Poetry Meets Physics: Poet Rae Armantrout Reading and in Conversation with Physicist Ben Buchler.

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Rae Armantrout, Ben Buchler and Russell Smith

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RUSSELL SMITH: Good evening, everyone, and welcome to Poetry Meets Physics: Poet Rae Armantrout Reading and in Conversation with Physicist Ben Buchler.

My name's Russell Smith, and I'm a Lecturer in Modern Literature in the School of Literature, Languages and Linguistics at ANU, and I'm going to be emceeing this evening.

I'd like to begin by acknowledging that we are meeting on the traditional country of the Ngunnawal and Ngambri people, and that sovereignty over this land has never been ceded. To put things in perspective, both science and poetry have been practiced in this place for many thousands of years, and so we pay our respects to elders past and present and their efforts to safeguard and maintain the knowledges and practices that have coexisted with this place for countless generations.

Before I introduce the speakers, I'll give you a brief rundown of the program.

First, I'll introduce Rae, who will read and talk about a selection of her poems, both poems that have a specifically science-y element, and new poems from her most recent collection *Go Figure*.

Then, I'll introduce Ben Buchler, a Professor of Physics at ANU, and an expert in nano-optics and quantum computing.

Instead of an ordinary conversation, the format for the next part will be a little unusual.

Rae and Ben have been asked each to prepare three questions to ask each other; first Rae will put her three questions to Ben, and then, having answered Rae's questions—to the best of his ability—Ben will put his three questions to Rae, and Rae will attempt to answer them—to the best of her ability. As far as I am aware, neither of them knows what the other's questions are going to be, so in the best scientific tradition, it's an experiment: we don't know exactly what's going to happen.

However, also in the best scientific tradition, we can hazard a hypothesis: that we will learn something about how scientific concepts—and especially the mind-bending strangeness of quantum physics—can inform the work of a contemporary poet, and, contrariwise, how contemporary poetry can perhaps prompt scientists to reflect on their models of reality and their knowledge of it, its underlying concepts and, dare I say it, its meanings and its metaphors.

After that, we'll have some time for questions from the audience, so if something comes up that piques your curiosity or raises a question, make a note of it. And, as I say to my students, I mean this quite literally, as in don't just a make mental note of it, write it down, physically, on a piece of paper or on your phone. It will help everyone if you have a concise and well-phrased question. As I suspect we are about to be reminded, the question in your head is little more than a fleeting event produced by electrical impulses and chemical neurotransmitters: make your question just that tiny bit more real by writing it down.

After the audience Q and A, we'll wind up, but I'll mention now that copies of Rae's most recent book *Go Figure*, as well other books of hers, will be available to buy in the foyer, and Rae will be staying around afterwards to sign copies. The bar will be open, so please feel free to linger over a glass of wine, stimulating conversation, and a freshly purchased book of poetry.

Introduction: Rae Armantrout

So, we are very fortunate to have with us this evening one of the most distinguished contemporary poets in the US today, Rae Armantrout.

Rae Armantrout has published more than two dozen books, and among her many awards and prizes are the Pulitzer Prize and the National Book Critics Circle Award for her 2009 collection *Versed*. For more than twenty years she was a renowned and revered Professor of Poetry and Poetics at the University of California, San Diego. Her most recent collection, *Go Figure*, was published only last month by Wesleyan University Press. We'll hear her read some of the poems from that shortly.

In introducing Rae, I thought I'd stick my neck out and try to give a sketch of where Rae's poetry sits in the landscape of contemporary American poetry. And then, sticking my neck out even further, I'll give you my take on what Rae's interest in contemporary physics, and especially quantum physics, brings to her poetry and what kind of work it does there.

I'm counting on Rae to correct me if I'm wrong. I actually don't mind being corrected; I find it's the one way to be certain you're learning something.

Postlanguage Lyric

Rae's poetry is often categorised as 'postlanguage lyric'. I suspect this term may not be familiar to many people in the audience, and if you're like me, the term is a little baffling when you first come across it. I'll try to explain what I think it means.

Paul Hoover, in his note on Rae Armantrout in his anthology *Postmodern American Poetry*, writes, 'she has been associated with language poetry despite being

suspicious of the term, which [and here he quotes one of Rae's essays] 'seems to imply division between language and experience, thought and feeling, inner and outer' [Armantrout, 'Why Don't Women' 31]' (Hoover 429).

So, what is Language Poetry?

Language poetry was—and continues to be—a significant movement in postwar American poetry. In the simplest terms, it can be seen as a reaction against the so-called confessional poetics of poets like Sylvia Plath and Robert Lowell, and more broadly, a rejection of the idea of lyric poetry. Lyric basically names the idea of poetry we're all familiar with: the voice of an individual speaker narrating its experiences and expressing its thoughts and emotions. Importantly, however, in much lyric poetry, the 'I' of the poem is not necessarily the poet themselves, but often a kind of persona. Even so, with the confessional poets, the 'I' was associated quite literally with the poet, and their poetry was read as a kind of anguished autobiography.

Language poetry—which emerged in the late 1960s and early 1970s— wanted to do away with all that: the notion of poetry as the expression of a speaker or a personality, or as they might have put it, the 'bourgeois ego'.

Language poetry wants to treat language as a thing in its own right: words don't refer, or mean, and still less are they a medium for the communication of thoughts or feelings; instead, they are things, material objects, patterns of marks. Language poets often make poems by putting together clumps and clusters of language that they pick up from the world around them—soundbites of television or radio advertising; snippets of news media or text from the fine print of consumer packaging; fragments of overheard conversation; notes written by strangers on forgotten scraps of paper.

Rae's poetry often contains these elements of language poetics: words as found objects, de-subjectivised and re-contextualized, placed in new arrangements where, without a speaker, they speak in their own voice, with a deadpan failure to read the room, or a weird inhuman irony.

But, as Hoover pointed out, Rae refuses to abandon the idea that language, and poetry in particular, could and even should deal with thought and experience. This is why the notion of postlanguage lyric is something of an oxymoron, but a very productive one. It is sceptical of the idea of language as a medium of expression, of communication, of a certain ideal of clarity and relatability. But her poetry also refuses to conform absolutely to the language poets' principle that language, in a sense, has nothing to say; it aims, instead, to use words as a registration of thought

and experience, while not assuming any kind of straightforward, conversational intelligibility.

