

VERA'S WORK ON **DARK MATTER AND THE MOVEMENT OF GALAXIES** TRANSFORMED OUR UNDERSTANDING OF THE UNIVERSE. IN HER CAREER, SHE USED HER INFLUENCE TO ADVOCATE FOR WOMEN AND DIVERSITY IN SCIENCE.

"THE IMPLICATION IS THAT MOST OF THE MATTER IN THE UNIVERSE IS NOT RADIATING AT ANY WAVELENGTH THAT WE CAN OBSERVE. AT LEAST **NINETY PERCENT** OF THE MATTER IN THE UNIVERSE IS DARK."

"WE BECAME ASTRONOMERS THINKING WE WERE STUDYING THE UNIVERSE, AND NOW WE LEARN THAT WE ARE JUST STUDYING THE FIVE OR TEN PERCENT THAT **IS LUMINOUS.**"

"**IN A SPIRAL GALAXY**, THE RATIO OF DARK-TO-LIGHT MATTER IS ABOUT A FACTOR OF TEN. THAT'S PROBABLY A GOOD NUMBER FOR THE RATIO OF OUR IGNORANCE-TO- KNOWLEDGE. WE'RE OUT OF KINDERGARTEN, BUT ONLY IN ABOUT THIRD GRADE."

Her observations were confirmed each time.

Prominent astronomers ridiculed her work, insisting they could prove her wrong. They tried.

Building on earlier theories and her own observations, **VERA PROPOSED THAT THERE IS MORE MATTER IN THE UNIVERSE THAN WHAT WE CAN SEE**—much more! Without it, the laws of gravity just don't work—galaxies should just fall apart.

In the 1970s, astronomers assumed that **STARS AT THE EDGES OF GALAXIES WOULD MOVE SLOWER THAN STARS AT THE CENTER.** In theory, it made sense. Mercury moves much faster than Neptune because it's closer to the Sun. But Vera observed that stars at the edges of the Andromeda galaxy moved much faster than expected.

THE PALOMAR OBSERVATORY, 1965

But Vera's most important observation revealed **SOMETHING WE CAN'T SEE.**

Many male astronomers were skeptical of her career choices and her revolutionary astronomical observations.

It's a real problem, because we don't have a lady's room

Now you do.

During the Great Depression, a young girl named Vera built a telescope from cardboard tube and an old lens. **SHE LOOKED UP AT THE STARS AND NEVER STOPPED.**

WE KNOW SO LITTLE ABOUT THE VAST, DARK COSMOS. WHAT WE DO KNOW, WE OWE TO SCIENTISTS LIKE DR. VERA RUBIN, WHOSE OBSERVATIONS REVEALED 90% OF THE STUFF IN THE UNIVERSE.

BIG HISTORY PROJECT | Written by BENNETT SHERRY | Art by KAY SOHINI

# REVEALING THE DARK - VERA RUBIN

1928-2016