

# The Objective View

December 2002  
Newsletter of the Northern Colorado Astronomical Society

Jan Kok, President  
[kok@ezlink.com](mailto:kok@ezlink.com) 970 266 0318  
Kimon Berlin, Vice President  
[kimon@deepskymarines.org](mailto:kimon@deepskymarines.org) 970 267 9908  
Gerry Reynolds, Treasurer  
[gerryreynolds@earthlink.com](mailto:gerryreynolds@earthlink.com) 970 226 0705  
David Chamness, Secretary and AL Correspondent  
[dec@ftc.agilent.com](mailto:dec@ftc.agilent.com) 970 482 1794  
Tom Teters, Web Site Editor  
[tomt@starmon.com](mailto:tomt@starmon.com) 970 482 5702  
Dan Laszlo, Newsletter Editor  
[djlaszlo@aol.com](mailto:djlaszlo@aol.com) 970 498 9226

Meetings first Thursday of each month

**Next Meeting: December 5 7:30 pm**

## 3 D Astrophotography: Comets by Bryan White

**NCAS Business at 7 pm  
Nominations for Officers 2003**

### Meeting directions

**Discovery Science Center  
703 East Prospect Rd, Fort Collins**  
<http://www.dcsm.org/index.html>

In Fort Collins, from the intersection of College Ave and Prospect Rd, head East about 1/2 mile. See the Discovery Center sign to the South. Enter the West Wing at the NE corner. From I-25, take Exit 268, West to Lemay Ave, continue West 1/2 mile, see Discovery Center on the left.

**NCAS Star Party Dates  
December 6, 7, 27, 28**

Cactus Flats site is on undeveloped parcel of prairie about 6 miles West of Briggsdale. Take Colo Hwy 14 East from I-25 (Exit 269). Go 19 miles East to Ault. Continue 18 miles East of Ault. At County Rd 65 (Milepost 170), turn North, go one mile. Site is through the wire gate on the right, no road, close gate and set up. Beware of the cactus. Our standard nights are the weekend of the New Moon, sometimes a weekend before and after. The site is now officially wheelchair accessible, but there are no facilities so bring essentials. Call **Tom Teters**, [starmon@jymis.com](mailto:starmon@jymis.com), with questions about star party status or dates, 482-5702 or 482-0807.

### Discovery Science Center Starwatching

January 10	6:30 pm
February 7	6:30 pm
March 7	6:30 pm
April 4	7:30 pm
May 9	8:00 pm

**Longmont Astronomical Society 1st Quarter Moon Public Viewing Nights, Flanders Park**  
December 7

## Other Events

Little Thompson Observatory Star Night, Berthoud  
December 20 Star Night 7 – 10 pm  
<http://www.starkids.org>

Cheyenne Astronomical Society  
December 20 Cheyenne Botanical Garden  
<http://users.sisna.com/mcurran>

Open House, Chamberlain Observatory, dusk to 10 PM  
Dec 14 303 871 5172  
<http://www.du.edu/~rstencil/Chamberlin/>

Longmont Astronomical Society  
December 19, Longmont Christian School, 550 Coffman St  
<http://laps.fsl.noaa.gov/cgi/las.cgi>

## November 7 Program

### Open Forum

#### NCAS Members

Max Moe demonstrated his dark sky meter, built with a green LED and ammeter mounted in a PVC pipe. He found limiting magnitudes of 6.3 at the Pawnee site, and 4.5 in central Fort Collins, at zenith. Dorothy Pillmore showed a map of the moon from Japan. Jan Kok read some of the Kanji characters. Dorothy also showed a vertical ring sundial. Dan Laszlo showed some early digital camera images of the Moon and Saturn.

#### Scope for Sale

Coulter 10 inch Dobsonian. Like new. Includes Kellner eyepiece, eyepiece rack, red-dot aiming device, aperture stop, dustcap. \$600. Call Gene, 970-568-0545.

**From Archer Sully: Sky Transparency and Seeing Forecast**  
I've altered the following link for Colorado.

[http://cleardarksky.com/csk/prov/Colorado\\_clocks.shtml](http://cleardarksky.com/csk/prov/Colorado_clocks.shtml)

#### Best Looks

Moon	by Venus and Mars on 12/1, 30 by Saturn 12/18, by Jupiter 12/23
Mercury	Low in SW, evenings, last half of month
Venus & Mars	low in ESE predawn, by Mars first week low in ESE predawn
Jupiter	Overhead predawn
Saturn	Visible from early evening through night by Crab Nebula 12/31
Uranus	in Capricornus early evening
Neptune	in Capricornus early evening

#### Geminid meteors peak on December 13-14

Best view is expected for several days up to the peak, between Moonset and dawn.

