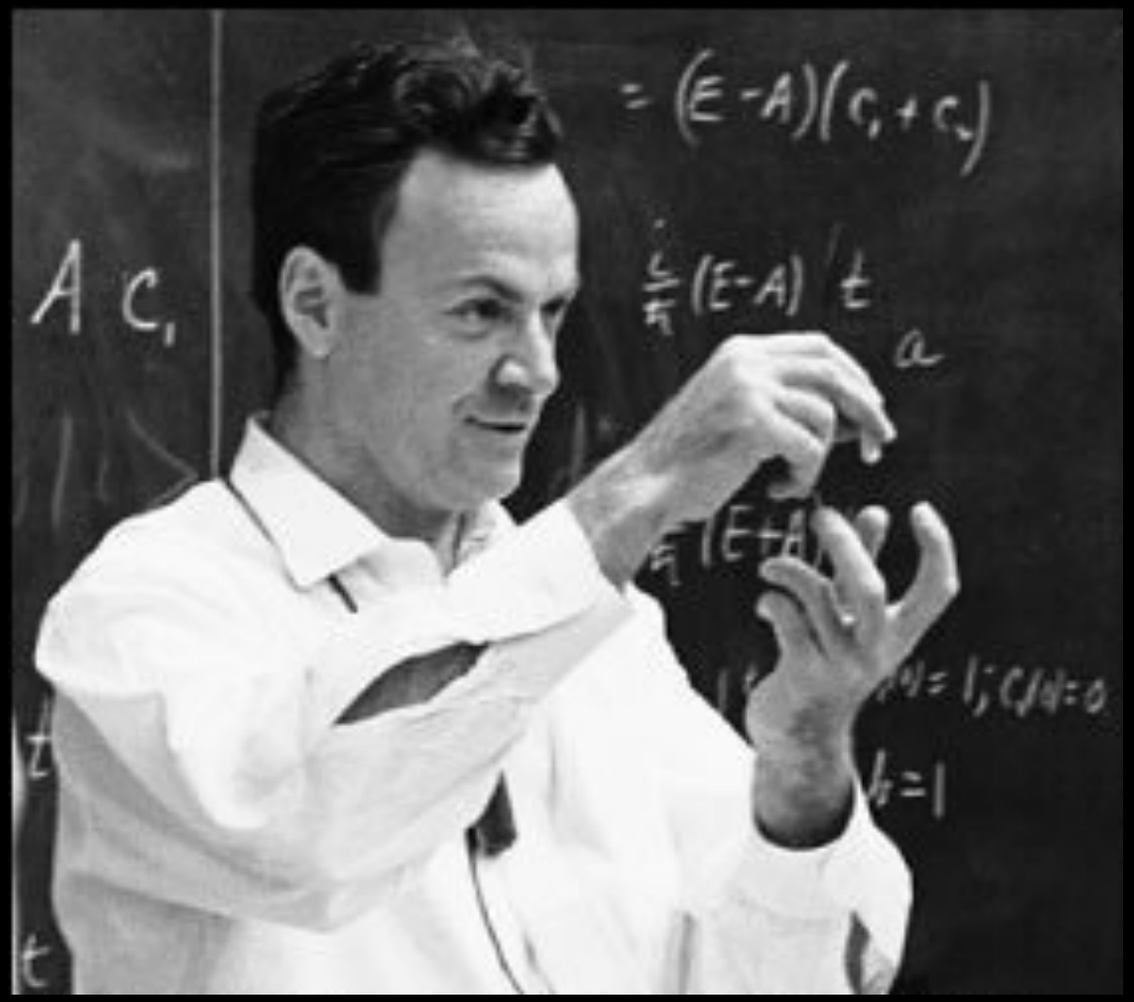


Coherent Communications —
What We Can Learn from Theoretical Physics

Kevin Barron

LISA 2017



"I think I can safely say that nobody understands quantum mechanics."

Richard Feynman

Disclaimers

- Not a Physicist
- Don’t play one on YouTube
- Ideas presented here are my fault
- KITP is not part of the “California School”

1. Explore the connection between communication and coherence

2. Use the IP stack as a model for human communication

3. Briefly survey some wider instantiations of coherence




30 MIN MON-SUN PERMIT REQUIRED

Why are we here?


