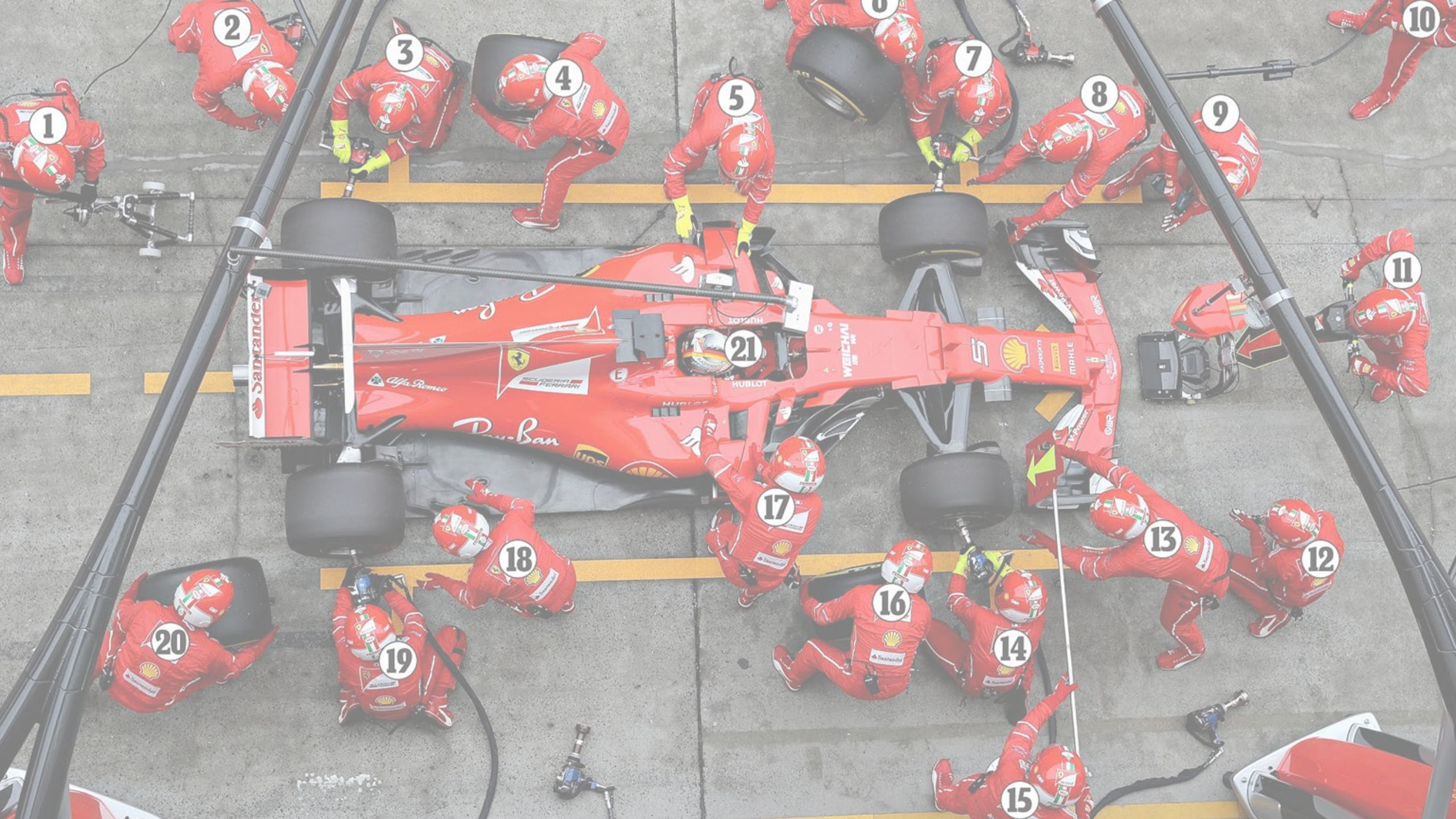




# Team Science

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Formula one pit crews—  
teaming is a science

An aerial photograph of a Formula 1 pit stop. A red Ferrari Formula 1 car is positioned in the center, with its driver wearing a helmet with the number 21. The car is surrounded by 21 pit crew members, all wearing red racing suits with white helmets and numbers. The crew members are numbered 1 through 21, with some numbers appearing on multiple crew members. They are working on the car, including changing tires and adjusting components. The scene is set on a grey asphalt track with yellow and white markings. Two large black cranes are visible on the left and right sides of the frame, extending over the pit area. The text "Formula one pit crews—teaming is a science" is overlaid in white, sans-serif font across the center of the image.