# The Objective View

December 2002  
Newsletter of the Northern Colorado Astronomical Society

**Subj: \* NCAStro \* New Member to Be**  
Date: Thursday, November 21, 2002 9:34:44 AM  
From: rmoench@lamar.colostate.edu  
To: ncastro@jymis.com  
cc: ethursto@lamar.colostate.edu

Emily and I are pleased to announce that we are expecting a new NCAS member to arrive around March 27. Any suggestions on a prenatal astrophysics program would be appreciated.

All conditions nominal, go for launch.

Randy  
\*\*\*\*\*

**Subj: [FRAC] SpaceWeather Phone**  
Date: Wednesday, November 20, 2002 10:37:48 PM  
From: tjteters@jymis.com  
To: ncastro@jymis.com, front-range-tac@seds.org

He's a great idea for us astro-conscience  
<http://www.spaceweatherphone.com/>

Zzzzzzz...!(oh, what a great night's sleep I'm getting)!...RRrrriinnngggg...Hell-o astro-friend...it's 4am, do you know where your aurora borealis is????  
tomt

Did you sleep through the Northern Lights? Or miss the space station when it flew over your backyard? How about that meteor shower you heard about ... the day after?  
Sometimes there's no substitute for an old-fashioned phone call.

Sign up for SpaceWeather Phone and we'll call you when things are happening in the skies above ... while they're happening!  
Interested? Send us an email and we'll notify you when our phone service is ready.

\*\*\*\*\*

**From Jim S: Best Moon Site I've Seen:**  
<http://www.moon-phases.com/>

\*\*\*\*\*

**Subj: Re: \* NCAStro \* California Leonids, Ken VanLew**  
Date: Friday, November 22, 2002 9:47:01 AM  
From: dec@ftc.agilent.com  
To: kvanlew@sdcoc.k12.ca.us  
cc: ncastro@jymis.com

Ken,

I was out in my back yard from 3:10 to 4:30 AM. I saw 1 per minute from 3:10 to 3:30 with 50% cloud cover. Then up to 4/minute from 3:30 to 3:50 AM with 20% clouds. They declined to 1/minute after 4:00 AM and clouds increased to 80% by 4:15, 95% by 4:30.

There were little bursts of 3 in 1 second around 3:40. I saw brighter meteors before 3:30, and smaller ones when they got more numerous.

Dave Chamness

>

> Greetings from San Diego  
> I haven't heard how the Colorado Leonids went, but we had some nice moments in  
> San Diego. We hit 2 nice bursts between 2:30 & 2:40 AM PST with about 1/second  
> or 3600/hour looking away from the moon and the distant lights of San Diego.  
> ZHR during those bursts had to be higher than 5,000, but they were only  
> bursts. Most of the time activity was 5-10/minute with some good colors, but  
> no bolides seen.  
> Hope things are going well for all of you in Ft Collins. I miss the seasons,  
> but weather here is like living in Hawaii, so I can't complain.  
> Ken VanLew  
\*\*\*\*\*

**Subj: [FRAC] Leonids from Crow Valley**  
Date: Wednesday, November 20, 2002 9:55:51 AM  
From: tjteters@jymis.com  
To: front-range-tac@seds.org

Greetings astro-friends,

Well this Leonid meteor report is hardly worth writing about. CCDPete and I made it out to Cactus Flats around 1:30, it was quite windy so we trucked it on over to The Crow. Cloud cover was 90% with a small clear band on the west horizon, which we began to 'will' to enlarge. It didn't work! Pete set up his prize winnings 5" Meade and we peaked at Jupiter & Saturn, when the cloud relented. But it was a night of sucker holes for us. Around 3-3:30 we saw about 12 meteors through thin cover. It sounds like this was the best time to be observing from the foothills. We wasted a lot of gas. Well the company was good. It can only get better,  
tomt

\*\*\*\*\*

**Subj: [FRAC] Leonid report**  
Date: Tuesday, November 19, 2002 9:03:52 PM  
From: gary30views@earthlink.net  
To: front-range-tac@seds.org

First I would like to thank Martin Butley for letting us invade his space. We used his field for viewing, about 6 acres, behind his new house and barns in Hygiene. The moon being one day shy of full made this my first full moon meteor shower. You might think that sounds crazy, but despite the bright sky we got to see about several per minute and sometimes several at a time. No big fireballs were reported, but saw many with trails that took a second or so to dissipate.. Last year was the big one in my eyes, new moon instead of full moon.

