THE

FLINT RIVER OBSERVER

NEWSLETTER OF THE FLINT RIVER ASTRONOMY CLUB

An Affiliate of the Astronomical League

Vol. 18, No. 2 April, 2014

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Please notify **Bill Warren** promptly if you have a change of home address, telephone no. or e-mail address, or if you fail to receive your monthly *Observer* or quarterly *Reflector* from the A. L.

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Club Calendar. Fri.-Sat., Mar. 28-29: JKWMA observings (Site #3, at dark); **Thurs., Apr. 3:** Pike Co. Kiwanis Club luncheon talk (noon, Concord Restaurant, Concord, Ga.); **Thurs., Apr. 10:** FRAC meeting/lunar observings (The Garden in Griffin, 7-10 p.m.); **Sat., Apr. 12:** Bluebirds & Bluegrass Festival booth (Dauset Trails, 9 a.m. -4 p.m.); **Thurs., Apr. 17:** Gordon College observing (Abbot's Farm, Barnesville, Ga., 9:15 p.m.); **Thurs., Apr. 24:** Gordon College rainout date (same time & location); **Fri.-Sat., Apr. 25-26:** JKWMA observings (Site #3, at dark).

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President's Message. You may want to put on your waders to read this month's *Observer*, folks, because **Bill Warren** is goin' knee deep in b.s. As you read his article, "The Two Greatest Mysteries in the Universe," you're likely to stop, sniff the air and wonder whose septic tank is overflowing.

(Actually, he just wanted to see if he could simplify two very complex topics.)

Welcome back to FRAC, **Doug & Laura Maxwell!** (They rejoined at our recent public observing at Truett's.)

Doug has a *very* nice 16" Lightbridge Dob and has earned four observing pins (Messier, Double Star, Caldwell and Basic Outreach). His crowning achievement, though, is his homemade 13" Dob. It's a beautiful, finely crafted instrument.

Nowadays, you can buy a tracking device for your Dob; well, Doug *built* his from scratch – and this was in the days before tracking mounts for Dobs were commercially available! If you ever decide to build a Dobsonian mount or add a tracking mechanism to one, Doug is the man to talk to.

-Dwight Harness

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Last Month's Meeting/Activities. Dwight Harness, Steve Bentley & yr. editor showed the sky to about 125 students and parents at Daughtry Elem. School in Jackson, Ga., on Feb. 27th.

Our JKWMA observing on Feb. 28th had an interesting beginning. At about 7:30 p.m., **Larry Higgins, Alan Pryor, Aaron Calhoun & yrs. truly** were surprised to see a man walking up the road to where we were set up. It was **Brendan O'Keeffe, David's** brother and a club member from 10-12 years ago. Brendan was passing through the area on his way home to Columbus and decided to camp for the night at JKWMA and spend an evening observing with David and **Sarah** (David's daughter), who arrived shortly thereafter. It was fun to observe with the O'Keeffes again after such a long time. David still carries his 12" reflector in "the Casket," a huge wooden box that bears a resemblance to its namesake.

Later arrivals included **Felix Luciano & Truman Boyle.**

The evening was supposed to be clear throughout but, as Alan said, "The clouds kept going and coming, and coming and going." Sometimes the sky was clear, though, and we were happy to find that **Supernova 2014J** could still be seen near the SW tip of **M82**.

Our Mar. 8th International Sidewalk Astronomy Night public observing at Truett's Restaurant in Griffin was a huge success. We had 17 FRAC members and relatives present, including: **Truman Boyle; Larry Higgins;** Larry's cousin (and ex-FRAC member) **Stephen Byous; Dwight Harness; Tony Quinn; Aaron Calhoun; Carlos & Olga Flores; Erik Erikson; David & Sarah O'Keeffe; Smitty; Tom Moore; Doug & Laura Maxwell** and their grandson **Zachary;** and **yr. editor.** We talked about astronomy and showed **Jupiter** and the **Moon** to about 85 visitors.

