ARPAST

ARKANSAS PARANORMAL & ANOMALOUS STUDIES TEAM

Since the introduction of domestic digital photography c.1995, it seems that the field of ghost research has become inundated with photographs of "orbs" - small spheres, of differing colors, sizes and opacity, reputed by some people to be the "Basic Spirit Form" (BSF), the first stage in a manifestation.

These pictures first started to appear on the internet, on American websites, and usually chronicled in intrepid adventurer's exploits in cemeteries at night - suitable places for ghosts, surely, and so the connection with spooks was made, and has been accepted nearly without question since. But people who have experience with photographic equipment dispute their supernatural origin.

Orbs are allegedly ghost or spirit energies, or "multi-dimensional beings," invisible to the naked eye but visible as balls of light on film.

Though some people believe orbs are life-forms, they are most likely due to dust, reflections caused by flash or other naturalistic light sources caught on film.

Orbs are a very controversial item in the paranormal investigation field.

The fact is that 99% of all "orbs" are caused by dust, water droplets or other airborne particulate matter.

There's dust in the air all the time, even if you can't see it!

The amount and type of dust varies a lot and depends on many factors, including source, climate, wind direction and activity.

Dust is generated from a range of human activities and natural sources.

It may be made up of soil, pollen, volcanic emissions, vehicle exhaust, smoke, or any other particles small enough to be suspended or carried by or air currents. The stronger the current, the larger the particles lifted, and the more dust carried.

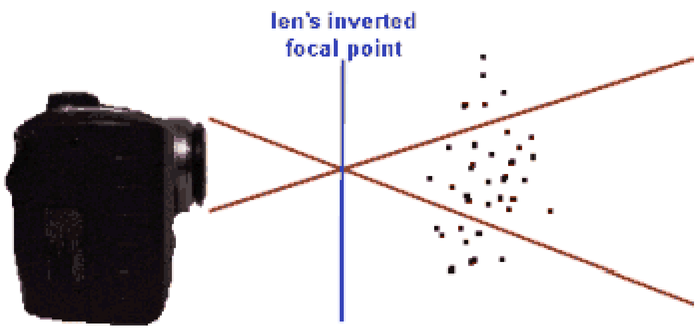
Clean rooms are used for testing purposes where dust must be monitored to ensure that no data is contaminated. They have classifications that are standardized classes based on airborne particle counts. For example, a class 100 clean room can have 750 particles per cubic foot that measure 0.2 µm, 300 at 0.3 µm and so on. If clean rooms can have that many particles in the air, think of what a typical living area may have.

A common misconception is that orbs are caused by dust in the camera or on the lens. This is false, as dust orbs are caused by airborne dust particles directly in front of the camera lens.

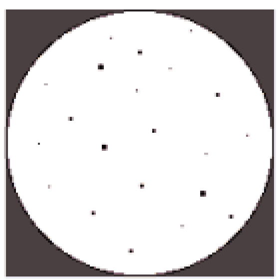
The most common orbs are caused by dust particles which float in the air.

You can see these dust particles with the eye when a strong sun-beam comes in through the window.

If one of these dust particles is floating just inches in front of the camera's lens, then the photographic flash makes it very bright. This bright dust particle is grossly out of focus, so it just shows up as a round spot of light in the picture.

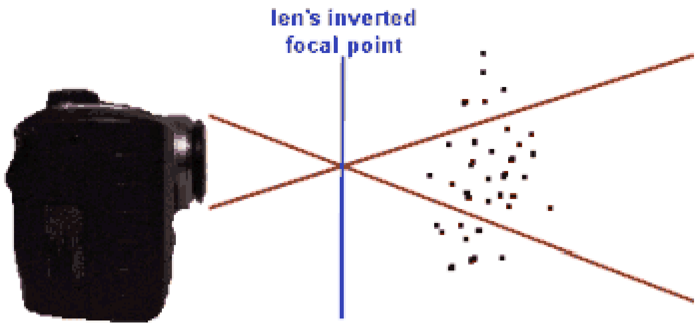


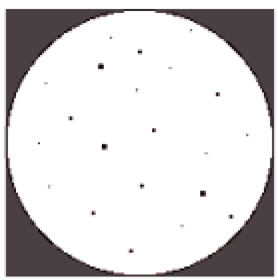
So how does this happen?



UV light from your camera's flash illuminates the dust and is then recorded by the camera's CCD.

The same phenomena can occur in NightShot video, except this time is light from the IR emitter bouncing off the airborne particles.





The image on the left shows how dust approaching the inverted focal point of the lens look more like orb phenomena. The camera lens's inverted focal point is the point that an object must be past to be in-focus. The closer they get to the lens the more they blur and become less distinct while dust particles near the focal point appear to be in focus and show apparent details such as a nucleus and rings. Dust past the focal point may or may not be recorded and if they are they simply look like white specks of light in your photograph. This is illustrated by the lower left picture.

The crucial factor in the equation is the UV light source from your camera's flash.
Digital cameras are sensitive to the UV and IR spectrums of light and this is why digital cameras are more likely to capture "orbs' than 35mm cameras. Snow, rain and pollen are also subject to this type of photographic effect.