I am very proud of the marines who stayed the distance to check it out. weather was cold as usual, about 25 degrees with breeze at times, made it feel even colder. Karen Mendenhall, Pam Wheaton, Martin and Gail Butley, Joe M and girlfriend Mary Anne, Bill Possel, Ray Warren, Jan K. president of Fort Collins astronomy club, Norm and Alvena Vojta, My wife Carol and Me, Gary G.

I set up 16 scope for views of Saturn and Jupiter. They are always awesome and full moon does not take anything away from these bright big boys. I was trying to see if I could actually see some of the meteors hit the moon surface. I think I saw one only, Jan K and I were looking for some. You need astro video camera with long time tracking and recording to get meteor hits on tape to share with people.

When it gets cold, watching meteor shower with friends is the way to do it to endure the night. Karen M and Pam W, you dark sky marines have earned your stripes braving the cold with me. I am proud of both of you guys. You could be my wing man anytime, bye, gary g

# The Objective View

## December 2002

Newsletter of the Northern Colorado Astronomical Society

Subj: [FRAC] Leonids from Hygiene  
Date: Tuesday, November 19, 2002 8:30:12 PM  
From: AlphaLyra@aol.com  
To: front-range-tac@seds.org

Well folks, we did have fun, never time wasted, but sure a disappointment as far as meteors when hoping for storm activity. Don't know if it just didn't meet predictions or if there could have been a storm of faint meteors that we couldn't see due to the bright Moon (and intermittent clouds). I know I saw a HUGE number of faint ones last year!

However, I had a few reports coming through on my cell phone: Northern California was clear, Seattle was socked in with rain, western Missouri was clear... but no storms here in the U.S. I guess the Leonids are on the faint side (and wow they're fast). And I swear, that was the brightest moon I've ever seen! GaryG exclaimed a couple times, "This is a first... out for a meteor shower under a Full Moon!" :)

I did hear second-hand, however, that Budapest had a real feast of a storm! So apparently that first wave in Europe was the good one for this year.

In Hygiene, skies were overcast until winds picked up around midnight (very windy for a bit!) and started blowing them away.

As always, with a great group of people, the best is made of any situation. Marty was a gracious host, as was Gary with his motorhome. Thanks to both of you! (Gary, please forward my thanks to Marty.) While waiting for the clouds to break and the storm to begin, we had a great time. Hung out in Gary's motorhome for a while, then went into Marty's house for a while. Marty had a DVD ("Stargaze" I believe it was called?) playing on a lovely TV screen with good sound quality, which had absolutely spectacular Hubble images accompanied by music reminiscent of "Hearts of Space." Quite mesmerizing at times. There was also an abundance of good food. Marty also has a Cockatoo, Conure and Lorie (sp?) that kept us entertained for quite some time. Being a previous bird-owner (Pam also) we were quite taken with them. They are intelligent, affectionate animals, and the cockatoo had a little crush on Gary! :) We passed the time with good conversation, Hubble slideshow with music, and very good food. Thanks, Marty!

At 1:00 or so, Pam and I out on our cots, only had clear sky in the direction of the moon! Very beautiful, with the clouds floating in front of it, the moonlight bright enough to see the snow on the distance mountains! Just gorgeous!!

BUT as lovely as it was..... still not exactly what we were there for...

After about 2:00, we had mostly clear skies in most directions until after 4:30ish!, and turned our cots a few times for best viewing, but still had some scattered clouds coming in here and there through the night. The clouds were bright too, adding to our lack of night vision. I had a visor on top of my knit cap to block the moonlight, but not sure how much good it really did, the sky was so bright.

The peak seemed to be from around 3:30-4:15 or so. There were a good amount of ooo's and ahhh's and we were treated to a few nice events, such as 3-4 at a time, 1-2 that seemed to be one that split, and I thought I saw one skip, though I do recall some conversation from last year that they are not really "skipping." Some bright ones, but no real fireballs that I saw. The crowd broke up around 5:00 a.m. and we said our farewells.

We had fun and did see some good meteors! Certainly no storm, but always a good time with fellow-astronomers. Those who showed up (some came and went

early or later) were, me, Gary and Carol G and her delightful parents, Pam W, Mike H, Ray W, Jan K, Joe and "wife" (sorry, didn't know them), and of course Marty! My apologies if I left anybody out.