In her essay 'Cheshire Poetics'—the title being, of course, a reference to the cat in *Alice's Adventures in Wonderland* which is capable of disappearing until all that is left is its smile—Rae writes:

> When I was a teenager I was given an anthology, and the poets I most loved there were William Carlos Williams and Emily Dickinson. So I was drawn to poems that seemed as if they were either going to vanish or explode—to extremes in other words, radical poetries. … I think my poetry involves an equal counterweight to assertion and doubt. It's a Cheshire poetics, one that points two ways then vanishes in the blur of what is seen and what is seeing, what can be known and what it is to know. That double-bind. (Armantrout, 'Cheshire Poetics' 55)

The critic Stephanie Burt draws out the same connection:

> William Carlos Williams and Emily Dickinson together taught Armantrout how to dismantle and reassemble the forms of stanzaic lyric—how to turn it inside out and backwards, how to embody large questions and apprehensions in the conjunctions of individual words, how to generate productive clashes from arrangements of small groups of phrases. From these techniques, Armantrout has become one of the most recognizable, and one of the best, poets of her generation. (Quoted in Naiman, n.p.)

If you know the poetry of William Carlos Williams, you'll know what he often uses very short lines, and if you know the poetry of Emily Dickinson, you'll know she frequently breaks her phrases up with dashes, turning them into compressed little packets of words, which are then linked with each other in surprising and unusual ways.

You will notice, when you see Rae's poems on the page, that she too uses very short lines, often of only a single word.

This gives the poems the look, I think, of a mathematical formula or a calculation, where each of the symbols might have a precise value and their arrangement express a precise logic.

Of course, language is not like this, words are far blurrier and more ambiguous, but Rae's short lines force words, perhaps, in the direction of mathematicity.

At the same time, of course, since Kurt Gödel's Incompleteness Theorem and Werner Heisenberg's Uncertainty Principle, both mathematics and physics have become blurrier and more ambiguous. What were once clearly defined entities and stable laws have become fuzzy, indistinct, context-dependent, statistical, conditional. Somewhat more like language, it would seem.

This, I think, is where Rae's interest in modern physics crosses over with her poetics. As you'll hear, many of Rae's poems play with the language and concepts of contemporary physics, with a lexicon that includes words like particle, photon, electron, atom, mass, speed, spin and entanglement. And what contemporary physics shows us is that, at least at the scale of the very large and the very small, the fundamental concepts that structure our sense of reality are illusory.

The notion of a matter as a solid thing—an illusion.

The notion of space and time as an empty stage and a vacant timeslot in which things can turn up and events happen—a trick of perspective.

The notion of cause and effect—no more than a bad mental habit.

Rae's poetry, it seems to me, uses the weirdness of quantum physics—its topsy-turvy ontology in which it takes all the running you can do to stay in the same place—as a kind of toolkit of concepts and metaphors and models and thought experiments by which to explore the weirdness of the world, even at the human scale in which we interact with it in our everyday lives.

I'm going to conclude with a couple of examples of quantum weirdness in poetry.

The first one comes from Emily Dickinson, and relates to a concept expressed by Carlo Rovelli in his book *The Order of Time*, in a chapter titled 'The World is Made of Events Not Things'. Rovelli explains that, while we conventionally think of events as interactions between pre-existing things, in fact it is the other way round, and supposedly solid matter is the product of events, interactions of forces, a knot of temporary stability, like a circular eddy in a current.

The strange ontology of the quantum account of matter is spookily prefigured, I think, by Emily Dickinson, in her poem that begins, ominously, 'I Felt a Funeral, in my Brain'. The lines I'm concerned with are:

> As all the Heavens were a Bell,
> And Being, but an Ear

This notion of being—matter, existence—as not solid, permanent, but an event like the hearing of a sound, the fleeting registration of a signal; and the Heavens, the universe, as a vibration of cosmic forces like the tolling of a bell—this seems to chime, to resonate, to spookily harmonise the quantum account of reality that at that time was at least sixty years in the future.

I'm going to end with a poem from this little chapbook titled *Entanglements*, which brings together a selection of Rae's science-related poems written over many years.

In her 'Note to the Reader' she expresses her gratitude both to the physicists she has discussed these ideas with, as well as the scientist-writers such as Carlo Rovelli and Richard Feynman, who, in her words, try 'to clarify the discoveries of modern physics for lay people'. She calls the collection *Entanglements*, she writes,

> not only for the baffling way two particles can become entangled so that they appear to communicate instantaneously, but also because of the way my daily life experiences and emotions became entangled (in these poems) with what I was learning about physics. (Armantrout, *Entanglements* n.p.)

The poem I'm going to read is called 'Making' (Armantrout, *Entanglements* n.p.; *Wobble* 1-2), a metapoetic title since the word *poetry* comes from the Greek word *poiesis*, meaning 'to make':

Making

"What made this happen?"
you ask every time

as if
compulsion itself
were mandatory,

the way light travels
at the speed of light
"because it must"

*

It is in no sense
Essential

that this crown of leaves,
sifted by wind

as if turning over
some problem,

is a grey-green

brightening into rust-red

at the tips

or that its equivocations
fill this instant

to the brim.

*

While light
has caught up

to itself
again

and only seems
to be making

time

Please make welcome Rae Armantrout.

[Audience applause]

RAE ARMANTROUT: Thank you, Russell. You read that poem really well. And I liked what you said about Emily Dickinson too. And when you were quoting that old essay of mine called 'Cheshire Poetics', it struck me—though I don't think I was thinking about this at the time—but it struck me how much the way I was

describing my poetics actually sounds like some phenomenon of quantum mechanics that is pointing in two directions and then disappearing somewhere in the middle.

Anyway, I'm going to start with... And some of these poems are from the book, actually—the new book—and some are even newer.

This one I wrote after I went to a conference that brought together a few physicists with some people writing poetry. I think there were only three physicists but it was great of them to come. And one of them said that he had to come because he wanted to find better metaphors for what happens at the atomic and subatomic level, because most of us were taught... I don't know how it is now, but most of us, in the past, were taught that an atom is like a little planet... something in the middle around which electrons orbit... like a planet with moons, that would be it... a hard ball with little pinball type things orbiting it. But he said that's nothing like really what an atom is, and that... I guess I'll read the poem. But I decided to try to take him up on the challenge and come up with a better metaphor. Not one that I think scientists will actually use, of course, but I thought why not try? And his name is Mark Kruse:

Transfer

For Mark Kruse

Now they tell us
"orbit" is wrong.

Electrons don't actually
"orbit a nucleus."

Perhaps they are looking for the word
"haunt."

One meaning of haunt
is to frequent.

To be known
to appear.

They say electrons leap

from nonexistent
rung to rung,

giving off energy

as a ghost may vanish
from one room
to materialize in the next,

causing the audience
to jump.