Lens flare is another phenomena that can cause false positives. A camera lens has a number of elements that work together to focus an image onto film.

The insides of lenses are coated with an anti-reflective material to help reduce the amount of secondary reflections known as ghost. In the case where bright lights are facing the lens, the lens coating is not fully effective and secondary reflections occur producing what are known as lens flares.

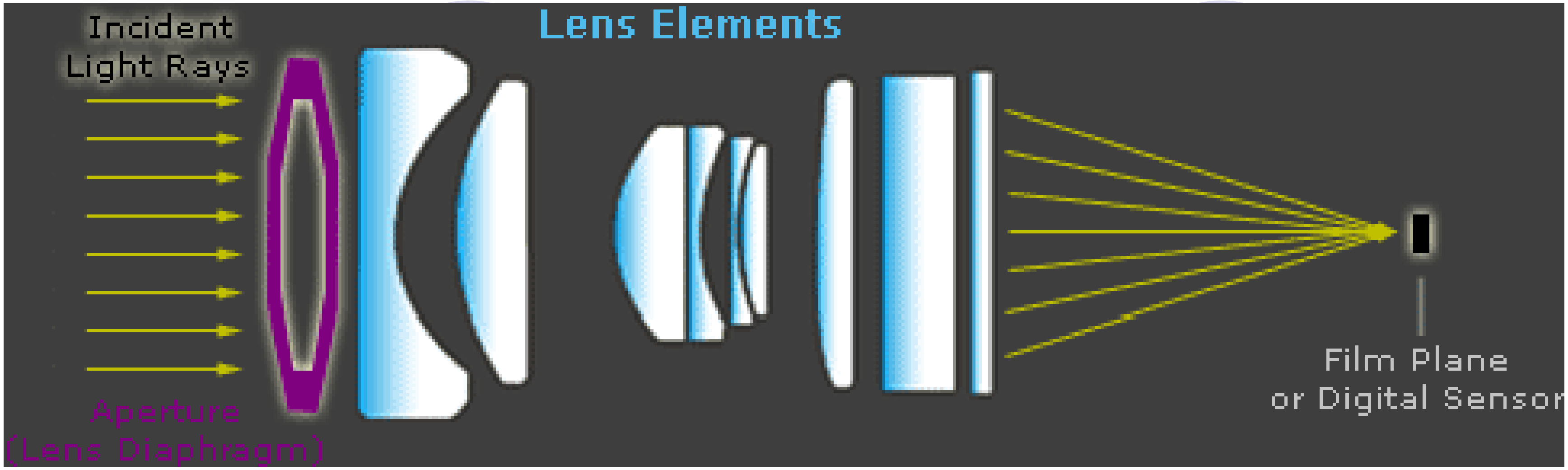
Lens flare is created when non-image forming light enters the lens and subsequently hits the camera's film or digital sensor.

This often appears as a characteristic polygonal shape, with sides which depend on the shape of the lens diaphragm. It can lower the overall contrast of a photograph significantly and is often an undesired artifact, however some types of flare may actually enhance the artistic meaning of a photo.

Understanding lens flare can help you use it -- or avoid it -- in a way which best suits how you wish to portray the final image.

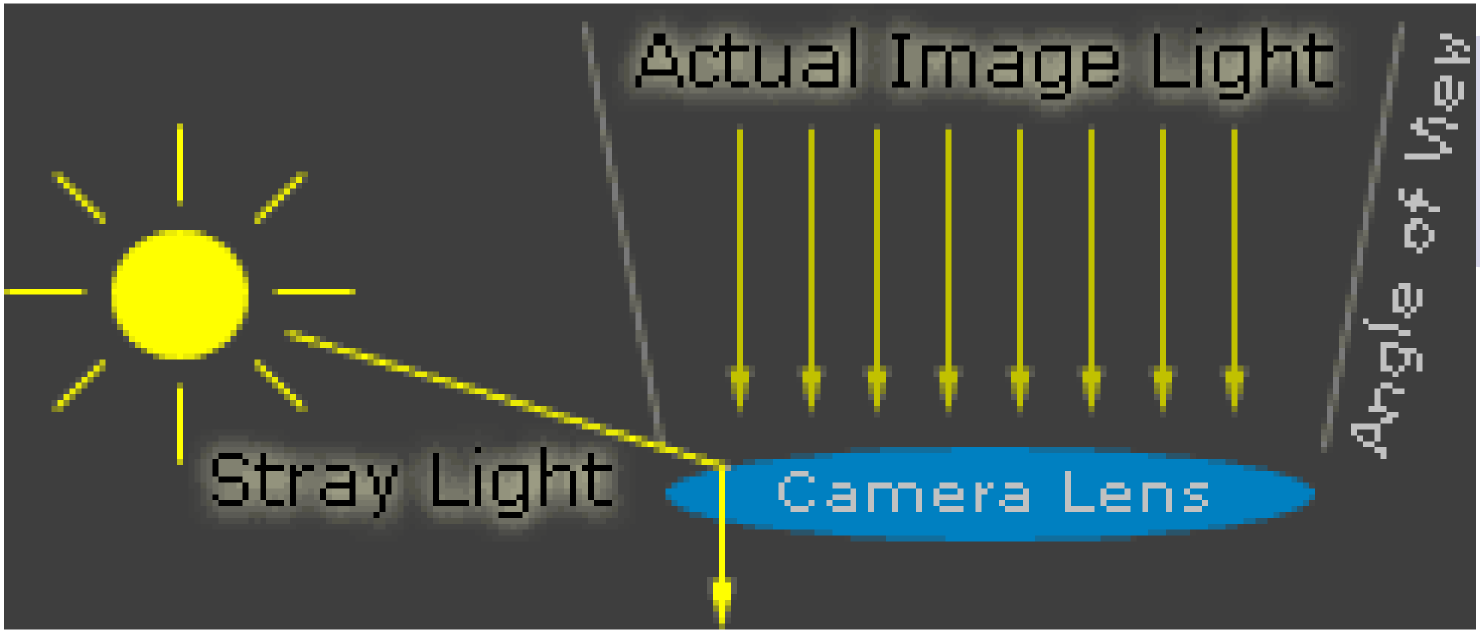
The above image exhibits tell-tale signs of flare in the upper right caused by a bright sun just outside the image frame. These take the form of polygonal bright regions (usually 5-8 sides), in addition to bright streaks and an overall reduction in contrast (see below). The polygonal shapes vary in size and can actually become so large that they occupy a significant fraction of the image. Look for flare near very bright objects, although its effects can also be seen far away from the actual source (or even throughout the image).