We had 13 members at our March meeting: **Tom Moore; Tony Quinn; Truman Boyle; David Tew; David O'Keeffe; Doug Maxwell; Steven "Saratoga Smitty" Smith; Felix Luciano; Cynthia Armstrong; Andy Hasluem; Erik Erikson; Dwight Harness;** and **yrs. truly.** Several members brought their telescopes, including Doug, who dazzled everyone with his new/old telescope. It's *new* because he bought it recently at an estate sale and had never used it; and it's *old* – a 40-year-old 102mm (4") Unitron refractor with a focal length of 1500mm, still in its original wooden packing box and looking as new as the day it was manufactured.

Above: Doug and his Unitron. From left to right, **Truman Boyle's** photo shows **Erik Erikson, Andy Hasluem,** Doug and **Tom Moore.**

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This 'n That. An article written by **yr. editor** -- "Why I Observe" -- appears on p. 12 of the March issue of the *Reflector,* the A. L.'s quarterly magazine. (Speaking of which, please let **yr. editor** know asap if you have not received your Mar. issue. We already know of two members who didn't receive their copy, and there may be others. We can't do anything about it, though, if you don't let us know.)

***Yr. editor** sent an article about FRAC and our March meeting to the following area newspapers: the *Barnesville Dispatch;* the *Barnesville Herald/Gazette;* the (Fayetteville) *Citizen;* the *Griffin, Zebulon Life, McDonough Life, Lake Spivey* and *Lake Jodeco* magazines; the *Griffin Daily News;* the *Grip* (Griffin); the *Henry County Times;* the *Henry Daily Herald;* and the *Pike County Journal-Reporter.* He'll follow it up with another, shorter article next month announcing the April meeting and asking them to update it every month for the rest of the year.

*We hate to nag, but a number of members have yet to pay their 2014 club dues. Our club's A. L. dues are up for renewal in May; please send your check for $15 (made out to FRAC) to **Dwight Harness** or **Roger Brackett** so we can keep you on our roll. (Their addresses are located in the upper left-hand corner of p. 1.)

*From **Alan Pryor:** "My 2-1/2-year-old granddaughter **Natalie** asked to see my telescope. She has been outside with me before when I had it out, but that was last summer. It must have made an impression.

"Anyway, I brought out a spotting scope since I was not going to use the telescope. I tried to demonstrate how to look through it, but while I was doing that Natalie went around to the objective end and looked from that direction.

"'I can see your eye!,' she said.

"I don't think she ever saw anything through the eyepiece, but she looked cute trying.

"I then brought out a small pair of binoculars. Natalie got the hang of looking through them real fast. Apparently, she saw a bird. Then she had to show everyone how to look through the binoculars.

"I wonder if she will remember the binoculars later in her life. I'm surprised that she remembered the telescope. But it was fun."

Later at home, Natalie built a telescope of her own. (Below.) In case you're wondering, her "telescope" is a (non-electronic) Magic Microphone that echoes your voice back when you talk into it. Her mount isn't very portable, but overall it's not bad for a barefoot amateur telescope maker's first try, is it?

Above: Natalie Pryor and her telescope

*The 10th annual **Tennessee Spring Star Party** that **Felix Luciano** and others have attended in the past will be held at Fall Creek Falls State Park in eastern Tennessee on **Fri.-Sat., May 2nd-3rd.** We'll have more to say about this free event in next month's *Observer*, but for now we'll say that, if you're interested in attending, you can phone **Lloyd Watkins** at 615-824-3005 or e-mail him at watkinsl@comcast.net.

*If you've watched the weekly segments of *COSMOS: A Spacetime Odyssey* so far, you already know that we're in for something special. **Neil deGrasse Tyson** is perfectly suited to host the series: his passion for science and astronomy is obvious in every sentence he utters, and his homage to **Carl Sagan** at the end of Part One was lovely.

The first segment featured two of Sagan's innovative approaches, i.e., the spaceship traveling from Earth to the farthest reaches of the universe and the cosmic calendar that reduces the universe's history to one year. (Using that scale, the telescope was invented [and man walked on the **Moon**] at 11:59:59 p.m.on Dec. 31st.)

