

SIM Lite Astrometric Observatory

Double Blind Search for Earths -2

Phase 1 Results (January–August 2008)

- **Reliability** in detections, (no. detections) / (no. detections + false-alarms), varied between teams from 40% to 100% (3 teams > 80%).
- **Completeness** (what fraction of detectable planets were detected?)
 - 48 of 95 planets with $P/T < 1$ were reasonably detectable with **SNR > 5.8**.
 - All were found by at least one team (most by 3 or 4 teams).

- Of 16 detectable habitable zone (HZ) planets, all were found by at least 2 teams.
- Of 12 detectable terrestrial HZ planets, all were found by at least 2 teams.
- The presence of multiple planets has essentially no impact on the ability to detect terrestrial planets in the HZ (major conclusion).
 - Can find Earths in solar system clones.
- This double blind study validated methods used to predict performance.

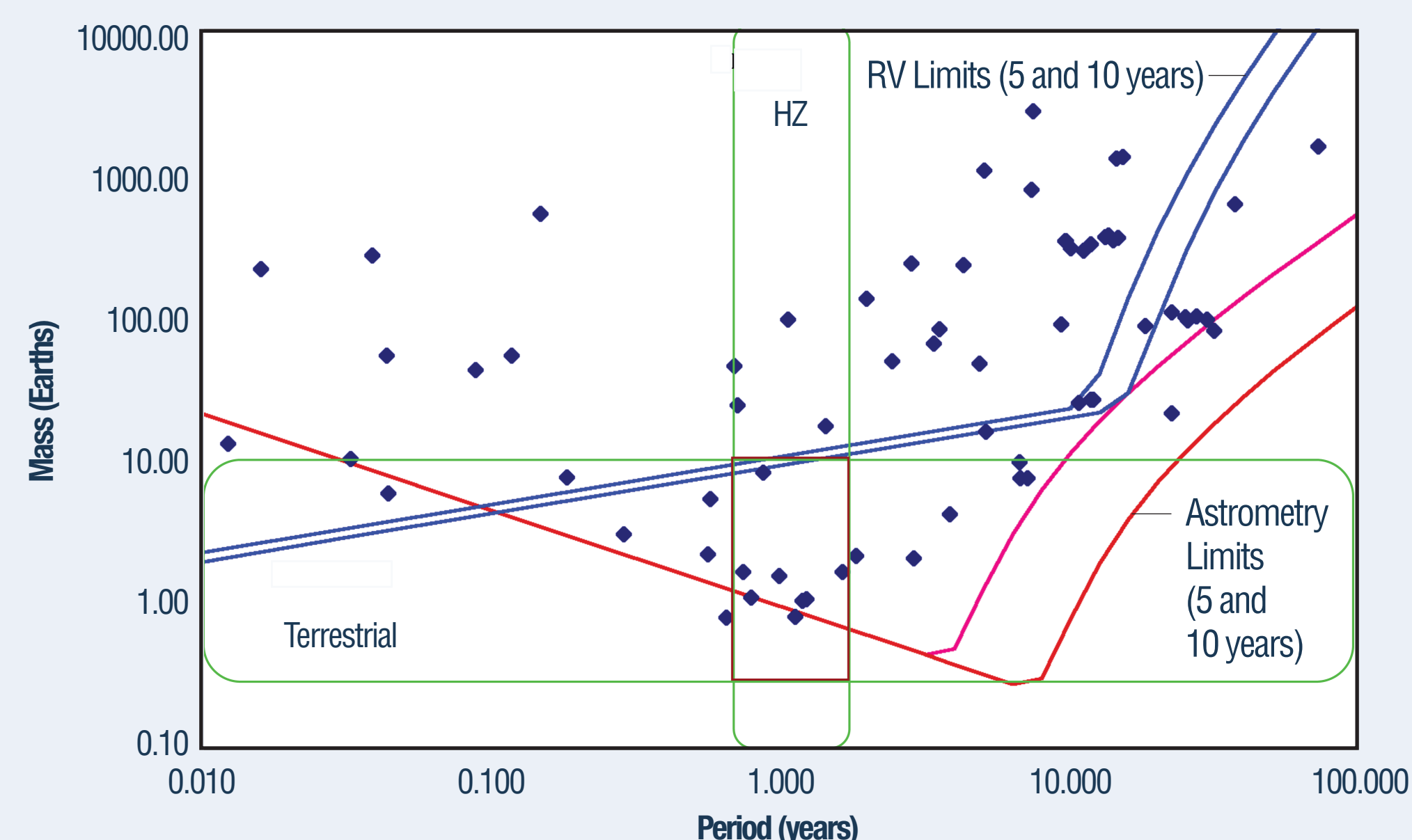
Reliability (vs. planet type)

- Astrometric detection of planets looks for a periodic signal (usually with a periodogram) in the presence of noise.
 - Set a low threshold for detection and you increase the number of planets you can detect, and at the same time you increase the number of false alarms.
- Reliability means — if we claim we've detected a planet, what is the probability that claim is true?

- Reliability = $(\text{No. detected}) / (\text{No. detectable} + \text{false alarms})$

Reliability	Team C1	Team C2	Team C4	Team C5
All	70%	87%	89%	98%
Terrestrial	41%	86%	80%	96%
Habitable Zone	44%	76%	79%	100%
Terrestrial and Habitable Zone	40%	80%	71%	100%

SNR-Based Detection Limits



Completeness (vs. planet type)

- There are 70 high-SNR (>5.8) planets (plotted); 48 of these have a period shorter than 10 years. We should have detected all of these, and we did.

- Completeness = $(\text{No. detected}) / (\text{No. detectable})$

Completeness	Team C1	Team C2	Team C4	Team C5
All	60%	91%	89%	95%
Terrestrial	28%	81%	81%	90%
Habitable Zone	53%	84%	84%	100%
Terrestrial and Habitable Zone	42%	71%	71%	100%

Phase 2 Objective (September 2008–January 2009)

- Extend study to real target stars
- Use more realistic number of 2-D observations.

Phase 3 Objectives (if funded)

- Non-Gaussian noise distribution effects on \sqrt{N} .
- Vary parameters that were fixed in Phase 1:
 - Effects of reference stars and their companions; coupling between proper motion, parallax and systematic radial velocity.
- How accurately can you predict a planet's position for a direct detection mission given a SIM Lite + radial velocity solution?
- Use interferometer optical path delays instead of projected sky positions.