(*Finalists*) 61-2

So some of—many of—my poems that are about physics—not that last one, but many of them—include some sections on physics with other sections that involve other things such as daily life or even other kinds of science. So:

As I Understand It

1

As I understand it
the universe was made of feelings—

attraction and repulsion,
they say,

or love and hate
as it's written
on a thug's knuckles—

taste/distaste.

These had to come first
so that things
could conglomerate.

*

Of course, there were issues.

Though photons
are just alike

they must still
be exchanged

“to assure gauge
Invariance.”

2

“subjects with damage
to this region
had less confidence
about an individual’s
ability to possess
traits.”

*

“Stop picking at yourself!”
my grandmother would say

That one had numbers, and I skipped [saying] the numbers, but maybe this time I’ll read the numbers:

Debt Economy

1

Say “The connectivity and continuity of space
owes its existence
to quantum-mechanical entanglement.”

It follows that existence is a debt.

So entanglement depends on the record
of a previous transaction
being accessed

which grows increasingly difficult
as the noise level rises

and scenes begin to merge
such that a daughter

is a mother
disappearing beyond

the cosmic horizon.

2

To put it more simply,
you've forgotten

what you want
to say

and the people
you wanted to speak to

are gone,
their images

an overlay

of grieving
and grievance

(*Go Figure* 43-4)

Now this is in two parts that are really very different. It was written during the first stages of the pandemic, and for some reason I was reading a book on the ideas about angels that the scholastic philosophers had in the middle ages, and it struck me how much of what they said about angels you could also say about subatomic particles.

So... this is a prose poem, too—so long lines. And I'll read the numbers:

Confounding

1

Angel-ologists didn't know what they were talking about, still they were prescient. This often happens. They had no idea they had predicted the behavior of subatomic particles.

The simplicity of angels confounded them. Angels, they reasoned, had no distinctive qualities. And yet millions, billions, perhaps an infinite number were thought to exist. There was a baffling blandness in this excess.

Many believed that angels, like electrons in an atom, could move between two places without passing through the intervening space, which calls the nature of space into question.

Most believed angels, being emanations, had no will of their own, though some had managed to rebel—or at least behave unpredictably.

It was thought that, as with photons, more than one angel could occupy the same space, and that, above all, threw *one* into confusion.

2

There came a time when everyone publicly congratulated themselves for having survived—but perhaps neither congratulation nor survival was to be taken literally. This was clearly no celebration. The mood was dark, even bitter. First there was the issue of what each had survived, which required a lengthy drop-down menu. Then came a list of those

absent—about whom, perhaps, the less said the better, as the public and the dead could easily be confused.

*The angel lore in this poem owes a debt to Eliot Weinberger's book *Angels and Saints*.

(*Finalists* 136)

Photo by Nathan Smith Photography

And this is based on a book I was recently reading about inflation theory. And there's a metaphor that's... I just had to use it because it seemed so absurd. It's in the second stanza, so you'll hear it and I think you'll recognise it:

Getting Real

1

Imagine being perfectly balanced,
perhaps on your head.

"Imagine the universe before the singularity
as an infinite set of pencils
standing on their tips."

Was *that* heaven?

Someone twitched.

Now we're falling forward
maybe forever—

with all the inertia
bodies are made of.

2

Anemone. *Anomaly*. *Anonymous*.
Anemone. She says hers

is the big red one
with a starburst
in the middle.

This one is dedicated to Carlo Rovelli, the physicist, who works on quantum gravity and—you [Russell Smith] were quoting him—about how time and space and... are emergent qualities depending on events. I actually had a short correspondence with him—but we seemed to be going around in circles. So it seems like... it would seem like to have an event you would have to have two different things that did something with each other, but apparently not, so... Anyway, my mind was boggled—not in a critical way, I don't claim to know anything about this and I would certainly take his word for whatever he's working on. But I was just... The way that language was being used in this context was mind-

boggling to me. And I was also reading this book, his book, while taking care of my granddaughters:

In Practice

(For Carlo Rovelli)

Heat cannot pass
from a cold body
to a hot one.

That's it.

That's "the one law of physics
that distinguishes the past
from the future"

with its clutter of burn-outs

when what matters
is who's wearing
the kitty-tail
right now!

Who thinks she knows
where meaning is.

Just wait.

"Times are legion, a different
one for every point
in space"

no matter how close;

how lonesome

(*Go Figure* 78)

OK, this is based partly on something I read—and which, Ben was telling me, sounds suspicious, but, anyway, it's still in this poem:

Jitters

1

Why is it I want to write
something that seems right

only on second thought
and even then leaves doubt

as to what it might mean
in the mind of a reader?

Am I on the fence
or am I hiding

behind the slimmest shreds
of likeness,

playing hide and seek,
keeping my options open?

Are you counting seconds?

2

Can I tell you a story?

As lightning begins by trying
different paths through space,

light sends out feelers,

finding the shortest path
through time.

Such waves (or "jitters")

moving in and out
from the main beam,

can exceed
the speed of light

rattling doors
to the future.

3

Of course, it's not polite
to ask questions about oneself.—
let alone suggest answers.

Ask God
what the rush is.

Picture This

Particles, whether long or short-lived,
arise from a "permanent
traveling disturbance
in a quantum field."

But we all know that
when a disturbance
is permanent,
it no longer disturbs.

Picture a tent city.

*

One way to think about it
is a kind of tension
rippling through space.

We know how tension
distributes itself
in a body, now
behind the eyelids,
now in the shoulders,

how it can be moved
but not removed

so that, when we suck
on our knuckles,
our neck muscles
can relax

briefly.

*

Why so tense,
we might wonder.

Did God yell "Hey!"
just once

as if testing
the acoustics?

The Uncertainty Principle

1

An atom "is localized
by an interaction"

the way you surprise yourself
by expressing an opinion

when asked,

one you didn't know you had
and may not hold

for long.

2

A subatomic particle is not
its mass or spin

the way a person
is not a body

and a poem is not
what it says.

And this is somewhat more general:

Think Back

Say an idea is math
without numbers.

For instance, you could say
that an idea
distorts consciousness
as a massive object
distorts space.

Such distortion
is sometimes known
as attraction

It pulls
a debris field
into orbit

(or a halo of microplastics).

You slip
from one thought
to the next
as a snake
sloughs off old skin.

Thinking back
is less reliable
than you might think.

(*Finalists* 130)

Just two more then. This is also based on something I read recently:

Tired Light Theory

1

The new idea
is that light
gets tired of passing
and begins to slow
once it's well past us

as it it had been all for show.

