Project ZOMBIE

How High is that Meteor?

If you live near (within about 25 miles) the John J. McCarthy Observatory, you are invited to join us in Project ZOMBIE. If you live further away you can use these guidelines to develop your own experiment.

Project ZOMBIE is a real science experiment that will allow participants to determine the altitude that meteors enter the Earth's atmosphere. Project ZOMBIE was designed to be simple and use minimal equipment so that many people may participate. Project ZOMBIE uses basic 35 mm cameras to produce images of meteor trails. When images of the same meteor trail are taken from different locations the trails will appear shifted, from image to image, compared to the much farther away background stars. This shifting of the trail is due to the meteor being imaged from different places and is called parallax. By using the principle of parallax and a little mathematics the altitude of the meteors can be determined.

ZOMBIE is an acronym for Zenith Oriented Meteor Baseline Imaging Explorer. The zenith is the point in the sky directly above you. For Project ZOMBIE cameras should point straight up, oriented to the zenith, with the top of the camera toward north. This will result in a picture with north up and east to the left, like this:

Project ZOMBIE is not new science, the altitude of meteors is well known and can be found in a number of publications and on the Internet. What is seldom mentioned in these media is how the published altitude was determined. Project ZOMBIE is a way to confirm both the methods used by and the results of previous experiments. In a wonderful book, Mike Reynolds says “By the end of the eighteenth century, accurate data collected by two German students showed that the altitude of most meteors is between forty-eight and sixty miles above the surface of the earth.” (*Falling Stars A Guide to Meteors & Meteorites*, 2001, Stackpole Books, ISBN: 0-8117-2755-6)

How to Participate

When:
The first round of Project ZOMBIE imaging will take place Monday night, August 12, 2002. As we get closer to this date, we may change the date if poor weather is forecast. You may call the Observatory at 860 354-1595 to see if the date is changed. We plan to begin the first image at 9:00 P.M. EDT and continue until at least 2 A.M.

What is required:
The most important requirements are the desire to participate and a camera that can take long duration exposures, 14 minute exposures are what we are specifying.

- Camera: An older manual 35 mm camera is the best choice for a camera With it you can set the focus to infinity (∞), the aperture, and the exposure time to the B or bulb setting.
- Camera lens: If your camera has interchangeable lenses, use the 50 mm focal length lens.
- Lens hood: This will help block unwanted light from your image and may help prevent dew from forming on the lens.
- Cable release: A locking cable release is needed to lock the camera shutter in the open position for an extended length of time. Most camera shops carry these for about $7.00
- Film: We will be using Kodak Max, 400 ISO color print film. You should use a fast film, 400 speed or higher. Color will help in identifying the stars and may provide some information on the meteor.

Other requirements:

A method for determining true north:

- For standardization we are specifying the image of the zenith is taken with north up. If you can identify the North Star, Polaris, and can see it from your imaging location, it is very easy and accurate enough to align the camera to it. Simply stand facing Polaris and place the camera on a table or a board so the lens is pointing straight up and the top of the camera is toward Polaris.
- If you can not identify Polaris, or can not see it from your location, you can use a compass. If you use a compass, be sure to take the magnetic variation (also called magnetic declination) into account. Compass needles point to the magnetic north pole. The magnetic north pole moves over time, currently at a rate of about 15 kilometers per year toward the north west. In 1994 it was in the Canadian Arctic, north of Hudson Bay at 78°N and 104°W. We want to align the cameras to true north which is on the rotational axis of the Earth. In this part of Connecticut compass needles now point about 13½° west of true north, so to orient the camera to true north you must rotate the camera 13½° clockwise from the direction the

compass needle points. Also when using a compass you must be careful to avoid magnetic interference with it. The camera and any other iron or steel objects near the compass will effect where the needle points.

A method for pointing the camera at the zenith:

- Use a level across the lens to insure the camera is pointing straight up.

