Humanity's next big Journey: Exploring Proxima Cen b and Habitable Planets around Nearby Stars

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Why directly imaging?

Spectrum of Earth (taken by looking at Earthshine) shows evidence for life and plants.
Taking images of habitable exoplanets: Why is it hard?
Coronagraphy ... Using optics tricks to remove starlight (without removing planet light)

← Olivier's thumb...
the easiest coronagraph
Doesn't work well enough to see planets around other stars

We need a better coronagraph... and a larger eye (telescope)
Water waves diffract around obstacles, edges, and so does light.
HR8799
Four planets, orbital periods on the order of 100yr
Each planet 5 to 7 Jupiter Mass

Subaru Telescope/ SCExAO (Currie et. al 2017)
M-type stars (low mass)

Habitable zone is close to star  
→ **big telescope needed to resolve it**
Star is fainter, so Star/Planet contrast is easier  
→ **can be done from ground** (no need to be in space)
Thirty Meter Telescope
Giant Magellan Telescope
European Extremely Large Telescope
Interstellar travel: pre-2000 studies

Several serious studies (Longshot, Orion, Deadalus)

Propulsion challenge is significant

Project Orion – using nuclear propulsion, massive spacecraft
Starshot project: Laser propulsion, robotic spacecraft (no human)

Leverages current/future technology developments:

- Small spacecraft (~gram)
- Ground-based laser propulsion (“don't carry your fuel”)

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~300 billion stars in our galaxy
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~30 billion habitable planets?

If 100 explorers were sent to visit each habitable for 10 seconds (only 300 million planets/explorer)...

... it would take 95 yrs to complete the habitable exoplanets tour ... in our galaxy alone
200 billion galaxies in the observable universe