Episode 47: **WMAP's Anistropy Trophy**

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Travis: Welcome to Slacker Astronomy; a podcast about astronomy and just about anything else that floats over our heads.

Pamela: Each week we bring you a news event from the world of astronomy. And when there is nothing to report, (groggy) we'll work on this hangover left over from our first anniversary bash last night.

Travis: (also groggy) Is that what that was? I thought a train hit me.

Pamela: Yeah a train full of nerds, geeks and the rest of society's ruffians.

Travis: So we've been on the air a year now, eh?

Pamela: Hence the one in one year anniversary

Travis: Wow. I remember way back when in the olden days when we had to record podcasts going uphill, both ways!

Pamela: (crotchety old woman) And there was no such thing as VIIIDDEOOO podcasts.

Travis: And Brokeback Mountain was still just a mountain with a stupid name!

Pamela: And Mac's still had powerpc chips!

Both: Ahh.. the good old days.

Travis: 2005, we hardly knew ye.

Pamela: And now in March, 2006 we learn a little bit about wwwwaaaaayyyyy back when, around 13.7 billion BC. to be exact.

Travis: For the past 4 and a half years NASA has had a satellite orbitting called the Wilkensen Microwave Anistropy Probe, or WMAP for short. WMAP's goal was to precisely map the cosmic microwave background to test some fundamental questions about the Big Bang.

Pamela: The cosmic microwave background, or CMB, is a 2.7 Kelvin background radiation that permeates space. It can be seen in all directions and is the heat leftover from the formation of the universe. It formed back when the Universe first became transparent to light. Prior to that, the Universe was opaque like hot glowing neon gas is opaque. This occurred between 300,000 and 400,000 years after the Big Bang.

Travis: For more information on the Big Bang listen to Pamela's Monolithic Monologue from last year, available on the SA Extra feed.

Pamela: So WMAP's initial map of the CMB is kind of like an infant's picture of the universe. It was released in 2003 to great fanfare.

Travis: Its results shed understanding of many questions about the Big Bang. Among them, it set the age of the Universe at 13.7 plus or minus 0.2 billion years. This was the first direct measurement of the age of the universe and agrees within the uncertainties of most of the other independent, indirect ways of measuring its age.

Pamela: After a little more than a year the raw data was released to the public, as is the policy for almost all NASA funded missions. After all, it is the American taxpayers who paid for this toy.

Travis: Now, three years later the WMAP team scientists have released a more careful study of the data. This new analysis has allowed astronomers to peer back beyond the era of decoupling, which is what they call the moment the universe became transparent. Now the WMAP astronomers claim they understand the first TRILLIONTH of a second after the big bang.

Pamela: They can do this by looking the small fluctuations, called anisotropies in the map of the cosmic microwave background. These fluctuations are very small, with the temperature changing from 2.7251 at the hottest spots to 2.7249 at the coldest spots – change of measured in the 1/1000th of a degree!

Travis: The fluctuations in the background are a result of fluctuations in temperature of the universe prior to the decoupling. These fluctuations are thought to date back to a trillionth of a second after the Big Bang.

Pamela: Let's step back for a sec. So, boom, the Big Bang begins. A trillionth of a second later there are slight fluctuations in the temperature of the baby universe. Those fluctuations have an effect on the way the universe looks 400,000 years later, which actually continue to effect how the universe appears today. Thus, we can see everything there is to see at all times in WMAP's maps.

Travis: We get a lot of questions to our info@slackerastronomy.org account about cosmology. We regret that we can't do more shows about this stuff. But as a friend of ours put it, THIS STUFF IS HAARRDD! The big results are few and far between, and there isn't always a lot in our news feeds to report on.

Pamela: And much of what we learn we learn from cosmological theory that can rarely be observationally proven. This is what makes this observational evidence so extraordinary. What we are seeing in the WMAP analysis was predicted over 25 years ago when Dr. Alan Guth published his cosmic inflation theory.

Travis: That theory states that for a brief moment of time soon after the big bang, the universe expanded at an incredibly fast rate - faster than the speed of light even. This was caused by negative vacuum energy and isn't well understood. However, its results are starting to become pretty well detected.

Pamela: Inflation explains why the Universe is structured the way it is. Those small fluctuations in temperature were expanded into larger fluctuations during inflation. They went on, in turn, to form the basics of things like galaxies.

Travis: Inflation makes specific predictions about these anisotropies. There are many

different flavors of inflation, but the simplest theory predicts that the amplitude of the fluctuations would decrease as their size decreased. This is confirmed with the new data.

Pamela: In addition, the results give us more accurate measurements of other properties of the current universe. For example, it predicts that only 4% of the universe is made of ordinary, baryonic, matter - the kind of everyday stuff that makes up you, me, and the planet.

Travis: And that is used in Twinkies.

Pamela: I think Twinkies actually count as an exception - they are anything but ordinary matter.

Travis: Well then, ordinary matter like the fat that twinkies put on your hips.

Pamela: Let's try and leave my hips out of this, but okay, yes that counts. So, WMAP confirmed that only 4% of the universe is made of up of baryonic matter, 22% of the universe is dark matter, and 74% is dark energy. This means that we don't have a clue what makes up a whopping 96% of the universe! If that doesn't put us in our place, I don't know what will.

Travis: So kudos to WMAP for shedding more light on our creation and then making us feel even smaller than we already did.

Pamela: That's it for our 47th episode of Slacker Astronomy. It's been a fun year and we look forward to another fun year. Please keep telling your friends and posting about us in your blogs and web sites. Word of mouth has got us to where we are today, with about 15,000 weekly listeners.

Travis: I remember when we started and Aaron said he'd be happy if we ever reached 500 listeners.

Pamela: That is explains why he doesn't play the stock market.

Travis: I think that is because he has no money.

Pamela: And no cents.... get it? Cents?! I crack me up.

Travis: Remember, show notes can be found at slackerastronomy.org and we put a picture in the album art.

Pamela: By the way, we are looking for sponsors for the next few months to help pay for Aaron and Travis's trip to the International Astronomical Union meeting in August.

Travis: At the meeting many cool things will be debated wand perhaps the debate over naming the new planet will finally be resolved!

Pamela: That's right, so help Slacker Astronomy get to this meeting. If you are interested in sponsoring us, send a note to info@slackerastronomy.org. We can be creative.

Travis: We can be your slaves. For Pamela and our author Aaron, thanks for listening.

Pamela: Clear skies and clear bandwidth. This has been a slacker astronomy

production. A podcast for you, for fun for the voices in our heads.

Pamela: Clear skies and clear bandwidth. This is Pamela on behalf of Travis and Aaron.

Travis: This has been Slacker Astronomy, a three-person collaboration for you, for fun, for the voices in our heads.

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