Analysis of rotation of CoRoT dwarf stars

IRa01 - L Rc01

Additional program P.I. F. Favata

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Sample selection criteria

- From CoRot database (Exo)
  - luminosity class V
  - $0.44 < B-V < 1.4$ ($\sim$F5-M0)

$\text{IRa01: 4993}$
$\text{LRc01: 5169}$

Total: 10162

3114 chromatic LCs
7048 white LCs
Analysis steps

- selection of valid flux data (no SAA fluxes)
- automatic separation of LCs in “initial” and “long” runs
- rebinning of the data to 2h (“correction” for the orbital period)
- detrend of LCs with polynomial fitting

- automatic selection of LCs without jumps
- Lomb - Scargle periodogram
- Folding with 1st and 2nd period
- Significance of the peaks (1000 LCs “resampled” for each target)
Selected LCs
Light curves without ‘jumps’

Total: 10162
Selected LCs:
Short: 4348
Long: 3521
Tot sel: 7869
~ 23% rejected
Lomb - Scargle periodogram

Some examples obtained

$P_{\text{rot}} = 46.7$ days
Lomb - Scargle periodogram

Some examples obtained

$P_{\text{rot}} = 14.5$ days
A test case: NGC 2264

Exoplanet CoRot database (SRa01)

8150 chromatic & white LCs

217 known members
(see P-XII 113 by Micela et al.)

catalogue periods for
156 members
(Lamm et al. 2004)
A test case: NGC 2264

Check:
Prot(routine) vs Prot(catalogue)
(Lamm et al. 2004)

156 LCs
(150 selected, 6 rejected)

derived periods well agree with published ones (within a factor 2)
Rotational Periods

Scientific goal: Selection of fast rotating stars
   Young stars $\rightarrow$ Recent star formation history in the solar neighborhood
Rotational Periods

$\sim 53\%$ F-type  $\sim 50\%$ G-type  $\sim 19\%$ K-type with $P_{\text{rot}} < 15$ days
Rotation-Age Calibration
(Gyrochronology Relations)

We assume:
1. constant star formation rate in $10^{10}$ years
2. rotation = $f(age)$

\[
P(B - V, t) = f(B - V)g(t)
\]

\[
f(B - V) = a[(B - V)_0 - c]^b
\]

\[
g(t) = t^n
\]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>a</td>
<td>0.407 ± 0.021</td>
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<tr>
<td>b</td>
<td>0.325 ± 0.024</td>
</tr>
<tr>
<td>c</td>
<td>0.495 ± 0.010</td>
</tr>
<tr>
<td>n</td>
<td>0.566 ± 0.008</td>
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</tbody>
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(Barnes 2007; Mamajek & Hillenbrand 2008)
Rotation-Age Calibration
(Gyrochronology Relations)

We assume:
1. constant star formation rate in $10^{10}$ years
2. rotation = $f(\text{age})$

excess of F, G and K-type stars with ages $t \leq 10^8$ years

excess of G and K-type stars with ages $10^8 < t \leq 10^9$ years

burst of star formation? in agreement with X-ray surveys results!
Next steps

Spectroscopic follow-up observations of candidate young stars with $P_{\text{rot}} < 15$ days are needed

Spectroscopic analysis:
- Lithium abundance
- Metallicity
- Radial velocity

to disentangle tidally locked binaries from young stars amongst fast rotators