



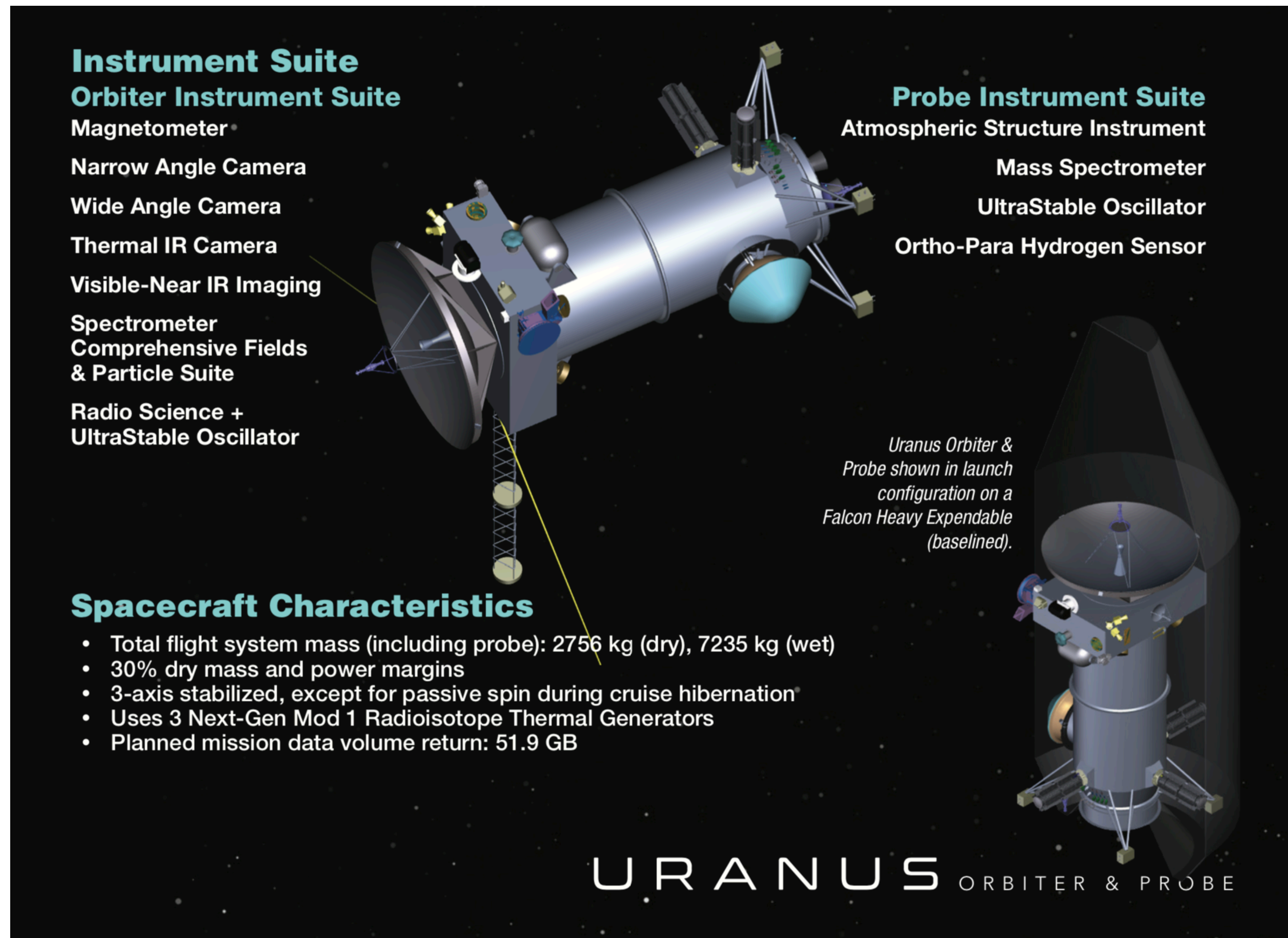
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# Ice Giant Missions as Gravitational Wave Detectors