And of course, not all is lost under any circumstance: my sister in Tucson got up early, went outside, wasn't seeing anything!... but then heard an owl hooting, found a Great Horned Owl silhouetted by the moon in a nearby tree, and then saw a fireball streak across the sky! Life's bonuses for taking the time to look around--just that alone is worth getting up early for! :)

Thank goodness for last year being New Moon! None of us will forget!... and that will apparently have to hold us over for a while. :)

--KarenM

P.S. One extra bonus! Pam was observant enough to point out the rarely observed, but exquisitely detailed, "Duck Nebula" (just a cloud ;-( ) passing swiftly overhead, brightly lit by moonlight! It was a high point of the evening and we exclaimed, "NEAR SKY HAPPENS."

\*\*\*\*\*

Subj: Re: [FRAC] Leonids from Longmont  
Date: Tuesday, November 19, 2002 11:54:51 AM  
From: dave@ewingdev.com  
To: front-range-tac@seds.org

on 11/19/02 5:23 AM, J&S at jsstars@worldnet.att.net wrote:

- > Quick report:
- > I dragged my complaining posterior out of the rack about 3:00 AM and
- > grabbed some coffee and plopped into the lawn chair by 3:25. The light
- > polluted sky was 60 or 70 percent obscured by fast-moving moonlit clouds and
- > I counted about 2 or 3 meteors per minute on average until about 4:00 when
- > the average seemed to increase to about 5 or 8 per minute. By 4:15 the
- > clouds had pretty much covered the sky. By 5:00 things cleared pretty well
- > and I went out for another 10 minutes but the rate seemed to have fallen off
- > to about 1 or 2 per minute. I didn't see any bright green streakers. :(
- > I'll call that about 200 per hour, peaking at about 400 from here. A
- > far cry from the 8000+ per hour we were seeing this time last year from a
- > clear dark sky. But of course, under this Denver/Longmont nebula I couldn't
- > see the background of faint ones that make up the majority of what can be
- > seen out in the dark.
- > It was nice to have the memory of last year's experience refreshed
- > though.

And from south-west of Hygiene. :)

I was too tired to go spend the night at the gathering in downtown Hygiene so I resorted poking my head out a couple of different times. Around 12:30 the sky was almost completely covered, and I never even went outside. At 2:00, things had cleared so that I could see maybe 1/4 of the sky. (I intentionally was laying down in a spot that obscured the very bright moon, so that cut off nearly half the sky already.) From 2:18 to 2:33 I counted only 9 Leonids (plus 2 non-Leonids). Not particularly impressive. I went back to sleep after reluctantly setting my alarm for 3:30.

At 3:30, things were even clearer. I walked outside in my stocking feet and no coat, determined to go right back to bed if I wasn't immediately inundated by fireballs. Two meteors streaked by within 30 seconds. Good enough!

From 3:47 to 4:02 I counted 40 Leonids. Not bad at all considering only about 1/3 of the bright sky was showing stars. This matches Jim's rate

# The Objective View      December 2002

## Newsletter of the Northern Colorado Astronomical Society

pretty closely. One of the meteors was at least magnitude -3, and it showed through probably the thickest cloud at the time. It's real magnitude must have been much brighter. I also saw one kinda faint meteor skip. And another two came in exactly matched pair - same time, same length, same brightness, and separated by about 7\* in the sky.

From 4:02 to 4:17 I counted only 19 more. This differs from Jim's report considerably, but for me the sky was covered with a thickening haze during that time. After that I decided to call it a night.

The peak rate for me matches about what I saw from stormy North Platte, NE last year. So that makes two years running with conditions that just didn't work out. I can only imagine how impressive they would have been from dark skies....

Dave

\*\*\*\*\*

**Subj: [Launch Alert] Scud Launch Seen**  
Date: Saturday, November 16, 2002 10:41:31 AM  
From: kd6nrp@earthlink.net  
To: launch-alert@mailman.qth.net

ASTRONOMY/SPACE ALERT FOR SOUTHERN CALIFORNIA

Brian Webb, KD6NRP  
Ventura County, California  
E-mail: kd6nrp@earthlink.net  
Web Site: <http://home.earthlink.net/~kd6nrp>

2002 November 16 (Saturday) 08:35 PST

### VANDENBERG AFB SCUD LAUNCH SEEN

During the past several weeks, I've been asked about the Scud missile launches scheduled to take place this year from Vandenberg AFB. With little advanced notice to the public or news media, the first Scud was launched from Vandenberg on Thursday morning at 11:25 PST. My co-workers and I were lucky enough to see this event from more than 100 miles away.

Although my office is 115 statute miles (185 kilometers) southeast of the launch site, and daytime liquid fuel missile launches are difficult to see, I decided to look for the launch anyway. The weather was very clear and I figured that the liquid-fueled Scud would briefly produce a vapor trail as it passed through the contrail zone, an area between 40,000 to 45,000 feet altitude\*.

