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From the director

Some of us are great artists or musicians or physicists or astronomers – or even all of the above. Many of us, on the other hand, have a particular skill or interest and then dabble in a host of different things. In so doing we may often wonder if we really are or could ever be really good at some of these things. At Christmas time I feel particularly like this when it comes to music. I did not grow up in a musical family and I only spent a little time taking piano lessons – long enough to feel excitement about making pleasing sounds come out of my own fingers but not long enough to become fluent in the language. I could see that a lot of practice might get me good enough to be proud of my efforts but somehow the roads diverged and I never quite got that far. When I hear a Christmas choir or even just raise my voice in a Christmas carol the excitement returns but usually only long enough to make me brave enough to finish the hymn!

Over the last couple of years I was beginning to wonder if my astronomy skills were headed down that same infinite road that my piano playing had taken. After a few years of tinkering with my two telescopes – and many happy evenings of visual treats – I decided I was on a roll and should try taking a few pictures. I figured out rather quickly that film astrophotography was beyond my patience both for manual guiding and for just waiting to see the fruits of my labor. That was probably a good thing because I suspect my heart would have fallen through a deep canyon with each roll of film that came back from the photo lab. Just about that time, however, a self guiding CCD camera came on the market with enough pixels that I thought I might just stand a chance at conquering the sky in a new way...and capture a part of it in an image that I could show to others. Since the visual observing experience that had just topped the scale for me at that time was a glimpse of the Horsehead Nebula that I saw in the mountains of Colorado, I (somewhat unwisely) set myself a goal of capturing that (very) little critter armed with my Questar, a new ST-7 camera and a laptop. I had no idea that this self-imposed challenge would prove to be even more challenging than making my left hand play a base rift on the piano at the same time my right hand was trying to plunk out a melody!

Rather than drag you through my entire learning experience let me simply enumerate some of the most important things I needed to learn before moving forward. Learning to stay outside in the cold long enough to get all the pieces working was perhaps the easiest psychologically since I love the outdoors and warm clothes aren't too hard to find...but one does need to find them, especially in New Jersey where given our light pollution there is simply no such thing as a short exposure unless you are imaging the moon or the brighter planets. From there one must learn a great deal of patience because there are so many pieces to the process that one must just build experience in all of them step by step. Yet the steps are each straight forward and somehow I actually managed to teach most of them to myself (with the help of a number of books and more experienced fellow club members) but I doubt I could have ever learned the piano this way! One by one I learned to judge the size of the small piece of the sky I could capture with the camera, where to buy all the adapter rings to piece together the camera, focal reducer, filters etc., how to connect everything up so I could reach focus and still keep the camera from slipping during the exposure, how to get a good enough polar alignment that

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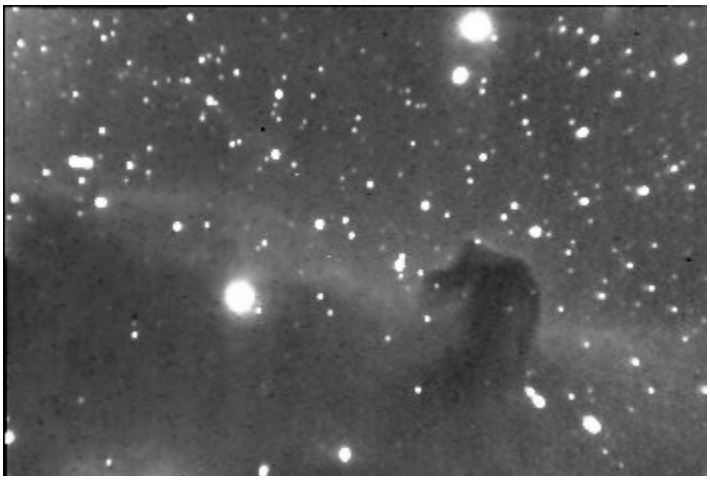

Horsehead Nebula (IC 434)

End 2:44 am EDT December 12, 2002. SBIG ST7 and Questar 7 on Losmandy Mount, Optec 3.3 Focal Reducer. 36 stacked 5 min exposures (3 Hours total). Binned 2x2. Auto guided. Background Flattened, SGBNR Filter Order 1.00 Radius .55

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the target stayed on the CCD chip long enough to get the tracker working, how to keep the disk drive on the laptop clean enough that there was room for several hours of frames (important to keep passing jets, neighbors car lights and feet that trip over the tripod legs from ruining an extended exposure) and (very important for me) how to find something in the sky when one will never see it through the eyepiece!

