CARDIFF UNIVERSITY

Cardiff School of Social Sciences

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The Title

‘Observation of Gravitational Waves from a Binary Black Hole Merger’

The necessity of ‘alternation’

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Estrangement

field notes written in 1997 (*Gravity's Shadow* p.540)

- Later, walking by myself around the site in the silent drizzle, I had a moment of estrangement from the project … Suddenly I saw that this was madness on the grandest scale! All this money, all this effort, all this steel, all this concrete—for what? To try and see movements smaller than the nucleus of an atom! After the initial delight in the achievement, the physicists too felt a little humbled and frightened. One or two of them remarked to me that "this had better work," or some such, and they said it without a chuckle.

- Why does anyone believe it anyway

The new thing in the world

The opposition as represented by Mermin

When I tried to explain … the article in the NY Times, I said it was the biggest accomplishment of physicists since the atomic bomb.

Making insanely small measurements

Small science combining with big science

Three dimensions of small and big science

Psychological: A developing science might depend on creativity or intuitive insights that occur best when attention is not diverted by routine tasks

a mature science would do better in conditions of predictable, cumulative progress, taking an analytic approach to problems.

Temporal: A developing science might need individuals to champion and push forward radical ideas and projects to the limit, which means leaving inventors to work on their own timetables

in a mature science, early freezing of designs, with inventors handing over control, would save wasted effort and allow an efficient division of labor, with the attention of specialists concentrated on pressing problems.

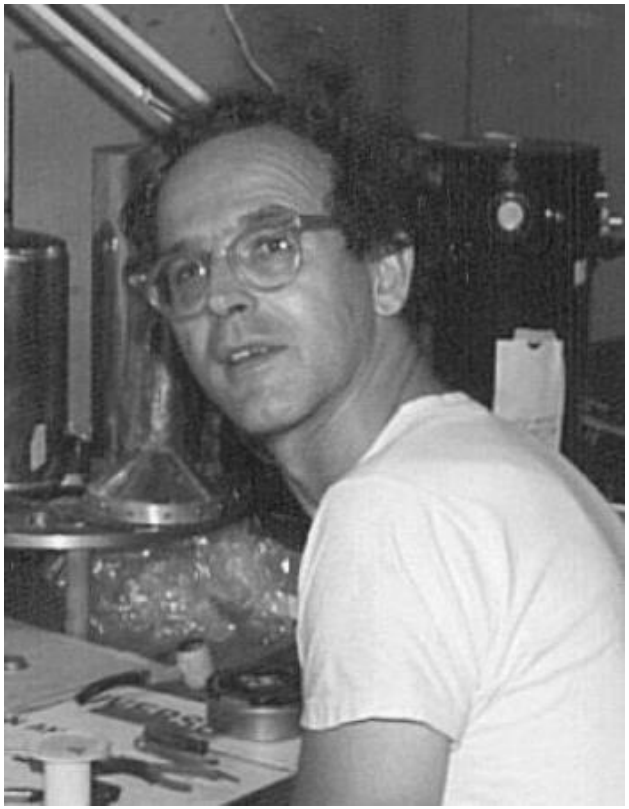
Cultural: The novelty needed by a developing science might arise more readily if scientists were relatively independent and could escape the social and cultural pressure associated with a dominant local "paradigm"—the local taken-for-granted ways of scientific thinking and doing

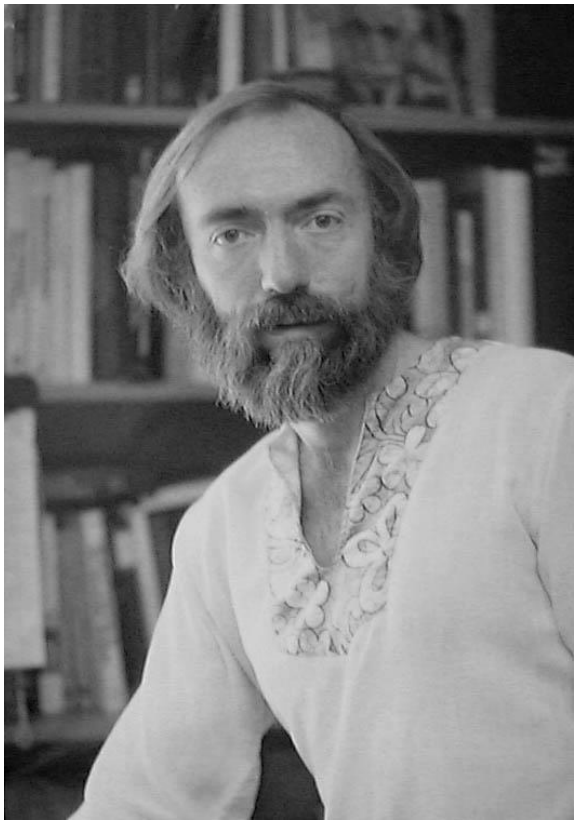
a mature science would gain from strong consensus within a solidaristic team.

History of large IFO GW detection

1984 – MIT/Caltech IFOs merged by NSF

Early 1980s onward – The Troika





THE TROIKA

Rai and Ron

[2000] [Ron's approach is] highly effective in some areas. I will say this: in most of the technical disagreements between Ron and Rai, Ron was right more often than not. There were more occasions when Ron's pictorial intuition stood up against Rai's mathematics than the other way round in spite of the fact that Rai's very good with that kind of stuff.

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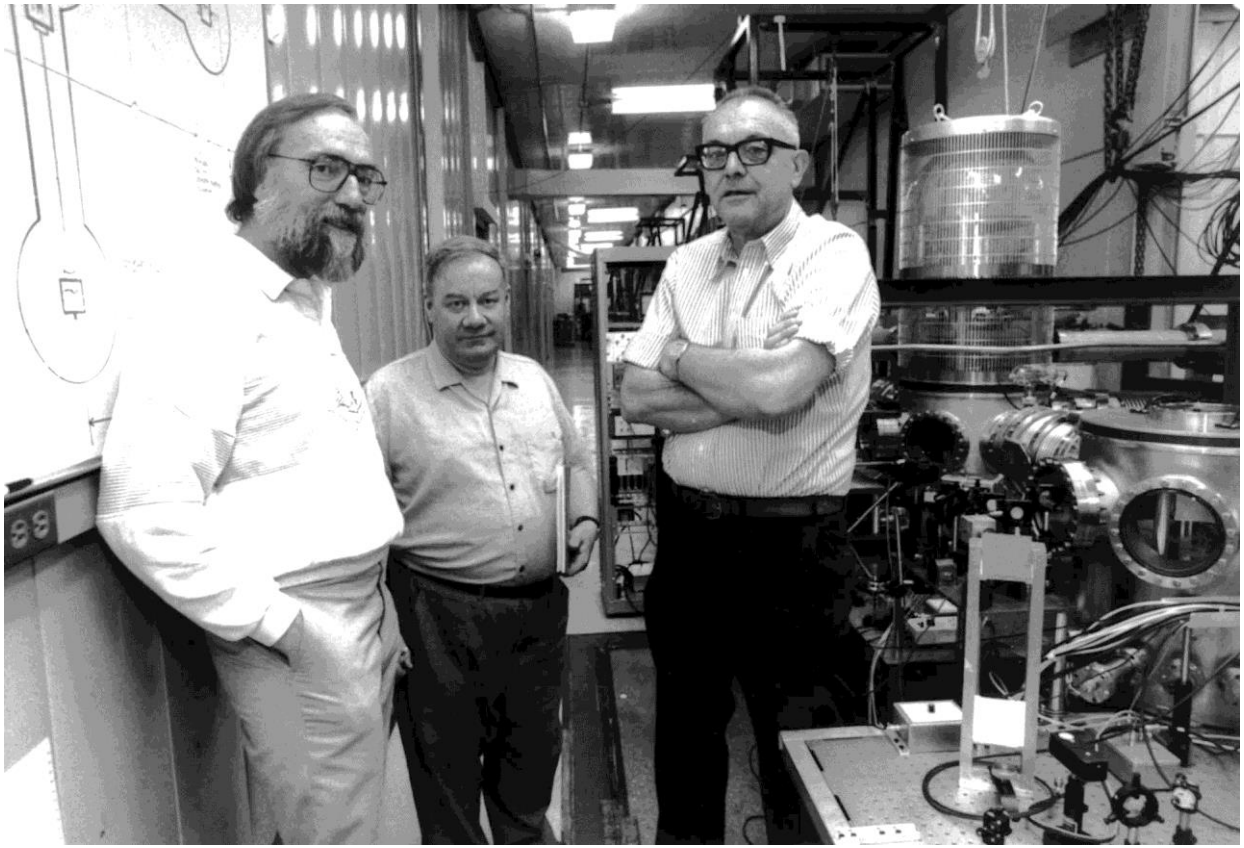
1987-onward Rochus (Robbie) Vogt

[LIGO moving toward big science]

Thorne, Drever and Vogt



Robbie on Ron

[1996] What frightened him about me was that I made decisions. He said to me, “How do you know that is the correct decision—we must keep all these options open.” And I said, “That means an exponential [explosion] as we go forward.” He did not understand the game we were in. We were funded to build an observatory, not to do independent research. And that is a discipline he could not accept. . . . He definitely felt I was a threat to the realization of his dream.

