Douglas Hudgins
NASA Headquarters
douglas.m.hudgins@nasa.gov
NASA’s Kepler Mission:
Searching for planets around other stars
The Kepler Field of View
May 2009 – May 2013
Detecting Planets
Exoplanet Missions

Hubble
Spitzer
Kepler
JWST
TESS
WFIRST-AFTA
New Worlds Telescope

Ground-based Observatories

2001 Decadal Survey
Astronomy and Astrophysics in the New Millennium

2010 Decadal Survey
New Worlds, New Horizons in Astronomy and Astrophysics
Elisa Quintana
SETI Institute at NASA Ames
elisa.quintana@nasa.gov
Searching for Habitable Worlds

The right size but hotter than Earth

Kepler-20e

Artist’s concept
Searching for Habitable Worlds

The right distance from its star but larger than Earth

Kepler-22b

Artist’s concept
Searching for Habitable Worlds
The right size and distance from the star!

Artist’s concept
Announcing Kepler-186f

The first validated Earth-size planet in the habitable zone of another star

Artist’s concept
The Kepler-186 System

Artist’s concept
Composition of Kepler-186f

Artist’s concept

MORE DENSE

Iron

Rocky

Ice

LESS DENSE
Earth, the one planet we know has life
Kepler-186f – the planet closest in size to Earth in the habitable zone of another star
• Kepler-186f is the first validated Earth-size planet in the habitable zone of another star
  • Right size – only 10% larger than Earth
  • Right distance from its star – 130-day orbit
• This discovery confirms that Earth-size planets exist in the habitable zone of other stars!
Tom Barclay
Bay Area Environmental Research Institute at NASA Ames

thomas.barclay@nasa.gov
M Dwarfs are Smaller, Cooler, Dimmer

G dwarf

Sun

M dwarf

Kepler-186
Detecting Planets around M dwarfs is Easier

G dwarf

Sun

M dwarf

Kepler-186

TIME

BRIGHTNESS

TIME

BRIGHTNESS
More Frequent Transits

Artist's concept

Earth

Kepler-186f

Kepler-186 System

Solar System

Planets and orbits to scale
M Dwarfs: Most Abundant and Nearest Stars

7 out of 10 stars in our galaxy are M dwarfs

The Sun’s nearest neighbors are M dwarfs
From Habitable Zone to Habitable Environment

Just because a planet is in the habitable zone doesn’t mean it’s habitable
Summary

• Kepler-186f demonstrates that Earth-size planets exist in the habitable zone of other stars

• Kepler-186f orbits a cooler star – more like Earth’s cousin than Earth’s twin

• M dwarfs are compelling targets to search for other Earths:
  • Most abundant
  • Nearest neighbors

• Future missions will characterize the planets around M dwarfs
Victoria Meadows
University of Washington
Virtual Planetary Laboratory Lead Team,
NASA Astrobiology Institute
vsm@astro.washington.edu
M dwarf planets may be the most common type of habitable world.
But the environments of these Earth cousins may be very different.
Factors Affecting Habitability

The star’s gravity and radiation can both affect habitability
Light from the M dwarf is redder than the light from our Sun

This changes how the planet interacts with its star’s light
Photosynthesis

If the planet is habitable, then photosynthesis may be possible
Summary

Kepler-186f is the first confirmed Earth-sized planet in the habitable zone of another star.

M dwarf planets interact differently with their parent star.

The majority of environments for life in the Universe might orbit M dwarfs.

Planets like this one will likely provide our first opportunity to search for life beyond the Solar System.