# Increasing Team Science

My view on the  
current state of  
science and teaming



# Benefits

- Solve big, really challenging problems
- Think about your problem differently
- Advance science more rapidly
- Interdisciplinary science is where I see the most exciting advances





# Challenges

- It's hard
- You have to want to work across fields
- Need different evaluation metrics to capture contributions
- Not all team members contribute equally

In 1916,  
equations o

## Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.*\*

(LIGO Scientific Collaboration and Virgo Collaboration)

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On September 14, 2015 at 09:50:45 UTC the two detectors of the LIGO Observatory simultaneously observed a transient gravitational-wave signal with a frequency from 35 to 250 Hz with a peak gravitational-wave strain amplitude of  $1.0 \times 10^{-21}$  predicted by general relativity for the inspiral and ringdown of the coalescence of two black holes of masses  $36^{+9}_{-8} M_{\odot}$  and  $29^{+4}_{-4} M_{\odot}$ , which resulted in a single black hole of mass  $62^{+4}_{-4} M_{\odot}$ . This observation is the first direct evidence of the existence of black holes and of the strong-field regime of general relativity.

In the source frame, the initial black holes had masses of  $36^{+9}_{-8} M_{\odot}$  and  $29^{+4}_{-4} M_{\odot}$ , and the final black hole had a mass of  $62^{+4}_{-4} M_{\odot}$ . These observations provide the first direct evidence of the existence of black holes and of the strong-field regime of general relativity.

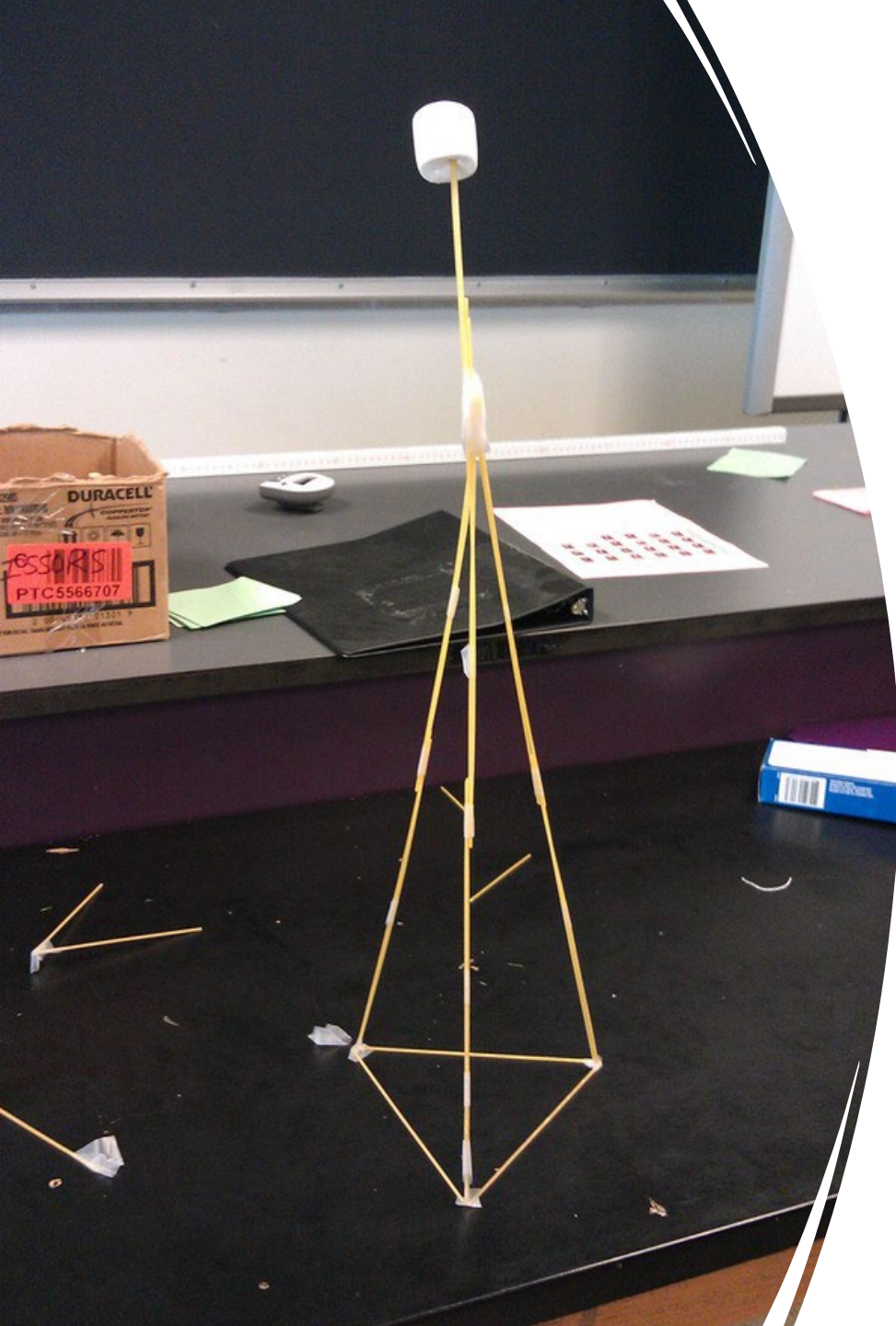
These observations provide the first direct evidence of the existence of black holes and of the strong-field regime of general relativity.