History of large IFO GW detection

1984 – MIT/Caltech IFOs merged by NSF

Early 1980s onward – The Troika

1984-1987 Frank Schutz – project manager

1987-onward Rochus (Robbie) Vogt

[LIGO moving toward big science]

1992 - Drever sacked by Vogt

1994 - Vogt sacked (by NSF)

1994 - Barish and Sanders

[Full transition to big science]

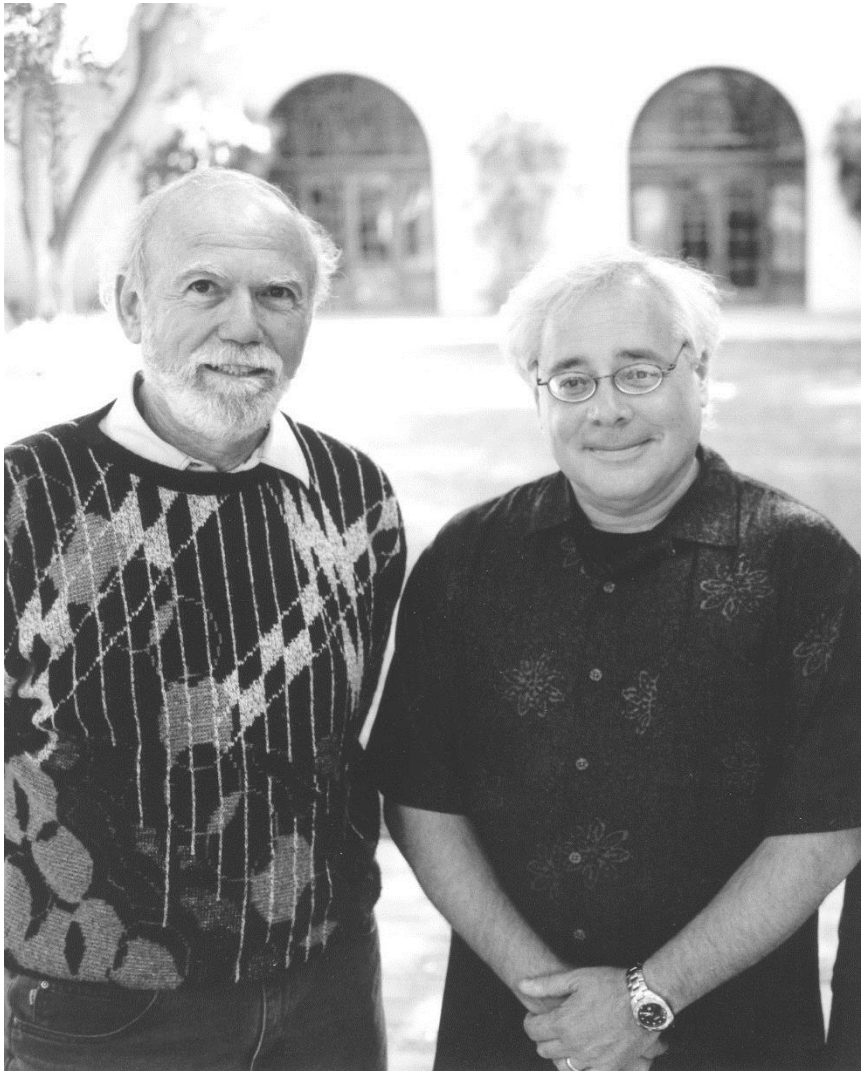
Later Jay Marx then Dave Reize

Transition to Advanced LIGO

History of large IFO GW detection

Full transition to big science

Barish and Sanders



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Successful Big Science: The Key

Because of the sums of money the opportunity cost of big science has a far wider impact

Therefore, small science is assessed by specialists but big science by generalists

Therefore the key to big science is good technical judgment + transparent and responsible management of resources *today* to create the conditions for scientific success *tomorrow*

SPIN-OFFS

Artificial Intelligence

BACON

Science isn't fitting a theory to a set of clean data points, it is deciding through discussion what is the set of acceptable data points

EXPERT SYSTEMS

Intelligence isn't just a matter of pouring in knowledge; it is a matter of reaching consensus about what counts as knowledge

ADAPTED FROM 1995 DRAFT OF *ARTIFICIAL INTELLIGENCE* REVIEW OF DREYFUS'S, 1996, *WHAT COMPUTERS STILL CAN'T DO*

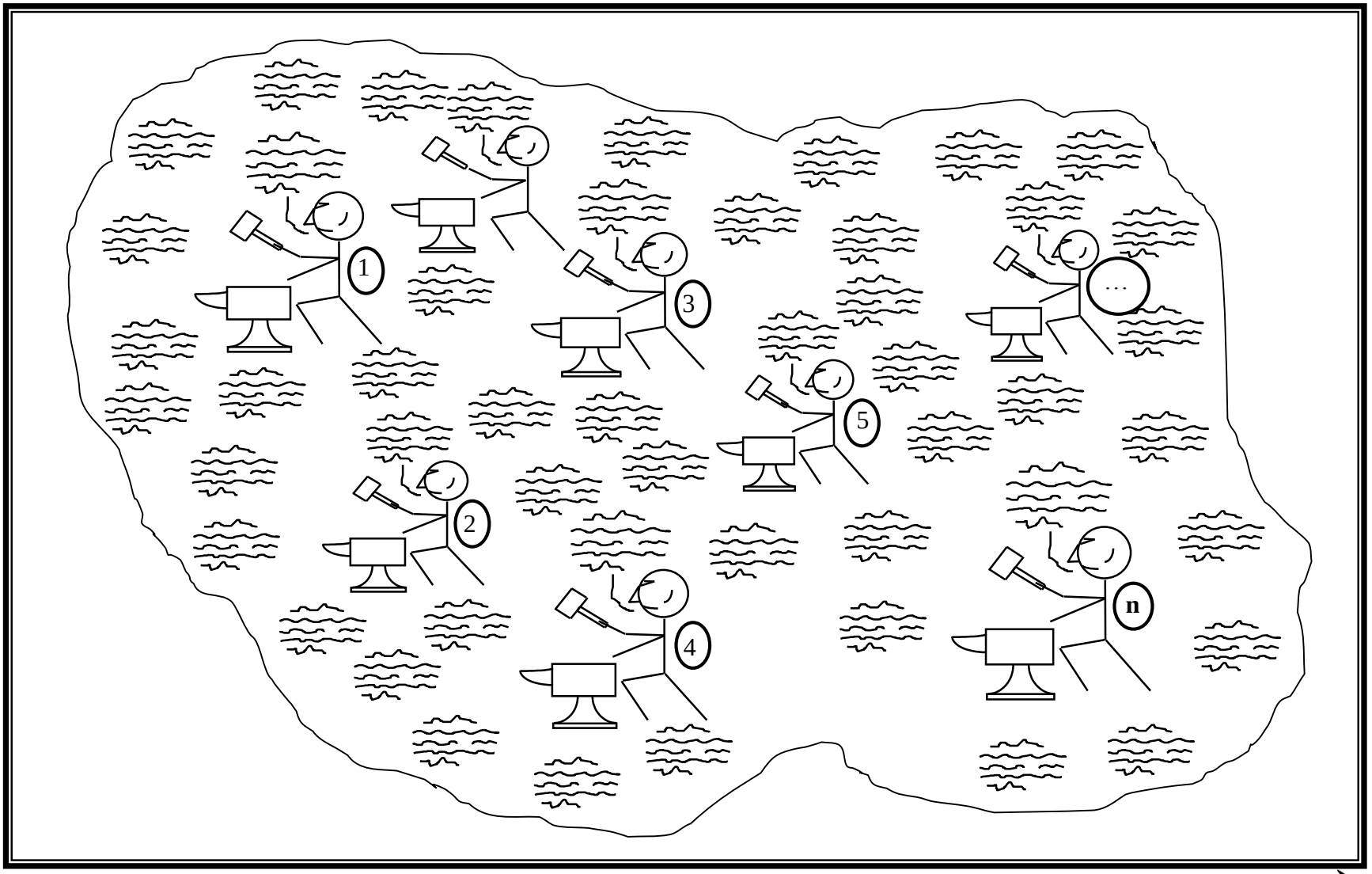
Wittgenstein said that if a lion could speak we would not understand it.... lions would not have, eg, chairs in their language in the way we do because lions' knees do not bend as ours do.

But this does not mean that every entity that can recognise a chair has to be able to sit on one. In principle, if one could find a lion cub that had the potential to have conversations, one could bring it up in human society to speak about chairs as we do in spite of its funny legs. It would learn to recognise chairs as it learned to speak our language, just as congenitally disabled people in our own society manage.

(This point has been used to argue that it is possible for computers to have human-like intelligence without human-like bodies.)

Given the capacity for linguistic socialisation, an individual can come to share a form of life without having a body or the experience of physical situations which correspond to that form of life.

