How does the Marinebeam Long Range Illuminator RLT really work?

It is important to realize that for LED spotlight applications, the Recycled Light Technology (RLT) within the Long Range Illuminator really works in several ways. Because of these patented improvements to light output, no other LED flashlight can compete with the brightness and throw of the beam. Even at very low lumen levels our Illuminator outshines much more powerful flashlights.

The reason RLT will always be king is because it can be added to any LED, no matter the power, and still increase the output. So, if any LED spotlight or lens technology comes along that is a contender, we can make it up to 2.5X brighter with the RLT technology. The best part is RLT is completely passive, and can be easily added to most any LED.

We will get to the ways that RLT affects the brightness and throw shortly, but first let's look at the conventional LED spotlight and how it works.

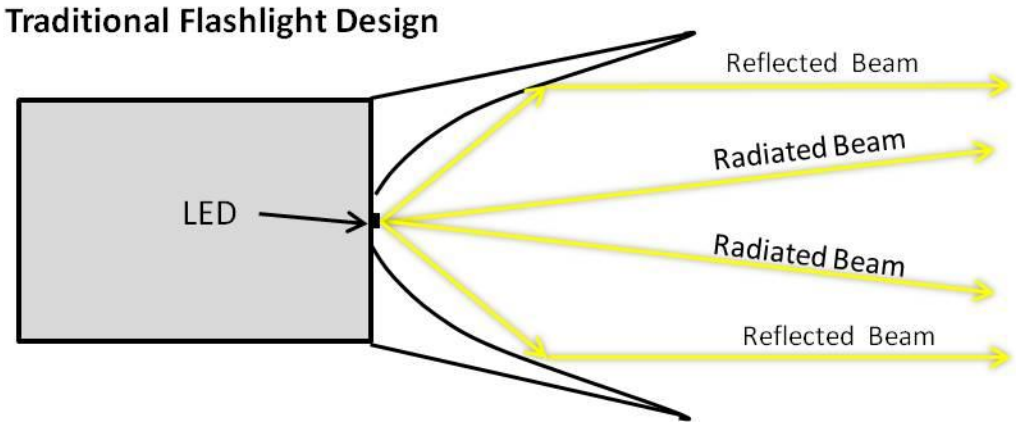
The most important point to know is that all conventional spotlights have 2 beams: The direct beam from the light source, and the reflected light that has been redirected by the reflector. This is obvious in the conventional LED and incandescent flashlights where you see two or more distinctive halos of light when you shine the beam upon a wall. The RLT, however, has only one beam. With the RLT, you will see that there is only one beam, and that is fully collimated, and actually projects an image of the LED chip itself when shined upon a distant object. You will also note that with the RLT there is no spill-over light whatsoever, so no second beam.

The pictures below illustrate the amount large amount of light wasted by a typical long range flashlight beam:

Typical aspherical flashlight spillover

Marinebeam light has no spillover

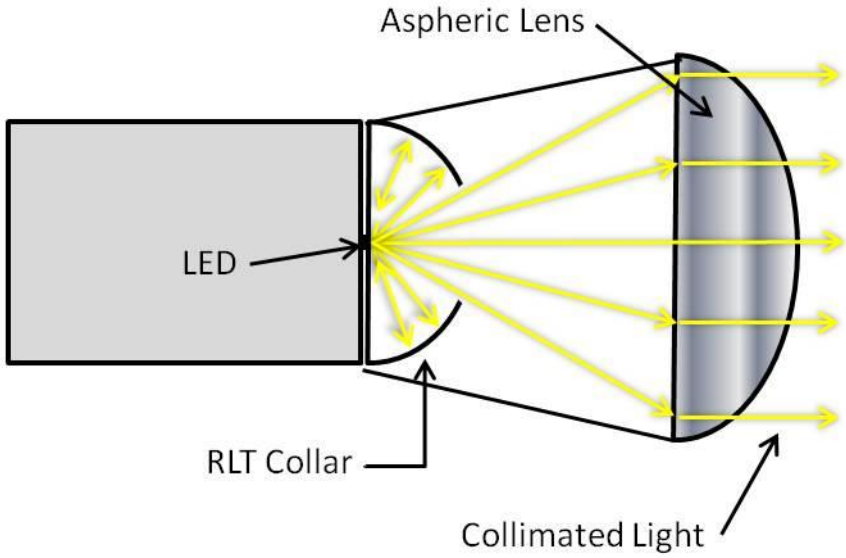
Normal flashlights have a parabolic reflector to redirect the high angle light from the LED out the end of the flashlight. If you shine a traditional LED or incandescent flashlight against a wall, then you will see that there are indeed 2 beams. One is a center "hot spot" and a second, less bright, and much wider halo beam . The hot spot is the reflected wide-angle light, while the less intense and wider light is the un-reflected radiated light coming directly from the LED. This is the "spillover" light. The RLT technology does not use such a reflector, and has no spill-over light, so, all of the light energy the LED is producing is in the center beam.



How does it do it?

The RLT is in fact a spherical collar with a hole in its center. its reflective inner surface faces the LED itself. It works by capturing all of the wide angle spillover light, and re-directing it back onto the surface of the LED. That is, sending all of that spill-over light back to the LED chip. This light, which is redirected onto the LED, re-excites the LED's phosphors and creates more white light in the center beam. In the center of the RLT collar is a hole, which allows all of the narrow angle light to pass through to the lens. This means both the LED's original center beam plus the recycled light, passes through the collar to the lens. The spillover light is added to the main beam, and boosted by the re-exciting of the phosphors.