Flare can take many forms, and this may include just one or all of the polygonal shapes, bright streaks, or overall washed out look (veiling flare) shown above.



All but the simplest cameras contain lenses which are actually comprised of several "lens elements."

Lens flare is caused by non-image light which does not pass (refract) directly along its intended path, but instead *reflects* internally on lens elements any number of times (back and forth) before finally reaching the film (35mm), or digital sensor/ccd element (digital camera).

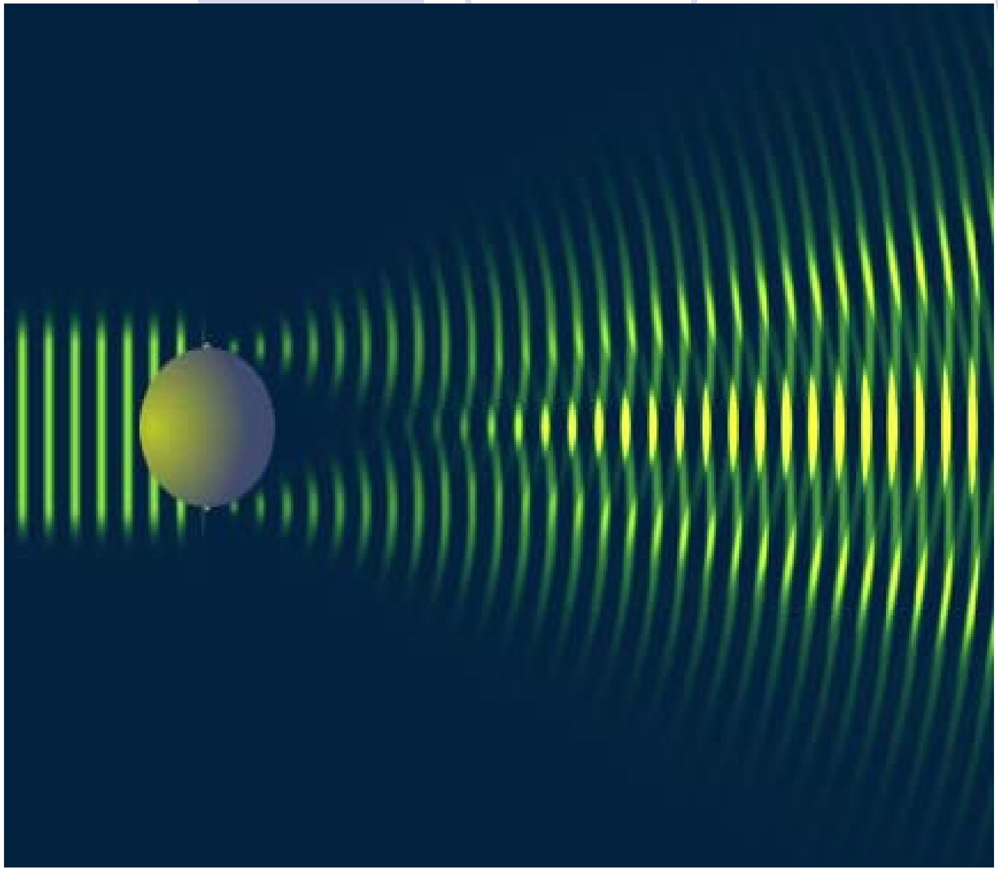


Lens elements often contain some type of anti-reflective coating which aims to minimize flare, however no multi-element lens eliminates it entirely. Light sources will still reflect a small fraction of their light, and this reflected light becomes visible as flare in regions where it becomes comparable in intensity to the refracted light (created by the actual image). Flare which appears as polygonal shapes is caused by light which reflects off the inside edges of the lens aperture (diaphragm), shown above.

