SIDEREAL TIMES

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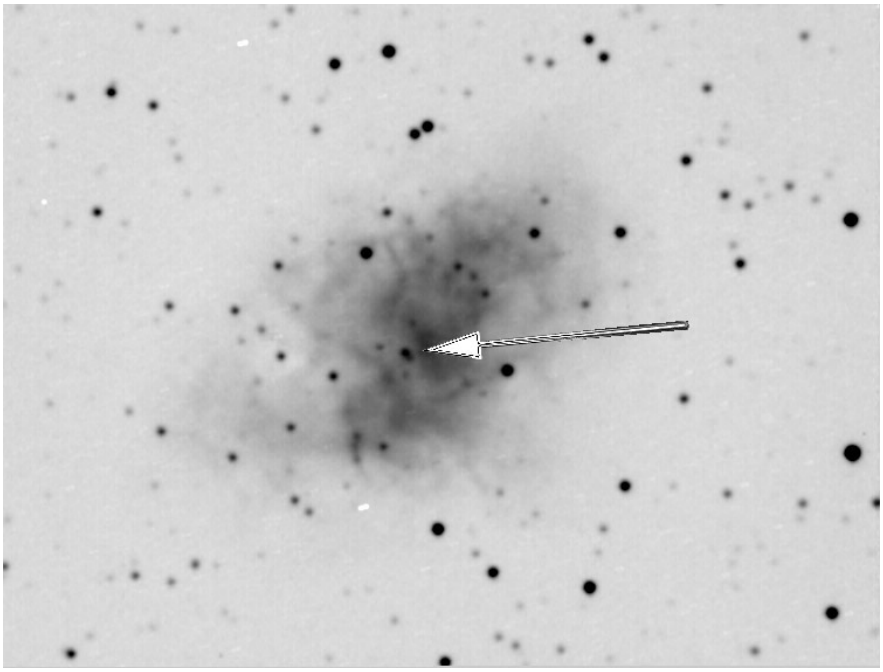
Technical Astronomy



After six months of trying to optimize my CCD imaging system I'm finally starting to have some success. Attached below is an image of the Crab Nebula (M1) I took November 24.

First some background. Over the past couple of years I've had a lot of success doing imaging at f/10 with my ST-6 camera on my LX-200 but because these images were unguided I was limited to integrations of about 60 seconds before tracking errors became objectionable. I decided to try a couple of focal reducers (Optec f/3.3 and my own f/6.5). I figured that shooting with shorter effective focal lengths would give me a wider field and make tracking errors less of a problem. However, the optical quality of the images that I got with these reducers was so bad that even a large set of calibration frames couldn't correct them to the quality I desired.

Since I had had success imaging at f/10 I decided to return to that configuration. However this would necessitate guiding the image. I decided to try a couple of off-axis guiders and use my ST-5C camera as an auto-guider. However, both the off-axis guiders I used allowed only a limited selection of guide stars and the search for a guide star often resulted in messing up the centering and focus of the main image.

I decided to try using the ST-5C auto-guider on my 4" Genesis refractor, which I mounted piggyback on the LX-200 as a guide scope. The Genesis is mounted on the LX-200 using Losmandy rings that are very sturdy (no differential flexure). Having a completely separate guide scope allows me to have a wide selection of guide stars within 2 to 3 degrees of the main target and I can center the Genesis on a guide star without adjusting the centering and focus of the main scope on the target.

Last night I finally got all the separate components working. I was using MaxIm DL 3.0 to control both the ST-6 and the ST-5C and the LX-200. Note: I was able to use the auto-centering feature of MaxIm DL, the images below were centered using it. The good news is that it works very well! The bad news is that you need a computer controlled GOTO scope in order to be able to use it.

After getting everything focused and aligned I decided to do a shot of the Crab Nebula. Conditions weren't ideal. The sky was clear but slightly hazy, M1 was about 50 degrees up in the east but only 38 degrees from the gibbous moon. Above is a JPEG I created from the stack of images I took. The stack contains four 4 minute integrations. Besides stacking, calibrating and a little stretching, no processing has been done to the image. Despite the auto-guider using some relatively long integrations (5 sec.) there are no visible tracking errors in the image. I checked the magnitude of the stars in the image against the Naval Observatory A2.0 catalog. The dimmest stars visible in the image are 18th magnitude.

