HabEx Targets pre-screening: Astrometric Measurements

Bertrand Mennesson
Jet Propulsion Laboratory, California Institute of Technology
The interest of pre-screening

- Other options for SY increase:
  - pre-screening of exozodi levels (LBTI, WFIRST, others?)
  - coping with binaries (Belikov MSWC etc)

- Worth noting that RV and astrometric measurements complement and reinforce each other → use both if possible
The pros of Astrometry

- Stand-alone mass determination
- Works on broader target sample (F stars OK, all inclinations OK)
- Less sensitive to stellar jitter than RV or TSI

<table>
<thead>
<tr>
<th>Period</th>
<th>rms(ΔX)</th>
<th>rms(ΔY)</th>
<th>rms(RV) without conv.</th>
<th>rms(RV) with conv.</th>
<th>rms(TSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>all</td>
<td>0.07</td>
<td>0.05</td>
<td>0.33</td>
<td>2.4</td>
<td>3.6 × 10⁻⁴</td>
</tr>
<tr>
<td>high1</td>
<td>0.09</td>
<td>0.06</td>
<td>0.42</td>
<td>1.42</td>
<td>4.5 × 10⁻⁴</td>
</tr>
<tr>
<td>high2</td>
<td>0.08</td>
<td>0.05</td>
<td>0.37</td>
<td>1.62</td>
<td>3.9 × 10⁻⁴</td>
</tr>
<tr>
<td>low</td>
<td>0.02</td>
<td>0.01</td>
<td>0.08</td>
<td>0.44</td>
<td>1.2 × 10⁻⁴</td>
</tr>
</tbody>
</table>

“Using the Sun to estimate Earth-like planets detection capabilities” (Lagrange et al. 2011)

- Breaks mass vs non coplanarity degeneracies in multiple systems
The cons of μas Astrometry

- Micro arcsec astrometry of solar type stars has to be done in space
- Expensive ( $ 500M)
- Proved difficult in the past
Mission Opportunities: US

- Explorers (MIDEX) call: Draft AO released on July 21, 2016
  - Cost cap likely too low (250M + ELV + any contributions < 100M)

- Probe Class mission concept studies as part of the Decadal survey preparations
  - Upcoming AO release this August
  - NOIs due mid-Sept 2016
  - Full proposals due to NASA mid-Nov
  - Cost range = 400 M to 1B
Mission Opportunities: ESA THEIA (M5)

• THEIA is a μas astrometric observatory
  – Based on a super-stable TMA telescope (0.8m primary and 0.6 deg FoV)

• THEIA addresses 3 main science topics:
  – Dark Matter (small scale structure- Observations of 25 MW dwarf satellites galaxies)
  – Compact Objects (quark stars)
  – Nearby Earths (10% of a 3-year mission):
    • census of ~50 nearby Sun-like stars with 95% completeness for Earth mass planets in HZ
    • Assumes 50 1h visits per star at 0.85 μas accuracy per visit per hour of exposure

• Submitted to 2014 ESA Cosmic Vision call for M4 (cost cap = 440M€)
  – Not selected but positive overall feedback

• Will be re-proposed in October 2016 as M5 candidate (cost cap = 550M€)

• PI: Celine Boehm, Durham University