

## BICEP2

#### The Search for the Beginning of The Universe

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#### The Search for Evidence of Inflation

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#### The Search for Evidence of Inflation

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#### **Cosmic Microwave Background**

#### The Universe's Baby Picture



#### Conclusions

The BICEP2 experiment found evidence for the theory of Inflation by measuring the effect of gravity waves on the **Cosmic Microwave Background.** 

### In other words

# Why do we live in the universe we do?

# What do we know about our universe?





# We don't know how the universe started

# We don't know how the universe started

# But we do know what the universe looks like now

# We don't know how the universe started

# But we do know what the universe looks like now and when it was younger.



time \_\_\_\_\_







\*Cosmic Microwave Background: what the BICEP2 experiment is studying



\*Cosmic Microwave Background: we'll come back to this, I promise





### STATT AT THE END

#### WHAT DOES THE UNIVERSE LOOK LIKE NOW?



#### BLACK HOLE!

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### WRONG!

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#### Aside on Sgr A\* G2


#### Aside on Sgr A\* G2 aka the cloud going through the black hole at the center of the galaxy



### A GALAXY!

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#### **ANOTHER Galaxy!**

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Your Evil Andromedan Twin Lives Here



## If you stuck out your thumb at arm's length







Distance to the Center of Our Galaxy

\$

Distance to the Center of Our Galaxy (About a factor of 10)

#### Galaxies are on average 3,262,000 Light Years Apart

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Our Sun is *only* **0.0001607** Light Years Away

## 3,262,000 👶 0.00001607

## 3,262,000 👶 0.00001607

## 3,262,000 🔷 0.00001607

### **202 Billion**

## **Galaxies** are **202 BILLION** times further away than the Earth and the Sun



## The Universe Today is **Big**

## The Universe Today is **Big**

## And Mostly Empty

## васк то тне разт

#### The Universe at 17.7 Billion Years

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Where do these **hot** and cold spots come from?

# The Very Early Universe was a plasma

# The Very Early Universe was a **plasma**

## Like our Sun






# The Very Early Universe was very very hot

# The Very Early Universe was very very hot

# It was also very very dense

# The Very Early Universe was very very hot

### It was also very very

dense









#### Inflation

#### Inflation

#### Inflation











## the temperature fluctuations in the **CMB**

# the temperature fluctuations in the CMB are those tiny

waves

### the temperature fluctuations in the **CMB** are those tiny waves **b I o w n** up by Inflation



### **BICEP2:** Background Imaging of Cosmic Extragalactic Polarization

# BICEP2 is looking for a signature of inflation

# BICEP2 is looking for a signature of inflation

#### **Gravity waves**

#### The Cosmic Microwave Background

### Gravity Waves

#### The Cos vity Waves Microy = Polarized Backg Light







### Why now?

seriously, we've had the CMB for like 35 years



**BICEP2: B signal** 



### WHY NOT NOW?

#### There is a much more mundane reasons why the **CMB** light would be Polarized

### **Cosmic Dust**





#### Conclusions

The BICEP2 experiment found evidence for the theory of Inflation by measuring the effect of gravity waves on the **Cosmic Microwave Background.**
The BICEP2 experiment found may have found evidence for the theory of **Inflation** by measuring the effect of gravity waves on the **Cosmic Microwave Background.** 

## **Cool Links**

- •Galaxy Zoo
- http://www.galaxyzoo.org/
- •APOD
- http://apod.nasa.gov
- SixtySymbols
- http://www.sixtysymbols.com/
- •AMNH YouTube Page
- http://www.youtube. com/user/AMNHorg
- •Dyer Observatory
- http://www.dyer.vanderbilt.edu/

- About The Black Hole in the center of our galaxy:
  - <u>http://www.space.com/24362-milky-way-black-hole-gas-cloud.html</u>
- Wolfram Alpha:
  - <u>http://www.wolframalpha.com/input/?</u> <u>i=distance+to+the+center+of+the+galaxy+i</u> <u>n+light+years</u>
- Illustris Simulations
  - <u>http://www.illustris-project.org/</u>
- Fun iPhone App
  - CMB Maps by Qingqing Mao