The second segment dealt with our planet and the evolution of plant and animal life on Earth. Our only reservations were that (a) it wasn't about astronomy, and (b) Tyson constantly insisted that evolution isn't a *theory*, but a *fact*. And we wondered: *If it's not a theory, why do scientists universally refer to it as the "theory of evolution"?*

Future installments of the 13-part series will bring fresh new approaches, emphases and updates in astronomy since 1980 when the original *COSMOS* aired. As **Larry Higgins** said, "This (the new *Cosmos*) will bring a lot of new people into astronomy." It will when they get back to talking about the universe and space.

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A galaxy is like billions of sand grains, each separated by miles from its nearest neighbor.

-Bob Berman (*Astronomy*, Mar. 2014, p. 9)

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Upcoming Meetings/Activities. Unless otherwise noted, we'll continue to hold our JKWMA observings at Site #3, i.e., the one located a mile from the gate.

Having said that, we'll wind up March with JKWMA observings on **Fri.-Sat., Mar. 28th-29th.**

At noon on **Thurs., Apr. 3rd, Dwight Harness, Steve Bentley** and/or **yr. editor** will give a luncheon talk for the Pike Co. Kiwanis Club at the Concord Restaurant in Concord, Ga.

Our lunar observings/FRAC meeting will be held from 7-10 p.m. at The Garden in Griffin on **Thurs., Apr. 10th.** We'll observe from 7-7:30, go indoors for our meeting and then return to our telescopes until 10 p.m.

On **Sat., Apr. 12th,** FRAC will host a booth in the Bluebirds & Bluegrass Festival at Dauset Trails from 9 a.m.-4 p.m. The event draws large crowds every year, and we'll need all the help we can get.

To get to Dauset Trails from, say, Hampton, come south on I-75 to Exit 205 (Ga. Hwy. 16). Turn left (east) toward Jackson on Hwy. 16, and after 3.9 mi. turn right on High Falls Road. Go 5.9 mi. on High Falls Rd., and turn left at Mt. Vernon Church Road. Dauset Trails will be 3.1 mi. ahead on the left. Admissions workers will tell you where we're set up.

We'll conduct a Gordon College observing for **Dr. Schmude's** students at Abbott's Farm a couple of miles south of Barnesville, Ga., at 9:15 p.m. on

Thurs., Apr. 17th. (Rainout date: **Thurs., Apr. 24th,** same time and location.)

To get to Abbott's Farm from Griffin, start at the junction of the 4-lane U. S. 19/41 Bypass and Williamson Rd./Ga. 382. Heading south on the Bypass, it's 19.1 mi. from Williamson Rd. to Brent Rd. on the left. Turn there, and turn left again into the unpaved driveway of the first house on the left.

Finally, we'll wrap up our April calendar with a pair of JKWMA observings at Site #3 on **Fri.-Sat., Apr. 25th-26th.**

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THE TWO GREATEST MYSTERIES IN THE UNIVERSE

article by Bill Warren

Introduction. Astronomers use optical and radio telescopes to study ordinary matter in the visible universe. Everything that can be seen comprises the visible universe*;* for everything else, we have to guess what it might be.

So let's start with a shocker: astronomers have found that *the visible universe comprises a mere **5%** of the universe's total mass!* The other 95% of the universe cannot be seen.

Many galaxies lie too far away to be detected by our telescopes. But most of that unseen 95% of the universe involves an entirely different (and more complex) problem: whatever it is, it does not emit or absorb light or other forms of electromagnetic radiation. It does not interact with ordinary matter at all, except in one limited but important sense: *gravity.*

And what might that unseen 95% of the universe be? (And if we can't see it, why do we even suspect that it exists?)

The second question is easier to answer.

"Within galaxies and between them…lurks more gravity – and thus more mass -- than makes sense…There's far more gravity in the universe than astronomers can account for."

-Bob Berman, "The Missing Universe"
(*Astronomy* [April, 2014], pp. 25, 26)

1. Dark Matter

In the early 1970s, an American astronomer, **Vera Rubin,** was studying something called the *rotation curve* of flat spiral galaxies.

Stars in spiral galaxies are most heavily concentrated near their centers, or cores; those stars literally whirl around the galaxy's axis of rotation.

Farther away from the core, however, the stars are more widely separated. They are gravitationally bound to (and rotate around) the core -- but because they lie so far out, they lag behind stars that lie near the core. The result is spiral galaxies with arms curving away from the direction of their rotation.

