POSSIBLE EXOMOONS AS TARGETS FOR SETI

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Abstract. Using data from Planetary Habitability Laboratory Exoplanet Catalogue we find exoplanets possible to have big enough satellites to host life. We suggest radio astronomy based methods to search for life on a possible exomons.

1. INTRODUCTION

One of the leading models describing planetary satellites formation comes from a series of papers developed by (Canup & Ward 2006) and it is known as the actively supplied gaseous accretion disk model. Dust grains within a circumplanetary disk stick and grow to form satellitesimals, which then migrate via type I migration. Continuous mass-infall from the protoplanetary disk maintains a peak circumplanetary disk density of approximately $100 \, \text{g cm}^{-2}$, allowing new satellitesimals to continuously grow. Once the planet has opened up a gap in the protoplanetary disk, the active supply halts and the circumplanetary disk rapidly diffuses in $10^3$ yrs, thus freezing the remaining satellites in place.

The mass fraction of satellite system is regulated to approximately $10^{-4} \, M_P$, where $M_P$ is mass of planet (Canup & Ward 2006), by a balance of two competing processes: the supply of incoming material to the satellites, and satellite loss through orbital decay driven by the gas. An alternative model is the solids enhanced minimum mass model (see e.g. Masqueira & Estrada 2003). In this model a much longer satellite migration timescale is present than the associated formation timescale. The model only qualitatively describes the expected mass ratios, unlike the actively supplied disk accretion.

1. 1. SELECTION OF DATA AND METHOD OF ANALYSIS

Most of the detected exoplanets are gas giants, many of which are in the habitable zone. These gas giants cannot support life, but it is believed that the exomoons orbiting these planets could still be habitable. In our analysis, assuming that scaling law (Canup & Ward 2006) observed in the solar system also applies for extrasolar super-Jupiters (Heller & Pudritz 2014), we used planet’s data from Planetary Habitability Laboratory Exoplanets orbital catalog and we selected only planets in the habitable zones more massive than Jupiter. They are presented in Table 1. We can see that
Table 1: Possible exomoons

<table>
<thead>
<tr>
<th>Planet Name</th>
<th>Mass</th>
<th>Star type</th>
<th>Distance</th>
<th>Satellite mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 10697 b</td>
<td>6.38 M$_J$</td>
<td>G star</td>
<td>106 ly</td>
<td>0.20 M$_\oplus$</td>
</tr>
<tr>
<td>HD 28185 b</td>
<td>5.7 M$_J$</td>
<td>F star</td>
<td>138 ly</td>
<td>0.18 M$_\oplus$</td>
</tr>
<tr>
<td>HD 23596 b</td>
<td>8.1 M$_J$</td>
<td>F star</td>
<td>169 ly</td>
<td>0.25 M$_\oplus$</td>
</tr>
<tr>
<td>HD 13908 c</td>
<td>5.13 M$_J$</td>
<td>F star</td>
<td>232 ly</td>
<td>0.16 M$_\oplus$</td>
</tr>
<tr>
<td>ups And d</td>
<td>10.19 M$_J$</td>
<td>F star</td>
<td>44 ly</td>
<td>0.32 M$_\oplus$</td>
</tr>
<tr>
<td>Kepler 419 c</td>
<td>7.19 M$_J$</td>
<td>F star</td>
<td>-</td>
<td>0.22 M$_\oplus$</td>
</tr>
</tbody>
</table>

selected planets orbit F and G stars. Maximum masses of possible satellites are all bigger than Mars mass.

Since we could not find exomoons with existing optical astronomy methods at least 10 years from present (Kipping 2014) we suggest to search for exomoons around these planets with radio astronomy based methods (see e.g. Noyola et all 2014) or SERENDIP (see e.g. SERENDIP) for extraterrestrial intelligence on possible exomoons.

Acknowledgment

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References

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catalog
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