Language and Practice



The spoken discourse that belongs to a practising community is their *'practice language'*

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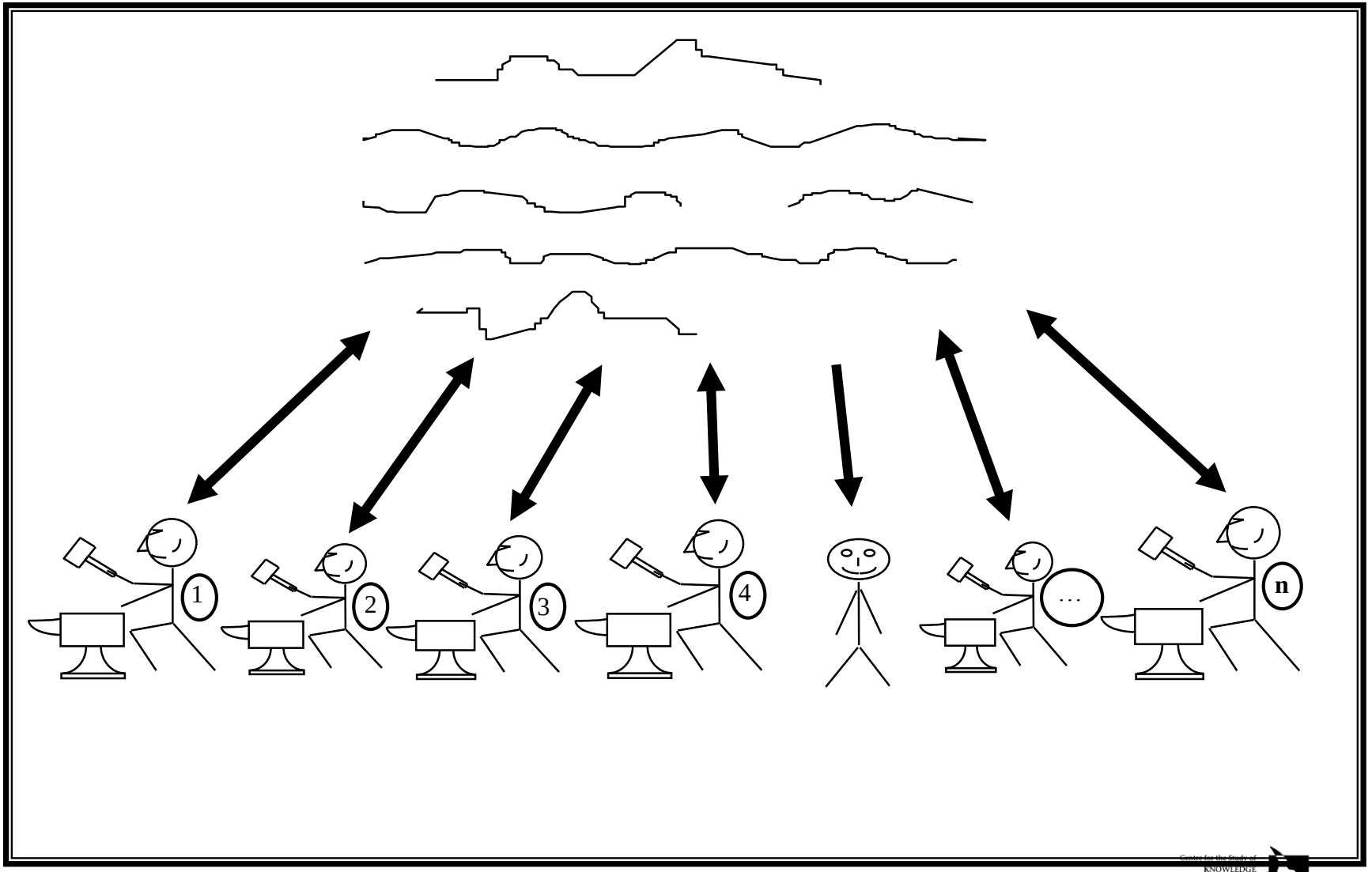
Language and Practice



Interactional Expertise

Is a practical accomplishment

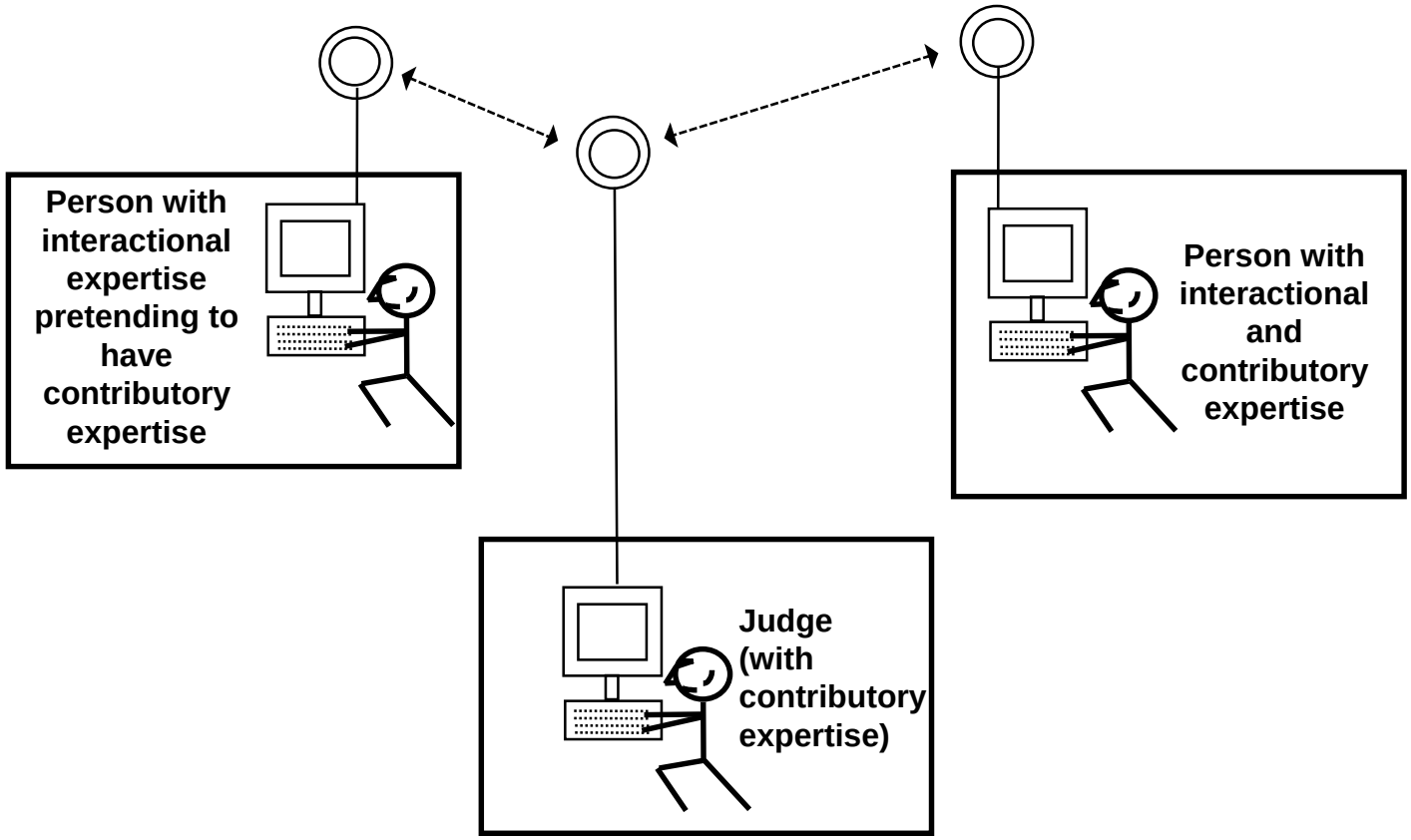
Not “walking the walk”

But not “talking the talk”

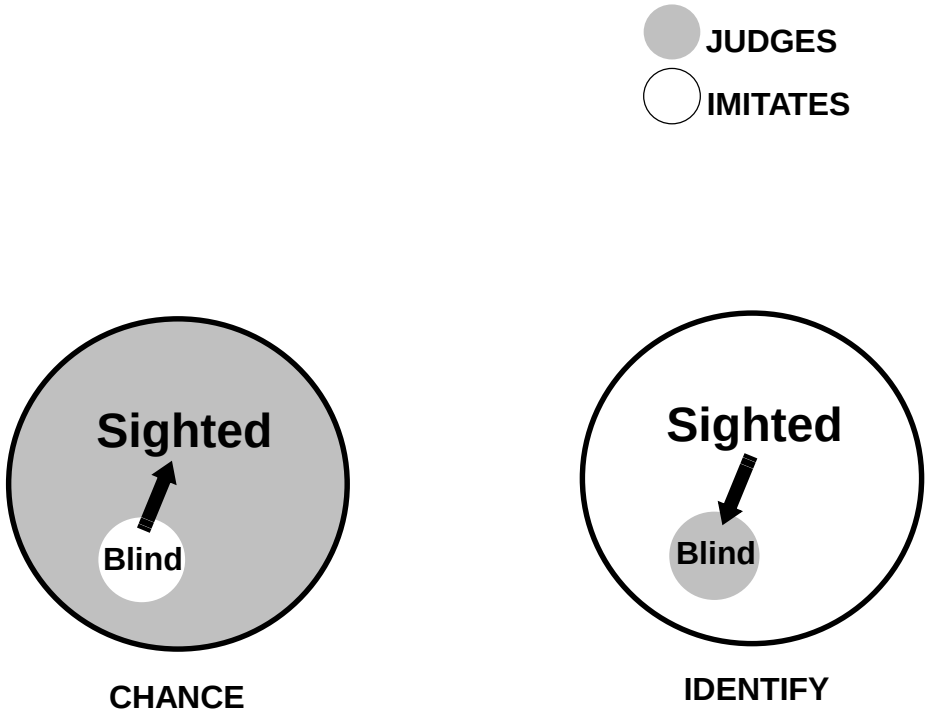
It is “walking the talk”