Also, along the way I found that many of these things were a lot easier to learn if I didn't try to base all my schooling on the likes of IC 434 (my dear Horsehead!) So I ate some of my pride and practiced on globular clusters and brighter galaxies and kept telling myself, "I can do it too" as I watched a few friends who seem to need much less sleep than I do soar ahead of me in their astrophotography conquests. I realized, though, that in the end taking rewarding pictures of deep sky objects with a CCD camera is mostly a matter of persistence, record keeping and building a reliable routine that comes from a lot of practice. After almost two years (and not *too* many late nights, really) I finally feel that the sky (and my equipment) is giving something back to me after all that I have put into it. Below is my first reasonable success at capturing the Horsehead nebula from my back yard in Princeton, N.J. On a night when I almost went to bed in tears when a sick daughter had needed my care enough to keep me from photographing the galaxy I had really targeted that evening, I realized that Orion was going to rise over the trees near my house around 11:30p.m. and stay above them before passing behind the trees to the West about three hours later. "What the heck," I told myself," I think I can pull everything together in time to make the exposure. It's worth a shot."

It may not be the ultimate such shot but I went to bed very happy that night. And when I was singing Christmas carols this Christmas Eve I remembered that night as the music made me feel great then too. It seems that practice and persistence really do help! Maybe someday I'll even try and get back to that piano. Happy Holidays...and Happy (sky) Hunting.

Kirk

Minutes of the

Regular Meeting of the AAAP

December 10, 2002

Director Kirk Alexander called the meeting to order at 8:02 PM. He then turned the floor over to Program Chairman Mark Lopez.

Mark introduced the speaker, Dr. Paul Stienhardt of Princeton University. The topic of the talk was the "Cyclic Model of the Universe". The talk was well received.

After the talk, Kirk reported that 5 minute member presentations would resume at meetings in the near future. Mark Jaworsky will present one early next year.

Ron Mittelstaedt reported that the current treasury balance is $X,XXX.XX. $200 was spent for the picnic last month.

Assistant Director John Miller had no report.

Program Chairman Mark Lopez reported that Anthony Aguirre of the Instute for Advanced Study would be next month's speaker. The speaker slots for all the remaining meetings next year have been filled.

Observatory Chairman Rex Parker was not present at the meeting but sent the following report by e-mail:

"For the observatory report, the facility is in "winter mode", water system is winterized, etc. Please mention that keyholders, and members & trainees as per guidelines, are welcome to use facility during the winter, but to use common sense regarding roof opening and not stress the chain drive when snow is on top. I was out there Friday morning after the snowfall and much of the snow had blown off, so by now it is probably able to be opened.

The last two training sessions were rain- and snow-cancellations. At this point there are no currently scheduled training sessions, and with the holidays coming up I recommend we hold until January, and even then with weather forecast in mind. Ron said he would be willing to run a session yet this year, so if he wants to arrange with trainees, he has my endorsement (but no expectations)."

Membership Chairman Saul Moroz reported that there are currently 122 members.

Kirk reported that Don and Anthony Monticello have agreed to run the registration for next year's Starquest.

Sidereal Times Editor Vic Belanger reported that the deadline for the January issue of ST would be Dec. 26th.

The meeting was adjourned at 10:07 PM.

Bill Murray

Letters to the Editor

Greetings!

We have recently updated our web pages related to the Mid Florida Stargaze. The Stargaze will be at Fisheating Creek Campground on U.S. 27 about 1/2 mile north of the intersection with Rt. 29 in Glades County. The dates are Thursday February 27th to Sunday March 2nd. Full details, including a registration form which can be printed and sent to our club, are to be found at the ASPB's website: www.palmbeachastro.org. The link to the Stargaze pages is in the yellow box near the top of the ASPB's home page. Please share this information with the other members of your clubs. If you have any questions or wish to discuss the Stargaze with me, please send me an email or call me at 561-487-0302. You can also use the email link on the Stargaze web page. I hope to see you all at the Stargaze.

Best wishes for a happy holiday season and clear, steady skies in the New Year.

