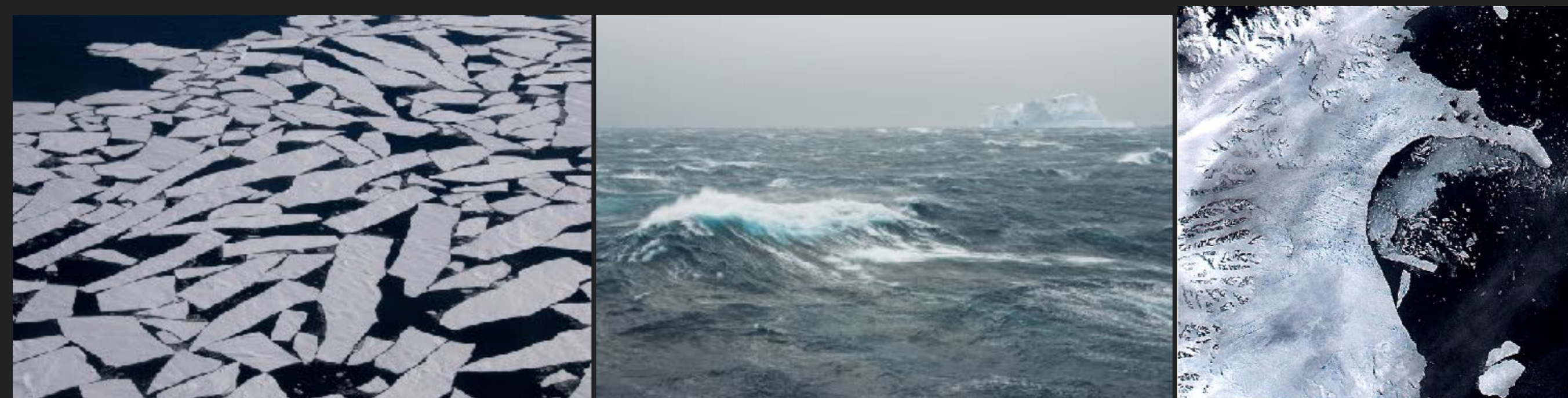
- ▶ Best known for "Potts Model" in statistical mechanics.
- ▶ Also transportation science and operations research.
- ▶ Pioneered links with SE Asia.

MY RESEARCH: (1) ANTARCTIC ICE SHELF DISINTEGRATION



- ▶ Glacier floating on ocean
- ▶ 100s m thick and 10s-100s kms long
- ▶ Disintegrations around Antarctic peninsula began 1995
 - ▶ Accelerate sea level rise

OUR FINDINGS



Sea ice loss + Ocean waves = Disintegration

- ▶ Sea ice is frozen ocean surface around Antarctic.
- ▶ Acts as **barrier** to ice shelves from ocean waves.
- ▶ Climate warming = sea ice loss around Antarctic peninsula.
- ▶ Allowed waves to trigger disintegrations.

ROLE OF APPLIED MATHEMATICS

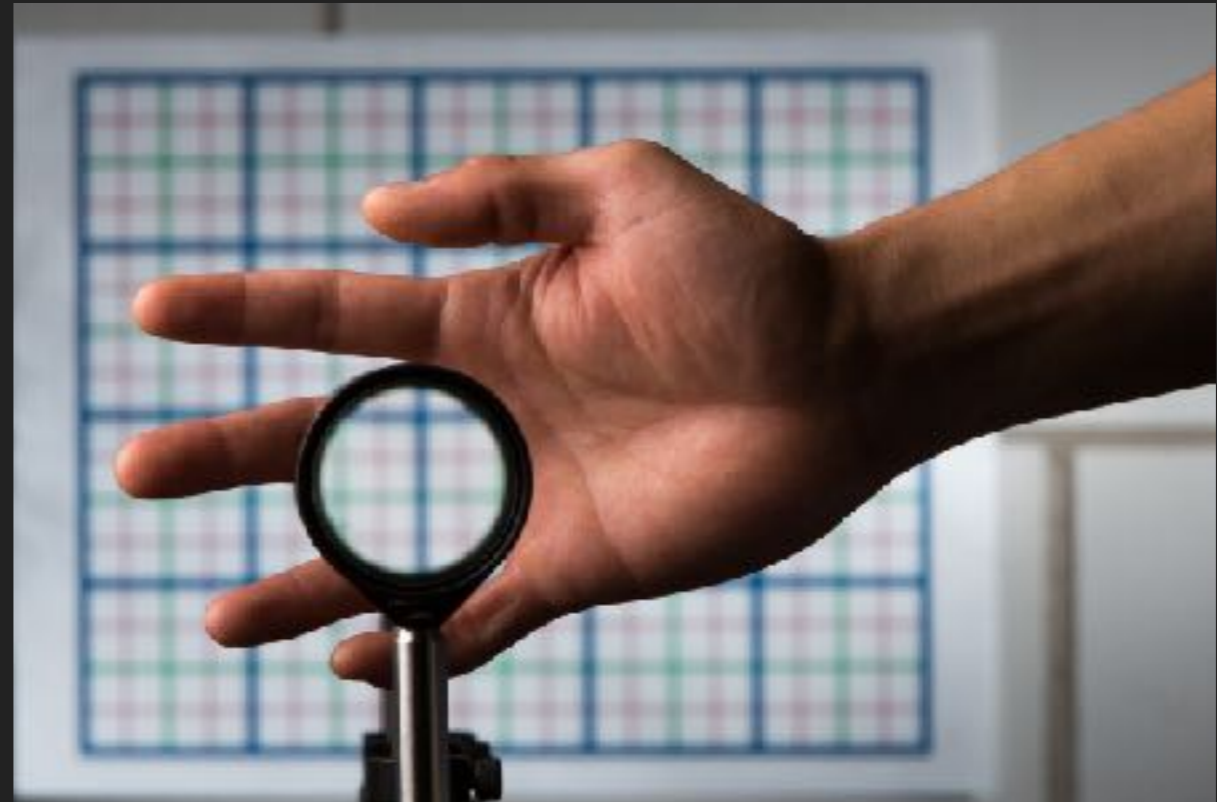
- ▶ Antarctic data patchy and expensive!!!!
- ▶ My collaborators (Australian Antarctic Division, Bureau of Meteorology and US institutions) had data on:
 - ▶ Sea ice loss, waves and disintegration timings.
- ▶ I provided mathematical models of:
 1. Waves energy reaching the ice shelves
 2. Impacts of waves on shelves.
- ▶ **Model predictions linked the datasets.**
- ▶ Findings published in Nature earlier this year.