I have added an arrow to the image to point out two dim stars near the center of the nebula. The dimmer of these two stars is the Crab Nebula pulsar (16th mag).

Bill Murray

From The Program Chairman

I hope that you all had as good a time as I did at the last meeting. It was an honor for me to take part in the celebration of the 40th anniversary of the AAAP. Thank you to everyone who helped to make the November meeting a very special occasion. The December meeting is also special because our guest speaker this month is Dr. Paul Steinhardt of Princeton University. The topic of his talk will be "The Cyclic Model of the Universe."

Dr. Steinhardt is the Albert Einstein Professor of Science and he is a member of the faculty of both the Department of Physics and the Department of Astrophysical Sciences at Princeton University. He, along with Alan Guth and Andrei Linde, won the 2002 Dirac Medal and Prize for the development of the concept of inflation in cosmology. He received his BS from Caltech University and his MA and PhD. in physics from Harvard University. He was a member of the faculty of the University of Pennsylvania from 1981 to 1998. He joined the faculty of Princeton University in 1998. He is one of the leading theorists responsible for inflationary theory. He constructed the first workable model of inflation and the theory of how inflation could produce seeds for galaxy formation. Dr. Steinhardt was also among the first to show evidence for dark energy and cosmic acceleration, introducing the term "quintessence" to refer to dynamical forms of dark energy.

Dr. Steinhardt will be speaking to us on Tuesday evening about his theory of the cyclic model of the universe. I have taken the liberty of including a short article about his new theory rather than me trying to explain it to you. If you would like to read more about this theory and the other work that Dr. Steinhardt is doing, please check out his fascinating web page at http://feynman.princeton.edu/~steinh/

I know that, after reading this article and after going to his web page, you will want to know more about Dr. Steinhardt himself. This can be easily accomplished just by attending the upcoming pre-meeting dinner. As usual, we will be dining at The Annex Restaurant, 128 ½ Nassau St. at 6:00 PM. If you would like to attend, and I hope that you do, please email me by Monday, December 9 at mal455@earthlink.net, or telephone me at 609-393-2565. You won 't be disappointed. Ask anyone.

Mark Lopez

The Endless Universe:
A Brief Introduction to the Cyclic Universe

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Over the last century, cosmologists have converged on a highly successful theory of the evolution of the Universe - the big bang/inflationary picture.[1] According to this picture, space and time sprung into being 15 billion years ago in a `big bang.' When the Universe emerged, it was filled with particles and radiation of nearly infinite temperature and density. Instants later, the Universe underwent a period of extraordinarily rapid, super-luminal expansion (`inflation') which made the Universe homogeneous and flat and which created fluctuations that seeded the formation of galaxies and large-scale structure.

In the last decades, cosmological observations have supported the predictions of the big bang and inflationary theory in exquisite detail.[1,5] They have also provided one major surprise. It appears that, billions of years after the big bang, following the formation of galaxies, some form of dark energy that is causing the expansion rate to accelerate overtook the Universe. Although dark energy was unanticipated and has no particular role in the big bang/inflationary picture, the general view has been that it can simply be added by fiat to the initial make-up of the Universe. There is no compelling reason for a new theoretical approach. Quite the contrary, many cosmologists regard the basic cosmic story as being settled.

In this context, a new paradigm has been recently proposed by Paul Steinhardt (Princeton) and Neil Turok (Cambridge) - the cyclic universe - that turns the conventional picture topsy-turvy. (Perhaps the model should be called an old paradigm since it reinvigorates ancient cosmic mythologies and philosophies, albeit using the tools of 21st century physics.) In this picture, space and time exist forever. The big bang is not the beginning of time. Rather, it is a bridge to a pre-existing contracting era. The Universe undergoes an endless sequence of cycles in which it contracts in a big crunch and re-emerges in an expanding big bang, with trillions of years of evolution in between. The temperature and density of the universe do not become infinite at any point in the cycle; indeed, they never exceed a finite bound (about a trillion trillion degrees). No inflation has taken place since the big bang. The current homogeneity and flatness were created by events that occurred before the most recent big bang. The seeds for galaxy formation were created by instabilities arising as the Universe was collapsing towards a big crunch, prior to our big bang.