A method to time your exposures:

- Since Project ZOMBIE is an attempt to photograph the same meteor trail from more than one camera, an accurate means of timing both the start time and the duration of the exposures is needed. The minimum equipment needed is an accurate watch that has been set to the accurate time. We want all images to be started on the hour and at 15, 30, and 45 minutes past the hour. Exposures should be made for 14 minutes, this gives you a minute between images to cock the camera and check its position and settings.
- For setting a watch to accurate time you can call the observatory at 860 210-4117. The Weather Channel broadcasts accurate time and many radio stations, including WCBS 880 AM also have a time signal on the hour. GPS units give accurate time. A high frequency radio (short wave) can receive time signals from WWV on 5, 10, 15, or 20 megahertz or CHU on 3.330, 7.335, or 14.670 megahertz. Accurate time is also available on the Internet.
- To time the duration of your exposures a kitchen type countdown timer can be used, it will sound an alarm when you should end your exposure. A short wave radio tuned to one of the above stations can also be used. Both of these methods produce sound to alert you of the exposure duration so you would not need to keep checking your watch.

A method of recording exposure data:

- A careful record of the exposure start/end times and duration is needed to compare the images. You can simply write down this information on a clipboard or in a notebook. A better method might be to use a portable tape recorder, then you would not need to use a flashlight to take notes and you could be watching the sky instead.

Other things you might want to have with you:

- Friends or family members make meteor watching more fun and safer.
- Warm clothes
- A reclining lawn chair or a sleeping bag on a ground cover.
- Insect repellent
- A flashlight covered with a red plastic film if possible
- Fresh batteries for all equipment that requires them

Procedure:

Decide where you will image from. The location should be convenient and safe and as dark as possible. Back yards are a good choice if they offer relatively dark skies. With a 50 mm focal length lens you will image only a small part of the sky (about 27° vertically by 40° horizontally) so you do not need a large open field for Project ZOMBIE imaging.

Get all your equipment together and make sure it is in good working order. Put fresh batteries in all equipment.

Put fresh film in your camera. We are using Kodak Max 400 ISO color print film. Use a fast film 400 speed or greater, if you have time experiment with faster films. An 800 speed film may be a good choice also, but very fast films have a tendency to fog over during long exposures, especially when used at a site with bright skies.

To aid the photo processor in framing the negatives to be printed you should take one picture of a daylight scene or an indoor brightly lit scene. When you take your film in for developing be sure to let them know that they are pictures of the stars.

When ready to image, orient your camera to point at the zenith with the top of the camera pointed true north. Using your 50 mm lens set the aperture to wide open or stop down the aperture only one *f* stop to no more than *f*/2.8, set your focus to infinity, and the exposure to the B setting. Attach the cable release and lens hood. Recheck your camera alignment and wait until it’s time to begin your first image.

Start your first 14 minute image the next time it is on the hour or 15, 30, or 45 minutes past the hour. Record the times you start and end each exposure and its duration. You should make other notes, like what film you used and your camera settings. You should also record other comments that may be helpful; if a meteor was seen, if an airplane or satellite or cloud may have traveled through your field of view, or anything else you think important.

When your film has been developed, if you have captured a meteor please contact the McCarthy Observatory so we can use your data for the project. Call 860 354-1595, email us at 932jjmo@snet.net, or just drop the images at the Observatory. We will need to know the location of your imaging site to determine the baseline distance or camera separation distance. A GPS position will be the most helpful and we can come and make this measurement quickly or loan you a GPS unit so you can make the measurement. We could get a close idea of your imaging location with just a street address though. If you do capture a meteor trail we would like to borrow your negative of it so we can have it digitized onto a CD disk. We will carefully return it to you in a day or two.

We plan to publish the results of Project ZOMBIE and so need to know if you want to be recognized for your efforts.

Most meteors are seen after midnight so the longer you can continue imaging the better your chances of capturing the trail of a meteor.

On the next page is a form you could use to record your imaging data.