8913 CVY







The End Result

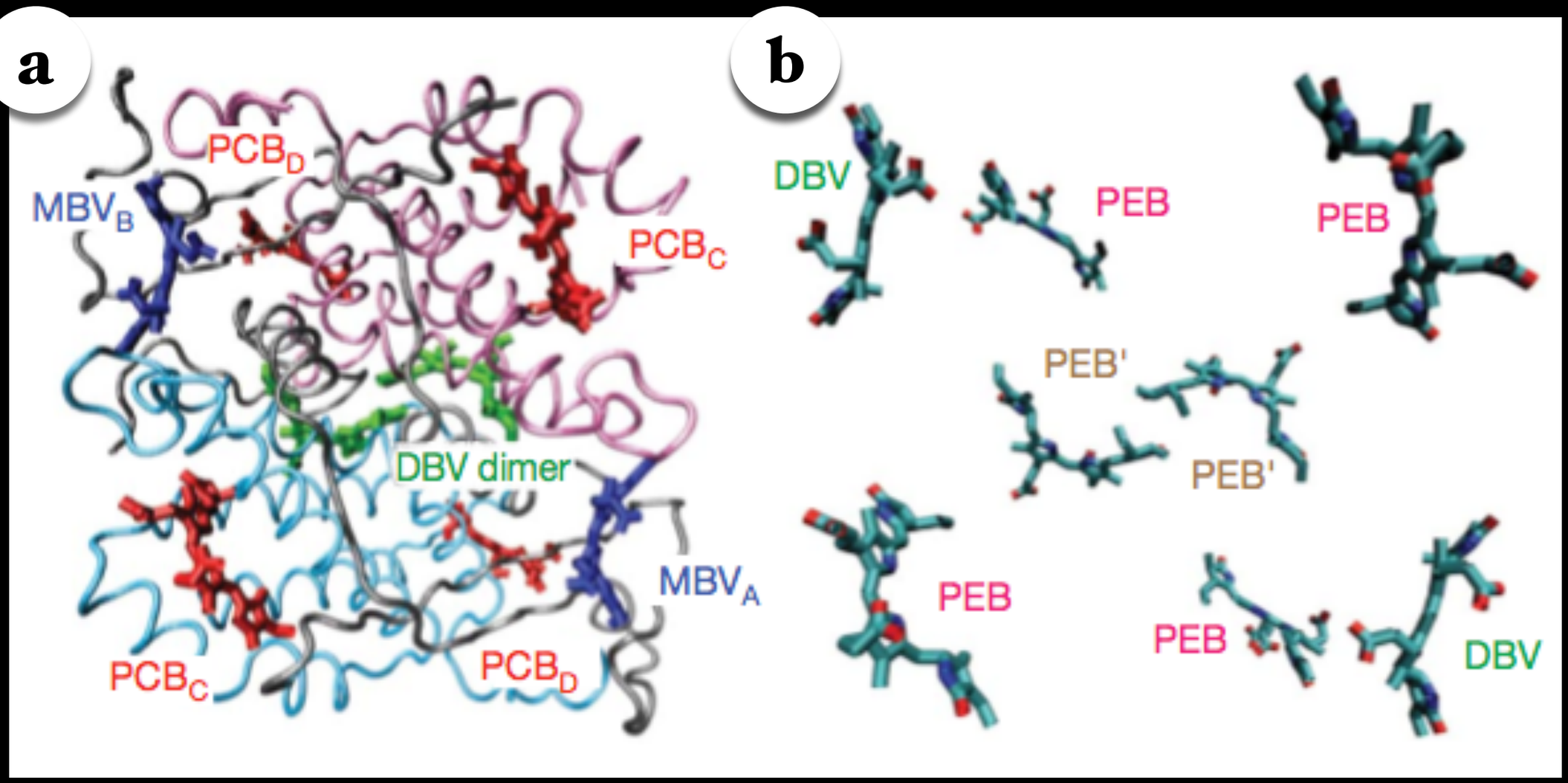
Everywhere in a Flash



Photo: Wired

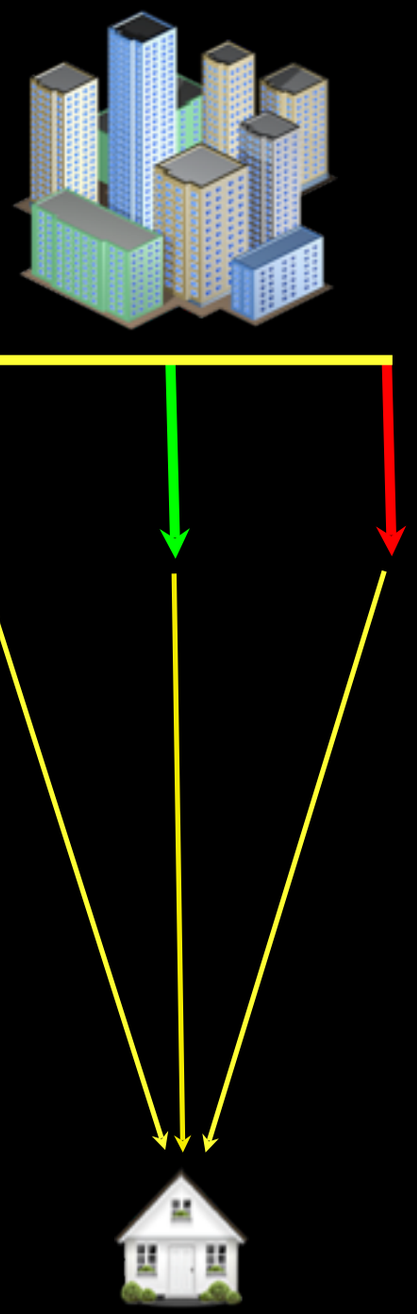
Light-harvesting Molecules

Processing Molecules



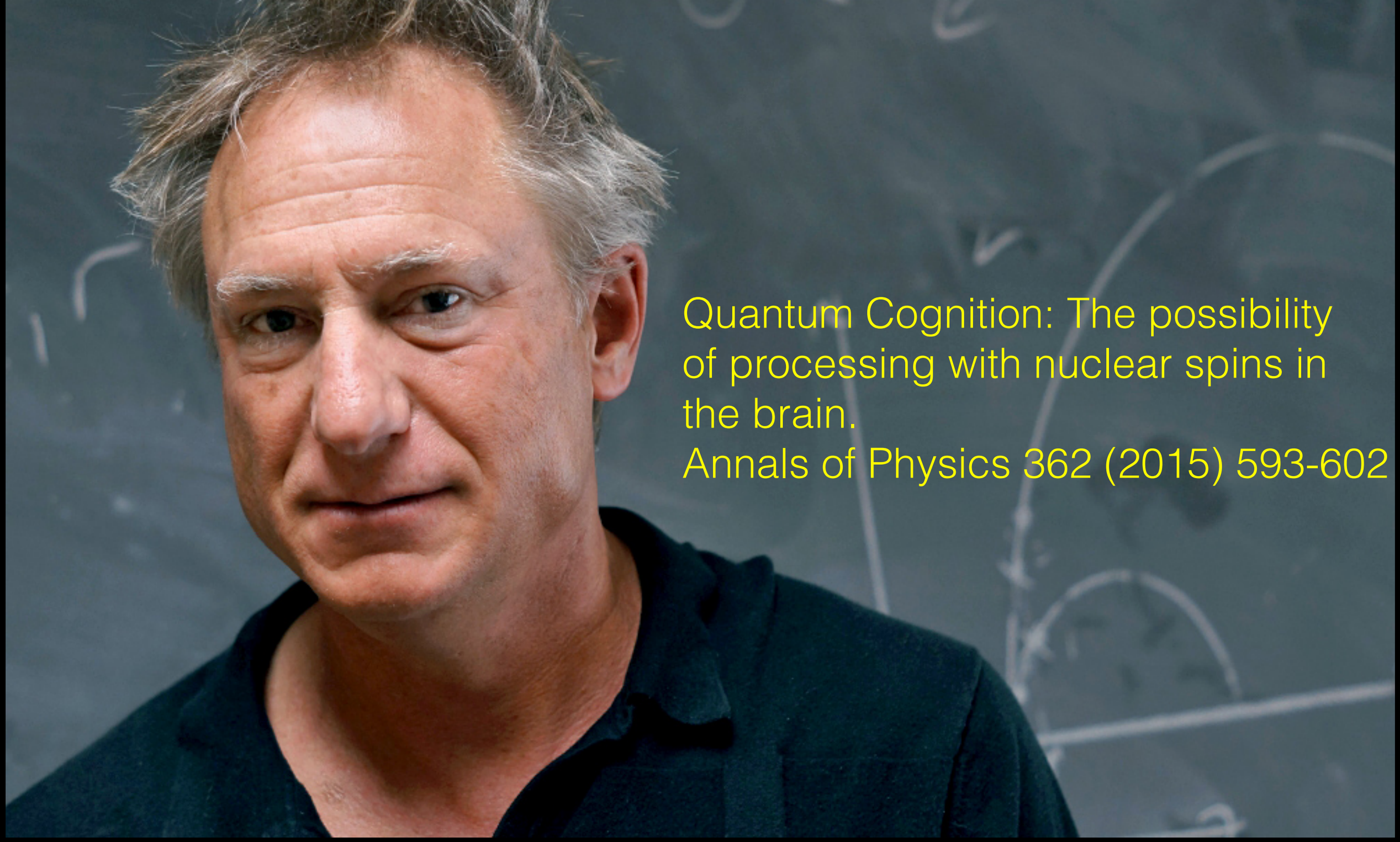
Coherent photosynthetic marine algae at ambient temperature

Quantum Coherence



So what's the relation to Communication?