Rubin's research involved comparing the rotation speeds of stars near galactic cores with stars located far out on the spiral arms. She expected, of course, to find that the outermost stars were traveling slower than stars in the core.

Hundreds of years earlier, **Johannes Kepler** (1571-1630) showed that **Jupiter** and **Saturn** move much more slowly in their orbits than the inner planets. Their gravitational bond to the **Sun** is much weaker. **Bob Berman** explains, "Gravity rapidly grows weaker with distance, so objects farther away must move more slowly." (p. 25).

What Rubin found in her research, however, was something altogether puzzling that defied logic: *no matter where stars were located along the spiral arms, they were all rotating at the same speed!* Rubin found the same thing with every spiral galaxy she investigated: all of the stars in each galaxy were moving at the same speed. It was an obvious impossibility, unless something else, presently unknown, was involved. Some unseen source of gravity must be interacting with the stars in such a manner as to keep distant suns from slowing down or leaving their orbits and flying off into space. Astronomers concluded that the visible portions of galaxies must be encased in some enormous form of unseen matter that can be detected only through its gravitational influence on visible matter. This unseen matter became known as **dark matter.**

So what exactly is dark matter?

An early theory held that it was ordinary matter that was hidden in dark, compact areas that did not emit or absorb light, such as black holes, dust clouds, neutron stars and failed stars known as brown dwarfs (collectively known as Massively Compact Halo Objects, or MACHOs). But there is not nearly enough mass in those objects to account for the shortage of mass in galaxies and galaxy clusters.

Present theory holds that dark matter is likely composed of unidentified subatomic particles that are unlike the electrons, protons, neutrons, neutrinos, etc., that comprise ordinary matter.

These theoretical particles are referred to as WIMPs – Weakly Interacting Massive Particles. If they exist, they are the glue that holds galaxies together because there is not enough ordinary matter to do so.

But that doesn't tell us much, does it?

Early map-makers used the Latin term *terra incognita* – "unknown land" -- to denote unexplored territories or areas that they knew nothing about. That pretty much sums up our present understanding of dark matter, doesn't it?

We like to think that we are the most intelligent of all God's creatures – and maybe we are. But it's somewhat humbling to realize that, after thousands of years of human progress, we know next to nothing about 95% of the universe we live in.

2. Dark Energy

Gravity. Gravity rules the universe. We are held to the Earth's surface by gravity. The planets in our solar system are held in place by gravity. The **Sun** and 100 billion other stars in the **Milky Way** are held in place by gravity. Galaxies, galaxy clusters and superclusters are bound together by gravity.

Most astronomers believe that the Big Bang kick-started the universe and its expansion. **Edwin Hubble** showed in the 1920s that the universe is still expanding.

Skip ahead in time and space to a distant future. Will the universe continue to expand forever? Or will the expansion eventually grind to a halt and reverse itself due to gravity? The answer depends on the amount of total mass in the universe. If there is not enough mass (and therefore gravity) to halt the expansion, it will continue forever. If the mass is great enough to halt the universe's expansion, it eventually will begin to shrink back on itself like black holes do.

For various reasons, astronomers have always assumed that gravity will eventually slow the universe's expansion. In research conducted during the 1990s, however, astronomers found that the universe is actually expanding faster now than it did billions of years ago.

Dark Energy. When you look at **Andromeda Galaxy,** you see light that was emitted 2.7 million years ago. But when you look at very distant galaxies, you're looking even farther back in time to see light that was emitted *billions* of years ago. And if you compare the distance to those near and far galaxies with their red-shift rates (recession speeds from us), you can determine whether the universe's expansion has slowed down or is speeding up.

The researchers were shocked to find that the expansion is accelerating, since, as noted earlier, they expected that gravity would eventually halt the universe's expansion. And since ordinary (visible) matter comprises only about 5% of the universe's total mass and dark matter adds just 23% more mass, something else must be contributing the rest of the mass in the universe. Some other unknown entity comprises the other roughly 72% -- and whatever it is, it is powerful enough to overcome the inward tug of gravity and push galaxies apart at an accelerating rate.