Although flare is technically caused by internal reflections, this often requires very intense light sources in order to become significant (relative to refracted light). Flare-inducing light sources may include the CAMERA'S FLASH, sun, artificial lighting and even a full moon. Even if the photo itself contains no intense light sources, stray light may still enter the lens if it hits the front element.

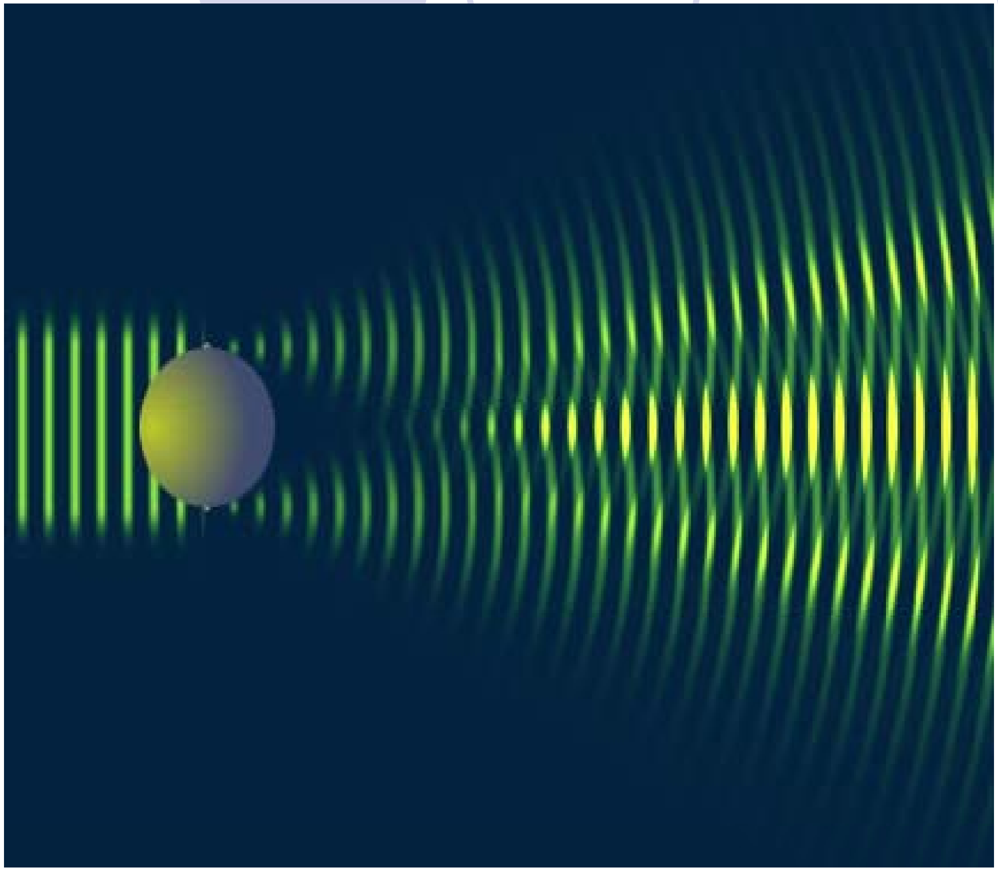
Ordinarily light which is outside the angle of view does not contribute to the final image, but if this light reflects it may travel an unintended path and reach the film/sensor. In the visual example with flowers, the sun was not actually in the frame itself, but yet it still caused significant lens flare.

Identifying false positives (dust orbs) in photographs using science.



Huygen's Principle predicts the future position of a wave when its earlier position is known. "Every point on a wave front can be considered as a source of tiny wavelets that spread out in the forward direction at the speed of the wave itself. The new wave front is the envelope of all the wavelets - that is, tangent to them."

This principle explains what happens when a wave hits an obstacle and the wave fronts are partially obstructed. It predicts that waves bend behind an obstacle, or diffract. Since diffraction only occurs for waves, not for particles, it verifies the wave nature of light.



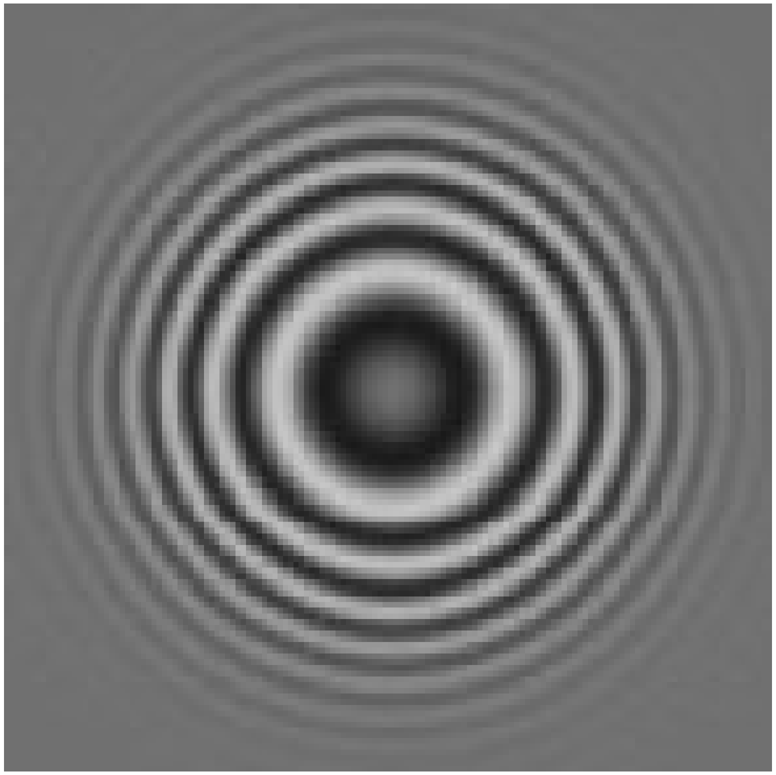
Diffraction is the spreading of light around the edges of a barrier. These form patterns called diffraction rings. In diffraction, the intensity of the bright lines (or fringes) is greatest for the central bright spot and decreases for the higher orders. Except for the central bright spot, the position of the fringe depends upon the wavelength of light.