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Bond<sup>726</sup>, C. B. Bond<sup>727</sup>, C. B. Bond<sup>728</sup>, C. B. Bond<sup>729</sup>, C. B. Bond<sup>730</sup>, C. B. Bond<sup>731</sup>, C. B. Bond<sup>732</sup>, C. B. Bond<sup>733</sup>, C. B. Bond<sup>734</sup>, C. B. Bond<sup>735</sup>, C. B. Bond<sup>736</sup>, C. B. Bond<sup>737</sup>, C. B. Bond<sup>738</sup>, C. B. Bond<sup>739</sup>, C. B. Bond<sup>740</sup>, C. B. Bond<sup>741</sup>, C. B. Bond<sup>742</sup>, C. B. Bond<sup>743</sup>, C. B. Bond<sup>744</sup>, C. B. Bond<sup>745</sup>, C. B. Bond<sup>746</sup>, C. B. Bond<sup>747</sup>, C. B. Bond<sup>748</sup>, C. B. Bond<sup>749</sup>, C. B. Bond<sup>750</sup>, C. B. Bond<sup>751</sup>, C. B. Bond<sup>752</sup>, C. B. Bond<sup>753</sup>, C. B. Bond<sup>754</sup>, C. B. Bond<sup>755</sup>, C. B. Bond<sup>756</sup>, C. B. Bond<sup>757</sup>, C. B. Bond<sup>758</sup>, C. B. Bond<sup>759</sup>, C. B. Bond<sup>760</sup>, C. B. Bond<sup>761</sup>, C. B. Bond<sup>762</sup>, C. B. Bond<sup>763</sup>, C. B. 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Bond<sup>802</sup>, C. B. Bond<sup>803</sup>, C. B. Bond<sup>804</sup>, C. B. Bond<sup>805</sup>, C. B. Bond<sup>806</sup>, C. B. Bond<sup>807</sup>, C. B. Bond<sup>808</sup>, C. B. Bond<sup>809</sup>, C. B. Bond<sup>810</sup>, C. B. Bond<sup>811</sup>, C. B. Bond<sup>812</sup>, C. B. Bond<sup>813</sup>, C. B. Bond<sup>814</sup>, C. B. Bond<sup>815</sup>, C. B. Bond<sup>816</sup>, C. B. Bond<sup>817</sup>, C. B. Bond<sup>818</sup>, C. B. Bond<sup>819</sup>, C. B. Bond<sup>820</sup>, C. B. Bond<sup>821</sup>, C. B. Bond<sup>822</sup>, C. B. Bond<sup>823</sup>, C. B. Bond<sup>824</sup>, C. B. Bond<sup>825</sup>, C. B. Bond<sup>826</sup>, C. B. Bond<sup>827</sup>, C. B. Bond<sup>828</sup>, C. B. Bond<sup>829</sup>, C. B. Bond<sup>830</sup>, C. B. Bond<sup>831</sup>, C. B. Bond<sup>832</sup>, C. B. Bond<sup>833</sup>, C. B. Bond<sup>834</sup>, C. B. Bond<sup>835</sup>, C. B. Bond<sup>836</sup>, C. B. Bond<sup>837</sup>

# How do you build the best team?

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- Diversity makes the outcomes stronger if the team has trust and is inclusive
- Barriers
  - Bias
  - Feeling threatened by outsiders
  - Limited diversity in some fields
  - Awareness of abilities of “non-traditional” contributors
  - Willingness to try something different that might take longer (deliverables and expectations of funding offices, employers, etc)



# Opportunities

- AI/ML and Autonomous Science may drive a change the culture
- But the community still needs to address the challenges
  - Start teaming earlier
  - Communicate about teaming
  - Establish a Code of Conduct in DEIA
  - Evaluate team behaviors
  - Mentoring
  - Sponsoring





Thank you