Without it, eg, no division of labour etc

The Imitation Game



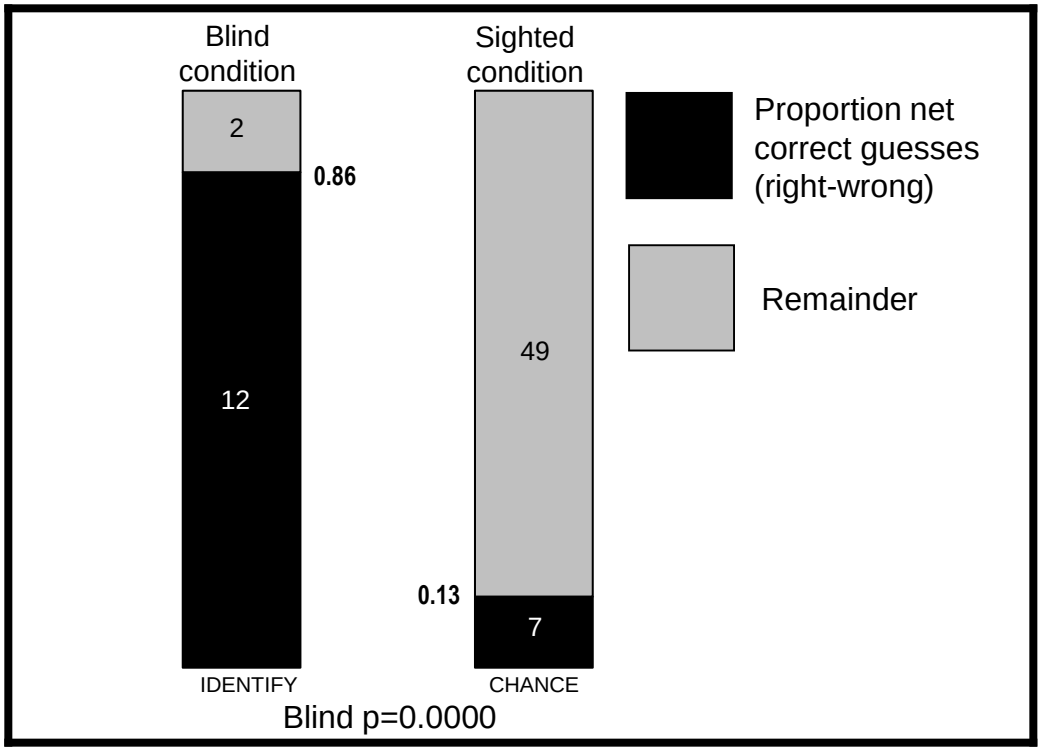
Experimental configurations



Qualitative data

RESPONDENT 1	JUDGE	RESPONDENT 2	*4 PHASE 2 JUDGES*
I watch Wimbledon a little bit on the television and occasionally the Australian Open in January	**So let me start with sport. Are you interested in tennis and do you ever watch it on the television?**	I like tennis but only watch big tournaments like Wimbledon	
Not being a tennis professional it is not for me to say if it should or should not be used. It does not really alter viewing	**So tell me what you think about the Hawk-Eye line judging system**	It adds an other element to the game which could make it more interesting	
I assume it's the same technology in cricket and in cricket, Hawk-Eye is between two and four mm out. If it is the same for tennis, then it is probably still more accurate than the human eye. If the players are happy with it and the umpires are happy with it then they should continue using Hawk-Eye	**But I want to know whether you think that the umpire or the players could ever make a better judgment than Hawk-Eye**	There is always a degree of uncertainty with both people and technology	
I think often a tennis player is not in a position to judge accurately as they are not usually parallel with the line. I think that if you set up a test for a line judge with two balls one which landed on the line and one which landed 1mm away from the line, I don't think they could tell the difference. If you think how small 1mm is then it would be so hard for them to judge.	**How accurately would you say a human can judge the flight of a tennis-ball? I mean, would you say they could tell the difference between touch the line and 1mm out 2mm out 1 cm out, 2 cm out, or what, and what would it depend on?**	it would depend on the speed the ball was travelling and the position of the judge relative to the line and obviously the closer the ball is the line the harder it would be to make a judgement. So you would have to judge each call on an individual bases as there are a lot of factors.	

Quantitative data



Imitation Game tests with the blind

Identification Ratios, 0.86 and 0.13

Effect size = 0.7

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Q2) Is a spherical resonant mass detector equally sensitive to radiation from all over the sky?	
A2)Yes, unlike cylindrical bar detectors which are most sensitive to gravitational radiation coming from a direction perpendicular to the long axis.	B2) Yes it is.
Q3) State if after a burst of gravitational waves pass by, a bar antenna continues to ring and mirrors of an interferometer continue to oscillate from their mean positions? (only motion in the relevant frequency range is important).	
A3)Bars will continue to ring, but the mirrors in the interferometer will not continue to oscillate.	B3) Bars continue to ring; the separation of interferometer mirrors, however, follows the pattern of the wave in real time.
Q5) A theorist tells you that she has come up with a theory in which a circular ring of particles are displaced by GW so that the circular shape remains the same but the size oscillates about a mean size. Would it be possible to measure this effect using a laser interferometer?	
A5) Yes, but you should analyse the sum of the strains in the two arms, rather than the difference. You don't even need two arms to detect GWs, provided you can measure the round-trip light travel time along a single arm accurately enough to detect small changes in its length.	B5) It depends on the direction of the source. There will be no detectable signal if the source lies anywhere on the plane which passes through the center station and bisects the angle of the two arms. Otherwise there will be a signal, maximised when the source lies along one or other of the two arms.
Q6) Imagine the mirrors of an interferometer are equally but oppositely (electrically) charged. Could the effect of a radio-wave on the interferometer be the same as a gravitational wave?	
A6) In principle you could detect the passage of an electromagnetic (EM) wave, but the effect is different than for a GW. Unlike EM waves, GWs produce quadrupolar deformations. A typical EM wave would change the distance in only one arm while a typical GW wave would change the distances (in opposite ways) in both, so the differential signal for the EM wave would be half that for a GW.	B6) Since gravitational waves change the shape of spacetime and radio waves do not, the effect on an interferometer of radio waves can only be to mimic the effects of a gravitational wave, not reproduce them. An EM wave could, however, produce noise which could be mistaken for a GW under the circumstances described.

Q5) A theorist tells you that she has come up with a theory in which a circular ring of particles are displaced by GW so that the circular shape remains the same but the size oscillates about a mean size. Would it be possible to measure this effect using a laser interferometer?	
A5) Yes, but you should analyse the sum of the strains in the two arms, rather than the difference. You don't even need two arms to detect GWs, provided you can measure the round-trip light travel time along a single arm accurately enough to detect small changes in its length.	B5) It depends on the direction of the source. There will be no detectable signal if the source lies anywhere on the plane which passes through the center station and bisects the angle of the two arms. Otherwise there will be a signal, maximised when the source lies along one or other of the two arms.

Sociologist fools physics judges

After more than 30 years of studying the physicists who work on gravity waves, spending countless hours talking to physicists and writing a book on the history and sociology of the field, social scientist Harry Collins had a question. Could he pass as a physicist?

He reckons he can — and he has the experimental data to prove it. Collins's study, to be published later this year, is the first experiment on the concept of 'interactional expertise', an idea that could influence areas such as peer review and science journalism. It could even help settle a question lingering since the science wars of the 1990s, when sociologists launched what scientists saw as attacks on the very nature of science, and scientists responded in kind.

Collins's claim rests on his answers to a set of seven questions about gravity-wave physics set by a gravity-wave physicist. His replies, together with those from a real gravitational physicist, were sent to nine researchers in the field (see 'Faking it'). Asked to spot the real physicist, seven were unsure and two chose Collins. The results appear in a paper co-authored with Rob Evans, like Collins based at Cardiff University, UK. It is due to be published this December in *Studies in the History of Philosophy of Science* (for a preprint see www.cf.ac.uk/socsi/expertise).

Nature sent the questions and answers to Sheila Rowan, a gravitational-wave physicist at the University of Glasgow. She was likewise unable to spot the impostor. "The answers are different but it's not obvious which are not by a graduate scientist," she says.

"I could not run LIGO [a US gravity-wave detector] or do lots of other things," says Collins. "But the results do show that outsiders can develop a kind of expertise in a scientific field", even if they cannot carry out the relevant experiments and do not know the mathematics involved.

Collins says this kind of expertise, known as interactional to contrast with the 'contributory expertise' that comes from being able to do experiments and develop theories, should not be dismissed. He points out, for example, that it is important in activities such as grant allocation, in which peer-review panels may include scientists who know the concepts associated with a field, but lack technical understanding.