But if light comes to rest,
is it still light?

2

Every bit aches
to be repositioned.

People who keep diaries
love life more than I do,
I think again,

taking tiny bites
of chocolate
in order to make it last.

And then lastly—this is not exactly physics, but it's science-adjacent, in fact it was even in *Scientific American*, which has a poetry column:

Fractal

If I were made of
homunculi

the way a cauliflower
head

is made of
little noggins

would I be gorgeous

like this green one -
a field of rockets

each nippled with
hard cones?

(*Go Figure* 11)

[Audience applause]

RUSSELL SMITH: Thank you, Rae, that was wonderful. Mind-bending and hilariously funny as well. It is my pleasure now to introduce Ben Buchler.

Ben Buchler is a Professor in the Research School of Physics at ANU. He works on nano-optics and quantum computing as well as contributing to the global search for dark matter, which appears to make up about 80% of the mass of the universe but has yet to be observed.

As I understand it, nano optics means manipulating light at the level of individual photons, and, if I've got this right, the human eye is, incredibly, capable of detecting a single photon. Some of Ben's work involves using photons to arrange atoms in arrays where they are all—my notes say, 'doing the same thing'—but I think it has something to do with atomic spin and not cancelling each other out. This then turns the atomic array into a highly sensitive 'spin detector' which may be capable of picking up changes in spin orientation that point to the existence of dark matter.

Another project Ben is working on involves using quantum states as a kind of computer storage or memory. Here's the explanation of this from Ben's webpage:

An optical quantum memory will capture a pulse of light, store it and then controllably release it. This has to be done without ever knowing what you have stored, because a measurement will collapse the quantum state. We are exploring a 'photon echo' process to achieve this goal. (Buchler)

Photo by Nathan Smith Photography

At this point, I don't really know if I've summed up Ben's research accurately or not. I'm a bit like Schrödinger's cat, hovering between incompatible possibilities. Ben is now going to play the role of the quantum observer, collapsing my phase space and revealing either my position, or my speed, but not both. I suspect it's a situation where I can either make myself clear, or get things right, but not both.

Please welcome Ben Buchler.

Rae and Ben will fire their questions at each other, like subatomic particles speeding around a particle accelerator, and we'll see what arises from these collisions.

RA: Kinda like a game show!

BEN BUCHLER: Yes, they use rock-paper-scissors to decide who goes first! I think you're going first.

RA: OK. So, in my poems, I try to be as accurate as I can to what I've read. I respect science very much, but I'm also experimenting with what happens if I play with these ideas. For instance, if I juxtapose physics with myth or with slices of daily human life. In one poem (I already said this), the one called 'In Practice', I put the voice of a child demanding to 'wear the kitty-tail right now' together with language from Carlo Rovelli's book on time, where he argues that time is not a fundamental property. I sometimes worry, of course, that I'm getting in over my head—'fools rush in' etc. The fact that you're here implies either that you're extremely good-natured (you probably are) or that you don't mind my small intrusions into your territory. So can you talk a little bit about how it feels from your side of the fence to read poetry, mine or anyone's, that attempts to grapple with what physics is telling us. Is there anything that a poet like me should be careful of, or just avoid doing?

Photo by Nathan Smith Photography

BB: Right. I think, for me, seeing this from the perspective I have... I spend a lot of time talking to other physicists about physics, and mostly they're the only people I talk to about physics because that's what I do. And, by and large, if you end up at a dinner party and start talking about physics people's eyes glaze over. You realise you're talking to the wrong audience. And so it's always very intriguing to me to see what parts of physics cross over into the public domain and inspire other things. And my personal thesis is that it doesn't really have to do with making the phone smaller, or dinosaurs, or sex, so it's probably never going to make it into the public domain as an interesting science story. And, so, for someone to be writing poetry or considering the way quantum mechanics may be analogous to or provide some kind of metaphor for daily life to me I think is really kind of fascinating. And the idea of an electron 'haunting' an atom I think is really interesting to me as well because... I've forgotten the name...

RA: Mark Kruse?

BB: Right. I think he hit the nail on the head there, in that... When we're trying to explain things like the concept of an atom to students in undergrad lectures, or high school, or anywhere, you use analogies because you can't point at an atom and say 'Look, here it is, have a look at it, here's the electron, here's the...' It doesn't work like that, there is no way of imaging those things, and so we are forced to use

analogies and metaphors. And a poor analogy and poor metaphor can lead people in entirely the wrong direction. And ultimately, as a physicist, when you're trying to understand something and make progress, there's a whole bunch of... pile of maths and equations that we can plough through and calculate how something works, but... Maybe some people work that way, but most of the physicists I know don't use that to inform themselves. They have some internal, mental picture of how things work, and the more accurate that is, the more progress they can make forwards in trying to figure out what actually is going on, because they... You can click together some mental picture of how things work and go 'Oh, maybe if I do this I'll be able to achieve this other goal I'm trying to achieve'. And so it's not mathematical progress, it really is progress in terms of having a mental model, or a metaphor, or analogy. And so, I think there is something to be said about using better language to explain how we understand things. And so, yeah, for me I think I like it, it's good.

RA: I'm glad. I'm glad you don't hate it—that would be awkward!

BB: I mean, I'm leaving right now! I'm horrified!

RA: I think it's interesting that awareness... that this crossover you talk about... information about quantum physics, which was developed really between 1900 and into the early 1920s, but it didn't start crossing into popular culture until, as far as I'm aware, about the early '80s, and, of course, since then there have been a whole lot of popular, even bestselling, books, some by science writers but some by actual physicists—Brian Greene, Carlo Rovelli—so it's a thriving genre... And I have friends who also try to read these books—I say 'try' because we think we understand something and then we get confused and we talk to each other about it... But I think it's strange that it... Why did it not cross over, or am I wrong about that?, into like popular discourse, for better or worse, and sometimes for worse, but you know what I mean, until this big lag of time of sixty years?

BB: Yeah, it's difficult to say, I mean, I think... Science journalism I think is really hard because if you write an article... I've had interactions with science journalists trying to explain my work, on various occasions... And so, at least in the modern day, if you can't explain the relevance of what you're doing to... how it will affect people, by and large media are disinterested in what you're doing, right?, they just don't care, because it's not... Like, 'What do I care what an atom does?' And so there's always a subset of people, I think a critical mass of people, who will read about these things because it's interesting and they're curious. And I guess that there always have been writers and scientists who have tried to communicate some of these things to people throughout... since the origin, the beginning, of quantum mechanics. And right at the beginning of quantum mechanics there are really interesting philosophical debates amongst the founders of the theory about,

you know, if a measurement collapses something and if a human was measuring it, would a dog measure it and collapse the wave function? And what about a frog? And they had a serious argument about, is something... You know, what things are conscious enough to collapse a wave function?