The central bright spot appears as the original, un-diffracted light.

The higher order fringes, contain a spectrum of the light colors comprising the original light.

Their position depends upon their wavelength. One color of light is distinguished from another color by wavelength.

Dust orbs have certain characteristics, such as possessing some sort of nucleus, and elongation around the central axis towards the edges of the photos.
These are the diffraction rings.



A simple way of thinking about it is to consider a drop of water hitting a pond. Ripples are produced as the drop strikes the pond's surface. Light behaves in a similar fashion. The problem with identifying dust "orbs" is that the ability to see the diffraction rings is dependent on the resolution of the photograph and if the "orb" is in focus (not too close to the lens).

This image shows a typical diffraction ring pattern that is found in dust particles.

When light interferes, the light waves produce alternating bright and dark bands of colors (interference fringes); nodal lines appear as dark bands and anti-nodal lines appear as bright bands. Violet light (with the shortest wavelength) is the least diffracted and red light (with the longest wavelength) is the most diffracted.

Angstrom: 1 A = 1 x 10-10 m

1. Spectrum types: Continuous

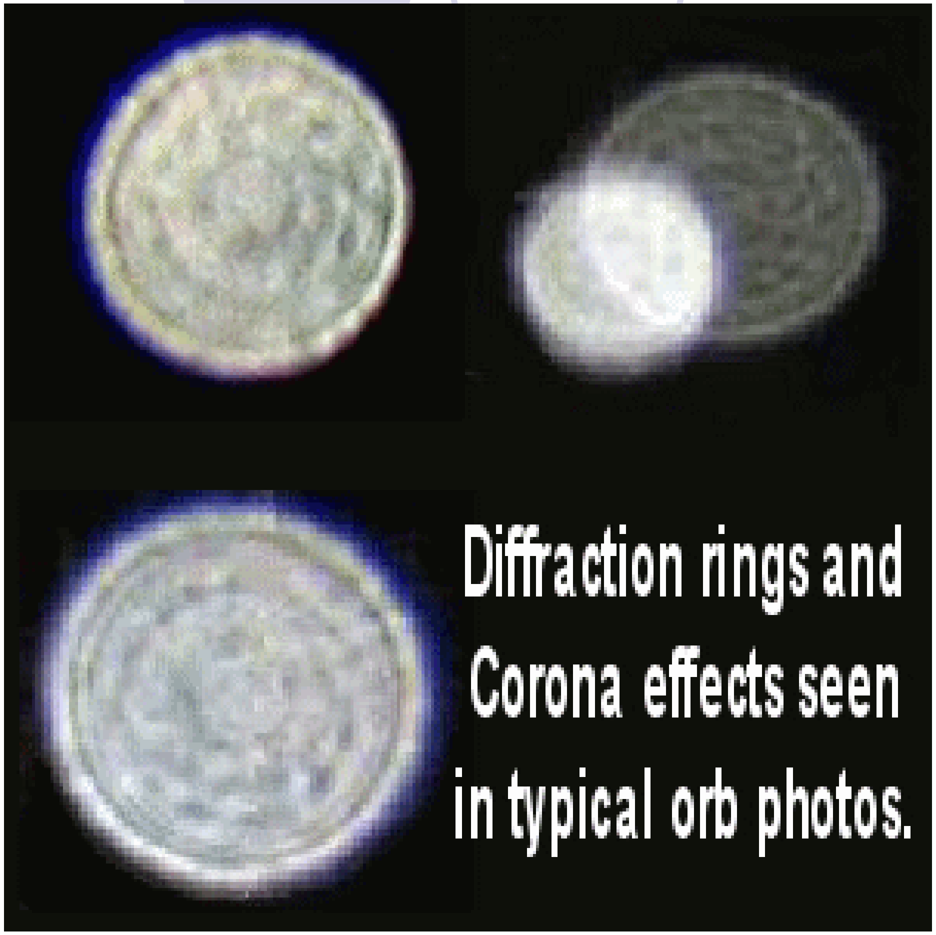
* produced by white light
* contains all the colors in the rainbow
* red light is diffracted the most and blue (violet) light is diffracted the least

2. Absorption (dark line)

* consists of dark lines on a continuous spectrum background
* energy is absorbed at characteristic frequencies

3. Emission (bright line)

4. Energy is emitted at characteristic frequencies



If you see diffraction rings in an orb, it is definitely dust as this phenomena occurs (in a photographic sense) only in very small and microscopic objects.