In a second experiment, Collins and Evans got groups of colour-blind people to pretend they could see colours. Judges compared their performance in conversation with that of people with normal sight. As Collins expected, the colour-blind, immersed in the language of colour vision, had the interactional expertise to pass as colour-perceivers. In contrast, people lacking perfect musical pitch could not pass for those who could. Very few have such an ability, so those lacking it have not learnt to describe how the skill feels.

T. CUCCIARELLI/PI

He might not be able to run this gravity-wave detector, but a social scientist passed himself off as a physicist.

Faking it

One answer to the following question is from an experienced gravity-wave physicist, the other is from social scientist Harry Collins of Cardiff University, UK. To find out which is which, see page 15.

A theorist tells you that she has come up with a theory in which a circular ring of particles is displaced by gravitational waves so that the circular shape remains the same but the size oscillates about a mean size. Would it be possible to measure this effect using a laser interferometer?

A: Yes, but you should analyse the sum of the strains in the two arms, rather than the difference. In fact, you don't even need two arms of an interferometer to detect gravitational waves, provided you can measure the round-trip light travel time along a single arm accurately enough to detect small changes in its length.

B: It depends on the direction of the source. There will be no detectable signal if the source lies anywhere on the plane that passes through the centre station and bisects the angle of the two arms. Otherwise there will be a signal, maximized when the source lies along one or other of the two arms.

If the concept of interactional expertise catches on, it could affect the argument about whether an outsider, such as an anthropologist, can properly understand another group, such as a remote rural community. The debate was part of the science wars, when some scientists claimed that sociologists studying science did not understand the disciplines involved, in part because they did not practise them.

Collins's results do not end that discussion, but they do suggest that outsiders can develop expertise in a field. Collins says that investigators now have a way to display their expertise — and that they and their critics can talk sensibly about whether it is appropriate.

One of the main protagonists in the debate was Alan Sokal, a physicist at New York University who authored a spoof science-studies paper that was accepted by *Social Text*, a cultural research journal. The paper, which consisted of meaningless arguments about quantum theory, was intended to expose what Sokal and others saw as a lack of academic rigour among sociologists.

Sokal says he is struck by Collins's skills in physics, but notes that such understanding would not be enough for more ambitious sociology research that attempts to probe how cultural and scientific factors shape science. "If that's your goal you need a knowledge of the field that is virtually, if not fully, at the level of researchers in the field," says Sokal. "Unless you understand the science you can't get into the theories." ■

Jim Giles

NATURE

6 July 2006

Different arrangements of GW imitation game

(**GW**) scientist

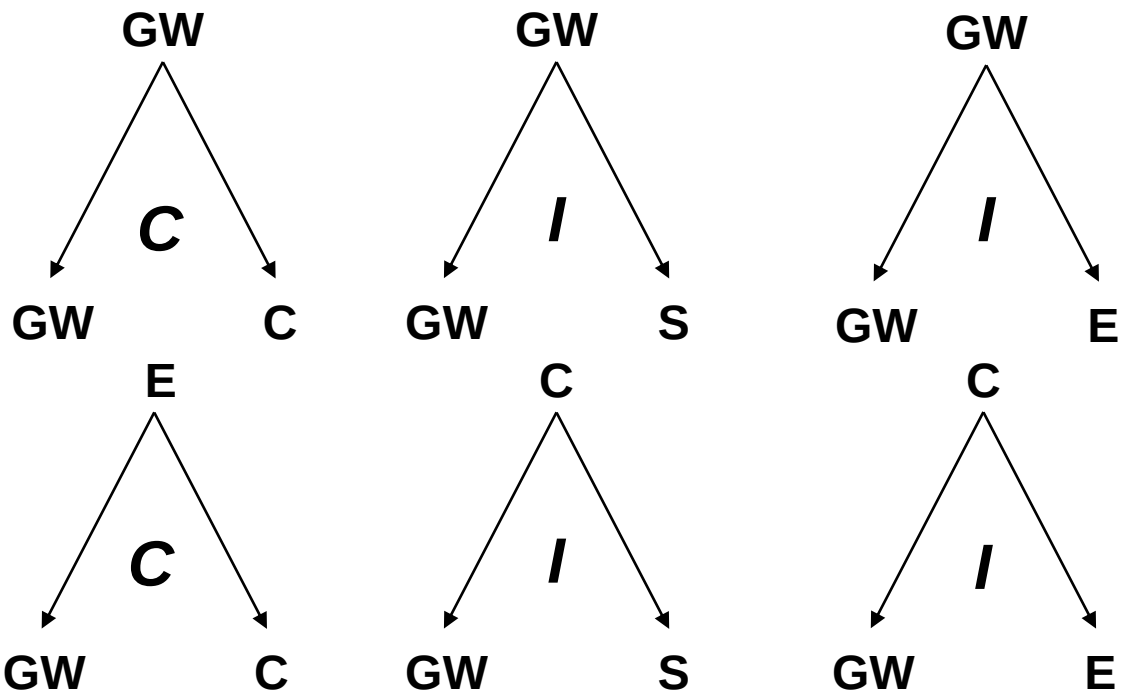
(**C**)Ollins

Non-GW (**S**)cientist [Astrophysicists and Astronomers]

(**E**)vans

C*hance*

I*dentify*



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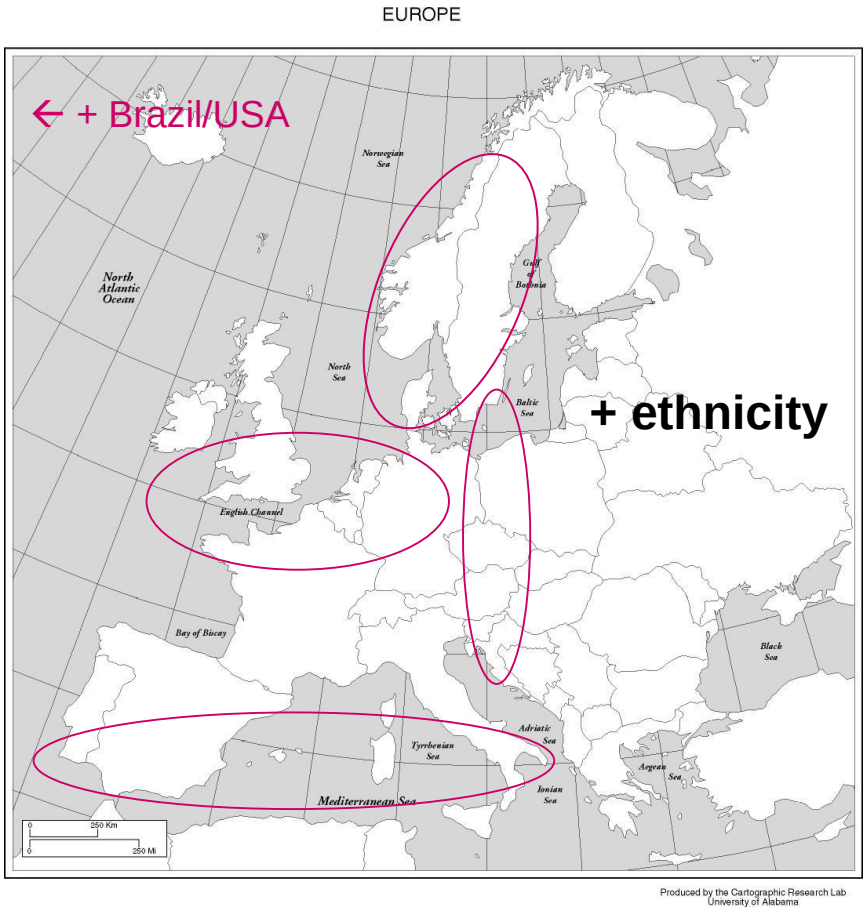
New method for comparative social analysis



Proposed European comparative project

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Periodic Table of Expertises (PTE)

UBIQUITOUS EXPERTISES						
DISPOSITIONS				Interactive Ability / Reflective Ability		
SPECIALIST	***UBIQUITOUS TACIT KNOWLEDGE***			***SPECIALIST TACIT KNOWLEDGE***		
EXPERTISES	Beer-mat Knowledge	Popular Understanding	Primary Source Knowledge	Interactional Expertise	Contributory Expertise	
				Polimorphic / *Mimeomorphic*		
META-	***EXTERNAL***		***INTERNAL***			
EXPERTISES	Ubiquitous Discrimination	Local Discrimination	Technical Connoisseurship	Downward Discrimination	Referred Expertise	
META-CRITERIA	Credentials		Experience	Track-Record		

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Primary Source Knowledge

IL NUOVO CIMENTO Vol. 111 B, N. 6 Giugno 1996

Search for correlations of gamma-ray bursts with gravitational-radiation antenna pulses

J. Weber and B. Radak

Department of Physics, University of Maryland - College Park, MD 20742, USA
Department of Physics, University of California - Irvine, CA 92717, USA

(ricevuto il 25 Maggio 1995; revisionato il 12 Gennaio 1996; approvato il 16 Febbraio 1996)

Summary. — Gravitational-radiation-antenna outputs were plotted, for 20 s periods which included one gamma-ray burst trigger time. Data were obtained for two gravitational-radiation antennas. For the first 80 burst times which were studied, it is observed that either the largest or second-largest gravitational-radiation detector pulse peak occurs within 0.5 s of the gamma-ray burst trigger time for 20 of the 80 gamma-ray bursts, for the larger of the two gravitational antennas. The probability that the correlations are accidental is estimated as approximately $6 \cdot 10^{-5}$.