And so to the extent that quantum mechanics crossed over into popular culture, a lot of it has been around this idea of the measurement process, and what collapses a wave function, and whether consciousness has a special place in the fabric of reality. And this has led to all kinds of problems, because I don't. Different quantum theorfists and different people working in quantum mechanics have very different pictures about how this works. Some of them think consciousness might be a thing. Others think that's just a load of bunkum and has nothing to do with it, we've just misunderstood the entire process. And of course if people take this idea that consciousness is somehow very important and then run with it they may be completely wrong, they're interpreting maths. The maths tells you how things work then you've got to find again an analogy to explain what is going on. Consciousness is one analogy in the collapse of wave function, but something else entirely different might be happening, we don't know. So I guess I'm well sidetracked now by your original question, which is 'Why don't people talk about this more?'

RA: Now they talk about it quite a bit. But in the years—I wasn't alive for some of these years, so maybe I'm wrong but it seems like quantum mechanics was pretty much established and known to the extent that, well almost to the extent that it's known now, by like, sorry, but the basics were down by about 1920 or so, right? But it didn't become popular, I don't think, til maybe that book 'The Tao of Physics', which I'm sure you're not aware of but it was a super bestseller. And that was, what in the early '80s or something? And from there it just took off in the public imagination. And the reason I said 'for better or worse' is that, it... sort of hippies and post-hippies were attracted to it. There was a meeting about it in Esalen in California, early on in the '70s and I think it kind of spread out from there. And there are people who will say that 'See, this means that we can move around in time, we can walk through walls'... Well, I'm making it sound a little more ridiculous than it is. But, extrapolating from the nature, to the extent that we know it, of subatomic behaviour to their own behaviour and possibilities—which, of course, for whatever reason, is not something that can be done, or at least not as we know it now.

I guess I should move on to my next question, which is (I think you already answered it, actually)... Oh, I did want to say something else, about consciousness collapsing the wave function. Not that I have any right to talk about it, but I don't like that idea... Doesn't seem like a lot of hubris? Doesn't it seem like 'It's us, we're...'

BB: I'm a hundred percent with you there. I don't like it either, which is why I'm much more attracted to interpretations of quantum mechanics that avoid that entirely.

I think I might have a a plausible answer to your question about why this stuff only came into the public domain more recently. Right at the beginning of quantum mechanics in the 1920s, when Einstein and others were working on this, they came up with all kinds of thought experiments to show that quantum mechanics must be ridiculous. And these were thought experiments until, sort of, the '70s and '80s when people started doing actual experiments and showing that these things that they'd come up to prove that quantum mechanics must be nonsense turned out to be measurable effects in the lab, and that may have kicked things off.

RA: Yeah, right, I remember reading about that.

Ok, so my second question. And I think you already answered this. It's my hubris—I want to talk about myself, so... I was going to say... I know you got to read my poems in advance, so did you have a favourite, and what was it, and why? (And later you can ask me if I have any favourites in your results!) But I think you already kind of started to answer that question. We can skip it if you want, or you can revisit it briefly.

BB: Yeah, I mean... The thing for me that I find interesting about the process of using new language and new ways of describing physical processes in quantum mechanics, or any other science really, is the idea that you might find more appropriate ways to describe things that we can never see and understand. And the idea of an electron 'haunting' a nucleus I really enjoy, that's nice. If I were teaching a course on atomic spectroscopy I would use that term.

RA: Put the poem in your syllabus. I'll be famous with science students in Australia.

Ok, and here's my last question. At UC San Diego I once co-taught a class with an experimental physicist named Brian Keating. It was called 'Poetry for Physicists', and it was his idea because there is a very popular class, at least in the United States, called 'Physics for Poets', and it pretty much just means dumbed-down physics. But he thought that physics students, or science students in general, needed to become better writers and better readers and better users of language and why not get a poet involved? So, we taught this class once, and as part of the course, part of the syllabus, I tried to come up with a list of things that poetry and physics have in common, at least as I... This was just me riffing, kind of, but what might they have in common? So that, Why are we teaching this class? Why Brian Keating and I are collaborating? And, I can't remember everything that was on this list, but, I came up with:

> the use of equations, which in poetry would be more like analogies, similes, metaphors,
>
> a taste for concision,
>
> an interest in hidden patterns,
>
> and, perhaps, the love of a good question.

So, I won't ask you to comment on that, but I have a two-part question. So, or maybe it's not a two-part question. So, in your view, what do poetry and physics share, if anything?

BB: Yeah, no, I think this again touches on this point that when a physicist is trying to describe a thing that they've found, or an effect that they've seen... We can use equations. We can use equations, and you can show another physicist an equation, and they'd go 'Oh, nice equation! Have you solved it?' And you'll go 'Yes, here's my computer. I've solved it.' And, that'll only take you so far. And the rest of it is language. You know, the whole scientific endeavour is a human endeavour that, in the end, is also a linguistic endeavour where we have to explain things to each other using words.

RA: And an imaginative endeavour.

BB: Right, right, yeah, and so, to that extent, the more we can use... Language in science and in physics is often very precise and formulaic, and particular words have particular meanings. Like, one that we use a lot in my field is 'coherence', and it has a very specific meaning that, outside of the subfield of the subfield of physics that I work in would mean something entirely different to someone else. So there's a lot of sort of codification of language like this in different scientific fields, which I think often makes it very difficult for someone to... You pick up a research paper and you read the thing, and all these words used in these very specific ways, and there's no glossary. And so, when you're trying to write a research grant—I mean, you want money to do your work. And it's going to a panel of people who are not... haven't been marinated in the stew of this rich and weird vocabulary and you have to know how to use other kinds of language to explain what you're doing. And so you need these tools. And to the extent that physics and poetry have things in common... we both need to be able to use language to describe things sometimes precisely and sometimes just in a way that has meaning to people outside our own sphere. And I think its becoming increasingly important in the scientific fields that people can do that, because you're not going to get grants unless you can.

RA: Right. I had some experience with this, in that I was the sort of head of our subsection for a while... I was in a writing program that gave an MFA and I was head of the section, which meant that I had to write for people's tenure files, and write for their promotions. And the things that I wrote in this context would go up to what we called CAP, which was the Committee on Academic Personnel, which would make the decision. But because UC San Diego is a big science campus—a lotta science there—a lot of the people on CAP were scientists. And so, things would come back from CAP... like I wrote for someone who had published in a small independent press, and the press was called 'Jaded Ibis', and you can imagine... 'How jaded was the ibis?' And then... I didn't have to write this, because it was about me, but there had been an article about me in the *New Yorker*, so, of course, I put it in my file, and CAP came back with 'Of what significance *is* the *New Yorker*?', as if... [?] Hard to say! So I know something of this problem.