- Not rare/exotic
- Potentially revolutionary
- Relation to Neurophysics



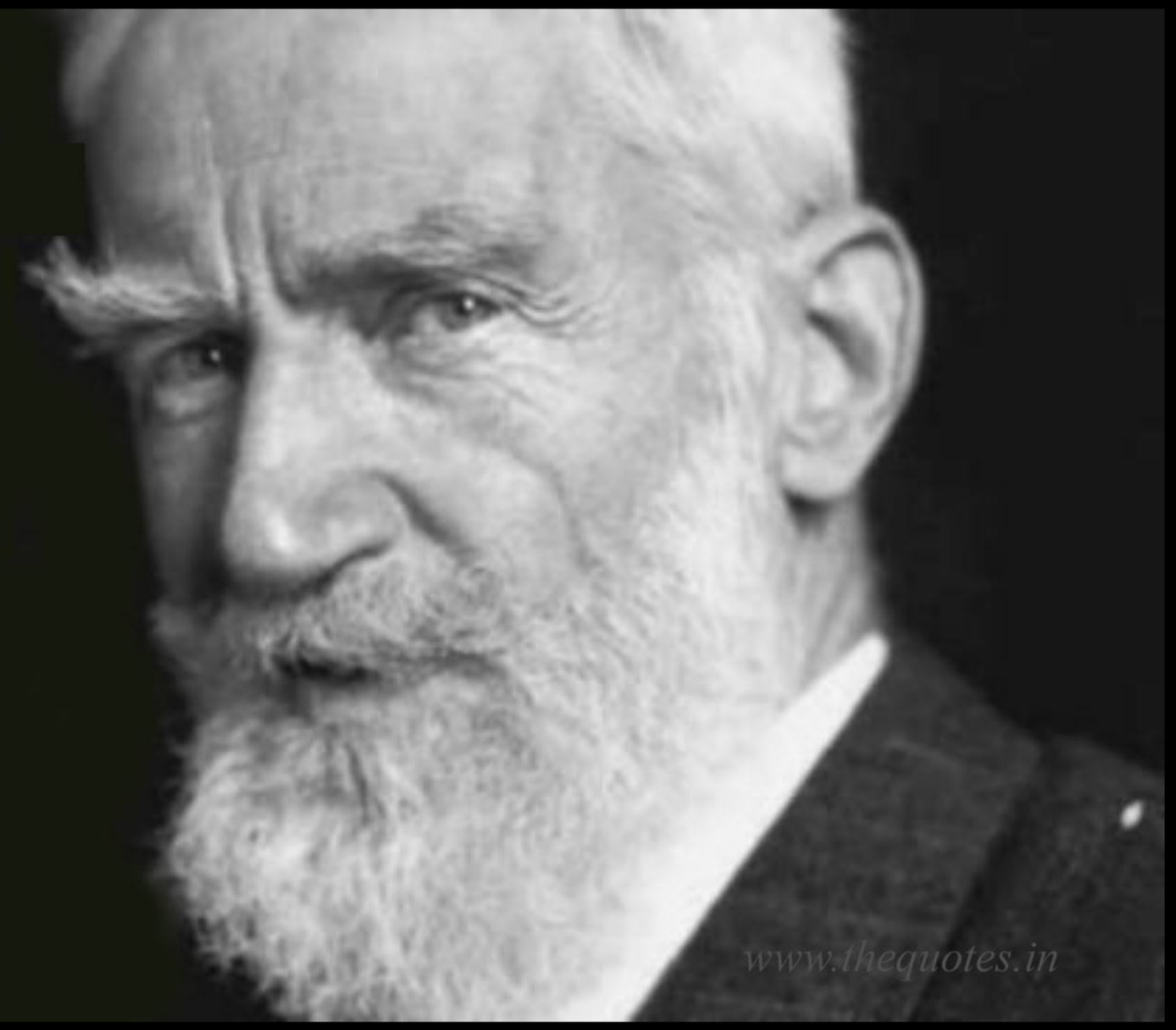
Matthew Fisher

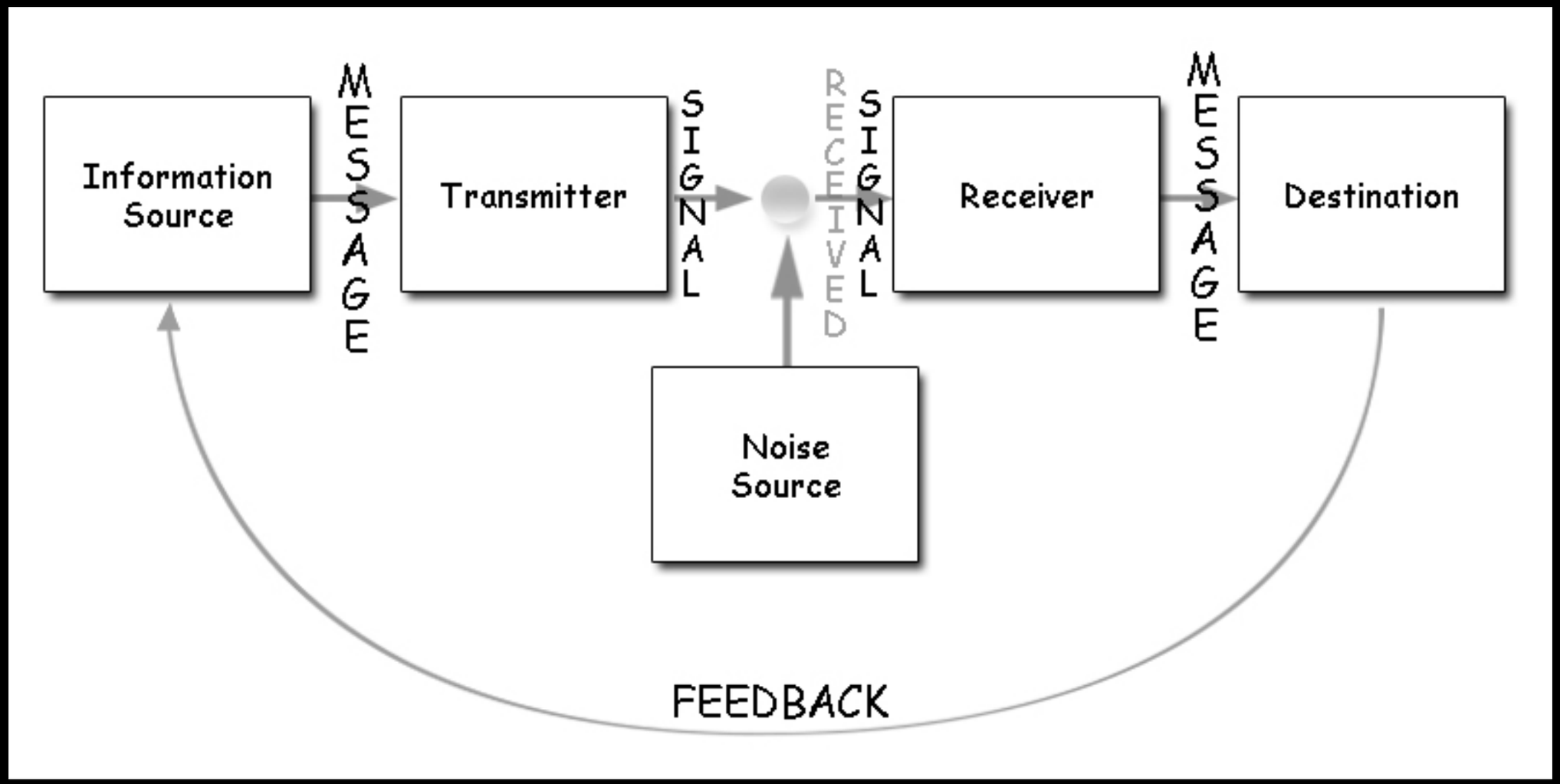
Human Communication

- Proximity-based
- Communication is bidirectional
- It is mutually authored
- More than sending/receiving msgs

The single biggest problem in communication is the illusion that it has taken place.