PACS 95.30Sf – Relativity and gravitation.

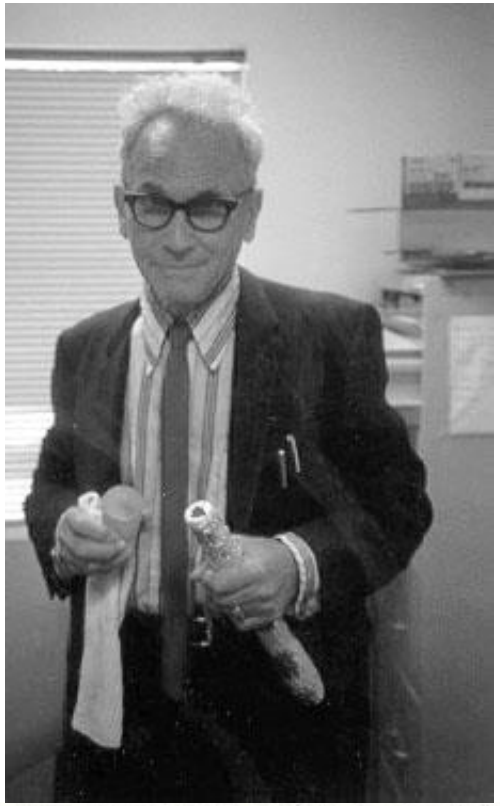
1. – Introduction

The First BATSE Gamma-Ray Burst Catalog begins with the statement that «In spite of two decades of study, the origin of gamma-ray bursts remains an enigma». Since the gamma-ray bursts may be associated with mass elements moving at very high velocities, bursts of gravitational radiation might be emitted.

Ormes and Weber, independently, suggested that there might be correlations between gamma-ray bursts and outputs of gravitational-radiation antennas. Search has recently been carried out by employing magnetic tapes with recorded outputs of two gravitational-radiation antennas which were operating for extended periods in 1991 and 1992.

2. – Analyses

The magnetic tapes which were studied have two channels with recorded data. One is for a 3600 kg mass gravitational-radiation antenna with the great isolation from seismic and electromagnetic disturbances resulting from the interior acoustic filtering and shielding of a large thick-walled vacuum chamber. The second channel records data for an earlier-design 1700 kg mass gravitational-radiation antenna with



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PACS 95.30Sf – Relativity and gravitation.

Mbeki to Second Chamber in 1999

There … exists a large volume of scientific literature alleging that, among other things, the toxicity of this drug [the anti-retroviral AZT] is such that it is in fact a danger to health. … To understand this matter better, I would urge the Honourable Members of the National Council to access the huge volume of literature on this matter available on the Internet, so that all of us can approach this issue from the same base of information. (quoted in Weinel, 2008)

Before and after September 14 2015

Meaning of discovery

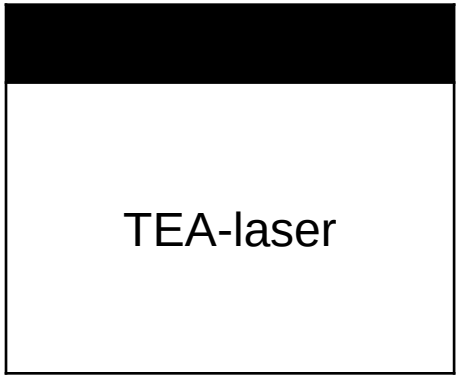
The long aha!

What discovery means for different people

Using different definitions

What discovery is said to mean by different people

Social construction



Scientists Disagree!

EXPERIMENT W

Scientist(a): that's why the W thing, though it's very complicated, has certain attributes so that if they see something, it's a little more believable ... They've really put some thought into it

Scientist(b): They hope to get very high sensitivity but I don't believe them frankly. There are more subtle ways round it than brute force ...

Scientist(c): I think that the group at ... W ... are just out of their minds.

EXPERIMENT X

Scientist(i): he is at a very small place ... [but] ... I have looked at his data, and he certainly has some interesting data.

Scientist(ii): I am not really impressed with his experimental capabilities so I would question anything he has done more than I would question other people's.

Scientist(iii): That experiment is a bunch of shit!

EXPERIMENT Y

Scientist(1): Y's results do seem quite impressive. They are sort of very business-like and look quite authoritative ...

Scientist(2): My best estimate of his sensitivity, and he and I are good friends ... is ... [low] ... and he has just got no chance [of detecting gravity waves].

Scientist(3): If you do as Y has done and you just give your figures to some ... girls and ask them to work that out, well, you don't know anything. You don't know whether those girls were talking to their boyfriends at the time.

EXPERIMENT Z

Scientist(I): Z's experiment is quite interesting, and shouldn't be ruled out just because the ... group can't repeat it.

Scientist(II): I am very unimpressed with the Z affair.

Scientist(III): Then there's Z. Now the Z thing is an out and out fraud!

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EXPERIMENT X

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Scientist(iii): That experiment is a bunch of shit!

Experimenter's Regress

Scientists can disagree because repeating an experiment involves transfer of tacit experimental skills and there is no criterion of successful transfer except outcome

To know if x exists must build an x-detector
To know if x-detector works must test it on x-detection
To know if it passes the test must know if x exists
To know if x exists must build an x-detector …

TO DISCOVER X MUST COEXTENSIVELY DEFINE X-DETECTOR AS SOMETHING THAT EITHER DOES OR DOES NOT DETECT X

Social construction 1

This formed one of the foundations of what became known as the

‘social construction of science’

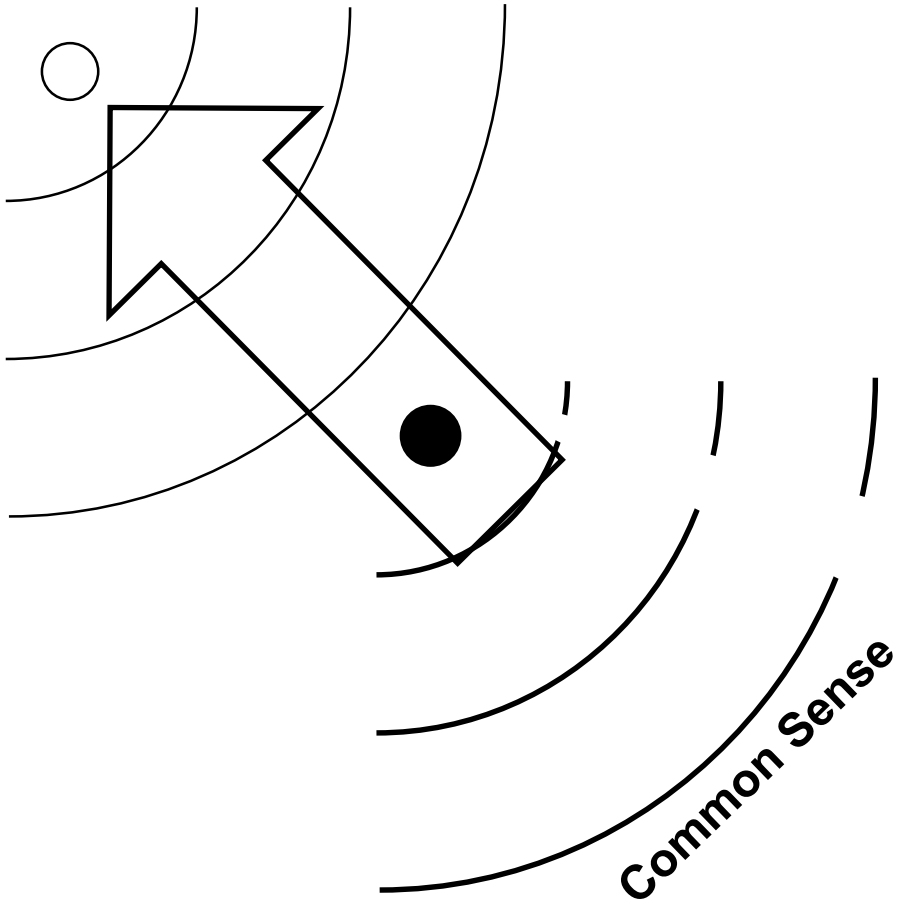
or the

‘sociology of scientific knowledge’