That theoretical force is referred to as **dark energy.**

So what is dark energy? Here's what little we know, in a nutshell:

*__Albert Einstein__ showed in his general relativity theory that $E=mc^2$ (energy = mass x the speed of light squared), so dark energy is related to mass, at least in terms of dark energy's gravitational effects on the universe.

*Since dark energy does not interact with light or other forms of electromagnetic radiation, it does not carry an electric charge. It probably is not composed of atoms as we know them.

*Unlike dark matter (which does not occur everywhere in the universe, but is limited to areas in and around galaxies and galaxy clusters), dark energy is present uniformly everywhere, including areas where there are no galaxies.

*Whatever it is, dark energy is not very dense, yet its profound effect on gravity has permitted the universe's expansion to continue to accelerate. You might think that, as the universe expands -- and because dark energy is everywhere -- the density of dark matter would be reduced over time and weaken its ability to overcome gravitational attractions. Yet there is no evidence of this.

One theory holds that, as the universe continues its expansion, the amount of dark energy will increase, causing the universe to expand forever and eventually tearing apart everything in it. For this to

happen, though, there would have to be an infinite amount of dark energy in the universe.

On the other hand, if the amount of dark energy is limited to what already exists, gravity eventually will overcome its effects and the universe will begin to sink back in on itself.

Neither of those possibilities seems particularly desirable, do they?

MOND. There is one other approach to the problem that I haven't mentioned. Some astronomers believe that dark matter and dark energy do not exist. The Modified Newtonian Dynamics (MOND) theory suggests that, for as-yet unexplained reasons, the effects of gravity may not be the same everywhere in the universe. MOND proponents contend that gravity might actually *increase* in areas where its effects should be weakest (e.g., along the outer edges of spiral galaxies). As one astronomer put it, It's easier to believe that gravity, a known force, operates in ways that we don't fully understand than to assume the existence of new kinds of matter and energy that don't fit into our present theories of particle physics.

So who is right? Who knows? (And as **Abbott & Costello** pointed out, Who's on first.)

Conclusion. Admittedly, dark matter and dark energy are complex topics. There are, however, a few things you should understand by now. First, in considering the possible existence of dark matter and dark energy, we're talking about radically new and different approaches to understanding the basic forms of matter and energy that exist in the universe.

Second, all of this is highly theoretical. We're talking about the smallest, most mysterious and least understood components of the universe. It's like trying to describe imagined extraterrestrial beings: you can talk all you want about what they might look like, but until you've seen one, you'll never know if you were right.

And third, isn't it strange that, in order to understand the universe and its workings, astronomers are studying the smallest parts of it?

Maybe we should sell our telescopes and buy electron microscopes. (As if that would help.)

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THE COCA-COLA SPACE SCIENCE CENTER

review by Jessie Dasher

A month ago, I had the opportunity to visit the Coca-Cola Space Science Center in Columbus, Ga. I was impressed. The center is educational and child-oriented, and is operated by Columbus State College. The young man who conducted the planetarium shows was an astrophysics student at the college.

Planetarium. The planetarium is state-of-the-art digital. I watched two different shows of about 45 minutes each. One was about black holes and the other our solar system. Both shows were designed for the 360^{o} planetarium view; they were not just tv shows broadcast on a curved screen. Each show began with a sky chart showing what can be seen in the night sky during the current month with the naked eye. The student operating the shows was knowledgeable about what was visible and invited us to attend their public observing.

Exhibits. Two of the most impressive exhibits I visited were a front wheel from one of the space shuttles that had been in space twice and a main engine cone that had been in space nine times. The complexity of the cone is never captured in a photo. (I touched it.) Another exhibit was a mock-up of a mission control station. There were other exhibits, but I did not have enough time to visit them.

Overall. A day trip to Columbus to see the Coca-Cola Space Science Center is worth taking the time and effort to see it. You need plan to stay about three hours if you want to see both shows. It is not a large facility, but for the science and space lover it is delightful.

After your tour of the center, Ruth Ann's Restaurant is just a block away. I recommend that you finish off your trip with one of Ruth Ann's bacon, lettuce, and fried green tomato sandwiches.

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Errata. The original 13-part tv series, *Cosmos: A Personal Voyage,* first aired in 1980, not in 1985 as stated in last month's *Observer.*

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