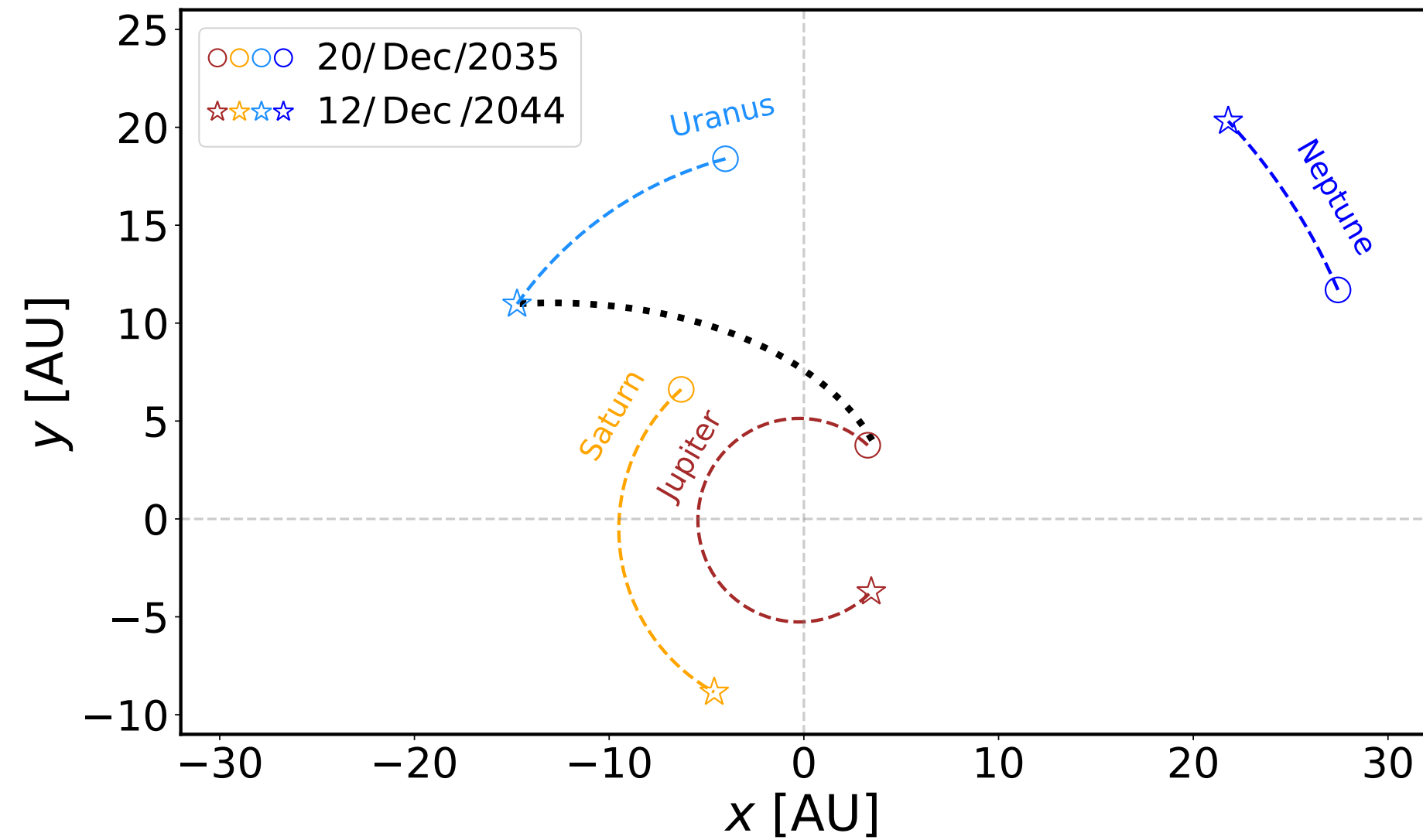
Deniz Soyuer, Lorenz Zwick, Daniel D'Orazio & Prasenjit Saha



The highest priority new Flagship mission for the decade 2023-2032 is the **Uranus Orbiter and Probe mission**. (*Planetary Science and Astrobiology Decadal Survey 2023-2032*)