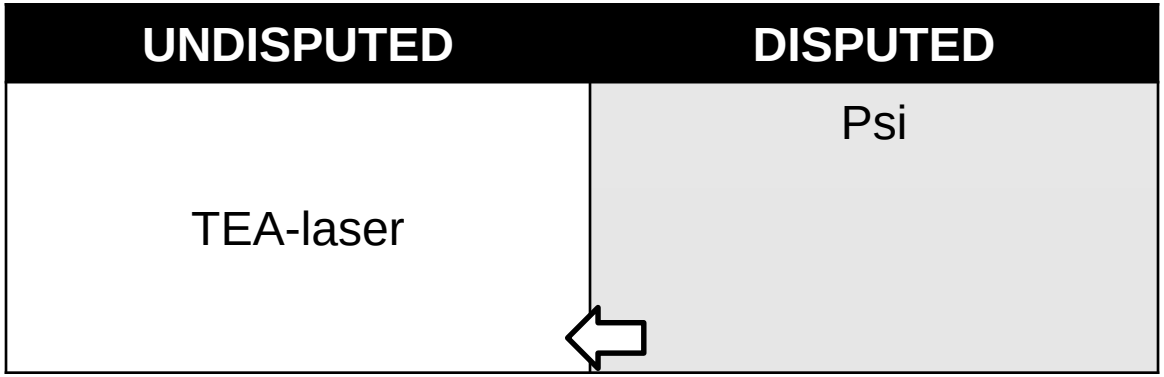
Social construction

UNDISPUTED	DISPUTED
TEA-laser	Psi High fluxes of GW

Two sets of gravitational waves



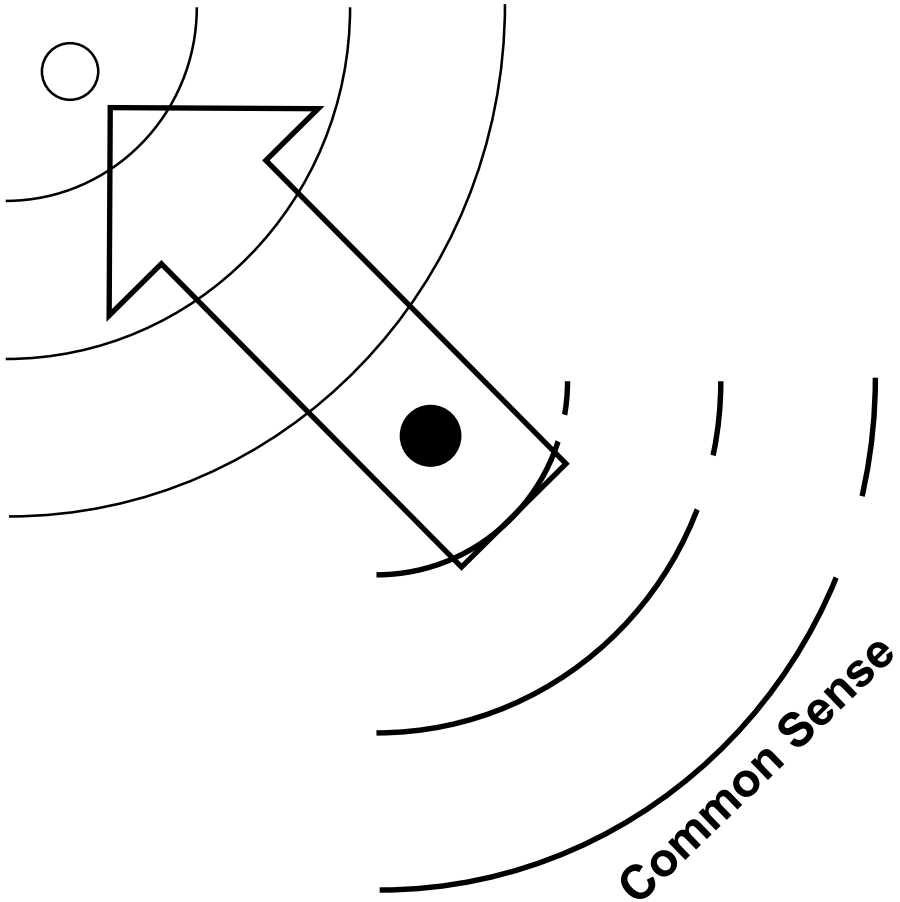
Gravity's Kiss and social construction



But to understand what this means one must retain the distanced perspective

One must know how to doubt to know why doubting has become so hard

Find those who do not share the social conventions



Invent ways to doubt because there is no one left to do it for me

When to stop questioning is a social convention

Malicious injection?

Could it be boson stars?

When is the machine the same?

Speed of GW?

The statistical logic? 5/7 sigma

Mind over matter?

UN-DISCOVER THE HIGGS!

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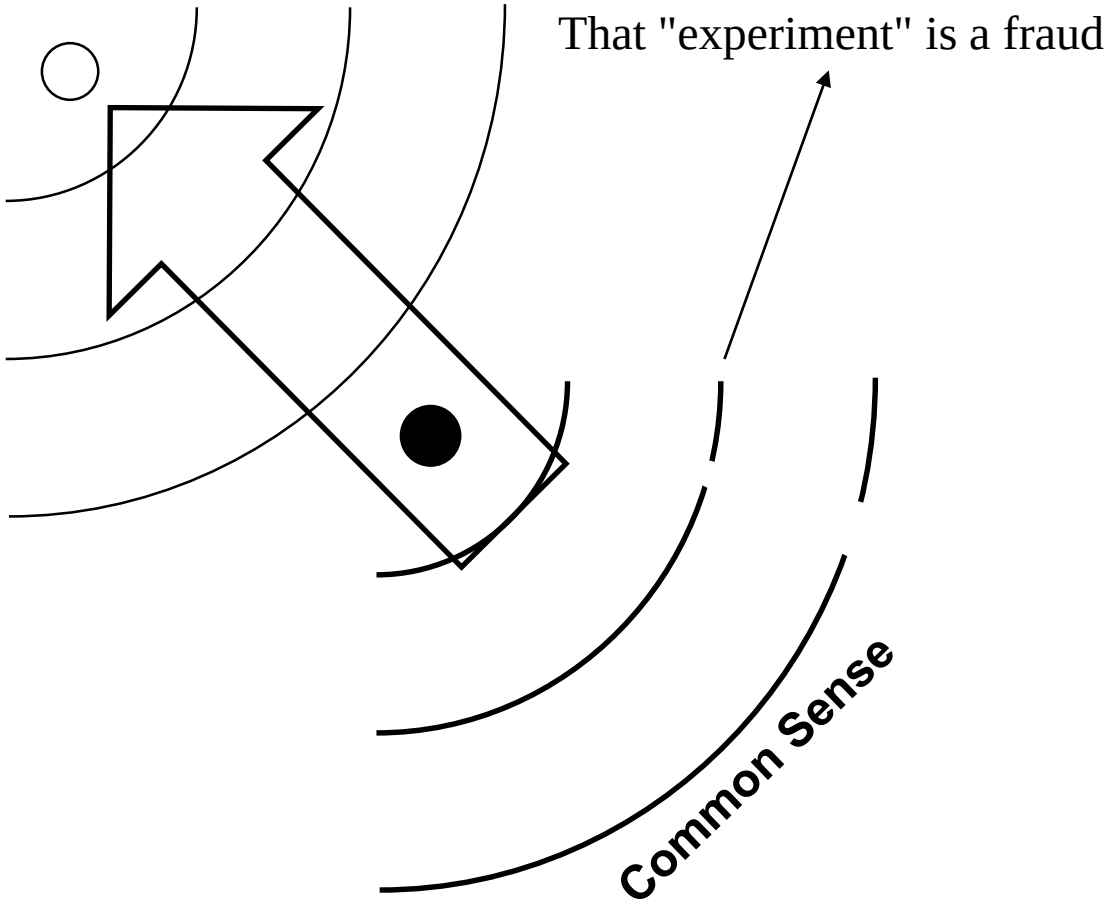
Find those who do not share the social conventions



Blind injection fraud

A physicist quotes the *New York Times*

The LIGO team includes a small group of people whose job is to create blind injections—bogus evidence of a gravitational wave—as a way of keeping the scientists on their toes.

The agenda is to convince academic physicists to not challenge Einstein theory of gravity, despite its numerous failings … A Nobel Prize will be awarded for LIGO "discovery"

viXra paper conclusion

10 Conclusions

LIGO did not detect Einstein gravitational waves and black holes. Black holes and Einstein's gravitational waves do not exist; they are not even consistent with General Relativity. The LIGO instability has been interpreted as gravitational waves produced by two merging black holes by a combination of theoretical fallacies, wishful thinking, and conformational bias. Black holes are products entire of violations of the rules of pure mathematics. General Relativity is riddled with logical inconsistencies, invalid mathematics, and impossible physics. …

LIGO is reported to have so far cost taxpayers $1.1 billion [48]. Just as with the Large Hadron collider at CERN, such large sums of public money demand justification by eventually finding what they said they would.

A comment on the critical viXra paper

What's most ridiculous to me is that this "discovery" is based on a single data point: a single coincidence! Has there ever been a real scientific discovery based upon a single data point? Doesn't that alone go completely contrary to the scientific method they profess to follow (or perhaps they no longer do profess it, but don't say so…)? Where are the independent confirmations of "gravity waves" and "black holes"? [A comment on the critical viXra paper]

Rai Weiss on the same problem

From the *New Yorker*

Since the September 14th detection, LIGO has continued to observe candidate signals, although none are quite as dramatic as the first event. “The reason we are making all this fuss is because of the big guy,” Weiss said. “But we’re very happy that there are other, smaller ones, because it says this is not some unique, crazy, cuckoo effect.” (*New Yorker*, Feb 11th 2016 ‘Gravitational Waves Exist: The Inside Story of How Scientists Finally Found Them’, by Nicola Twilley)

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THE END

Ireland Religion and RELATIVISM!