OK, you want to hit me with your questions?

BB: Sure. My first question is almost the reverse of your first question to me, and that is: When you're confronted with some sort of idea from a book you've read, or you're writing poetry that is crossing over between genres and physics and those kinds of things... Physicists perhaps have a deserved reputation for pedantry and precision, and I was wondering, like, when you finish this poem, do you worry that... how it'll be perceived... if people sort of nitpick and go 'Well, the way you've used 'gauge invariance' there is not entirely correct' (and I'm glad you didn't ask me that, by the way, because I have no idea about 'gauge invariance'... terrifying... don't ask me about that)... But these kinds of things, I mean, it becomes... When you're communicating to that audience or interfacing with that audience, are you nervous?

RA: Yes! I don't often have the opportunity to actually talk with a physicist. I have before, but not really... this is not my basic audience. But nonetheless, I do hope that I'm understanding what I'm reading and that I am... It does matter to me to be as accurate as I can be. Now, that sort of puts me at the mercy of the veracity of what I'm reading, right, and so there are two problems with that. I mean, not all sources are equal and, also, even when you're reading something that's by a top-notch physicist, things could turn out to be wrong. Paradigms can shift. When I first read about the shape of the universe, and put it in a poem, mostly because I thought it sounded bizarre, but it was 'The universe may be shaped like a saddle'. Well, now it's 'The universe is amazingly flat'. And, I don't know, maybe it is amazingly flat but maybe not. Maybe next it'll be shaped like a bow. I have no idea. So, part of that is something that I like to play with because I'm interested not only in physics but also in the limits of knowledge, and in epistemology, how we know what we know. But, on the other hand, I don't want to be saying things that are

outrageously wrong. So I'm trying to walk a line there, where I can take some liberties and still be more right than not.

Photo by Nathan Smith Photography

BB: Do you have a cadre of physics people that you pass your poems to and get them to peer-review them?

RA: No, not as much as I should. A physicist did translate the… he partly, helped, co-translated, that poem that Russell read, 'Making', into Spanish. And he was jazzed about the part about light catching up with itself, or... I'm not exactly sure why. So, I don't have a lot of physics buddies, so I have to just go with what I read and hope that I'm reading good things, and sometimes no doubt I'm not.

BB: Cool, alright. My second question is around the process of when you're writing a poem, did you read the physics and then go 'I want to write a poem about that' or do you have some sort of poem just waiting for the physics to come along? Like which... Chicken or the egg?

RA: Not the second one. Either I'm reading the physics and something that I read just strikes me, baffles me, boggles me, but in a way that makes me try to think of images and metaphors that would capture it. So... And that might be just because

I'm interested, and might be just chance. But also sometimes if I can't think of anything to write I'll deliberately try to read something that might spark an idea—might be physics, might be something else. Might be the newspaper, but it also might be physics or cognitive science or philosophy or maybe biology. But often physics. And I don't know, when I do that, if anything will strike my imagination, but sometimes it does. But I never know what I want... I never *have* the idea and go 'Let me find some physics that matches this idea perfectly, because that just doesn't seem like it would happen'.

BB: I guess I was imagining you might have a poem that's half finished, sitting in a drawer, that you don't know quite how to complete, and then one day you see some physics and pull it out, and it finishes it.

RA: I think that is a way that I work. Not just specifically with physics reading but... Lots of times, actually, I start on a poem and don't know quite how to finish it and then I just sort of have to look around, read, listen, take a walk, and see if something just comes up that goes in that place, somehow.

BB: My third question. I heard an interview on Australian radio a while ago with an Australian poet, writer, Alicia Sometimes, and she was telling a story about how when she was at, I think it must have been, primary school, she was dead keen on becoming an astronomer, astrophysics researcher, and her science teacher said 'That's not the sort of thing that women do, so you should do something else', and so she ended up being a writer and poet but circled back around later in life and writes poetry about astrophysics and that stuff. And so I was just wondering how it's been for you. Like, is ... Do you think you always had a physicist inside you, wanting to get out, that was pushed down at a young age, or...

RA: Yes, I think probably... I don't know that I had the ambition to be a physicist, but I don't think I got a fair chance to explore whether I did or not, because I think that... Someone my age—we don't have to go into that, but I'm over seventy—someone my age, and female... I was in advanced classes... I went to a public school, which is not what it means in Britain but what it means in the United States, and I was in advanced classes but I just at some point decided that I was not interested in math, which I really regret because now I think that math seems really cool. I wish I could do it. But, about... I did arithmatic and geometry and then I went 'Umm, I'm bored', and so I just deliberately kind of didn't do it, and so then I kind of bounced out the advanced track when it came to math. And nobody even tried to persuade me. Nobody, like... They didn't send me to the counsellor and say 'What's wrong, why aren't you doing this? There are some good reasons why you should do it'. It was just like 'Eh, yeah, you're a girl'. And not 'You're neurotic, let's help you get over this.' Just 'Eh...'. So, I was always sort of interested in the sciences because I was raised in a... bizarrely, in a fundamentalist, evangelical situation. And

so when I became an agnostic at the age of about twelve, then a lot of questions come to mind. Like how *did* the universe begin? And if it wasn't that God said 'Let there be light' then what's all this light? And so that started me thinking. And I was fascinated by a lot of subjects that I guess people still write about like 'What *is* the boundary of space? How could it stop? How could it not stop?' So, I think I'm interested in the things that physics looks into, perhaps because I'm interested in, kind of, ultimate questions. Whether I could have gone that direction and really been involved in it, I don't know. I mean, I can't regret my life now because my life's been OK, but I do think that women don't get a fair shake—didn't, and even now, my daughter-in-law was going to be a microbiologist and she did two post-docs in the field but then she got pregnant, she had twins, she dropped out for a while and then when she tried to get back in she couldn't really and, so, anyway now she's a lawyer. So, yeah, that's that story.

BB: I think that's it for the questions that we prepared.

[Audience applause]

RS: Thank you Ben and Rae for being very brave and fronting up for these questions fired out of the blue. We've got a bit of time for questions and discussion from the audience, so if anybody has a question or comment I can walk around with a microphone and Rae and Ben can share the [other] microphone between them. Has anybody got a question?