John J. McCarthy Observatory
Project ZOMBIE Imaging Log

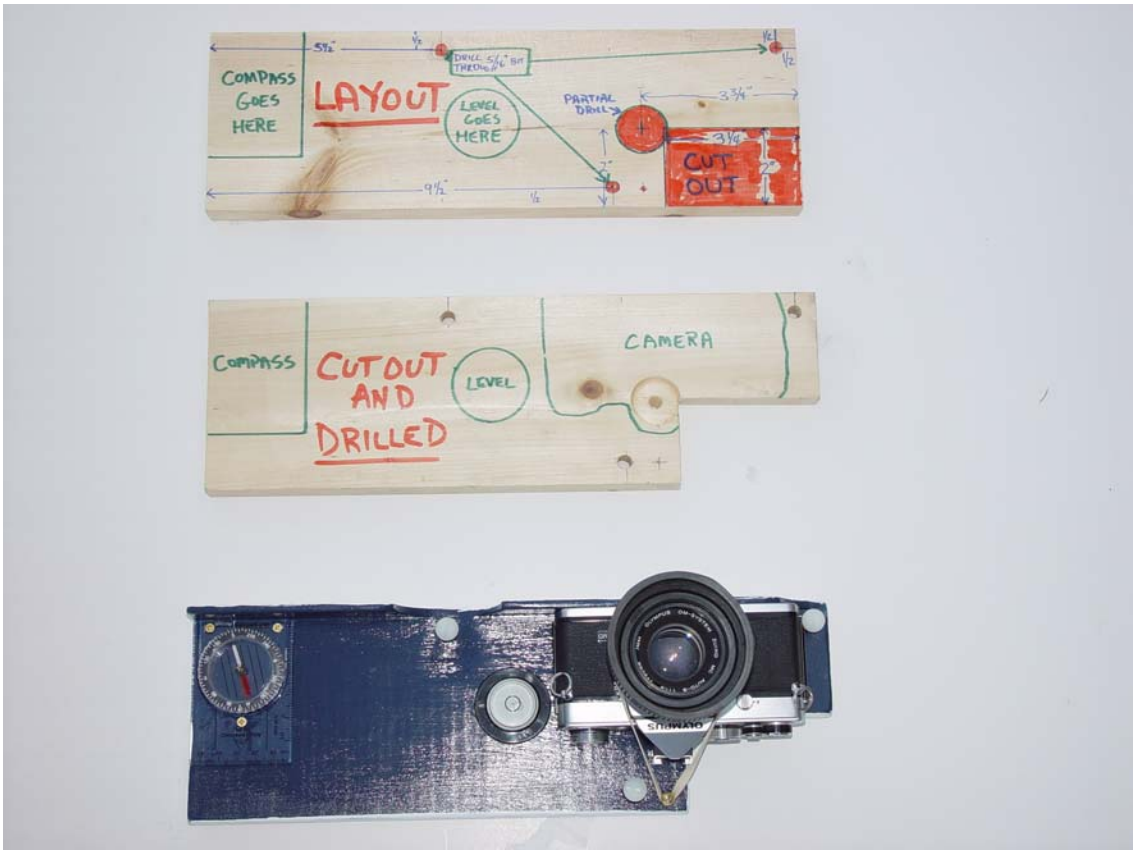
Observer				
Date		Location		
Camera model and lens used Camera settings				
Film				
Image #	Start Time	End Time	Duration	Comments

John J. McCarthy Observatory
Construction of the Project ZOMBIE Imaging Mount

This is a simple and inexpensive camera mount that you can build quickly. It will allow you to quickly and accurately set up the camera and it will produce the standard images we hope to get. But it has no other use than to help you produce images of the zenith that show trailed stars. If you can determine true north and can orient your camera to the zenith you do not need to build this mount.

The mount is made of a 14 inch piece of pine 1 x 5 board, a piece of 1¾ inch lattice, 3 nylon leveling screws and nuts, and a few brass wood screws. It is important to use non-magnetic materials in the construction so they do not interfere with the compass. The compass is the single most expensive component because it is the type that has a rotatable index so you can set the magnetic variation of your location and quickly align the mount to true north. The mount also has a surface level for easy alignment. It has been painted to protect it for its expected many years use.
Here are the materials you will need:

Here are the tools you will need:


COMPASS GOES HERE
LAYOUT
LEVEL GOES HERE
PARTIAL DRILL
CUT OUT
COMPASS
CUT OUT AND DRILLED
LEVEL
CAMERA