There are other signs to look for as well.

A corona is produced by diffraction of light by small particles. Every point on the illuminated surface is a source of scattered outgoing spherical waves (Huygens-Fresnel Principle).

Scattering from only two points is shown on the diagram. Along the central axis, the incident light direction, the crests of the two scattered waves always coincide to form a region where the light is strong.

Moving away from the axis, there is a direction where the crests again coincide to give beams of enhanced brightness at an angle to the incident light. In between there is a region where crests of one wave coincide with those of opposite amplitude of the other. The two waves cancel and there is darkness in those directions.

There is a another coincidence of wave crests at a larger angle and the light intensity is again enhanced. With increasing angular distance from the axis there are alternating bright and dark regions, a diffraction pattern.

In reality, light is scattered from all around the particle periphery and other low intensity waves arise from reflection and transmission through the particle.

The net wave amplitude at any point is the sum of the amplitude vectors, not intensities, of all the individual waves. The result is a very bright central region surrounded by less bright rings, a corona.

Corona formation, to a good approximation, needs no knowledge of the particle's interior because the surface scattered waves predominate. It could be water, ink or coal – the pattern is almost the same.

It depends primarily on the particle's size, shape and the wavelength of the light.

There is no need for the particle to be transparent nor even spherical. Small ice crystals, pollen grains and large dust particles all form corona. A white light corona is the sum of all the corona contributions from each spectral color.

Usually there will be more than one dust orb in the photos, and you get them most of the time at the location. Note that dust orbs are more likely to show up in a large number when you disturb the environment, such as when you just step into an empty room. You can analyze this effect in an image editing program by simply increasing the brightness of the photo.

Some photographs show geometric shapes, such as diamonds and octagon . This is caused by a lens curvature error known as "Coma“. Cameras with very small lenses and short focal lengths (such as digital cameras) are more prone to coma than other cameras with longer focal length lenses, such as SLR cameras.

When an object with a similar shape as the aperture of the camera lens is brought out-of-focus, the object will begin to take the shape of the aperture.

In other words, if the aperture of the camera is an octagon, an out-of-focus dust orb will begin to take the shape of an octagon, particularly towards the center of the image.

An example of Coma, magnified for clarity. Note that the picture has not been rotated, up in the picture is up in real life.

These are rain drops coming down, but the coma "tails" gives the impression that they are moving up.

One really REALLY COOL feature of orb photography & research:

They serve to break up the tedium and boredom during long investigations!

Fuji has posted ‘orb’ advisory

http://home.fujifilm.com/products/digital/shooting/flash.html

Flash reflections from floating dust particles

When you take pictures using the flash, whitish round dots appear in various parts of the image.

Causes and solutions

There is always a certain amount of dust floating around in the air. You may have noticed this at the movies when you look up at the light coming from the movie projector and notice the bright sparks floating around in the beam.

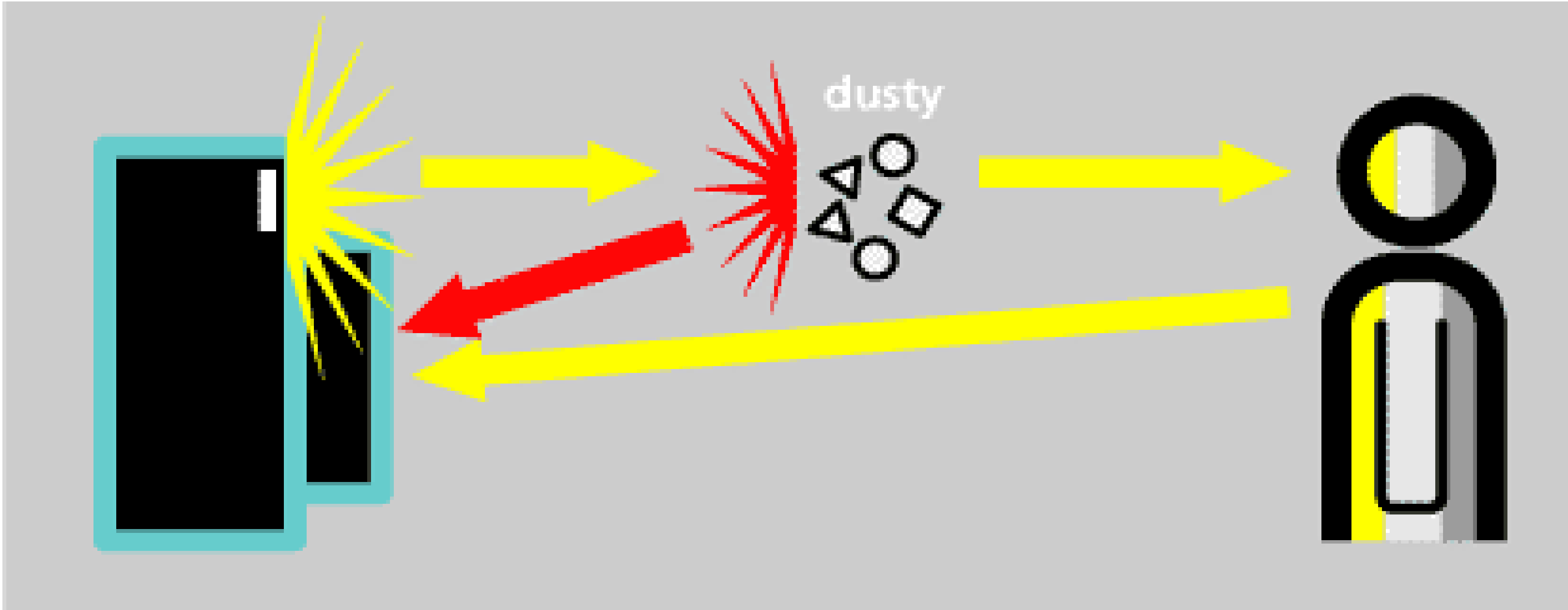
In the same way, there are always dust particles floating around nearby when you take pictures with your camera.