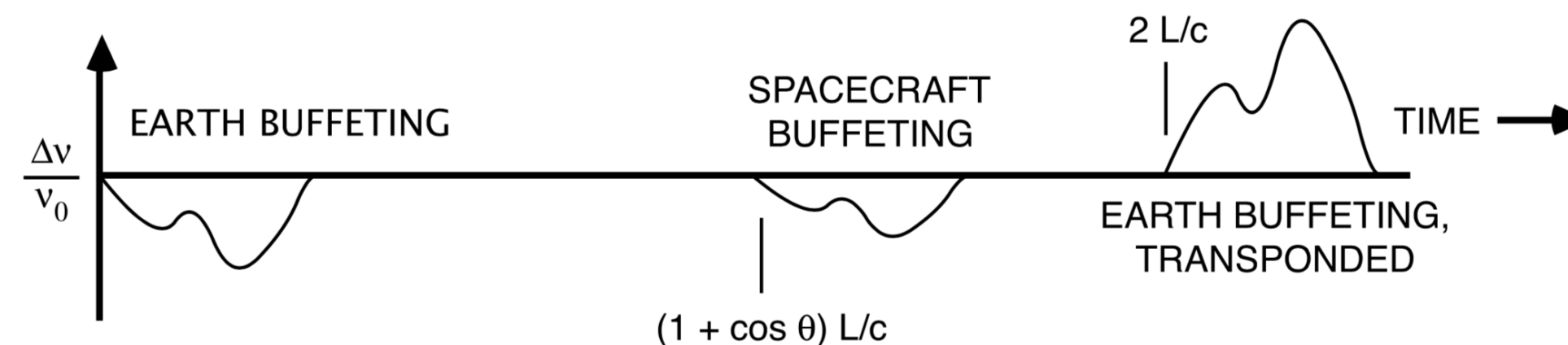
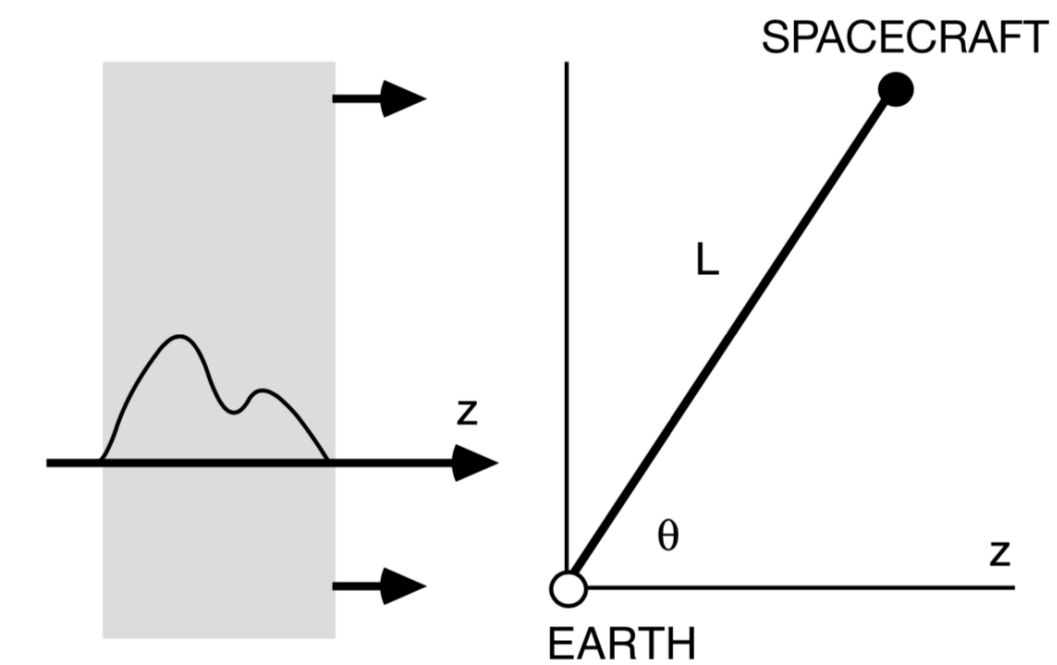


## Uranus mission trajectory



- ▶ **Jupiter gravity assist (JGA) on December 2035**
- ▶ **Reach Uranus on December 2044**
- ▶ **9 years of cruise time after the JGA**