Q: I was just wondering, for those of us who are very... aren't advanced in mathematics, whether we are doomed to never understanding contemporary physics or whether poets like Rae can actually help us understand, given that we're never going to really understand the formulae that seem to be the essence of it. You know, is it all formulae, and, if so, is it out of reach for me?

BB: If it's all formulae, if it's 100 percent maths, it's out of reach for me as well, to be honest. I think many people working in this field really do it. They develop intuition over years and then go back to the maths when you have to. At least, that's the way I work, and a lot of my colleagues. So, in terms of understanding the deeper meaning of the universe from all these equations, say, I really do think there is hope. I think if we, if it's... I feel, if you're a publicly-funded scientist it's almost your duty to try and explain what you're doing to people in a way that they can understand it, and you've got to make your best effort there, and to the extent that that is possible for people at least to have... making an effort... there's some level of effort required, I guess. With respect to things like quantum mechanics, the maths... as we know it, we know that physics is incomplete. Quantum mechanics and general relativity are mathematically incompatible theories, and they've both never been proven wrong, every measurement we make agrees with

one or the other of these two theories, but we can't bring them together in a regime where they matter at the same time. So we know there's something wrong. But... And so what comes next? And this is what a lot of the books that... when you read about quantum gravity, all these kinds of things... a lot of it is very speculative, I guess, because we don't know how it's going to mesh together, we have some ideas as to where it could go. But there are some things we definitely know about quantum mechanics—for example, that you've got a choice, the mathematics in quantum mechanics, as we understand it, gives you a choice: either things are not real til we measure them, or there are things that go backwards in time. Mathematically, it ends up being the same thing. You choose one of those two realities, because the maths tells you, it tells you that it has to be one of those two things. Either of those is absurd, and this is then the problem of trying to explain what that means and how that can be, because it defies common sense, you don't see that when you're going for a walk. You don't see an elephant go backwards in time. It's very difficult to explain these things, and... but I think we should try. I think it's important.

Q: I have a question for both really, whoever wants to be the one to jump in first. And it starts with a quote from T. S. Eliot. Eliot says that genuine poetry can communicate before it is understood. And I wonder, Rae, Ben... you have a poem, or have an equation, or a moment of astrophysical insight, do you think there is something that comes before a moment of understanding, both for a poem, and an equation, and if so, how do you explain to us the feeling of that experience.

[BB's phone responds: 'I'm not sure what you mean.' Audience laughter.]

RA: These devices. That's perfect. Well, I'll answer the physics part. I've heard that there were mathematical formulas, equations, that were developed, I don't know, a century before it was discovered that these particular equations or formulas perfectly describe something in nature. So, yeah, I think that *can* happen. I'm not so sure about it in poetry. I know that I start usually with a feeling, sometimes a feeling that something is strange, that probably goes along with physics, sometimes a feeling that something is wrong, or even very, very right, but I don't know what. And so, I'm working my way from the feeling to the specific thought or to the images or to the metaphor that's underneath the surface, and I don't see it immediately but I can feel that there's something there, something amiss, or something important, and it's a feeling that's guiding me to it.

BB: It feels like the question was asking about the moment of discovery. Is that what it's going to? I guess, in the field I work in, often, if you can construct a new system, a different way of containing atoms in a space, or preparing them in a particular way, then after you've figured out how to do that thing there's a whole bunch of different possibilities that opens up and you can start thinking about new

ways of using them to make a measurement of something or using them to store information in a new way. And so I think once you've got a new system like that then you start looking round for the possibilities. It becomes, I mean… You're dumped in a forest and you go knocking on all the trees to see what's inside, and every now and then you find something new and most of the time it's dead ends, so... But the feeling of finding something new is great, you go 'Oh look, there's a thing here and I can do something useful with it that might be new and exciting and interesting or a new way of making a measurement'. But normally that comes from having a... at least experimentally, because I'm an experimental physicist, having a new capability where you've been able to build something new that holds your system in a way that allows you to do stuff that was previously impossible because either it was too hot and too noisy or something like that. So, does that kinda get to your question more?

RS: This interchange between the experimental physics and the theoretical physics is this constant kind of feedback loop isn't it.

Q: Hi, yeah, thanks to you both. This has been riveting. Rae, I was really struck by the rhythmicality of your reading, the way the rhythms just started to emerge as you were reading the poetry and I'm wondering for both of you whether music is a point of overlap between poetry and physics or whether it's just 'No, nothing to do with each other on that level'.

BB: I remember, I never went to any of those earlier maths competitions in high school or anything like this, but I know people who did, and they said that every night people would just pull out their instruments and start playing because a lot of the mathematicians were also very gifted musicians. So I think there's definitely, at least anecdotally, there's a strong connection between interest in music and interest in maths, and equations. I don't play an instrument. My sister's a professional violinist. And I love music. I listen to it a lot. And, yeah, so, for me I don't know if there's a connection between that and physics. I enjoy both of them. But I think for a lot of people there is a connection, yeah.

RA: Yeah, I love music too. I guess a lot of people do. I especially enjoy rhythms. If I was going to have another career it might not be physicist, maybe I would be a drummer. I might have a knack for that. So, yeah, I don't write with a traditional metre, I think that's pretty clear, but I am very interested in cadence and the way syllables fall. And when I'm writing I read aloud to myself and sometimes the only... for a while, the only word that I can think of for what I mean like maybe has three syllables and I just know that three syllables is too many there and that I'm going to have to cut that back at least to two or hopefully to one. So, and I don't know why I know that, because, like I said, it's not that I'm using the traditional

prescribed pattern but it's just for the feel of it. To me I know that that line can't be that long. So, yeah, you're right to perceive that I think.

Q: This is really fascinating. My question actually just follows from that. Which is that, you know, I think to some extent, and either of you may have thoughts on this, we're talking about poetry under the influence of, or perhaps compossible with things outside of it, external to it, in this case science, but music also I think to some degree is external to poetry. But Bob Dylan may have challenged that with winning the Nobel Prize for literature. But my interest in that is to think about how... well there is actually something, which you were just talking about Rae, internal to poetry, being rhythm—in the old days more 'versification', but now still prosody, you know, and in William Carlos Williams' organic prosody there are ways to talk about modern poetry as prosodic, and that has been called a science. And so my interest whether there is something in poetry itself, which can be, perhaps not science in the same way, but talked of as a science of prosody internal to the constitution of poetry.