The launch window opened at 10:00 PST, but the launch was delayed until 11:25. Just before launch I went over to my coworker's cubicle that has a west-facing window. We were scanning the western horizon when somebody asked, "What's that?"

Sure enough, there was a thin, white, squiggly contrail - typical of a missile launch. The contrail was curved and arced away from the coast towards the west-southwest. Unlike an aircraft contrail, this one immediately began to dissipate and become more and more transparent. After three minutes or so, it was invisible.

I either saw the Scud as it was actually producing the contrail or a few seconds after it exited the contrail zone. It was rather

interesting.

\*The height of the contrail zone varies with the prevailing weather conditions. On Thursday I guessed that it was between 40,000 and 45,000 feet.

---

### SCUD NEWS STORY

Last Monday, KCLU-FM aired a news story about the Vandenberg AFB Scud launches. An MP3 audio file of the story is posted at:

<http://home.earthlink.net/~kd6nrp/library.htm>

Look for the link titled "scud.mp3".

\*\*\*\*\*

[http://www.space.com/spaceneWS/archive02/zerog\\_102102.html](http://www.space.com/spaceneWS/archive02/zerog_102102.html)

Firm Moves Closer To Commercial  
Zero-Gravity Flights

By JASON BATES

Space News Staff Writer

posted: 01:42 pm ET, 21 October 2002

WASHINGTON - A group of entrepreneurs, including former NASA officials, claims to be only a few months away from offering commercial airplane flights that mimic NASA's famous Vomit Comet, allowing passengers to experience weightlessness without the expensive rocket ride.

Zero Gravity Corp. (Zero-G) has received U.S. government approval to operate the aircraft and plans to begin flights in the first quarter of 2003, said Peter Diamandis, Zero-G's chairman and chief executive officer.

Diamandis began his quest to commercialize zero-gravity airplane flights in the mid-1990s, but only recently did the company overcome its biggest challenge to date, obtaining some of the necessary licenses from the U.S. Federal Aviation Administration (FAA) to operate the aircraft, he said.

The company has completed test flights for the FAA and received FAA certification for a special modification of a Boeing 727-200 for parabolic flights, Diamandis said.

Zero-G was advised by the FAA that the company can conduct commercial parabolic flights within the United States under Part 121 of the Federal Aviation Regulations and also has been granted a Supplemental Type Certificate, which recognizes that Zero-G's aircraft can safely perform the maneuvers to achieve weightlessness, Diamandis said.

An official with the FAA said Zero-G does not have all the licenses needed to conduct the flights.

Diamandis said Oct.10 that the company still needs to select

# The Objective View      December 2002

## Newsletter of the Northern Colorado Astronomical Society

an operator that has FAA approval to operate under Part 121. Once the operator is selected by Zero-G, the operator will have to go through the final approval and coordination process with the relevant local FAA Flight Standards District Office before conducting flights.

To provide passengers the experience of weightlessness, an aircraft climbs at a 45 degree angle and then dives at about the same angle, creating a zero gravity environment for about 25 to 30 seconds. The maneuver, called parabolic flight, is repeated from 20 to 60 times during a single flight.

Zero-G, based in Santa Monica, Calif., plans to lease multiple Boeing 727 jet aircraft to provide the zero gravity experience to customers, Diamandis said. The aircraft will be configured to carry up to 30 clients and have space for operations such as science experiments, movie sets or just an area to float in, he said. Zero-G will have different platforms to fit inside the aircraft based on client needs, and some clients may even own their own platforms or pallets to go inside the aircraft.

The company is targeting multiple markets beyond adventurers who want to experience zero gravity, Diamandis said. Other potential customers include research and science flights, corporate incentive programs, and the entertainment industry, which already has provided Zero-G with its first payday, he said.

Zero-G leased a 727 for the flight testing needed to obtain the FAA certification, Diamandis said.

During the series of six flights in January 2000, a studio used the aircraft to film scenes for an upcoming movie. The service was similar to what NASA provided to the producers of the movie Apollo 13, who filmed scenes with actors experiencing weightlessness while flying in NASA's KC-135 aircraft, known inside and outside the agency as the Vomit Comet.

Zero-G will sell flights directly to the entertainment industry, corporations and researchers, Diamandis said. For the tourist market, the company plans to sell whole flights to retailers who then will resell the individual rides. He would not disclose what Zero-G plans to charge any of its potential customers.

Most of the funding for the project is coming from private investors, Diamandis said.

Bryan Emerson, president of Starlight Capital Inc. and Wired Capital Inc., a pair of Houston-based investment equity firms, helped introduce Diamandis to several potential investors. The Houston market provided a good source of investors for Zero-G, mostly from individuals looking to diversify their holdings outside of the petroleum and real estate areas, Emerson said.

