Exoplanet Science in the UV

The request I received for today's talk:

"~10 min quasi-review talk on exoplanet science in the UV that takes into account decadal recommendations and mission concepts at all scales that map to the science aims."

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(currently on sabbatical at the Harvard/Smithsonian Center for Astrophysics)

Evgenya Shkolnik, UVSTIG, January 10, 2022

Credit: Abel Mendez

Astro2020 Exoplanet Science Questions

From the EASS Panel —
Exoplanets, Astrobiology, and the Solar System

Q1. What is the range of planetary system architectures?

Q2. What are the properties of individual planets, and what processes lead to planetary diversity?

Q3: How do habitable environments arise and evolve within the context of their planetary systems?

Q4. How can signs of life be identified and interpreted within the context of their planetary environments?

Discovery Area (DA): The search for life on exoplanets.

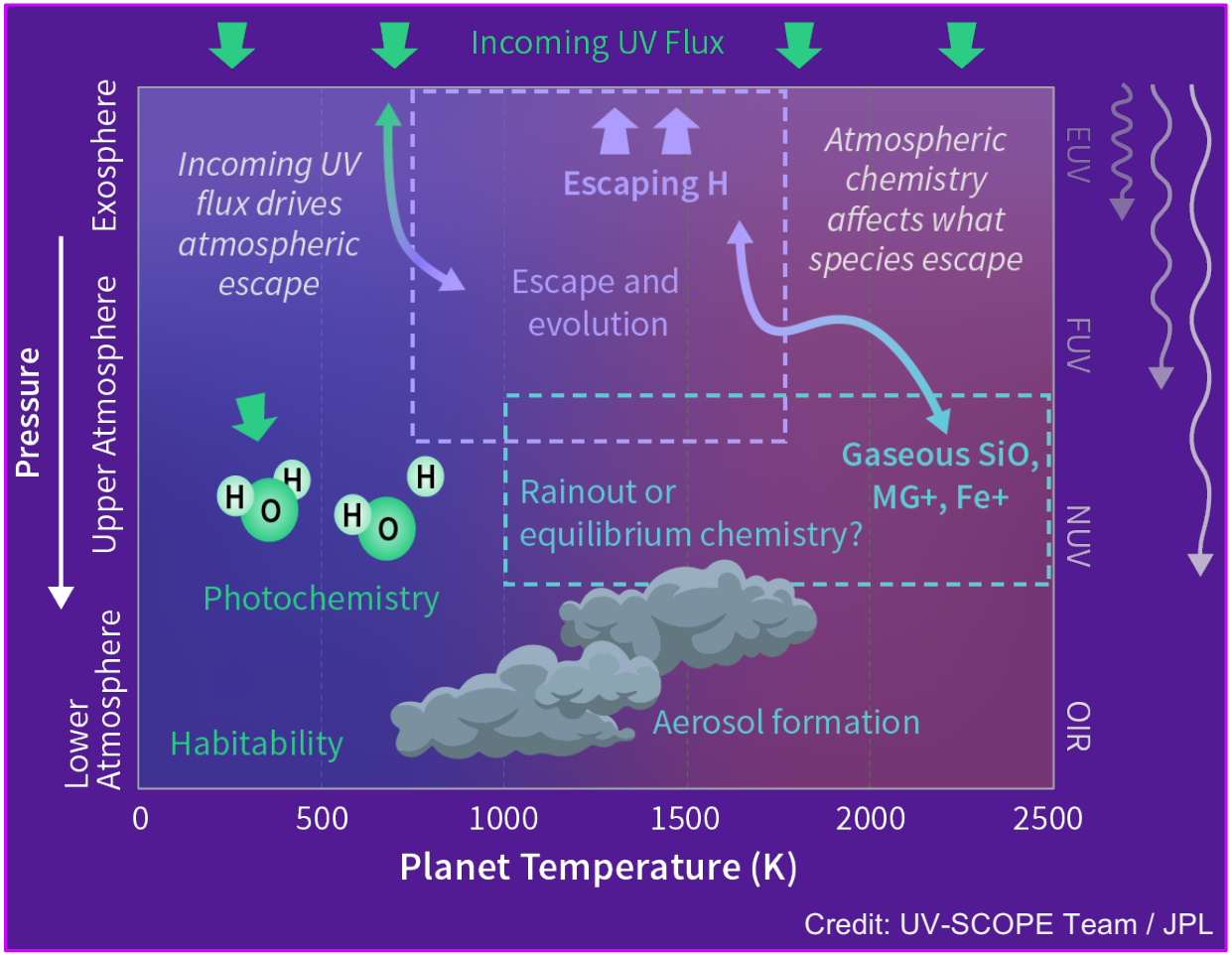
The UV has an important role.