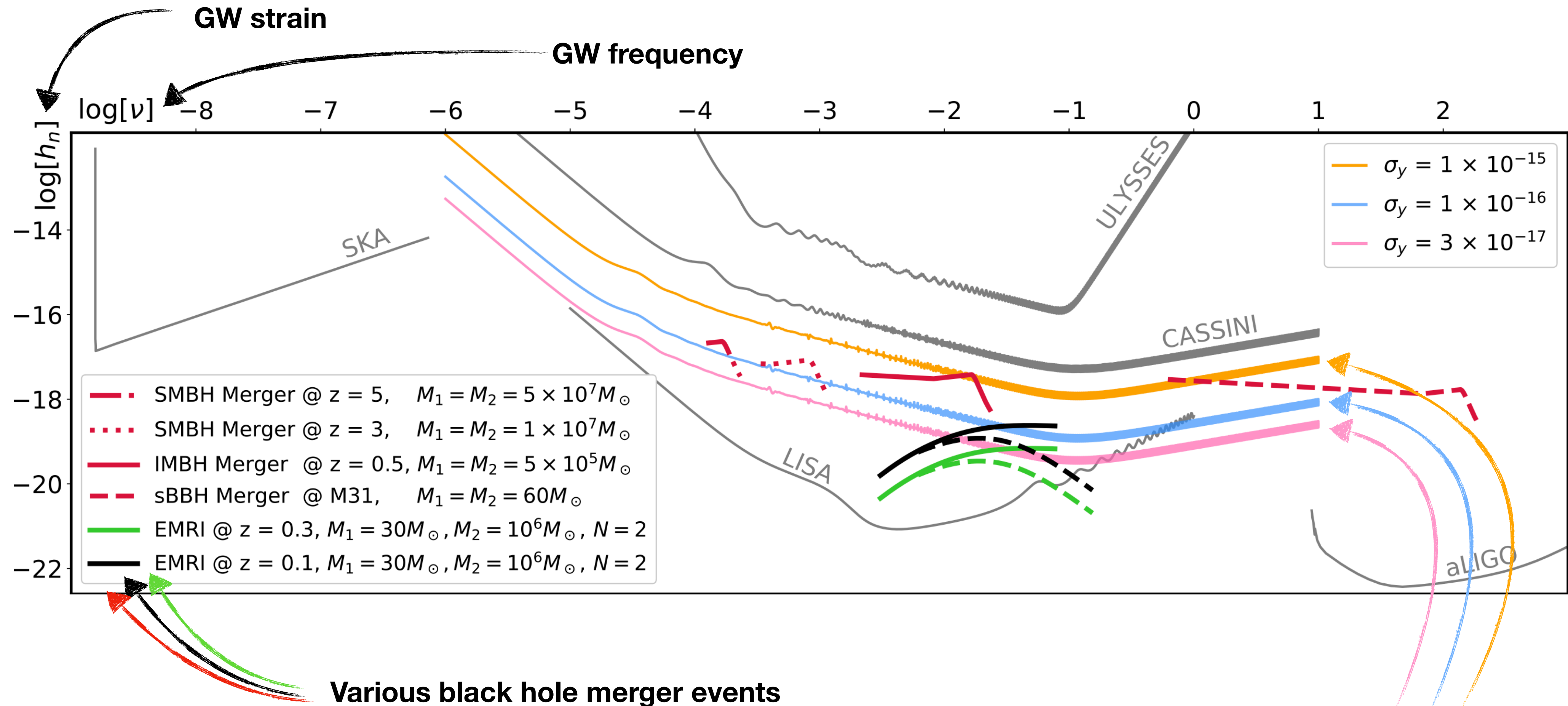
- ▶ **GWs** passing through between the spacecraft **transponder** and the **transmitter/receiver** at Earth cause variations in the light traveltime between the two.
- ▶ This corresponds to a **Doppler shift** of the **transmitted/received** signal.





## Ice giant missions...

- ▶ can be designed to be sensitive to **supermassive black hole binary mergers**,
- ▶ will be crusing simultaneously with **LISA** → **huge potential for joint detection!**



Sensitivity curves for a noise improvement of 3, 30, 100 times Cassini-era values

# Takeaway

## Ice giant missions...

- ▶ could play a critical role in expanding the horizon of GW searches,
- ▶ may even be the first to detect the first **supermassive blackhole binary merger**,
- ▶ combined with **LISA**, would improve **source localization** by an **order of magnitude** compared to **LISA** by itself.

## Challenges:

- ▶ Convincing people to actually send a mission. ✓
- ▶ Accurately modelling the black hole population to manage expectations.
- ▶ Improving the various noise sources on the Doppler link.

*Soyuer et al. 2021*