"I would say there has been strong interest among individual

investors," Emerson said. "I am very bullish on the Zero-G opportunity."

The next step for Zero-G is signing a partnership agreement with a cargo carrier operation, Diamandis said. A partner will help defray aircraft costs by using the 727 to ferry cargo at night and leaving time for zero gravity flights during the day and on weekends, he said.

Such an arrangement will allow Zero-G to operate its business without having to own the aircraft and cut the cost per flight, Diamandis said. "Because we are using cargo operators, we already are flying thousands of flights per year," he said.

By cutting the cost of aircraft ownership, Zero-G hopes to be profitable within its first year of operation, Diamandis said.

Zero-G hopes to sign a partnership by the end of the year, which will leave enough time to modify aircraft for parabolic flight and be in business before the end of the 2002 first quarter, he said.

Flights will be operated out of several U.S. cities, as Zero-G plans to move a fleet of two to four aircraft around the country, Diamandis said. The firm has coordinated airspace with the FAA in locations throughout the United States, over the oceans, the Great Lakes and deserts to perform the flights, he said.

While Zero-G will have no commercial competitors operating in the United States, similar flights are offered by Novespace of Paris, a commercial subsidiary of the French space agency, CNES, using an Airbus A300. In addition, Arlington, Va.-based Space Adventures, sells rides in Russia on an Ilyushin 76 at a cost of \$5,400 per person, according to the company's World Wide Web site.

The start-up of Zero-G "may cut into our business a little," said Eric Anderson, president and chief executive officer of Space Adventures, but he hopes the addition of another competitor will create more interest in the market.

While NASA also provides research flights on its KC-135, Zero-G hopes to offer a "complementary or supplementary resource to NASA," in that market, Diamandis said. "If corporations or universities are having a difficult time getting onto NASA's aircraft, they may be able to use us as an alternative."

While NASA can offer the use of the KC-135 on a cost-reimbursable basis, the Commercial Space Act of 1998, also "makes it clear that NASA can't compete with private industry," Diamandis said.

\*\*\*\*\*

Jodrell Bank Observatory  
University of Manchester  
Macclesfield, U.K.

# The Objective View

## December 2002

### Newsletter of the Northern Colorado Astronomical Society

Contact information:

Dr. Ian Browne  
University of Manchester, Jodrell Bank Observatory  
Telephone: UK (0)1477-572615  
Email: [iwb@jb.man.ac.uk](mailto:iwb@jb.man.ac.uk)

Professor Peter Wilkinson  
University of Manchester, Jodrell Bank Observatory  
Telephone: UK (0)1477-572602  
Email: [pnw@jb.man.ac.uk](mailto:pnw@jb.man.ac.uk)

Professor Roger Blandford  
California Institute of Technology, Dept of Astronomy  
Telephone: USA 626-395-4200  
Email: [rdb@tapir.caltech.edu](mailto:rdb@tapir.caltech.edu)

Dr. Kyu-Hyun Chae  
University of Manchester, Jodrell Bank Observatory  
Telephone: UK (0)1477-572635  
Email: [chae@jb.man.ac.uk](mailto:chae@jb.man.ac.uk)

7th November 2002

Press Release 2002/11

#### New Evidence for Dark Energy in the Universe

An international team of astronomers, led by scientists at the University of Manchester have produced new evidence that most of the energy in the Universe is in the form of the mysterious "Dark Energy". The new evidence comes from a 10-year census of the sky for examples of gravitational lenses, which are seen when a galaxy bends the light from a distant quasar to form several images of the same quasar. Linking the number of lenses they found with the latest information on the numbers of galaxies, the scientists have been able to infer that most of the energy in the Universe is likely to be in an invisible, and presently unknown, form.

Dark Energy is closely related to the idea of a Cosmological Constant introduced by Einstein over 80 years ago, but most astronomers, including Einstein himself, have always strongly doubted its reality. However, in the past 5 years several independent groups of astronomers have amassed evidence suggesting that Dark Energy exists and could well dominate the total energy of the Universe.

Dark Energy only affects the properties of the Universe over very large distances and the observations which are sensitive to its presence, in particular studies of exploding stars in distant galaxies, are all close to the limit of current capabilities. Astronomers have therefore been keen to exploit many different tests and Dr. Ian Browne makes the point that "the new gravitational lens test is based on completely different physical arguments to the previous ones and so provides independent evidence in support of Dark Energy".

