



THE STAR DIAGONAL

THE JOURNAL OF THE OGDEN ASTRONOMICAL SOCIETY

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Meeting Announcement

We will not be holding a formal meeting in July or August. We look forward to seeing you at Monte Cristo and our other Star Parties. Please watch OAS_News for any last minute events.

OAS Minutes, June 2008

The monthly meeting of the Ogden Astronomical Society was held at the Ott Planetarium on the campus of Weber State University on June 12, 2008. It was called to order by President Mike Klein at 7:30pm.

Announcements:

- June 24 – YW group at Wolf Mountain.
- July 19 – Snowbasin Moon Party
- July 25 – Wolf Creek star party.

We also discussed our elections and the Nominating Committee. The Nominating Committee for this year are:

Dale Hopper – Chairman
Brad Powell
Eugene Marshall

This year we will need to pick a new President & Vice President. Nominations will also be taken for Secretary and Treasurer. Elections will be held at our Annual Meeting on September 11th. Mike has served for two years and is not eligible to run for President. Also, our current VP, Dustin, is considering moving his family for a job opportunity back east.

The Nominating Committee will be calling each of you to see if you would be willing to service in any of the positions in the Executive Committee. Please consider running.

We were going to watch a lecture for My Favorite Universe but we had technical issues with the DVD player.

The meeting then adjourned and some of the members met at Village Inn for some refreshments and further conversation.

David Dunn

Star Party Schedule

The proposed dates for the public star parties are as follows.

Jul. 19	Snowbasin
Aug. 16	Snowbasin
Aug. 23	Antelope Island
Sep. 6	Antelope Island
Sep. 13	Snowbasin
Oct. 4	Antelope Island

Requested Star Parties

July 2	Wolf Creek
Aug. 22	Terrace 3 rd Ward Camp

Our Private Star Parties are as follows.

Jul. 30-Aug. 2	Monte Cristo
Aug. 27-30	Monte Cristo
Oct. 24-25	Messier Marathon (TBD)

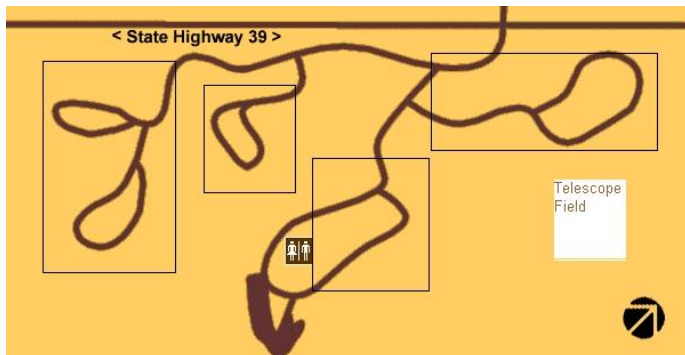
Night Sky Network

We received a new kit from the Night Sky Network. It is titled “Super Nova”. We will also be receiving a new “Black Hole” kit to replace the one that was damaged in the fire.

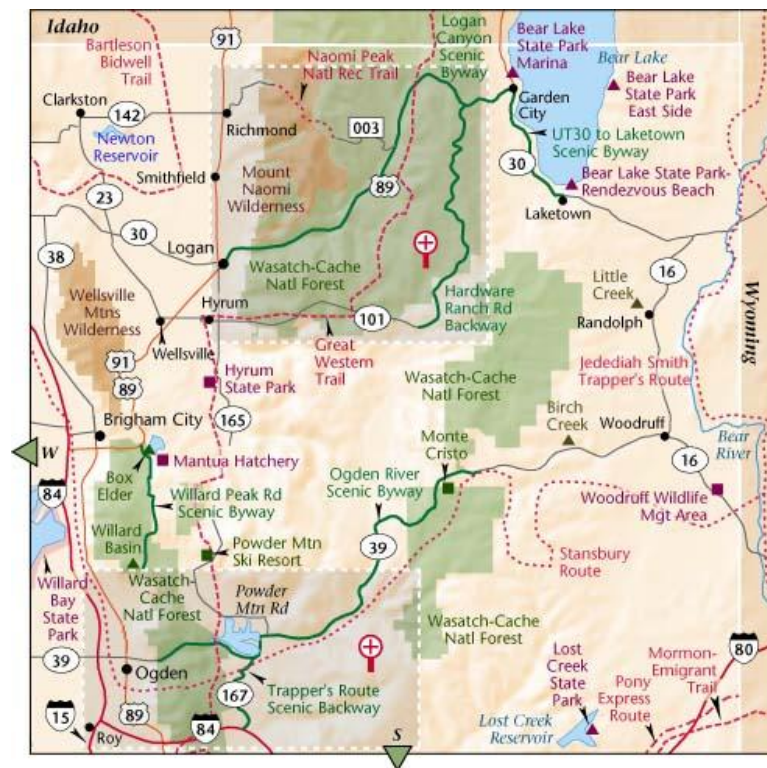
Monte Cristo

For those that are new to OAS, our Monte Cristo Star Parties are one of the highlights of the year. This is a star party where we go camping at the Monte Cristo campground on highway 39 in Rich County. The formal star party is Friday and Saturday nights. Many of us arrive as early as Tuesday to get more observing time. When the weather is nice, this can be a great place to observe from. We are at almost 9000 ft. The light domes from the cities are far away so they don't interfere with our observing. When the air is stable, we have seen really neat detail in galaxies like M101 and M51. The dust lanes in M31 are real nice as well.