The prospects for an alternative cosmology that is so different from the well-established convention would seem extremely dim. Yet, the cyclic model recoups all of the successful predictions of the big bang/inflationary theory and has sufficient additional predictive power to address many questions, which the big bang/inflationary model does not address at all: What occurred at the initial singularity? What is the ultimate fate of the Universe? What is the role of dark energy and the recently observed cosmic acceleration? Does time, and the arrow of time, exist before the big bang? Or after the big crunch?

In the new paradigm, each cycle proceeds through a period of radiation and matter domination consistent with standard cosmology, producing the observed primordial abundance of elements, the cosmic microwave background, the expansion of galaxies, etc. For the next trillion years or more, the Universe undergoes a period of slow cosmic acceleration (as detected in recent observations [1]) which ultimately empties the Universe of all of the entropy and black holes produced in the preceding cycle and triggers the events that lead to contraction and a big crunch. Note that dark energy is not simply added on - it plays an essential role. The transition from big crunch to big bang automatically replenishes the Universe by creating new matter and radiation. Gravity and the transition from big crunch to big bang keep the cycles going forever. In fact, as will be discussed, the cyclic behavior is a strong attractor. That is, even if the Universe were disrupted from its periodic behavior, it would rapidly re-converge to the cyclic solution.

The linchpin to the new paradigm is the transition from big crunch to big bang. The transition was thought to be an impossible passage in which the laws of physics blow up. However, recent

(Universe, continued on page 3)

(Universe, continued from page 2)

developments in superstring theory suggest that the cosmic singularity is otherwise, as the two authors have argued in a recent paper with Justin Khoury (Princeton), Burt Ovrut (Penn) and Nathan Seiberg (IAS). Superstring theory relies on the idea that the Universe contains nine or ten spatial dimensions, depending on the formulation, all but three of which are curled up in a compact manifold of microscopic size. In this framework, the big bang and big crunch may be an illusion. Expressed in the usual variables of general relativity, it may appear that our usual space and time are disappearing. However, viewed with the proper variables, our usual space dimensions actually remain infinite and time runs continuously. The transition from big crunch to big bang is due, instead, to the collapse, bounce and re-expansion of one of the extra dimensions. For example, in a variant known as M-theory, the Universe consists of two branes (surfaces) bounding an extra dimension, and the singularity corresponds to a collision and bounce of the two branes. The temperature and density of ordinary radiation and matter remain finite at the bounce, and particles move continuously in a natural and intuitive way. By dispelling the myth that the big bang is a beginning of space and time, superstring theory opens up new possibilities for the cosmological history of the Universe. Six months ago, the "ekpyrotic model" [4] was proposed by Khoury, Ovrut, Steinhardt and Turok as one new possibility based on the idea of making a universe from a single collapse of the extra dimension. The cyclic model builds on lessons learned from the ekpyrotic example to produce a picture with remarkable predictive and explanatory power.

Observations

While at the last Northeast Astronomy Forum, I visited the Software Bisque display. My main reason for the visit was to inquire about the delivery date of our Paramount ME mount. On display was a Casio Cassiopeia Pocket PC running "The Sky" software. Though it seems a neat idea that a sky atlas could run on such a small unit, my interest perked up when I learned that T-Point was also a function of the software. I thought the "Go To" feature was only reserved for the motorized type scopes like the Meade LX200's and Celestron 2000 series.

A couple of years ago I surrendered to the new age of digital setting circles. Found them very useful in our light polluted skies where at times only bright stars were visible. The newest version of "The Sky for Pocket PC" is now able to work with certain digital setting circles. The close proximity of JMI and Software Bisque in Colorado made it possible for the DSC owners to have the "Go To" feature like the motorized scopes.