When a quasar is gravitationally lensed by an intervening galaxy two or more images of the quasar are produced but they are hard to recognise as the images are less than one thousandth of a degree apart. The team therefore employed several of the world's most powerful radio telescope arrays to make radio pictures of thousands of distant quasars. Professor Peter Wilkinson points out that "we chose to use

radio telescopes for our survey since they can pick out details many times finer than optical ones, even the Hubble Space Telescope". The census showed that about one out of every 700 distant quasars is lensed by a foreground galaxy.

To calculate the fraction of the energy in the Universe which is Dark Energy Manchester's Dr. Kyu-Hyun Chae combined the gravitational lens statistics with the latest results on the numbers and types of galaxies in the Universe made with optical telescopes. The result which emerged is that around two thirds of the Universe's energy appears to be Dark Energy. The remaining third is made up of Dark Matter, whose form is presently unknown, and "ordinary" matter which makes up the stars and planets. For both of these forms of matter gravity acts as normal and attracts. In contrast Dark Energy has long-range anti-gravity properties and now appears to be causing the expansion of the universe to accelerate, rather than slow down as would be expected if gravity was the dominant force. While astronomers have no idea about what Dark Energy might be, these new results add to their growing confidence that it is real.

Further Information:

#### Gravitational Lensing and the CLASS survey

Galaxies, bend the paths of light (or radio waves) and can act as distorting lenses focussing the light from a more distant object e.g. a quasar, lying behind the lens. The first such gravitational lens was discovered by a team led by a Jodrell Bank astronomer Dennis Walsh in 1979. A brief illustrated introduction to gravitational lensing can be found at:

<http://www.jb.man.ac.uk/booklet/GravitationalLenses.html>

The gravitational lens survey referred to in the main text is called CLASS, which is an acronym for the Cosmic Lens All Sky Survey. A description of the survey and a montage of the radio images of all the CLASS gravitational lenses can be found at

<http://www.jb.man.ac.uk/research/gravlens/class/class.html>

The idea underlying CLASS was to make radio maps of very many distant radio sources looking for evidence of the splittings and distortions characteristic of gravitational lensing. Three major radio telescopes which were used in turn to make the census are:

- The Very Large Array (NRAO) in Socorro NM USA
- The UK National Radio Astronomy Facility MERLIN (JBO)
- The Very Long Baseline Array (NRAO)

with each offering a unique combination of resolution and observing speed. The VLA (lowest resolution, highest speed) made the initial survey; MERLIN (higher resolution -- similar to that of the Hubble Space Telescope) followed up promising candidates: the VLBA (highest resolution) followed up the candidates not ruled out by MERLIN. After this systematic sifting process the identification of the survivors as gravitational lenses was almost certain. However we then observed each of the survivors in the optical and infra-red bands with the Hubble Space Telescope; this invariably revealed the lensing galaxy and hence confirmed that we had indeed found a lens.

By adopting such a rigorous protocol, which took many

# The Objective View

## December 2002

### Newsletter of the Northern Colorado Astronomical Society

years follow through, the observing team is confident that the likelihood of any lenses being overlooked is small. Eventually CLASS found 22 cases of lensing, about 1 for every 700 radio sources examined. Full details of the CLASS survey are about to be published in the Monthly Notices of the Royal Astronomical Society and have just become publicly available on:

<http://xxx.soton.ac.uk/abs/astro-ph/?0211073>  
<http://xxx.soton.ac.uk/abs/astro-ph/?0211069>

#### Dark Matter, Dark Energy and the Flatness of Space

Dark Matter: is matter with normal gravitational properties but which does not emit sufficient electromagnetic radiation to be observed directly in any type of telescope. Large amounts normal matter (in the form of stars or hydrogen gas) in galaxies and clusters of galaxies, are seen to be moving so fast that they would escape, unless there is up to ten times more gravity than that of the normal matter itself. This additional gravity is ascribed to Dark Matter but what it consists of is currently unknown. Astronomers now favour the idea that the Dark Matter must be in the form of sub-atomic particles which do not interact strongly with normal matter. Searches for such particles are underway at many laboratories throughout the world.

More about Dark Matter:

<http://astron.berkeley.edu/~mwhite/darkmatter/dm.html>

Dark Energy: Einstein's General Theory of Relativity also allows for the existence of Dark Energy (also called the Cosmological Constant). This is a property of empty space that causes the universe to expand more and more rapidly. Unlike Dark Matter, whose effects can be seen within a single galaxy, Dark Energy only shows up in observations which probe significant fractions of the observable Universe. The accelerating expansion of space was discovered in the last few years by observations of distant supernovae but the observations are difficult and open to other interpretations.