Regards, Jay Albert
Secretary, ASPB

[*Jay Albert was a member of AAAP for many years and served four terms as Director, 1984, 1985, 1988, and 1989. ed.*]

From The Program Chairman

Last summer, I read a very interesting article in the August 2002 edition of ***Scientific American*** by Mordehai Milgrom titled ***Does Dark Matter Really Exist?*** Please bear with me. I will get to our guest speaker for the January meeting. In his article, Professor Milgrom questions the existence of Dark Matter. Dark Matter is theorized to be a large quantity of, as yet, an unidentifiable and invisible material that is present throughout our universe. It is theorized that Dark Matter is responsible for holding galactic

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systems together and that without it, galaxy-mass structures just would have not come into existence. The systems that make up our universe (the stars and gas that make up galaxies and the gas and galaxies that make up galaxy clusters) move about but do not go flying off into the cosmos as they whirl around each other. This fortunately occurs because they are held in place by the gravitational pull from the other components of the system (gas, stars, galaxies, etc.). The laws of physics dictates how much mass has to be present in order to counterbalance the motion of the system and thereby allow the system to maintain its existence. Unfortunately, there is a problem. The total sum of mass that astronomers actually observe does not equal the mass that should be there. There is a discrepancy when astronomers tally up the mass that they observe and compare it to the mass they calculate is needed to generate the gravity necessary to keep everything together. Researchers use the theory of Dark Matter to explain this discrepancy.

The point of Dr. Milgrom's article is this. The discrepancy in mass is not necessarily explained by the existence of Dark Matter. The problem can possibly lie with the laws of physics that tell us the amount of mass that should be present. Professor Milgrom has proposed a modification to Newton's second law that changes the relation between force and acceleration when the acceleration is low as in galactic systems (the acceleration of the solar system toward the center of our galaxy is one angstrom per second per second, as compared to the Space Shuttle toward the center of the Earth which is about 10 meters per second per second) This idea proposed by Professor Milgrom some twenty years ago is known as MOND, for Modified Newtonian Dynamics.

This is how Professor Milgrom explains his theory, and I quote from his Scientific American article. "MOND introduces a new constant of nature with the dimensions of acceleration, called *a-sub-* 0. When the acceleration is much larger than *a-sub-* 0, Newton's second law applies as usual: force is proportional to acceleration. But when the acceleration is small compared with *a-sub-* 0, Newton's second law is altered: force becomes proportional to the square of the acceleration. By this scheme, the force needed to impart a given acceleration is always smaller than Newtonian dynamics requires. To account for the observed accelerations in galaxies, MOND predicts a smaller force—hence, less gravity-producing mass—than Newtonian dynamics does. In this way, it can eliminate the need for dark matter."

What does MOND have to do with our guest speaker for January? Well, our guest speaker, Dr. Anthony Aguirre, of the Institute for Advanced Study, wrote a commentary about MOND that also appeared in the August issue of Scientific American. In it he states that even though MOND is out of the mainstream, it is far from being a wacky theory. His commentary is printed below at the end of this article. Please read it, I think you will find it very interesting. I did. Consequently, I figured he would be a great guest speaker. .

Dr Aguirre is a theoretical cosmologist at the Institute For Advanced Study, School of Natural Sciences, in Princeton, NJ.. He received both his M.S. and his PhD in Astronomy from Harvard University. From Harvard, he went directly to the IAS. Dr. Aguirre has been published in at least twenty professional journals and he was awarded the Keck Fellowship and the John Parker Merit Scholarship. He also received an award for undergraduate teaching at Harvard and he was a finalist for the Leroy Apker Prize for Achievement in Physics. In 1998, as a 25-year old grad student, he developed a theory, on his own, that gave an alternate explanation for the dimming of distant galaxies. His theory, that questioned the most talked about astronomical discovery of that year, was given serious consideration by his advisors and instructors.

(See http://www.news.harvard.edu/gazette/1999/02.04/cosmic.html) As I am sure you will agree, this is very impressive for a person who isn't quite thirty years old.

If you really want to be impressed, don't forget to come to the pre-meeting dinner and meet this very exciting young astronomer. Dr. Aguirre is the future of astronomy and I think we all will be reading about his discoveries in The New York Times, Scientific American, and the Astrophysical Journal for years to come. Years from now, you can tell people you had dinner with this superstar of astronomy. As usual, we will be dining at The Annex Restaurant, 128 ½ Nassau St., at 6:00 PM before the meeting. Please contact me by email at mal455@earthlink.net or telephone me at 609-393-2565 if you would like to attend the dinner. You can let me know by Tuesday morning, January 14.