Q1 → UV as a probe of atmospheric mass loss and formation environment

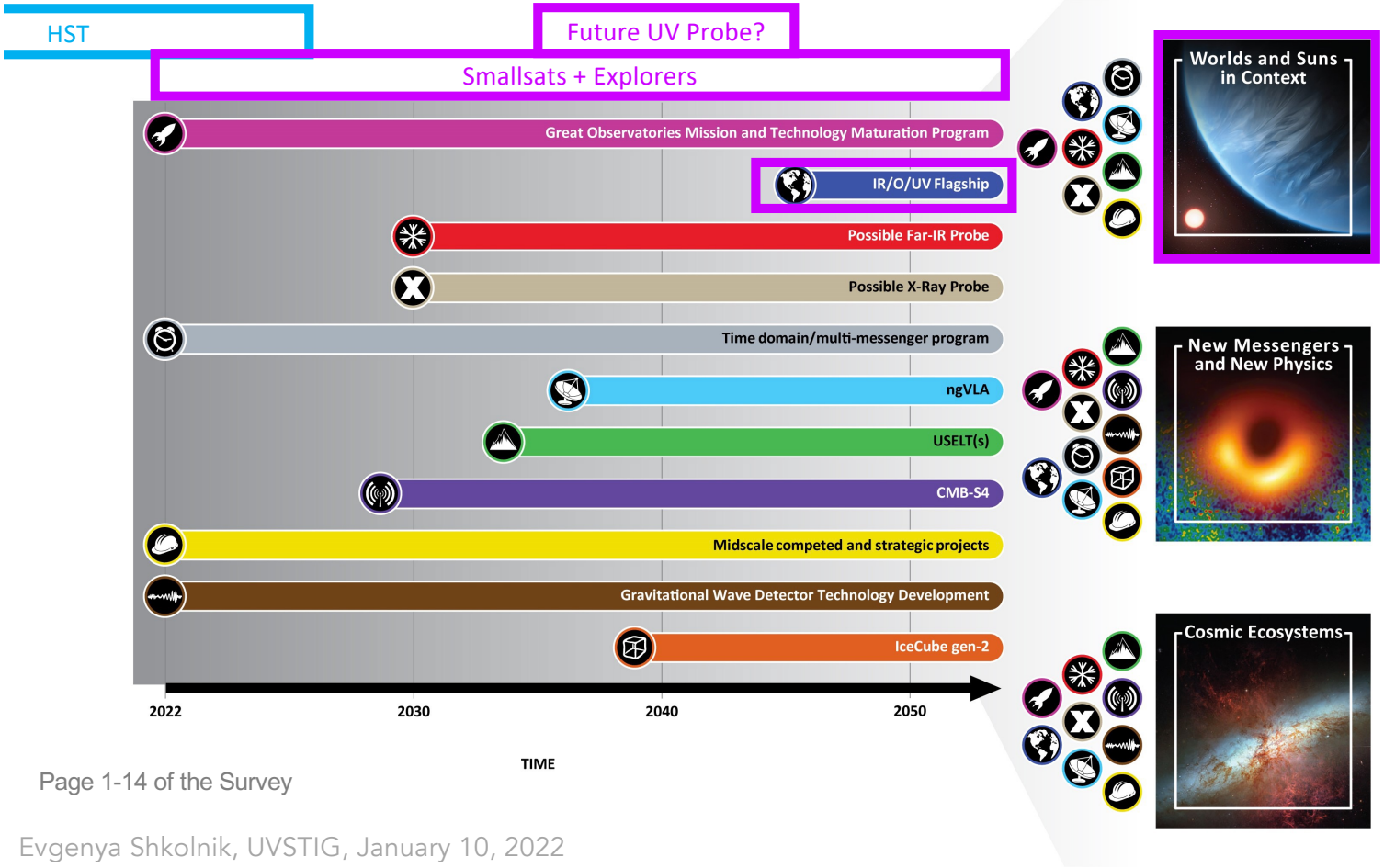
Q2 → UV as a probe of the planet's upper atmosphere

Q3, Q4 → Impact of incoming UV stellar flux on habitability and detection of biosignatures

DA → All of the above



The Astro2020 UV Context



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Flagship: IR/O/UV Telescope

- ~6 m off-axis inscribed diameter provides robust sample of **~25 spectra of potentially habitable planets,** and would be transformative for general astrophysics
- Estimated cost: $11B
- Target launch: first half of 2040's

Exoplanet UV CubeSats

Q2. What are the properties of individual planets, and what processes lead to planetary diversity?