When you use the flash, the light from the flash reflects off the dust particles and is sometimes captured in your shot.

Of course, dust particles very close to the camera are blurred since they are not in focus, but because they reflect the light more strongly than the more distant main subject of the shot, that reflected light can sometimes be captured by the camera and recorded on the resulting image as round white spots. So these dots are the blurred images of dust particles.

You can reproduce this problem relatively easily by taking a picture right after you put away goods that create a lot of dust, such as feather bedding.

In actual photography, this problem frequently arises in shots taken at construction sites, etc. It may also occur when it is raining or snowing. Compact cameras in which the flash and the lens are close together are particularly susceptible to this problem.



Solutions

- Make the surroundings as bright as possible so that you can shoot without using the flash.
- If the flash is detachable, hold it away from the camera.
- Take the picture in a less dusty location.

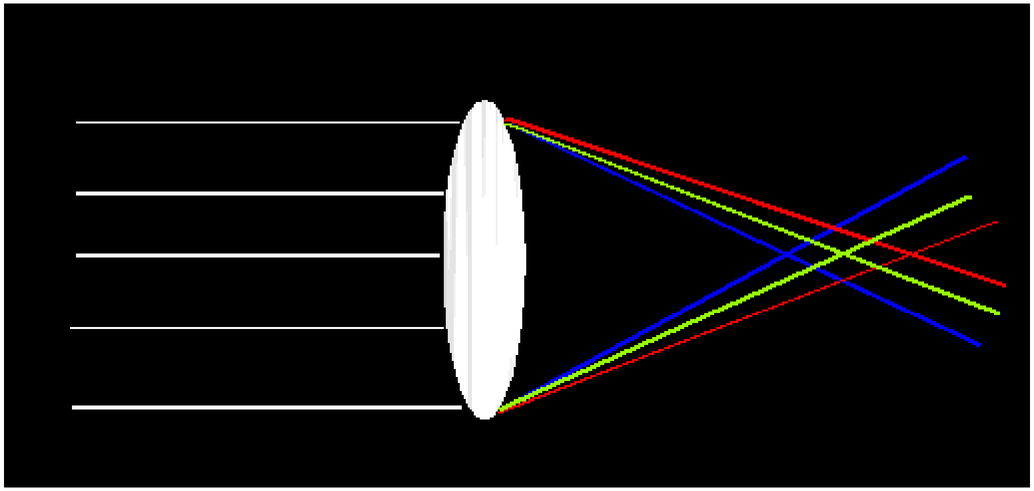
Other possibilities

Orbs can be caused by drops of Liquid - liquid orbs are usually created by rain droplets, moisture spots on the lens or some other water related reason. If a photograph is taken outside and rain drops are present in the air immediately in front of the camera then it is quite likely that orbs will show up on the picture.

Even raindrops too small to be seen easily with the naked eye, especially in the dark, can still produce large orbs in pictures. Each drop acts as a tiny mirror, an efficient one at that due to their spherical shape, reflecting a small amount of flash light straight back to the camera. So in a relatively dark scene, each rain drop returns a relatively large amount of light for it's size.

Chromatic Aberration

More than 200 years ago, Newton showed that white light was composed of multiple wavelengths. Simple lenses will refract (bend) light differentially as a function of wavelength. Short (blue appearing) wavelengths are refracted more than long (red appearing) wavelengths. Consequently, lenses like the one shown below will not image light all in one place.



