Text Description of Webb Diffraction Spikes Infographic

Extended Description

This is a diagram labeled “Webb’s Diffraction Spikes”. The top right of the image shows three stars producing eight-pronged diffraction spike patterns. This diagram is composed of five sections.

The first section is headlined “What Are Diffraction Spikes?” Below the headline is a caption that says, “Have you ever noticed that bright stars in your favorite space images have unique spikes around them? These are known as diffraction spikes. Diffraction spikes are patterns produced as light bends around the sharp edges of a telescope. While all stars can create these patterns, we only see spikes with the brightest stars when a telescope takes an image. For most reflecting telescopes, including Webb, diffraction spikes appear when light interacts with the primary mirror and struts that support the secondary mirror.” Below this is an image of Webb’s observing side, including its 18 gold hexagonal segments, science instruments, primary mirror, struts and secondary mirror.

The second section is headlined “How Does Diffraction Happen?” Underneath this headline is a caption that says, “Light, which has wave-like properties, tends to radiate from a central point outward, similar to how water behaves when a stone is tossed into it. As light encounters an edge, it is bent and redirected, sending it in different directions. In situations where these light waves meet and interact, they can either become more amplified or cancel each other out. These areas of amplification and cancellation form the light and dark spots that show in diffraction patterns.” Underneath this caption are two boxes, lined horizontally. The first box, on the left, is a star that displays Hubble’s Diffraction Pattern, which has four-points – two vertical and two horizontal points. The second box, on the right, is a star that displays Webb’s Diffraction Pattern, which has eight-points – two vertical, two horizontal and four diagonal points.

The third section is headlined, “Primary Mirror Influence”. Underneath this headline is a caption that says, “Primary mirrors in reflecting telescopes cause light waves to interact as they direct light to the secondary mirror. So, even if a telescope had no struts, it would still create a diffraction pattern. The shape of the primary mirror, in particular the number of edges it has, determines the mirror’s diffraction pattern. Light waves interact with those edges to create perpendicular diffraction spikes.” Underneath this caption are six images, broken into rows of three. The first three are labeled, “Primary Mirror Shape”, which display a circle, square and hexagonal shape, like Webb’s, in white. The last three are labeled, “Image of Point Source”, and display the patterns due to the “Primary Mirror Shape” underneath. The first displays a diffraction pattern with a solid, bright center and alternating dark and light circles. The next shows a six-pointed spike pattern with alternating bright and dark regions. The last shows a complex fractal of light and dark regions within eight spikes – the closest representation to Webb’s.

The fourth section is headlined, “Strut Influence”. Underneath this is a caption, which describes the graphic below it, and says, “The number and position of struts holding up the

secondary mirror determine the struts' diffraction spike pattern. In the first row, there is a set of struts organized in a single line. When light hits a strut, the light bends into a single, perpendicular pattern of amplified and cancelled light (represented by a yellow dashed line). In the second row, a second set of struts is added to the first, creating a second, perpendicular diffraction spike (represented by a red dashed line). In the third row, there are three struts with two of them at an angle. In this case, there would be three diffraction spikes, with each spike perpendicular to a strut (represented by yellow, red, and blue dashed lines)."

The last section is headlined, "Webb's Eight-Pointed Stars". Underneath the headline is a caption that says, "Like most reflecting telescopes, the diffraction spikes for Webb are defined by its primary mirror and struts. Webb has three struts, with two angled at 150 degrees from its vertical strut, and its primary mirror is composed of hexagonal segments that each contain edges for light to diffract against. Webb's struts are designed so that their diffraction spikes partially overlap with those created by the mirrors. Both of these lead to Webb's complex eight-pointed star pattern." At the bottom of this diagram is Webb's eight-pointed star pattern organized by its "Strut Influence", which overlaps parts of the star with red borders, and its primary mirror influence, which overlaps parts of the star with yellow borders. Above this image are more images that show the Webb's segmented primary mirror and struts, with the primary mirror's borders highlighted yellow and its struts highlighted red.