CUTE: The Colorado Ultraviolet Transit Experiment

PI Kevin France

Fleming et al. 2018
France 2020

- 6U CubeSat, Launched Fall of 2021
- Aims to observe atmospheric escape from ~12 giant exoplanets.
- Near-ultraviolet (250–350 nm) with an R ≈ 2,000 spectrograph.

Exoplanet UV CubeSats

Q3: How do habitable environments arise and evolve within the context of their planetary systems?

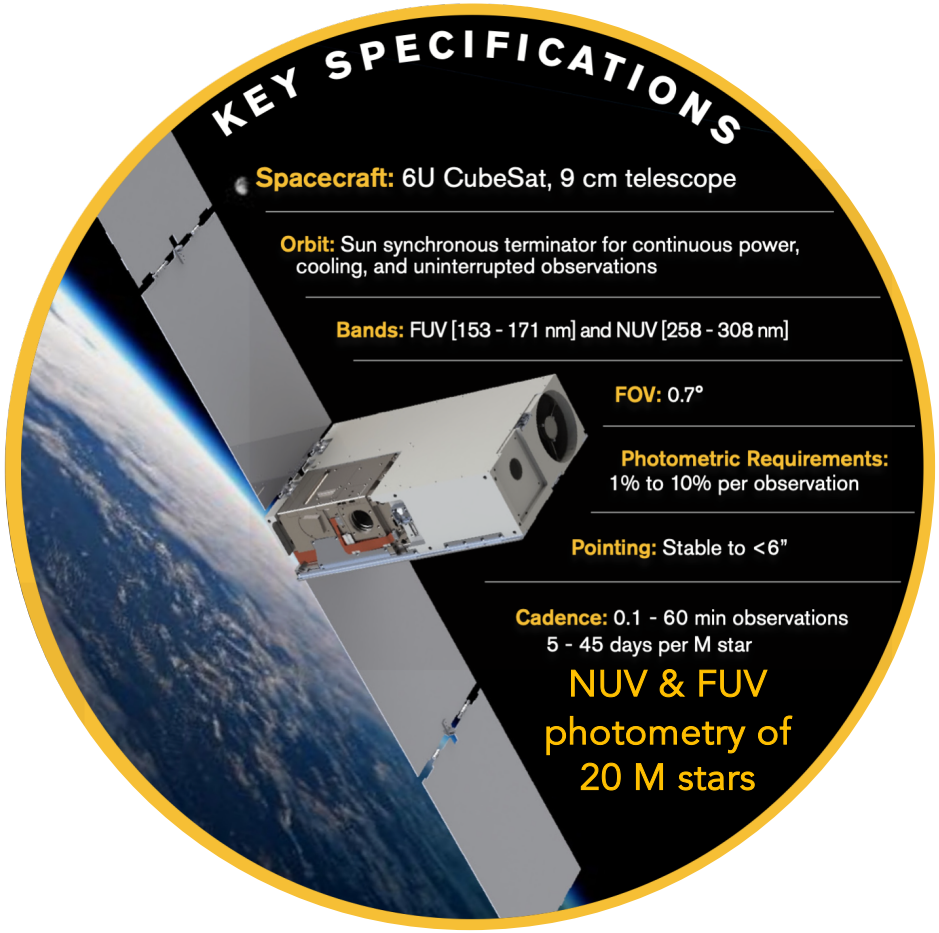
Q4. How can signs of life be identified and interpreted within the context of their planetary environments?

SPARCS

Star-Planet Activity Research CubeSat

PI Evgenya Shkolnik

Shkolnik et al., 2018
Scowen et al., 2018
Ardila et al., 2019
Jewell et al., 2019



More Exoplanet UV Missions?