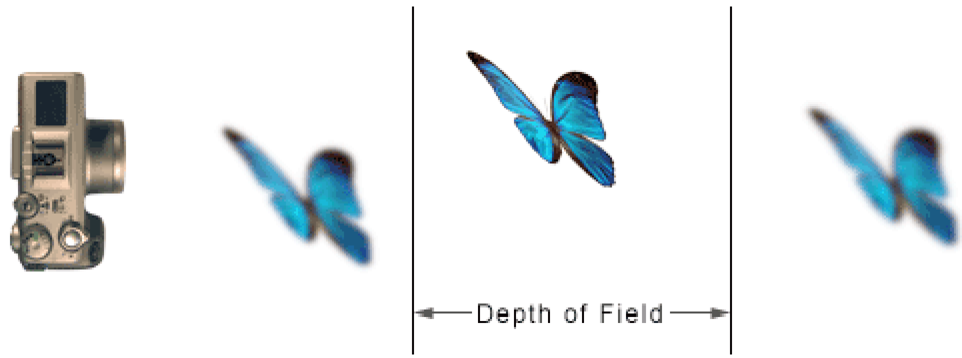
This example of Chromatic Aberration also exhibits the Cats Eye Effect.

What makes Solid particles or drops of Liquid cause Orbs?

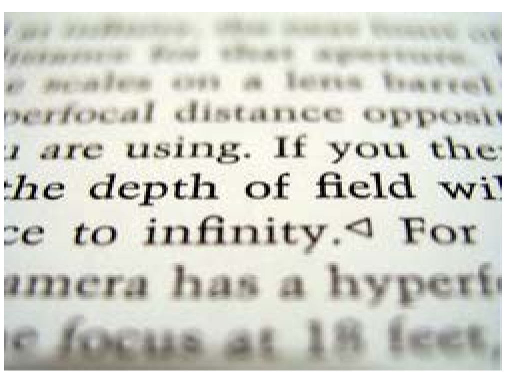
The fundamental cause in either case is to do with some thing called:

- Depth of Field

- Circle of Confusion.

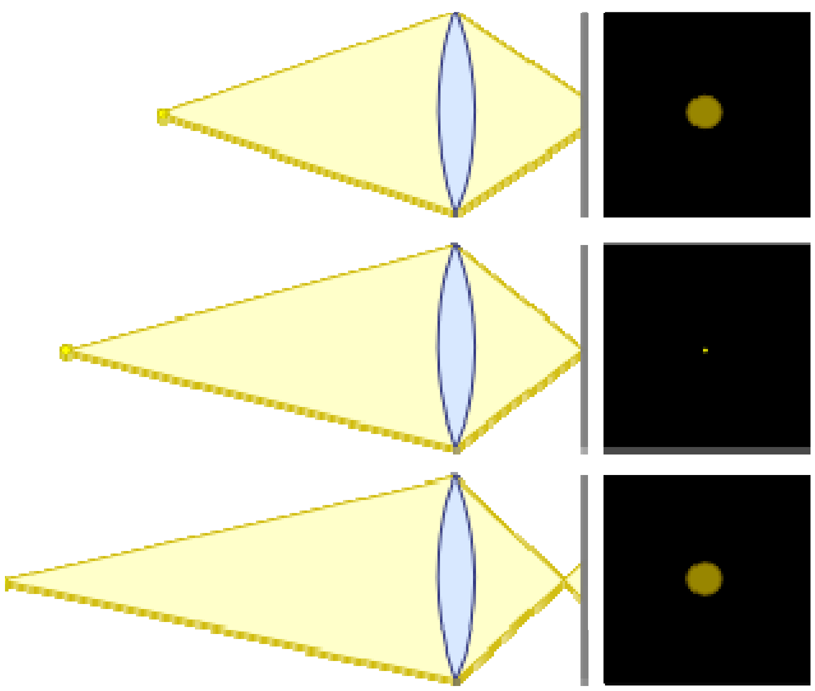


In optics, particularly film and photography, the depth of field (DOF) is the distance in front of and behind the subject which appears to be in focus. For any given lens setting, there is only one distance at which a subject is precisely in focus, but focus falls off gradually on either side of that distance, so there is a region in which the blurring is tolerable. This region is greater behind the point of focus than it is in front, as the angle of the light rays change more rapidly; they approach being parallel with increasing distance.**



The area within the depth of field appears sharp while the areas in front and behind the depth of field appear blurry.

Light from a point source at the correct distance will produce the image of a point on the film. A point farther away or nearer will produce the image of a disk whose border is known as "circle of confusion."



This diagram show how a Circle of Confusion is created when the object being photographed, on the left here, is not at the exact focal point, also known as the hyperfocal point.

Flashing orbs

Sometimes in video footage, orbs that flash on and off repeatedly, are seen.

A likely cause for these flashings orbs may be that they are flat dust particles that are rotating. If a reflective airborne particle is flat then it is highly improbable that it will constantly present the same side of itself to the viewer, it will most likely rotate as it moves. Therefore alternate sides will be seen as it rotates. At the times where the camera is presented with the most surface area of this flat rotating particle, face on, it will reflect the most amount of light to the camera and will appear lit, or on. It doesn't matter which side, front of back is being presented.

But when the edge of the particle is being presented it will be all but invisible due to the lack of visible surface area needed to reflect light back to the camera and will appear unlit, or off. So as it rotates an alternate edge, face, edge, face, are seen. This gives rise to the flashing effect that we occasionally see.

As flashing orbs are quite rare we can deduce that most dust particles are not flat but are roughly spherical or thread-like structures - in this way the amount of light reflected from them from any given angle would roughly be constant.

Thank you!

Any questions?