PRE-MAIN SEQUENCE POPULATION OF SCO-CEN UNVEILED WITH GAIA DR2

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The characterization of the stellar content of OB associations has traditionally relied on kinematic information from proper motions and radial velocities to separate the association members from the foreground and background field star population (de Zeeuw et al. 1999; Wright & Mamajek 2018). This led to a bias in the association membership toward the more massive stars, as kinematic information was usually lacking for the low-mass pre-main sequence members. Dedicated spectroscopic and photometric surveys uncovered only a limited fraction of the pre-main sequence population in, e.g., the Sco OB2 and Orion OB1 associations (e.g. Preibisch et al. 2002; Preibisch & Mamajek 2008; Briceno et al. 2018; Kounkel et al. 2017).

Zari et al. (2017) used the *Gaia* DR1 (Gaia Collaboration et al. 2016b,a) data in combination with 2MASS photometry (Skrutskie et al. 2006) to isolate the pre-main sequence population in the apparent magnitude vs. color diagram and map the distribution of the young stars in the Orion region. Kounkel et al. (2018) subsequently used *Gaia* DR2 (Gaia Collaboration et al. 2018) parallaxes and photometry to construct an observational Hertzsprung-Russell diagram in which they more precisely isolated the pre-main sequence population in Orion. We apply this technique to the Scorpius-Lupus-Centaurus-Crux area on the sky, which contains the Sco OB2 association (Blaauw 1946). We select from *Gaia* DR2 all stars with galactic coordinates $285° \leq \ell \leq 360°$ and $-10° \leq b \leq +32°$, thus covering a wider area around the traditional boundaries of the association (see Figure 1), and with parallaxes between 5 and 12 mas, covering the known distances to the Sco OB2 association subgroups (Wright & Mamajek 2018). The relative parallax errors were restricted to $< 10\%$ and sources with potentially spurious parallax values or poor photometry (Appendix C of Lindegren et al. 2018) were removed. The resulting sample contains 120 911 sources for which the observational HR diagram is shown in the left panel of Figure 1. The pre-main sequence population is clearly separated from the main sequence at colors $(G_{BP} - G_{RP}) > 1$, where at $(G_{BP} - G_{RP}) > 2$ the separation is well above the 0.75 magnitude expected from a population of equal mass binaries. We proceeded to isolate this population as well as the young early type stars through a selection by hand in the color-absolute magnitude space (the selection polygon is available from the Jupyter Notebooks accompanying this Research Note). The distribution of the 14 459 selected stars on the sky is shown in the right panel of Figure 1.

There is a very clear concentration of the young stellar population which follows the traditional boundaries of the Sco OB2 association, consistent with most of the selected sources being association members. The Upper Scorpius region stands out as the densest concentration of young stars with the sparser distribution in the Upper Centaurus Lupus and Lower Centaurus Crux areas showing clear hints of clumps of young stars (indications of substructure were also found by de Zeeuw et al. 1999). The concentration of sources near $(\ell, b) = (290°, -5°)$ corresponds to the IC 2602 cluster ($\varpi = 6.74 \pm 0.25$ mas; Gaia Collaboration et al. 2017). Our expanded search reveals an additional population of young stars potentially associated with Sco OB2 ($b \sim 5°$ and $\ell \sim 345°$) at a mean distance of ~ 180pc (5-6 mas). This population was also noted by de Zeeuw et al. (1999) (their Section 4.5 and Figure 9), and in Mamajek (2016).

The software is available at: https://github.com/Jurgenvilla/Gaia_DR2_ScoCen

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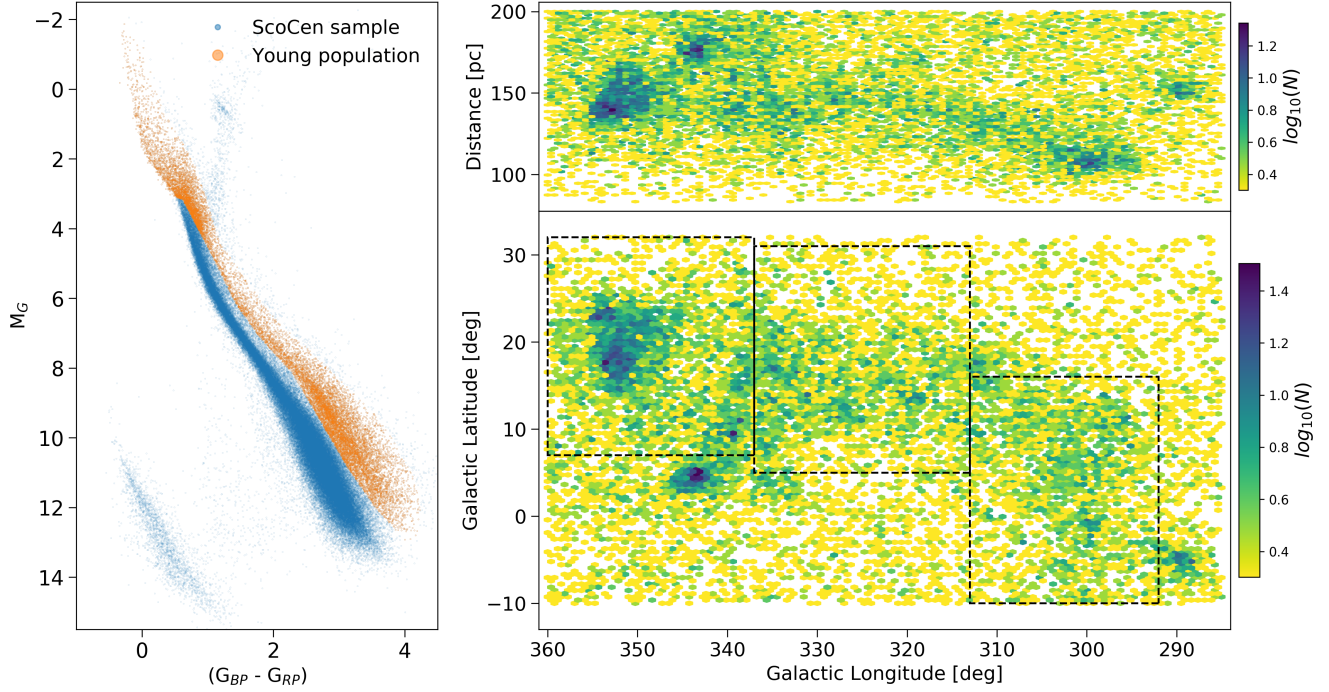
Figure 1. Left: Color-magnitude diagram of the Sco-Cen region with the young stellar population highlighted in orange. **Bottom right:** Sky distribution of the young stellar population. The three subgroups of Sco OB2 (from left to right, Upper Scorpius, Upper Centaurus Lupus, and Lower Centaurus Crux), as defined in de Zeeuw et al. (1999), are indicated. **Top right:** Distance distribution (with distance calculated as $1/\varpi$) as a function of Galactic longitude.

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[1] http://www.astropy.org/

[2] http://matplotlib.org/

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