Current Pioneers ($20M)? **None**

Mission of Opportunities (MidEx; $35M, $75M)? **We'll find out this summer…**

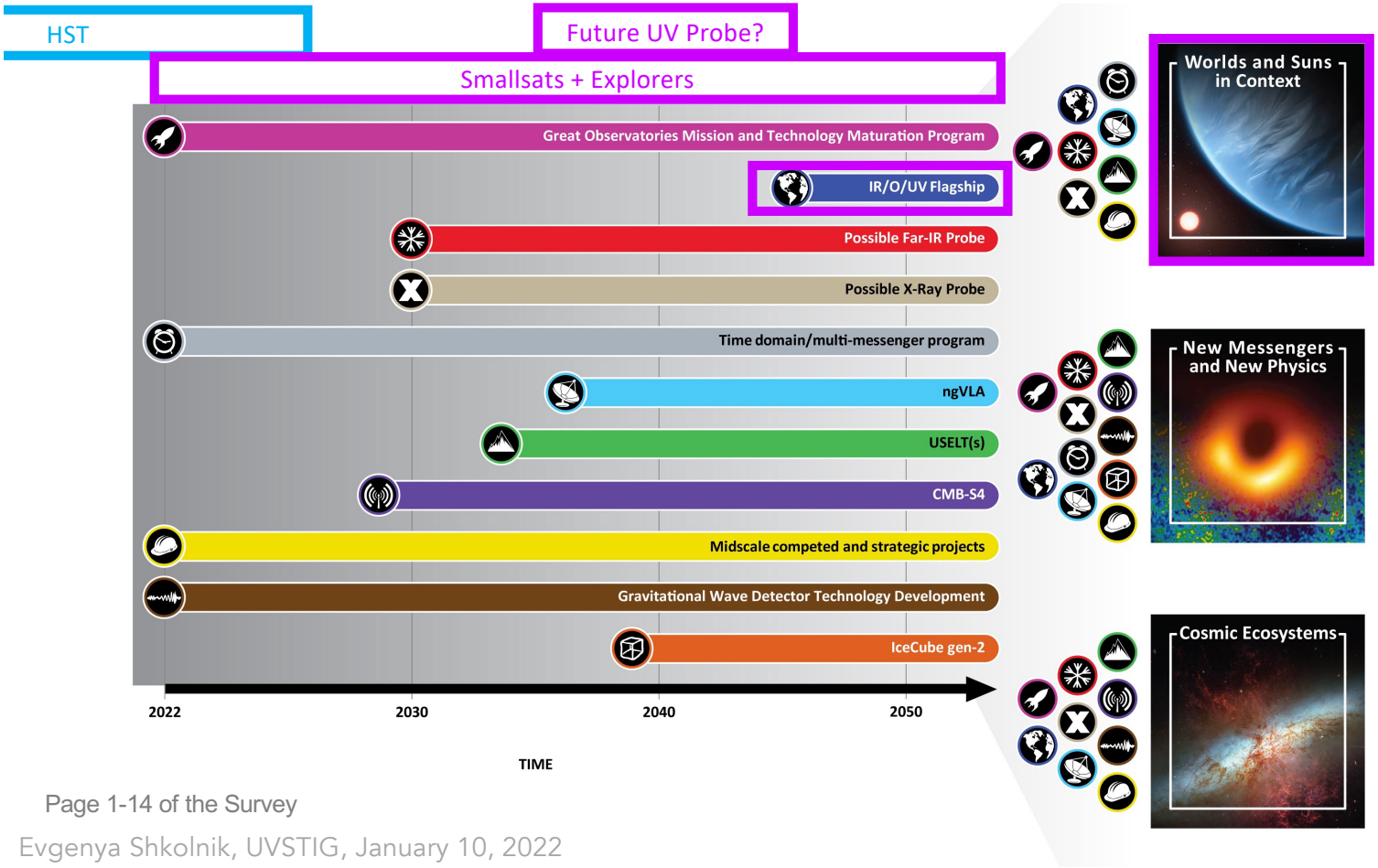
Current Small Explorers (SMEX; $145M)? **None**

Mid-size Explorers (MidEx; $300M)? **We'll find out this summer…**

Probes ($1B)? **Not in the UV for quite a long while….**

IR/O/UV Flagship ($11B)? **Yes! To be launched in the 2040s**

The "UV-Gap" still needs to be filled.



Summary:

Exoplanets are a top Astro2020 priority.

An IR/O/UV Flagship demonstrates the Survey's appreciation of the UV for exoplanet science.

There are many good reasons to study exoplanets in UV with smaller, dedicated missions ahead of the 2040's.

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