George Bernard Shaw

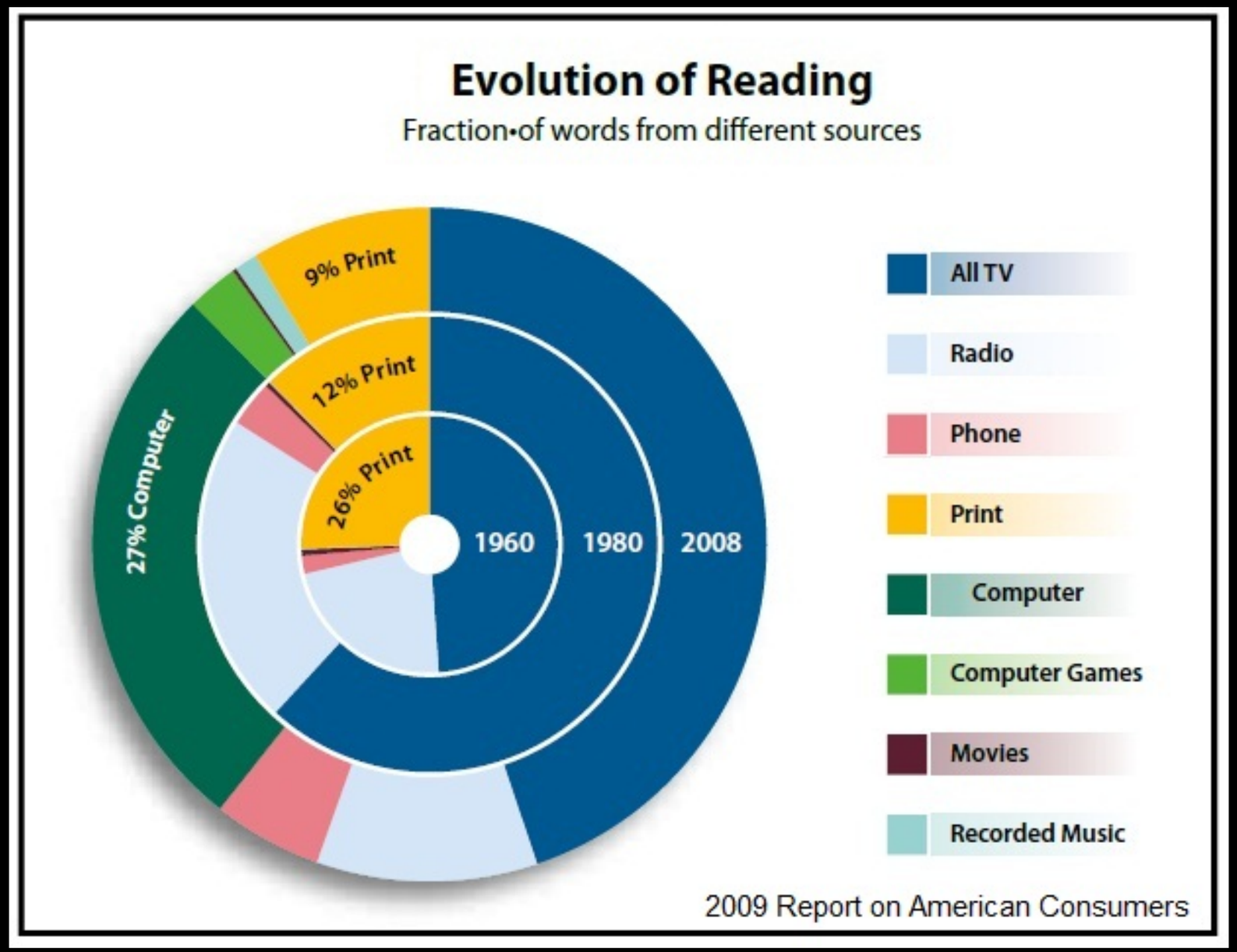




Shannon / Weaver

Model of Communication

Information Consumption





The New Normal

	TCP/IP	OSI	USAGE
	Layer 5 App/Process	Application Layer	End User Apps
		Presentation Layer	Data Transmission Codes
		Session Layer	Telecomm sessions
	Layer 4 Transport	Transport Layer	Transfer between nodes
	Layer 3 IP	Network Layer	Routing & Connections
	Layer 2 Network Interface	Data Link Layer	Transmission Control
	Layer 1 Physical	Physical Layer	Physical Transmission

IP/OSI Model

HUMAN	TCP/IP	OSI	USAGE
Coherence	Layer 5 App/Process	Application Layer	End User Apps
Clear Intention		Presentation Layer	Data Transmission Codes
Common Goals		Session Layer	Telecomm sessions
Shared Language	Layer 4 Transport	Transport Layer	Transfer between nodes
	Layer 3 IP	Network Layer	Routing & Connections
Common Rules	Layer 2 Network Interface	Data Link Layer	Transmission Control
Physical Presence	Layer 1 Physical	Physical Layer	Physical Transmission