In July an FAA inspector came to our facility and was using a Casio Cassiopeia to record his notes. I didn't realize all the features this small computer had. With modem card one could go on line to obtain e-mail or Internet sites. I was also hesitant to buy the pocket pc because of its price of around $400. The FAA inspector informed me that he obtained his through E-Bay at a price of around $150. I now thought that this was in my price range.

It took me several tries to figure how the E-Bay system worked but finally won the bid for a Cassiopeia E-115, which came with the optional fax/modem card for $145. There is a E-125 model which the only difference is it uses the new USB port where the E-115 uses the older serial port. I chose the E-115 because I use an iMac at home and at work the PC's only have serial ports.

Using a program called ActiveSync made the transition between tabletop PC and Pocket PC a snap.

The next step was getting the cables correct. The users guide made the installation of the plugs and gender changers fairly easy. It was very gratifying when installed on my scope I received the message that the pocket PC had link up with the rest of the Go To system.

The first time I used the pocket PC was at the Summer Star Party. It worked flawlessly. The only slight problem was that I have to sync on each object because of being slightly off the object when slewed. Software Bisque told me that high resolution encoders were need. I then purchased 8192 tick encoders.

I had the pocket PC I bought for Saul on eBay at the AAAP picnic at Washington Crossing Observatory. The PC work much more accurately and was a great help when searching for dim objects in the light polluted skies of Central New Jersey.

The luxury of the Pocket PC with T-Point is that I now never have to move from the seat to look at charts. One can become a real Air Chair potato.

Ron Mittelstaedt

From the Treasurer:

The treasury balance is XXXX after the 40th anniversary picnic and dinner expenses. There are 126 members.

Note: Michele, our publisher, will continue putting the dues renewal date on the upper right corner of each Sidereal Times address label. This is the date that your renewal membership is due with the AAAP. Those with club magazine subscriptions to Astronomy or Sky and Telescope or both would want their subscriptions renewed about three months prior to the date of your club renewal. Please act accordingly, for if you wait until your club dues are due to pay for your magazine subscription you may miss one or two issues.

I am not going to send out renewal notices to members who get magazines; they get enough notices from their respective publishers. If I don't receive your renewal on the date indicated on your address label you will be dropped from the roster. If you are a keyholder, the respective observatory chairmen will be notified and you will be asked to return the key.

The dues structure is a follows:

$30 basic membership.
$60 for membership and subscription to Astronomy or Sky and Telescope magazine.
$90 if both magazines are desired with membership.

If you have a Sky and Tel subscription please send the subscription notice and the postage paid envelope when renewing your membership.

You may send the dues directly to me at: Ron Mittelstaedt-Treasurer, 149 Palmer Lane, Ewing, NJ 08618-3207

Ron Mittelstaedt

Deadline for the January Issue:
December 26, 2002

Minutes of the

Regular meeting of the AAAP

November 12, 2002

Director Kirk Alexander called the official meeting to order at 8: 06 PM. This was after a very enjoyable 40th Anniversary Dinner attended by about 35 people. We were treated to a slide show by John Church, which showed details of the construction of our observatory in 1977.

Program chairman Mark Lopez introduced the evening's speaker, Professor Freeman Dyson, professor emeritus of The Institute for Advanced Study. The title of Prof. Dyson's talk was "Looking for Life in Unlikely Places: Reasons why planets may not be the best places to look for life". The talk was well received.

Treasurer Ron Mittelstaedt reported that the treasury stands at XXXX.

Webmaster John Miller informed members of some new features to our web site such as a link to current events related to astronomy.

Observatory Chair Rex Parker reported that the physical structure of the observatory has never been better. With the weather changing, the water system has been shut down for the winter. The first training session, held on November 7, for potential new keyholders was attended by 6 people. Trainers were Rex Parker and Bill Murray. The second training session is planned for November 21 (subsequently cancelled due to rain).

The 40th Anniversary Picnic held on November 2 was well attended and enjoyed by all. There were roughly a dozen telescopes and binoculars set up afterward. Thanks go to those who helped and brought scopes and binoculars.

Ron displayed the official letter notifying our club that we have 25 more years at the observatory.

The meeting was adjourned at 10:08 PM.

Lisa I. Yeh, Secretary

December 2002

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