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Relativism and the social analysis of science

To press forward with sociological understanding of scientific change in an assiduous way requires that one is not allowed to cut off inquiry at any point one desires by saying ‘they believe that because that’s how it has proved to be’

‘Act as though the natural world in no way constrains what is believed to be’

From viXra

The LIGO Scientific Collaboration and the Virgo Collaboration have announced that on 24 September 2015, LIGO detected an Einstein gravitational wave directly for the first time, with the first observation of a binary black hole merger. The announcement was made with much media attention. Not so long ago similar media excitement surrounded the announcement by the BICEP2 Team of detection of primordial gravitational waves imprinted in B-mode polarisations of a Cosmic Microwave Background, which proved to be naught. According to the LIGO and Virgo Collaborations, the gravitational wave LIGO allegedly detected was generated by two merging black holes, one of ~29 solar masses, the other of ~36 solar masses, at a distance of some 1.3 billion light years. The insurmountable problem for the credibility of LIGO's claims is the questionable character of the theoretical assumptions upon which they are based. In this paper various arguments are presented according to which the basic theoretical assumptions, and the consequential claims of detecting gravitational waves, are proven false. The apparent detection by the LIGO-Virgo Collaborations is not related to gravitational waves or to the collision and merger of black holes.

The proposal

CALTECH/MIT PROJECT

FOR A

LASER INTERFEROMETER

GRAVITATIONAL WAVE OBSERVATORY

December 1987

LIGO-M870001-00-M

By comparing the source strengths and benchmark sensitivities in Figure II-2 and in the periodic and stochastic figures A-4b,c (Appendix A), one sees that *(i) There are nonnegligible possibilities for wave detection with the first detector in the LIGO. (ii) Detection is probable at the sensitivity level of the advanced detector. (iii) The first detection is most likely to occur, not in the initial detector in the LIGO but rather in a subsequent one, as the sensitivity and frequency are being pushed downward*.

History of small scale GW detection

1970s – room temperature bars (Weber)

first bench-top interferometers

(Weiss's [MIT] idea and Germans build)

1979 – Drever goes to Caltech

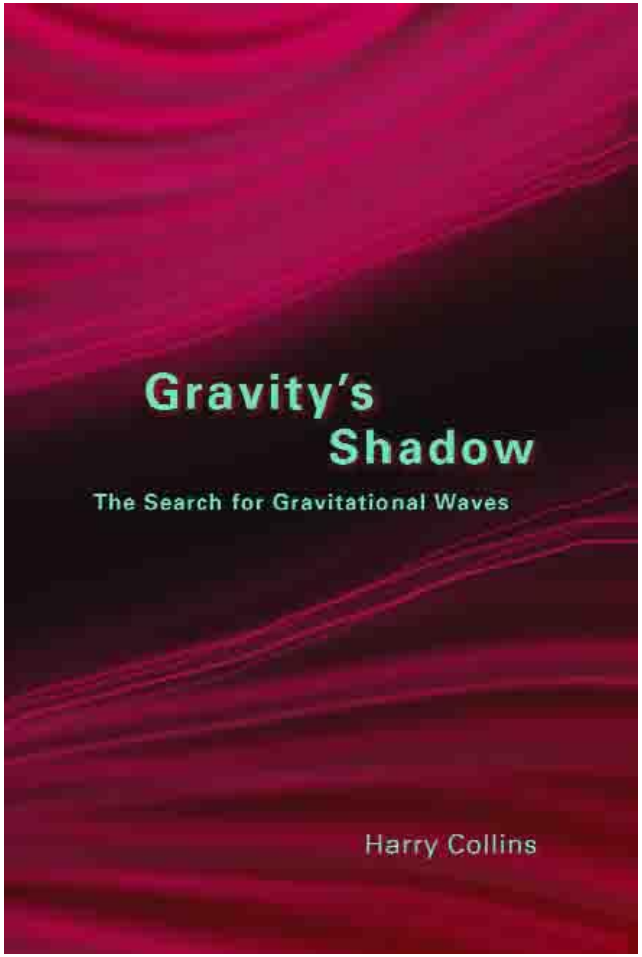
1980s – 1990s cryogenic bars

Caltech 40 meter interferometer

Weiss proposes huge devices

University of Chicago Press

2004



12(30)-year case study: 870 pages

www.cardiff.ac.uk\socsi\gravwave

or Google Harry Collins

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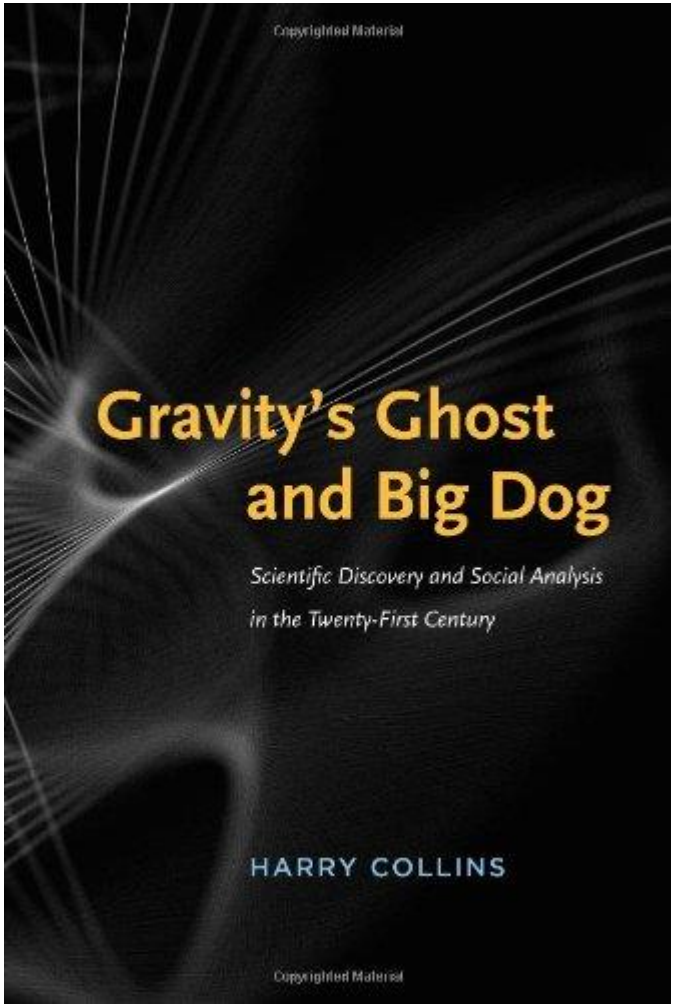

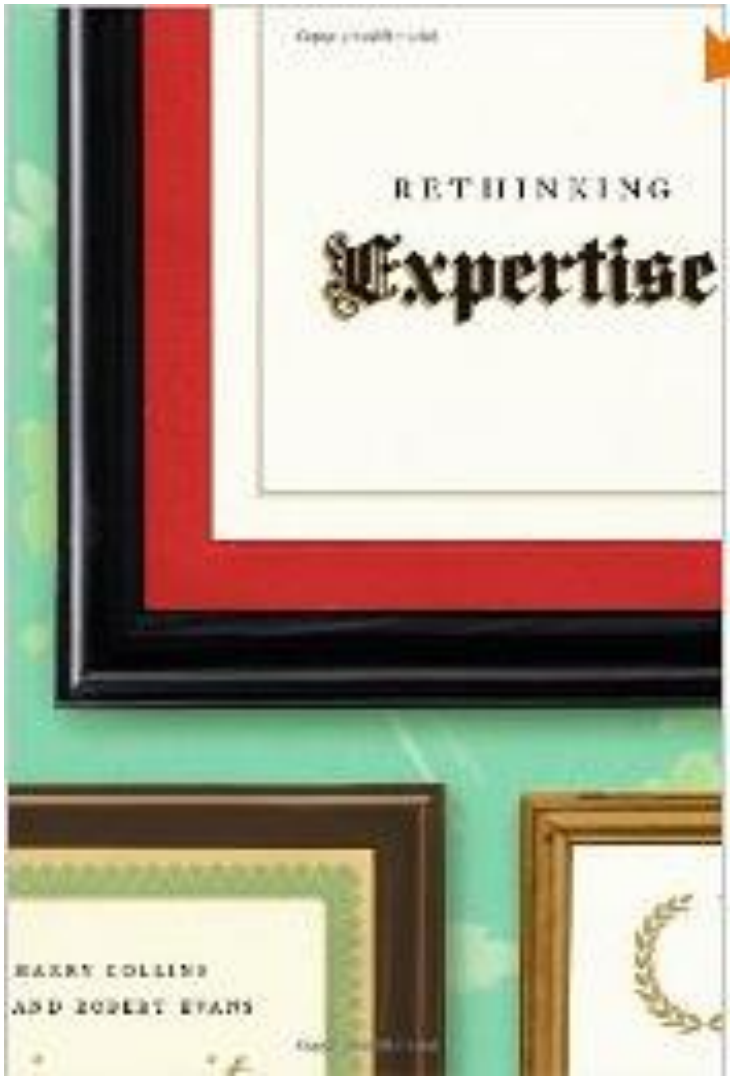

2007

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2014

The Republicans *(Nature, Sept 9 2015)*

[T]he Secret Science Reform Act of 2015, a US bill … would "prohibit the Environmental Protection Agency from proposing, finalizing, or disseminating regulations or assessments based upon science that is not transparent or reproducible". Passed in March by the House of Representatives essentially along party lines (Republicans in favour, Democrats opposed) and now awaiting action by the Senate, the bill has been vigorously opposed by many scientific and environmental organizations.