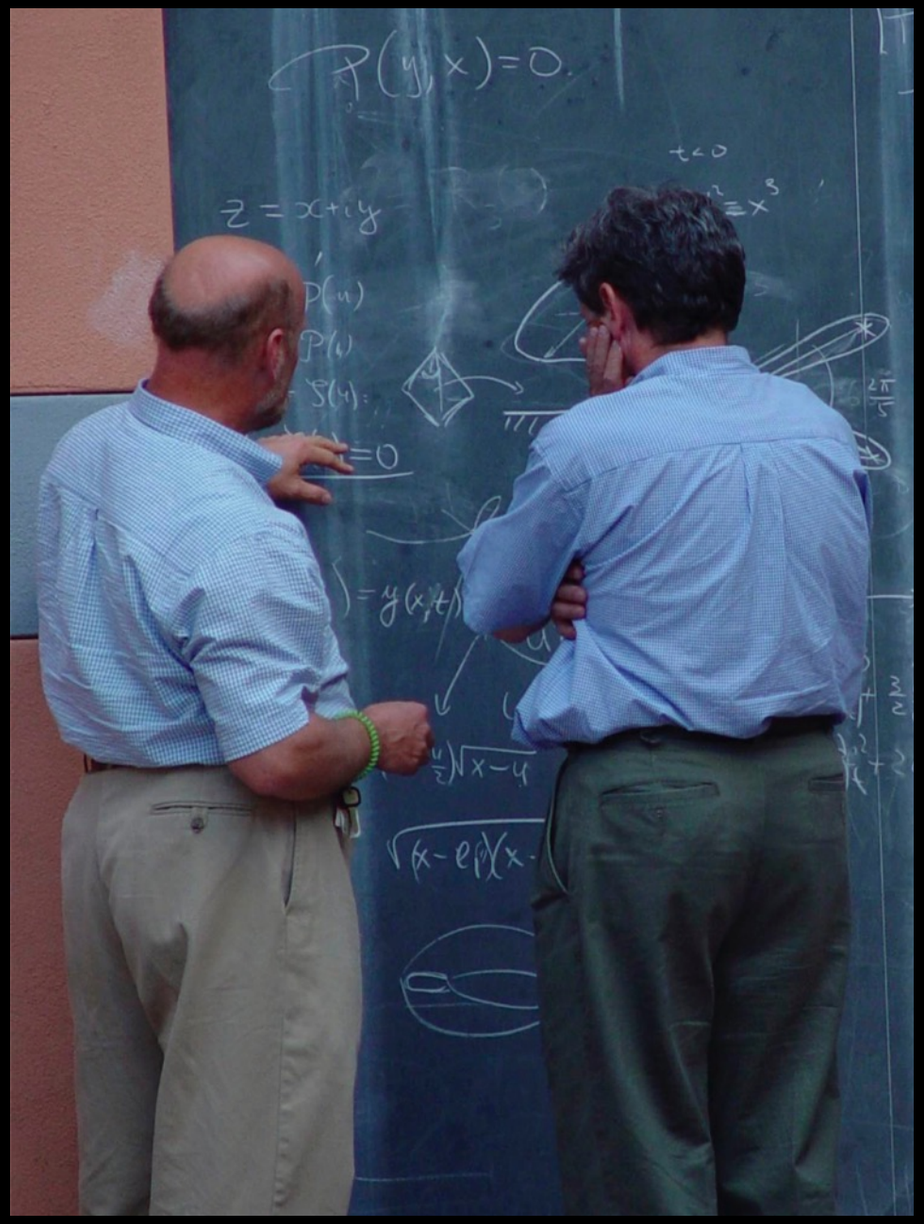
Human Comms

	HUMAN	TCP/IP	OSI	USAGE
Respect ->	**Coherence**	Layer 5 App/Process	Application Layer	End User Apps
	Clear Intention		Presentation Layer	Data Transmission Codes
	Common Goals		Session Layer	Telecomm sessions
	Shared Language	Layer 4 Transport	Transport Layer	Transfer between nodes
		Layer 3 IP	Network Layer	Routing & Connections
Trust	**Common Rules**	Layer 2 Network Interface	Data Link Layer	Transmission Control
	Physical Presence	Layer 1 Physical	Physical Layer	Physical Transmission

Human Comms

Coherent Communication

engaged conversation takes time





Kohn Hall

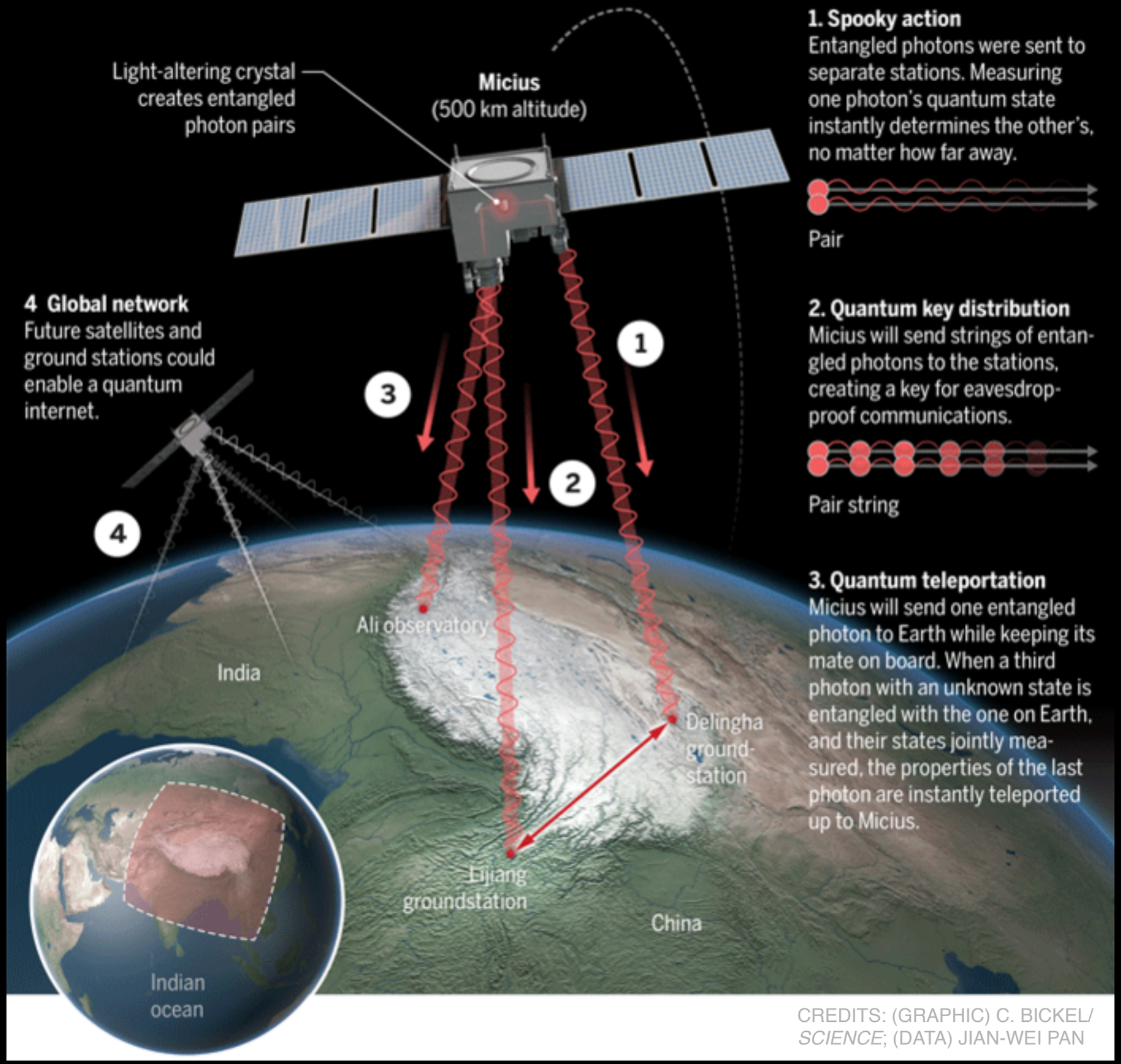
The Kavli Institute for Theoretical Physics

A Model For Coherence

- physical presence provides rich cmns environment
- unperturbed, stable state
- coherence at a distance

Quantum leaps

China's Micius satellite, launched in August 2016, has now validated across a record 1200 kilometers the "spooky action" that Albert Einstein abhorred (1). The team is planning other quantum tricks (2–4).



1. Spooky action
Entangled photons were sent to separate stations. Measuring one photon's quantum state instantly determines the other's, no matter how far away.

Pair

2. Quantum key distribution
Micius will send strings of entangled photons to the stations, creating a key for eavesdrop-proof communications.