Marinebeam RLT Design



To understand this better, it helps to know that white LED light is actually made by starting with a blue LED, and then adding a phosphor mix to its surface, which will absorb that blue wavelength light emitted by the LED die and re-emit it in a new wavelength (technically a group of different wavelengths that combine to make up white light). The resultant white LED light sometimes still has a bluish cast, and that is because it still has a dominant blue wavelength. What the RLT does is send that light back to the LED so it is re-converted into more white light. The RLT has taken the normally wasted spillover light, and not only redirected it into the center beam, but also given it a boost by creating more white light. So, there are really at least two mechanisms at work here.

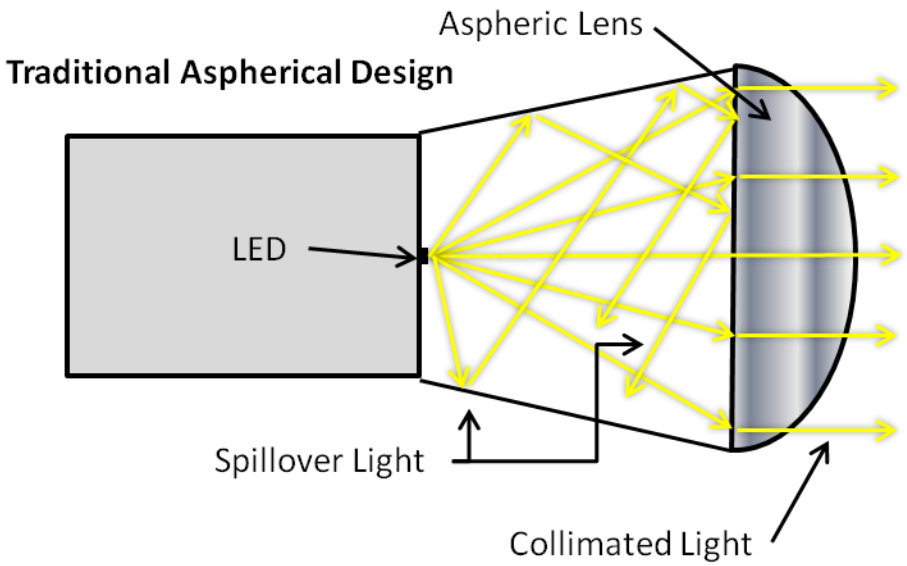
When the blue light is converted to white light, it actually converts to a warmer color temperature as well. This means that we can start with a bluer or cooler LED, which has more efficacy than a warmer white light, yet still end up with a more aesthetically-pleasing and "whiter" light. Brighter too!

So, we not only capture and redirect the normally wasted spillover light, but we also recycle that light to create more white light.

With our Illuminator we are not necessarily trying to make the most powerful LED light. Quite the contrary. What we are trying to do is increase the efficiency of the light so we can use the least amount of LED energy to create the brightest light, with the longest beam distance. So, fewer Watts, but more light.

With the RLT mechanism described above, we have already removed the spillover light and then added it, with a boost, to the main beam. Something no other flashlight or LED can do. So, at this point there is already only a single beam. While the beam is already more distributed and intense, we now need to collimate the light into a narrower beam to get the distance we want. Collimation is essentially making a spot light with an infinite focal distance. To do that, we use an aspheric lens. An aspheric lens collimates (or makes parallel) any light beams which travel through its focal point. So, positioned correctly, it makes a nice long beam. It also "images" the LED chip. This means that is projects a picture of the chip on the wall. A nice clean picture, with sharp edges.

"But wait" you say. "I have seen such flashlights before!" Indeed. There are many flashlights on the market using aspheric or TIR lenses that project an image and seem to have no spill-over light. How is this so? Well, it helps to remember that these flashlights still have two beams. They are only "hiding" (or losing) the second beam. This means they are focusing the main beam only, and therefore losing all of the spill-over light that can account for up to 50% of the total lumens. To prove it to yourself, look inside a light with an aspheric or zoomable lens. You will note that there is no reflector. You already know there is spill-over light from the LED itself, even without the reflector, but where is it going? There is no RLT, so it is not captured, and it is at too high of an angle to go through the lens or its focal point. So, it is just bouncing around endlessly inside the flashlight housing to be lost forever.



In the case of the RLT, that wasted light is actually captured, intensified, and added back to the main beam. So, it is not only brighter, but it all goes through the lens at relatively small angles. So, no spill-over whatsoever. No wasted light, and all of the available energy from the LED goes down range.

To review, here is a recap of some of the mechanisms contributing to the brighter, longer range light with RLT:

1. The RLT captures the spillover light and redirects it back to the LED.
2. The LED is re-excited and converts the blue wavelength in the LED light to more white light.
3. Unconverted light is also redirected due to scatter.
4. The second beam is removed entirely, allowing all of the light to travel through the focal point of the lens and be collimated. No wasted light, no second beam.
5. A more powerful, but bluer cool-white LED, can be specified, yet result in a warm LED color. This means you can get a brighter more efficacious light, and still get the pleasing color of a less bright selection.