We obtain a permit to use a meadow to the north of the campground. We set up our telescopes there. We have potluck dinners on Friday and Saturday night. We also have "Tea Parties" each day at around lunch time. These are fun events where we sometimes discuss different astronomy topics or just enjoy each others company. We usually have several snacks prepared for the tea parties. They have included chips and salsa, cookies, chips and Doug Sandwiches (Ritz cracker, Salami, sharp Cheddar cheese and a Jalapeño pepper).



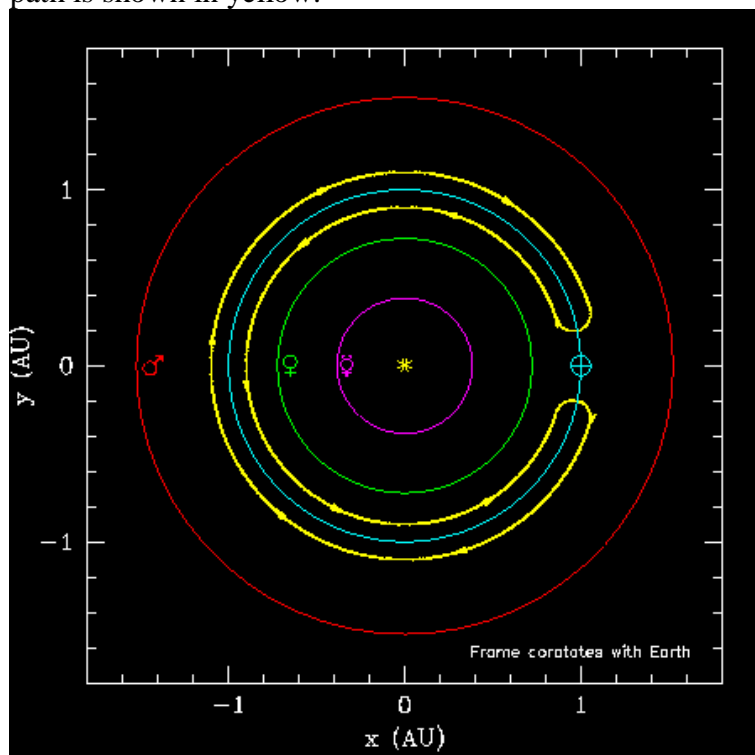
Map of Monte Cristo campground. There are more restrooms than noted. You want to try to get in the small loop by the Telescope field. The other loop near the field is also close.



The motion of asteroid 3753 Cruithne

Near-Earth asteroids (or NEAs) are our closest neighbours in the Solar System - some of these objects have been known to pass closer to the Earth than the Moon. These objects, which range in size from 30-40 km (eg. *1036 Ganymed* and *433 Eros*) to a few metres, are important to our understanding of past and present Earth impact rates, and are likely to prove useful as bases and/or mineral sources as humans move into near-Earth space. The near-Earth asteroid 3753 Cruithne is in an unusual orbit about that of the Earth, one which is known in the lingo of celestial mechanics as being *co-orbital* with the Earth (meaning it shares the Earth's orbit with it) and, more particularly, as being of the "horseshoe" type. Horseshoe orbits are named because of their shape in a reference frame which *corotates with their accompanying planet*, and have been known theoretically for many years. A *corotating* frame just means one in which the viewer orbits along with one of the planets, in this case the Earth. It is analogous to imagining oneself floating above the north pole of the Earth as our planet goes around its orbit, and watching the path the asteroid from this vantage point. By looking at the asteroid in this way its unusual behaviour becomes apparent: it is much

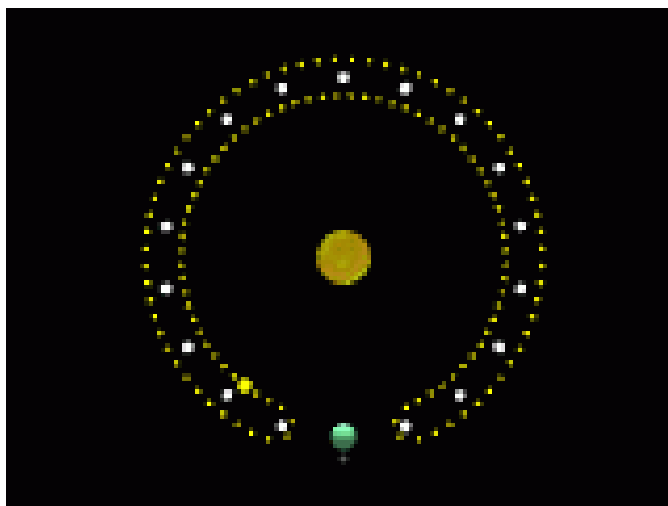
more difficult to distinguish when viewed in a non-rotating frame. Before considering the motion of Cruithne, let's examine a less complicated situation first. The simplest type of horseshoe orbit is pictured below, for a *hypothetical* asteroid. Only the orbits of inner planets of the Solar System are shown. They are indicated by their traditional symbols: from the Sun outwards they are Mercury (magenta), Venus (green), Earth (blue) and Mars (red). The asteroid's path is shown in yellow.