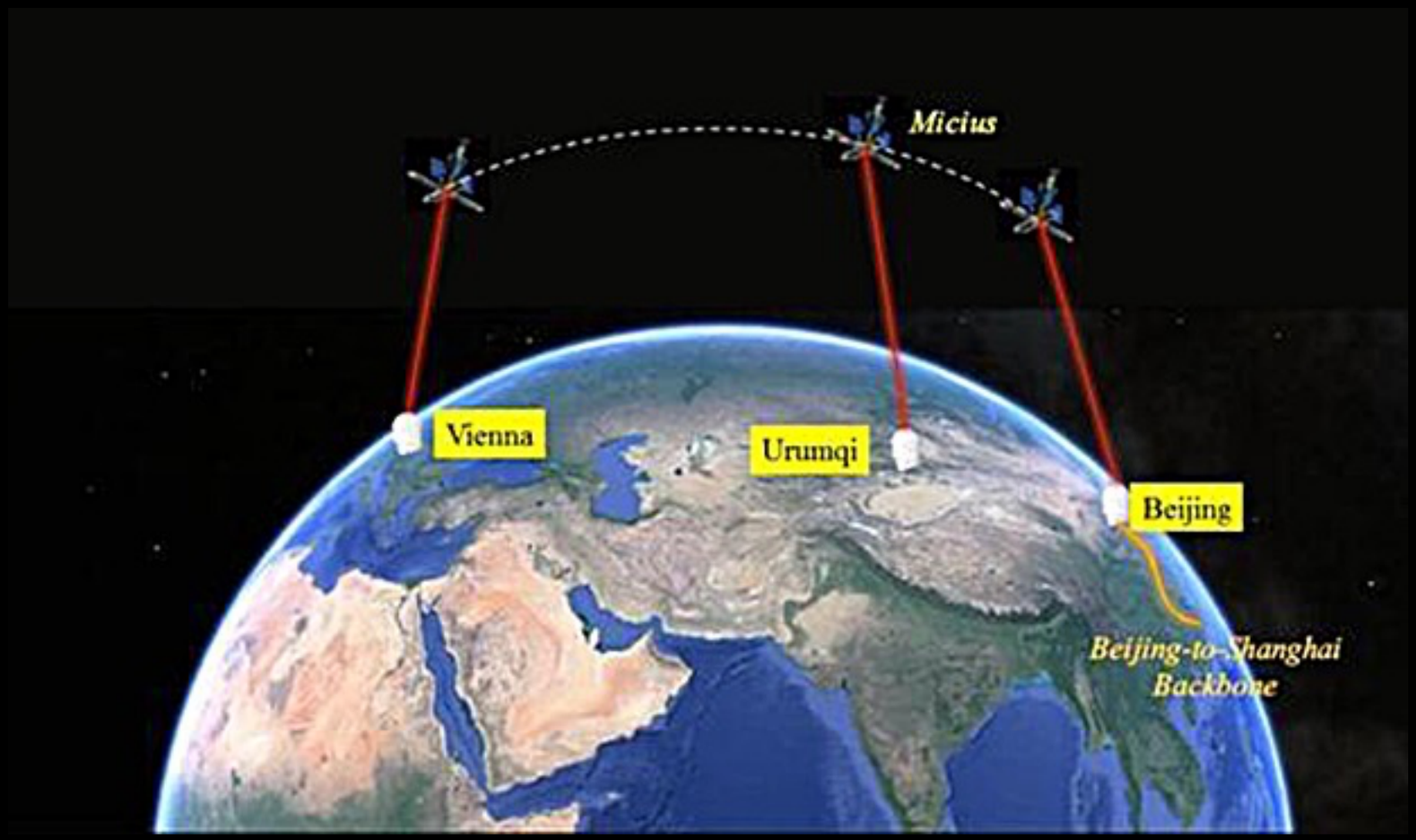
Pair string

3. Quantum teleportation
Micius will send one entangled photon to Earth while keeping its mate on board. When a third photon with an unknown state is entangled with the one on Earth, and their states jointly measured, the properties of the last photon are instantly teleported up to Micius.