MY RESEARCH: (2) “META” MATERIALS

“Material engineered to have properties not found in nature”



Negative refraction

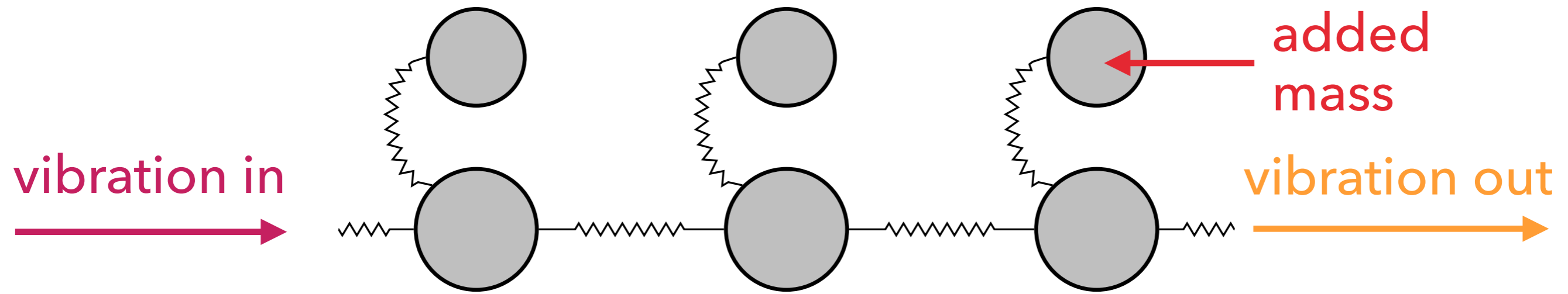


Invisibility cloaking

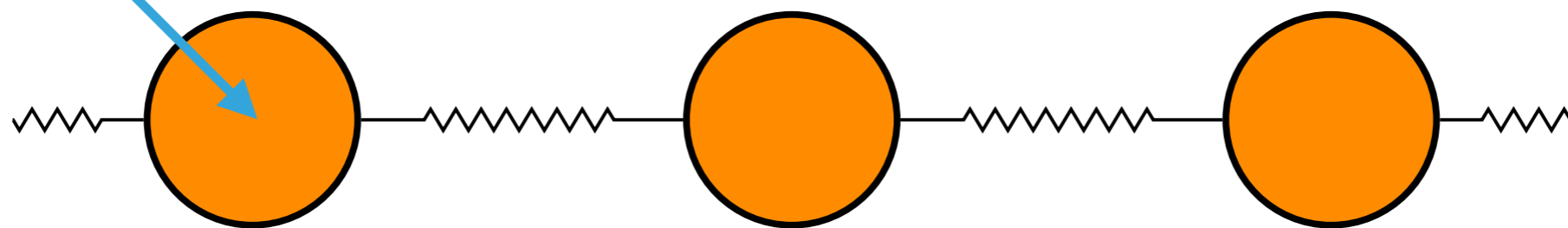
- ▶ Ideas spread from optics to, e.g.:
 - ▶ Seismology: protect structures from earthquakes
 - ▶ Acoustics: minimise noise pollution from vehicles, etc.

ACOUSTIC METAMATERIALS & ROLE OF APPLIED MATHS

Simple example: Prevent vibrations along mass-spring chain



"effective" mass




- ▶ Can have: effective mass \gg mass + added mass
- ▶ Or: negative effective mass!!!!

CONCLUSIONS

- ▶ The “applied” part counts in Applied Mathematician.
- ▶ Adelaideans can be proud of UoA’s history in Appl Maths.
- ▶ I use Appl Maths training to contribute to diverse areas of science & engineering.
 - ▶ Others focus on particular area.
- ▶ My colleagues work on problems in nanomechanics, high-performance computing, biology, epidemiology, social networks, bushfires, *and many more.*

 ecms.adelaide.edu.au/maths/research/

 maths.adelaide.edu.au/luke.bennetts

 @LukeBennettsUoA



THE UNIVERSITY
of ADELAIDE