More about Dark Energy and the searches for it:

<http://supernova.lbl.gov/>  
<http://cfa-www.harvard.edu/cfa/oir/Research/supernova/HighZ.html>  
<http://supernova.lbl.gov/~evlinder/sci.html>

The Flatness of Space: The General Theory of Relativity is based on the idea that matter and energy cause space to become curved. In curved space geometry works differently to normal flat (Euclidean) geometry: the angles of a triangle don't add up to 180 degrees. Einstein showed that the curvature of the entire universe depends on the amount of matter and energy in it. If the amount of matter/energy is just right, space is flat, and traditional school geometry does apply. Recent observations of the Cosmic Microwave Background Radiation (CMBR), which effectively measure the angles of a triangle, are showing that space is indeed flat. Both Dark Matter and Dark Energy contribute to the flatness of the universe but there is not enough Dark Matter to make the universe flat, so the CMBR results provide additional evidence that there must be a contribution from Dark Energy.

Up-to-date information ("A New Picture of the Early Universe") on the results from a UK telescope (the Very Small Array) studying the CMBR can be found at:  
<http://www.jb.man.ac.uk/news/vsa>

#### The Importance of the New Gravitational Lensing Test

Claims for new physical phenomena, such as Dark Energy, require very strong evidence to back them up. Since all the previously reported observations are close to the limit of current observational capabilities and depend on various assumptions about the properties of the Universe, it is vital to find new and independent ways to look for the effects of Dark Energy. The statistics of gravitational lensing provides such a test.

The basis of the calculation is that the probability of a distant radio source being lensed by an intervening galaxy depends on the volume of the observable Universe and hence on the amount of Dark Energy. The lensing probability increases rapidly as the fraction of Dark Energy in the Universe increases. While additional results and assumptions are needed to infer the Dark Energy content, these are different and independent from those required by the other methods.

#### The New Lensing Calculation

Dr Kyu-Hyun Chae made a detailed analysis of lens statistics based on the final results from the 10-year CLASS census for gravitational lenses and the latest results on the numbers of galaxies in the Universe made with optical telescopes. In particular Dr. Chae noticed that the lensing cross-sections of galaxies (or, effective lens sizes) measured by the image splittings were smaller than previously thought, and consequently required a large amount of Dark Energy in the Universe for the observed rate of multiple image splittings to be compatible with the measured numbers and types of galaxies in the nearby universe.

The new calculations now agree with the other methods, as a result of including much more extensive data: i.e.

- many more lenses have been found and their red shifts and the redshift distribution of the distant quasars have been measured.
- the angular splitting in each lens image has been determined, which tells us the cross-section for lensing directly (see comment above)
- the latest results from two large recent galaxy surveys: the Anglo-Australian 2-degree field survey and the Sloan Digital Sky Survey which have counted the number of potential lens galaxies in the local universe.

Dr. Chae's calculations assume that the average number of distant galaxies per unit volume of space is the same as that found locally. It is possible that the number of galaxies is less at high redshift but this would only serve to increase the amount of Dark Energy implied by the new results. It is also possible that the lens survey has missed some cases of lensing -- but more lenses would again only increase the implied Dark Energy content. Our results therefore add strong, and completely independent support for a Universe dominated by Dark Energy (constituting about 70% of the energy in the Universe).

# The Objective View      December 2002

Newsletter of the Northern Colorado Astronomical Society

The text of the paper which has just appeared in Physical Review Letters can be downloaded from:  
<http://www.jb.man.ac.uk/research/gravlens/class/PRL51301.pdf>

The CLASS team members

University of Manchester Jodrell Bank Observatory

A. Biggs, I. Browne, K.Chae, P. Helbig, N. Jackson, S. Mao,  
M. Norbury, J. McKean, P.Phillips, C. Sykes, P. Wilkinson, E.  
Xanthopoulos, T. York

California Institute of Technology  
R. Blandford, L. Koopmans, T.Pearson, A. Readhead

National Radio Astronomy Observatory  
S. Myers

Netherlands Foundation for Radio Astronomy  
A. de Bruyn

Space Telescope Science Institute  
C. Fassnacht

University of Bonn  
L. King

University of Pennsylvania  
D. Rusin, D. Marlow  
\*\*\*\*\*

From: Dan Laszlo  
2001 S Shields St    Building H  
Fort Collins    CO    80526

## Clear Sky Clock Update from Tom Teters

Attila has just published new area Clear Clocks for some of our favorite sites. See the NCAS weather page!!  
Now we'll NEVER make that 40-80 mile trip and experience clouds skies again, whewwww.    tomt

**TO:**