Not a Bad Idea

MOND is out of the mainstream, but it is far from wacky

By Anthony Aguirre

Although the great majority of astronomers believe that dark matter exists, an alternative hypothesis- a modification of Newtonian gravitational dynamics (MOND)—has quietly endured since its proposal in 1983. As Mordehai Milgrom discusses in the accompanying article (*Does Dark Matter Really Exist?, Scientific American, August 2002*.), MOND can claim an impressive number of correct predictions regarding the dynamics of galaxies. The reactions of most astronomers fall into three categories:

1. MOND is a tautology. It explains only what it was expressly designed to explain. It has made a few fortuitous predictions, but the success of those predictions has been exaggerated by its proponents.

2. MOND describes a surprising, even mysterious, regularity in the formation and evolution of galaxies. The standard theory of gravity still applies and dark matter still exists, but somehow the dark matter emulates MOND. When applied in detail to unusual galaxies or to systems other than galaxies, MOND will eventually be shown to fail.

3. MOND replaces Newtonian dynamics under certain conditions. It is one aspect of a theory of gravitational dynamics that will supplant Einstein's general theory of relativity.

The first view, through uncharitable, was the one held by most astrophysicists for much of MOND's history. In recent years, however, outright rejection has become much less tenable. MOND's myriad predictions have been confirmed. Many of these studies have been performed by those critical of, or neutral toward, Milgrom's hypothesis. Moreover, MOND reproduces the statistics of galaxy properties at least as well as dark matter models do, even though these models describe crucial aspects of galaxy formation in an ad hoc way. Most impressively, MOND can predict the details of galaxy rotation using only the distribution of visible

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matter and an assumed (fixed) ratio of mass to luminosity—a feat beyond the ability of dark matter models. These predictions and the observations they are compared with, go far beyond what was available at the time of MOND's formulation. MOND is no tautology. Meanwhile standard dark matter theory has run into difficulty when applied to galaxies. For example, it predicts that the dark matter cores of galaxies should be far denser than observations indicate. researchers still lack computers powerful enough to simulate galaxies in full. But many theorists have taken the discrepancies seriously enough to consider modifications of the properties of dark matter. The successes of MOND and the difficulties for dark matter have, such problems could be an artifact of computational limitations, converted a number of astronomers from the first view to the second. Relatively few, though, have gone from the first or second view to the third. Why? I think there are three reasons.

First, as both its opponents and proponents point out, MOND is a modification only of Newtonian dynamics. Despite some effort, MOND's proponents have yet to formulate it in a way that can be applied to post-Newtonian phenomena such as gravitational lensing and cosmic expansion. Either no such theory exists or it is inherently difficult to develop. Whatever the reason, MOND has been unable to confront—and hence pass or fail—some key tests.

Second, it is not clear that MOND works well in systems other than galaxies. For example, its predictions about the temperature of hot gas in clusters of galaxies disagree starkly with observations, unless clusters are dominated by —what else? — undetected matter. One might hope (as do MOND's proponents) that this matter could take a recognizable but hard-to-see baryonic form such as small stars or warm gas. Those possibilities are not currently ruled out, but they are strongly constrained both observationally and theoretically. And it is rather disquieting that dark matter (even if in a prosaic form) must be postulated to save a theory devised to eliminate dark matter.

The third reason, related to the first two, is that standard dark matter theory has scored some impressive triumphs in recent years. Numerical simulations predict a spatial distribution of intergalactic gas that is in exquisite agreement with observations. Independent estimates of the mass of dark matter in clusters all agree with one another. The predicted growth of structures correctly links the galaxy distribution we see on large scales today with the tiny temperature fluctuations in the cosmic microwave background radiation from 13 billion years ago.

So what are astronomers to do? Those who are most sympathetic to Milgrom's hypothesis should continue the search for a fundamental theory of MOND, without which the idea will never draw the majority of physicists away from the standard paradigm. For others, I think that it is productive to study, test and use MOND as a convenient rule of thumb whether or not one accepts a modification of Newtonian dynamics. Perhaps we could call it Milgrom's Fitting Formula, or MIFF, to emphasize that we are using it as a practical tool while reserving judgment about whether standard physics is indeed wrong. If general relativity is correct, and dark matter real, then as the precision of measurements increases, MIFF will ultimately fail. In the meantime, MIFF can provide a compact summary of a great deal of knowledge concerning galaxy formation and evolution.

[*Anthony Aguirre is a theoretical cosmologist at the Institute for Advanced Study in Princeton, N.J. He is the lead author of two critical studies of MOND, available online at arXiv.org/abs/astro-ph/0105184 and arXiv.org/abs/hep-ph/0105083*]

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