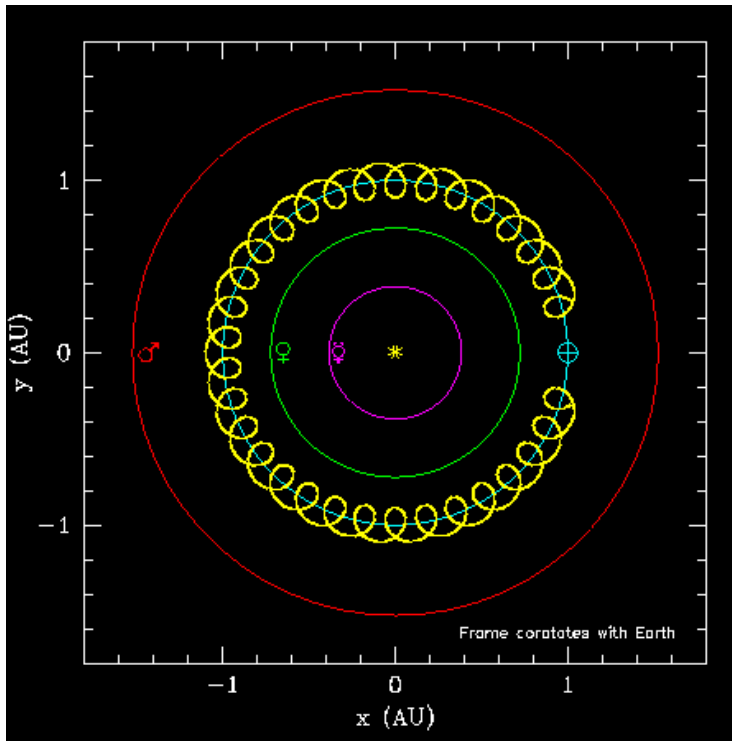
In this (co-rotating) picture, the Earth is stationary (at the crossed circle symbol), and we watch this hypothetical asteroid go around. We see it approach the Earth, and when it gets close enough, it turns around and retreats, only to repeat its performance on the other side. This unusual arrangement, in which close encounters with a planet do not result in impacts or strong distortion of the asteroid's orbit is termed a "horseshoe" orbit because of its shape. Note that the asteroid doesn't go around the Earth, but rather shares the Earth's orbit with it.

Another way to think of this horseshoe is to consider a three-lane, circular race track. The Earth is a large truck moving at a constant speed down the centre lane and the asteroid is a car. When in the outer lane, the car is going a bit slower than the truck, and the truck starts to catch up. But just when the truck is

about to pass, the car switches to the inner lane and speeds up. It then starts to pull away from the truck, but because the track is circular, the car will eventually catch up with the truck from behind. When it gets close, the car again switches to the outer lane and slows down. Then the whole cycle repeats. This is what is happening in a simple horseshoe. Both vehicles share the same highway, but in a coordinated fashion so as to avoid collision. In reality, the delicate coordination of the asteroid and the Earth is performed by the laws of celestial mechanics, and requires just the right conditions.



Horseshoes can be more complicated than that shown above. Though no examples have been known in nature before now, theoretical studies had shown that spiraling horseshoes, like that in the cartoon shown below, are also possible. In terms of the car-truck picture described above, the truck (the Earth) is still going at a constant speed in the centre lane, but the car is constantly changing lanes and speeds, so the truck sees it alternately fall back and pull forward. Though more complicated, the car still alternates between catching up with and falling behind the truck. Again, an asteroid in such an orbit would be effectively "repelled" from the Earth at each close approach (see the [FAQ](#) for more details)



Cruithne is on an spiraling horseshoe orbit, similar to the one sketched above, but its behaviour is even stranger. First, it is an even more tightly-wound spiral, with kidney-bean shaped loops. Secondly, one part of the horseshoe actually overlaps the position of the Earth when viewed from above. A series of four frames (to be read left to right) showing a time lapse of Cruithne's horseshoe is shown below. Note again that Cruithne's horseshoe is composed of tightly wound kidney-bean shaped spirals which are almost impossible to distinguish individually in the picture. Remember, there are two types of motion going on: 1) every year, the asteroid traces out a kidney bean, 2) over time, this kidney bean drifts along the Earth's orbit, tracing out a spiral which, when complete (after 385 yrs) fills in an overlapping horseshoe".

Thomas Dougherty