**THE BREAKTHROUGH INITIATIVES: A NEW SEARCH FOR LIFE IN THE UNIVERSE.** S. Pete Worden and Pete Klupar[1] Breakthrough Prize Foundation, 3000 Sand Hill Road, 4-180, Menlo Park, CA 94025, USA, pete@breakthroughprize.org.

**Introduction:** The **Breakthrough Prize Foundation** was founded six years ago to celebrate the achievements of the world's most extraordinary scientists.

On July 20, 2015 at the Royal Society in London, Yuri Milner and Stephen Hawking announced the **Breakthrough Initiatives** - founded by Yuri and Julia Milner to explore the Universe, seek scientific evidence of life beyond Earth, and encourage public debate from a planetary perspective. Funded at $100M, these include a Search for Extra Terrestrial Intelligence (SETI) called 'Breakthrough Listen' and a prize contest entitled 'Breakthrough Message'. Radio SETI observations have begun at the Green Bank Radio Telescope and Optical SETI at the Lick Observatory both situated in the United States. Further Radio Observations will soon commence at the CSIRO Parkes Radio Telescope in Australia. Radio and Optical observatories in Chile may also play a key role in detecting SETI signals – particularly from the nearest stars such as Alpha Centauri as well as regions of the galactic center only visible from the southern hemisphere

On April 12, 2016 atop the One World Observatory in New York, Yuri Milner and Stephen Hawking announced 'Breakthrough StarShot', an initiative to develop and launch Earth's first interstellar probe to our nearest star system, Alpha Centauri, within a generation. Facebook's Mark Zuckerberg joined Milner and Hawking to oversee the initiative – initially funded at $100M. These Initiatives are global in scope and impact with open-source scientific results made available internationally.

In the last decade and a half, rapid technological advances have opened up the possibility of light-powered space travel at a significant fraction of light speed. This involves a ground-based **light beamer** pushing ultra-light **nanocrafts** – miniature space probes attached to **lightsails** – to speeds of up to 100 million miles an hour. Such a system would allow a flyby mission to reach Alpha Centauri – four and a half light-years away - in just over 20 years from launch, and beam home images of possible planets, as well as other scientific data.

Breakthrough Starshot aims to demonstrate proof of concept for the ultra-fast light-driven nanocrafts, and lay the foundations for a first launch to Alpha Centauri within the next generation. Along the way, the project could generate important supplementary benefits to astronomy, including solar system exploration and detection of Earth-crossing asteroids.

A number of hard engineering challenges remain to be solved before these missions can become a reality. Breakthrough StarShot has three phases. The first, $100M phase will proceed during the next number of years to develop the key technologies in laser beamer and lightsail technology. If successful the next phase would be a privately-funded $500m-$1billion prototype system designed to propel a nanocraft at an order of magnitude or more than possible today. This effort would be followed by a public-private partnership to build the system that could direct hundreds of nanoprobes to the Alpha Centauri system at 20% the speed of light – making the journey in about 20 years and sending images back to earth. Our goal is to develop a system of similar cost to the CERN Large Hadron Collider and to launch humanity's first interstellar probes within a generation.

The key element of the StarShot system will be the laser beamer – estimated to consist of an optical system a square kilometer in scale. The beamer will be located in the Southern Hemisphere in order to be able to access the Alpha Centauri system. The best location for the beamer is at a very high, dry site. Our analyses show the best sites are in the Atacama Desert in Chile.

On August 24, 2016 the European Southern Observatory (ESO) announced the discovery of a potentially earth-like planet orbiting Proxima Centauri – the third and smallest star in the triple star Alpha Centauri system. The observations were made using ESO's Very-Large Telescope (VLT) at the Paranal Observatory.

On Jan 9, 2017, in Santiago Chile the Breakthrough Initiatives announced a joint project with ESO to use the VLT to determine if similar planets orbit the other two stars in the Alpha Centauri system. Other ground and space-based observations are under study to supplement and expand our search for a nearby life-bearing planet. The StarShot probes are designed to further study and confirm the character of these exoplanets.