4 Global network
Future satellites and ground stations could enable a quantum internet.

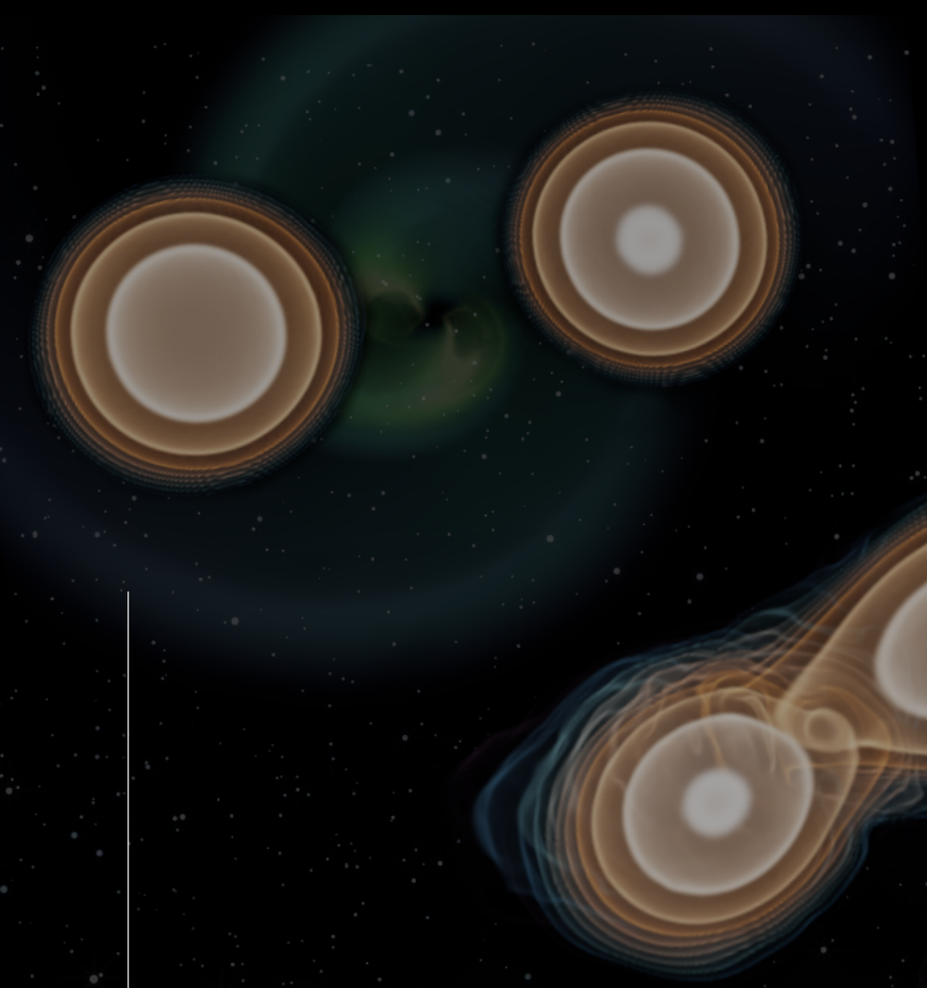
CREDITS: (GRAPHIC) C. BICKEL/ *SCIENCE*; (DATA) JIAN-WEI PAN

Quantum Key Distributon



First Cosmic Event Observed in Gravitational Waves and Light

Colliding Neutron Stars Mark New Beginning of Discoveries

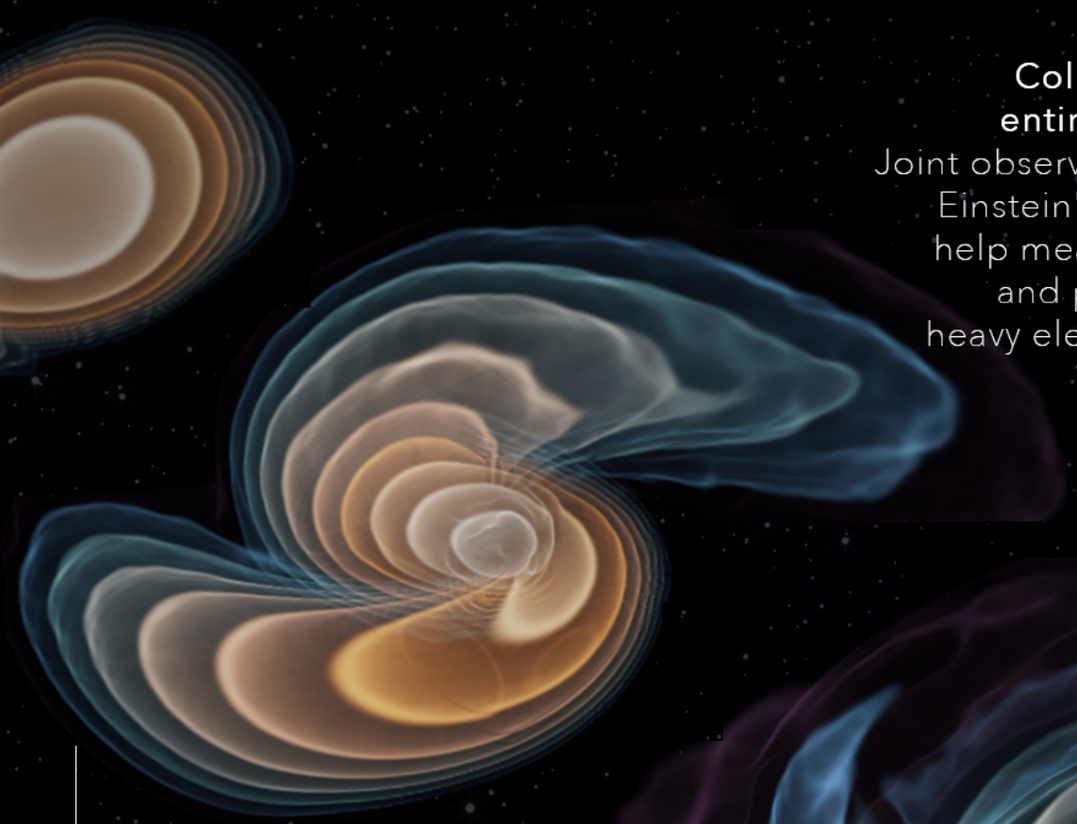


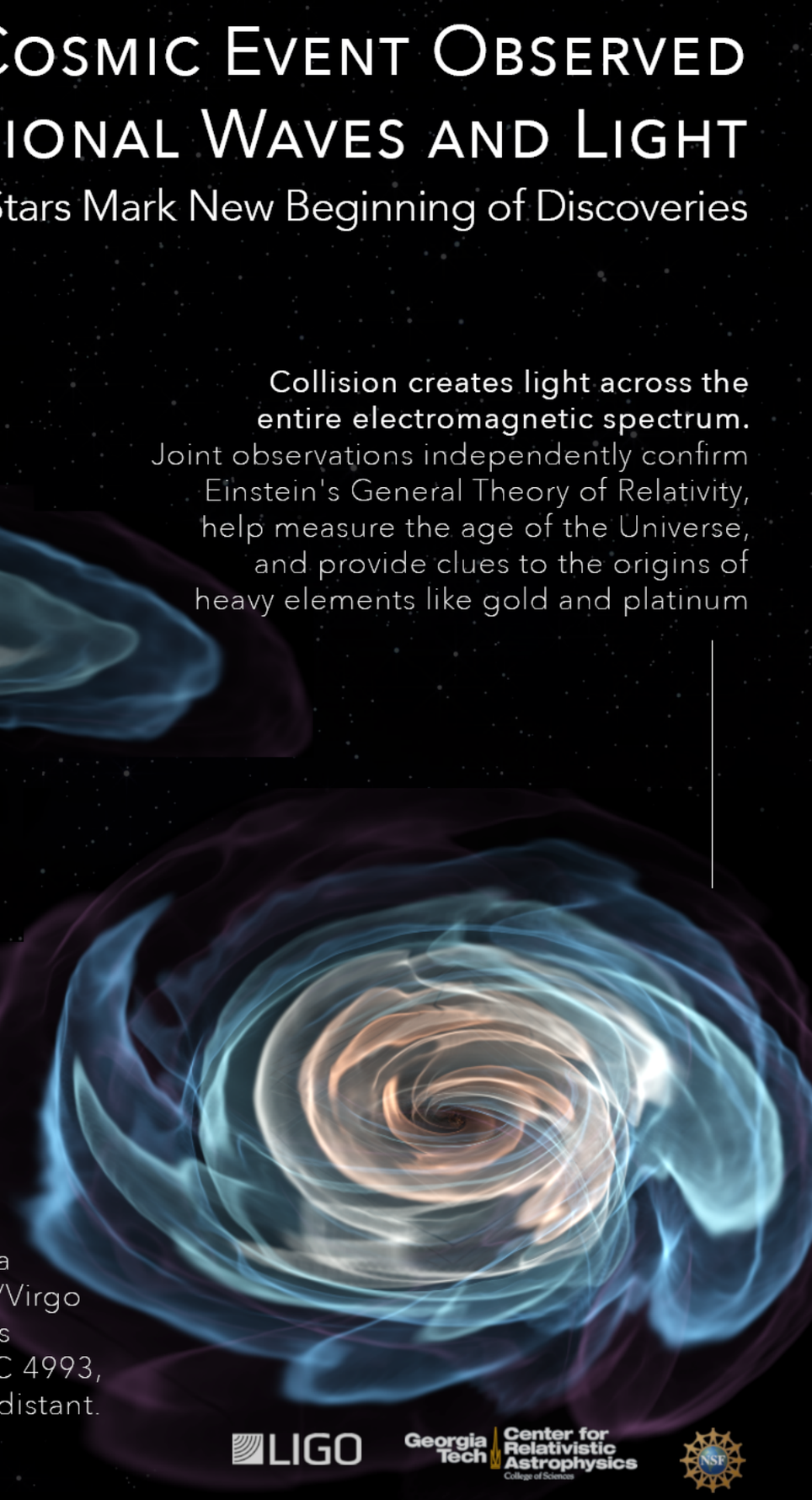
Gravitational wave lasted over 100 seconds

On August 17, 2017, 12:41 UTC, LIGO (US) and Virgo (Europe) detect gravitational waves from the merger of two neutron stars, each around 1.5 times the mass of our Sun. This is the first detection of spacetime ripples from neutron stars.

Within two seconds, NASA's Fermi Gamma-ray Space Telescope detects a short gamma-ray burst from a region of the sky overlapping the LIGO/Virgo position. Optical telescope observations pinpoint the origin of this signal to NGC 4993, a galaxy located 130 million light years distant.

Collision creates light across the entire electromagnetic spectrum. Joint observations independently confirm Einstein's General Theory of Relativity, help measure the age of the Universe, and provide clues to the origins of heavy elements like gold and platinum