Photo by Nathan Smith Photography

RA: Well, I think there have been some poets who want to talk about it that way but I think that's a kind of, you know, science envy, physics envy... There is a book called 'Physics Envy' that's about poetry. There's a chapter about me in it. Not an

unfriendly chapter, but... It starts with Charles Olsen, and he may be one of the people you're thinking of. So, there was the authority of science, especially coming off of Einstein's huge theory and how it was confirmed in various ways and startled the world. I suppose poets wanted a piece of that, right, but I don't think it's that direct. I do think there's a kind of arithmetic to rhythm and to music and to poetry. Versification in the old days, verse, traditionally, they used to call metre 'numbers'—'how his numbers ran' would mean how good he was at metre. So I think there's a kind of connection at that level. A sort of basic rhythmic level maybe.

BB: I guess I'd almost challenge the premise of your question, to the extent that, I maybe misunderstood, but it seems as though you're siloing things and saying 'This is outside of that', but human experience is very broad and we've all got the same basic stuff floating round inside our skulls, and I don't know that it's so useful to separate those different endeavours. To me, they are strongly connected, for some of the reasons I guess we've been talking about in terms of being able to understand things intuitively and sometimes linguistically and being able to explain to other people. These all seem really connected to me, rather than separated, if that makes sense?

RS: I think we've probably got time for two more questions.

Q: Ben, and you as well Rae... My observation of the way you've spoken throughout this conversation has been... like, even just before you were like using a metaphor about being thrown into a forest and knocking on wood, and these kinds of things, and I was wondering if you ever kind of observe the kind of poetry that you create in talking about your work and then how, Rae maybe, I think that you talked about, kind of the concision of language in poetry and in physics and I think the way you've spoken tonight as well has been quite concise and mathematical in a way and very like talking a lot about the kind of theories of physics, which has been interesting, seeing a bit of a swap between the physicist and the poet, tonight, and just your thoughts on that, for both of you.

BB: Yes. I guess it's a similar thought to one that I've expressed before, which is that people do different things with their lives but they're not that different, and, broadly speaking, Rae and I are the same, compared to any other species on earth and, sure, we understand things from a different perspective but ultimately we still have to explain things using the words that we have and the more words I have the better the job I can do and maybe the more physics Rae has the better job she can do, and then we all do better and everyone's a winner.

RA: Well, I do get kind of bored with poetry that is just about how sad someone is about their last breakup. It's like the world's bigger than that... look around. And

so I guess I've just always been interested in the questions... What are... What is light? You know, etcetera, etcetera. But I think all humans have, right? I mean, that's what myth is about, it's about trying to answer these questions, it's what religion is about. And it's what science is about and so why shouldn't it be what poetry involves? I'm not really down on somebody writing love poetry but I just mean that it's not *just* that, it's not *just* flowers and love, so why not engage with the contemporary sciences.

Q: I don't know if this will trigger anything, but I'm just wondering if either of you have anything to say about physics in translation, because if you're reading books about physics and you're getting... I mean, I'm just wondering about the kind of figures that get used in, say, English physics and then what happens when it gets *translated* into English, if there's anything comes to mind.

RA: I don't know. I mean, I've read Carlo Rovelli's books and I assume he writes in Italian, because he's an Italian and it gets translated. But since I don't read Italian I'll never know how good that translation is. That's often a problem. But I don't have much to say about that, sorry. What about you [Ben]?

BB: Yeah, I don't really know either, I mean, I guess, pretty much all scientific literature now is in English, and sometimes that English is really not very good because it's been written by people who have learnt it as a second language and it's really hard. It's not meant as a criticism of people writing these papers necessarily, but because we now have this effectively common language that we use through science I think it has diminished the overall quality of the writing because it's harder to express these ideas coming at it from a second language. And so that can be an issue.

I can remember when... well, I don't remember, I remember being told... My uncle did a PhD in chemistry at ANU back in the early '70s I think and he had to learn German to read the research papers at the time because so much of the chemistry was published in German, and now everything has flipped and there's very little published in anything other than English. And, so, I think that is definitely an issue and I don't think there's necessarily a solution to that that I can think of off the top of my head. But, yeah, that's the only sort of intersection I see there I think at the moment for me.

RS: Thank you Ben. And thank you Rae. And thank you everyone in the audience for those really stimulating questions.

We're going to wind up now.

Before we wind up, I want to remind you that copies of Rae's most recent book *Go Figure*, as well others of her books, are available to buy in the foyer. Rae will be staying around afterwards to sign copies, and the bar is still open, so please, do stay around for a drink, a sneaky book purchase, and continued conversation.

I want to end with expressions of thanks. First, to Monique Rooney and Amelia Dale, my colleagues in English at ANU, who have organised Rae's visit and this event, and Kate Mitchell and ANU's Research School of Humanities and the Arts, who provided funding support.

Thanks are also due to Caroline Stacey and the team at the Street Theatre, which has supported many recent events in conjunction with staff and visitors at ANU; we are very grateful for that relationship and may it continue to grow and flourish.

And thanks to you, too, the audience, for your attention and your questions; please give yourselves a modestly restrained self-congratulatory round of applause.

And finally, please give an unrestrained round of applause for our speakers, Ben Buchler and Rae Armantrout.

Thanks for coming and enjoy the rest of your evening.

[Audience applause]

Photo by Nathan Smith Photography

RAE ARMANTROUT is the award-winning author of eighteen books of poetry, most recently *Go Figure* (2024), *Finalists* (2022) and *Conjure* (2020). Her collection *Versed* (2010) won a National Book Critics Circle Award, a Pulitzer Prize, and was a finalist for a National Book Award. Her work has appeared in countless anthologies including *Best American Poetry* (2007), *'Language' Poetries: An Anthology* (1987) and *In the American Tree* (1986).

BEN BUCHLER completed a PhD on the electro-optic control of quantum measurements in 2002. This work led to one of the early demonstrations of quantum teleportation. He then took up postdoctoral position in Zurich working on nano-optics where he measured the quantum properties of single molecules as they emitted light. Returning to the Australian National University in 2006, Ben began working on quantum memory experiments that aim to trap and release the quantum information stored in photons for applications in quantum communication and computing. Since 2018, Ben has been a partner in the dark matter search operated by the Global Network of Optical Magnetometers for Exotic physics (GNOME). This effort aims to solve one of the biggest problems in modern physics, where it appears that most universe is made of material we have never observed.

RUSSELL SMITH is a lecturer in modern literature and literary theory at the Australian National University, Canberra. He has published widely on the work of Samuel Beckett, as well as on various topics in modernist and contemporary literature, literary theory and visual art. His current research examines the influence of James Joyce's 1930s radio listening on *Finnegans Wake* and its analysis of the emerging global wireless communications network.

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