LIGO

Georgia Tech College of Sciences Center for Relativistic Astrophysics

NSF

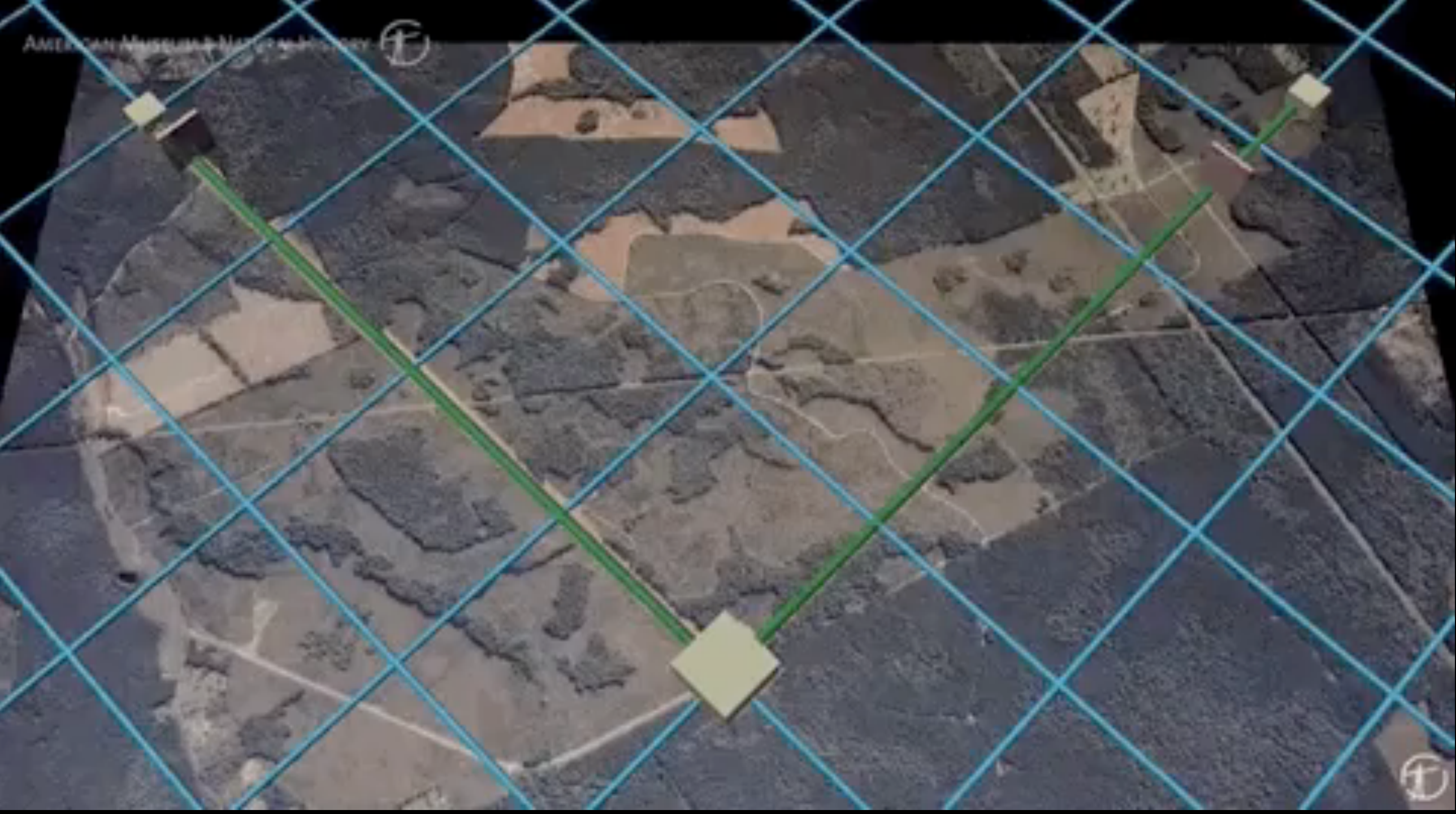


Image: American Museum of Natural History

LIGO Process

Full Circle:
Kip Thorne & Walter Kohn

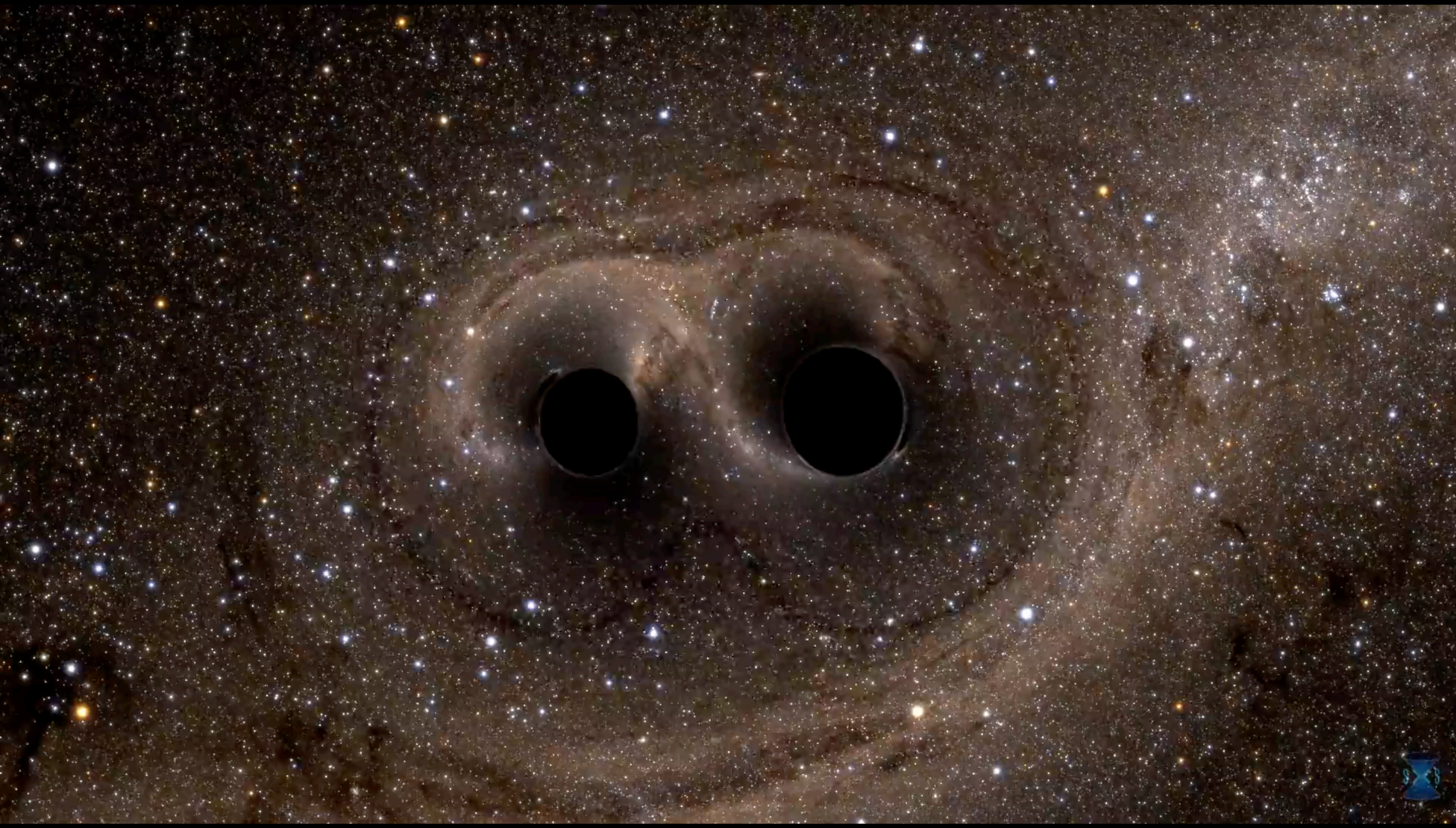


Summary

- Human communication is messy, but evolving
- Using a systems approach, we can apply various models
- IP stack is a useful reference point
- Coherence is ubiquitous, providing a powerful metaphor
- All models are subject to scrutiny & need to be periodically revised - or entirely revised

Potential* Takeaways

- develop a culture of conversation
- create a level playing field for all participants
- minimize distractions/chaos
- iterate - allow plenty of follow-on conversations (rather than simply focus on accomplishing decisions
- encourage an atmosphere of trust and respect



Conclusion

- New models lead to new understanding
- Data must support the model
- Nature does not repeat itself (but it often rhymes)
- Is coherence a useful metaphor for communication?
- All models and metaphors need to be revisited and revised periodically

Reaching Coherence:

Q & A

References

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