1 ADQL query

- *A simple copy/paste of the ADQL queries in the ESA Gaia archive webform does not work: the first query returns an error. I believe the table name is wrong, and the gaia. prefix should be removed from the field names. Please confirm that this is the case and update the appendix. I report below the query that worked for me...*

  The referee is right. There was a typo in the ADQL query, which was corrected in the text. We report the query here for convenience:

  ```
  select gaia.source_id, gaia.ra, gaia.dec, gaia.l, gaia.b, gaia.phot_g_mean_mag,
  gaia.phot_g_mean_flux, gaia.phot_g_mean_flux_error, gaia.pmra, gaia.pmdec,
  gaia.parallax, gaia.pmra_error, gaia.pmdec_error, gaia.parallax_error
  from gaiadr1.gaia_source as gaia
  where gaia.l>=190.0 and gaia.l<=220.0 and gaia.b>=-30.0 and gaia.b<=-5.0
  ```

  Note that the query is different from what was used by the referee, and contains also the parallax and proper motion information (as recommended by the referee).

- *The second query returns only 3,000,000 sources. It must be split it two queries otherwise it reaches some time or memory limit. I would recommend to also add the parallax and proper motion measurements to this second query, as they are useful as well (gaia.parallax,gaia.parallax_error,gaia.pmra,gaia.pmdec,gaia.pmra_error,gaia.pmdec_error)*

  E.Z run the query, but she did not experience any memory limit. Maybe the referee does not have an account on the Gaia archive? In the appendix we also specified that it is indeed quite convenient to have a personal account on the archive, since that allows to save queries and store data.

- *Even after that, the second query returns only 5,165,246 Gaia sources, instead of the 9,926, 756 quoted by the authors. I am not sure where the difference comes from? It does not seem to be another memory limit Applying the JHK photometric selection (equations 2, and ph_qual="AAA"), I am left with 1,480,323 sources, similar to the figure mentioned by the authors (1,476,110), but not exactly equal. I would appreciate if the authors could confirm these numbers, and eventually give more details in the Appendix on how to perform the query to get the exact same results.*

  The 9,926,756 sources are the 'Gaia-only' sources (obtained with the query above). There are 5,059,068 in common with 2MASS and with angular distance < 1 arsec. Finally, the 1,450,911 sources are those left after applying the JHK photometric selection (eq. 2 and ph_flag = 'AAA'). The numbers were updated in the text .

- *I see that you use gaiadr1.tmass_best_neighbour for the cross matching. But if I understand well, this table gives the closest 2MASS neighbour with no distance limit. Please correct me if I am wrong, but I understand that all the sources have a gaiadr1.tmass_best_neighbour, and in some case it might be very far away and unrelated? If this is the case, you probably want to add a constraint to the query so that the maximum acceptable distance is e.g. 1. I did a test and included xmatch.angular_distance* *in the ADQL request. I found that $\tilde{1}00{,}000$ cross matches have separations > 1", and are probably unrelated. Its a small fraction ($\sim$ 2 %) but it can easily be removed.*

The referee is correct. We added the condition and repeated the analysis, though there are not major changes.

2 KDE analysis

- *Bandwidth: Are you sure the KDE bandwidth is 0.05deg (and then 0.03deg in Section 3.2)? It seems really small (that is about 2$\sim$3arcmin) given the low density of TGAS stars after all the cuts in magnitude, color, ppm... Your final TGAS sample is about $\sim$10,000 stars1, for a total area of 750 deg^2. That's about 13 stars per deg^2, or just $\tilde{3}$ stars within the size of your kernel, which would result in a very noisy density map... I tried and it indeed gives a very noisy maps that does not look like the one you show. I suspect it is just a typo, as the figures look good. By eyes it looks like you used a bandwidth of the order of 1 deg, but I might be mistaken. Can you confirm?*

  Yes, the values reported in the paper are wrong by a factor of 10. The actual values are indeed 0.3 (*Gaia* DR1 sources) and 0.4 (TGAS).

- *The galactic coordinate system used in this study is not an equal-area projection. Using a single isotropic gaussian kernel on a non-equal-area projection leads to distortions as one gets further away from the equator (galactic plane). On the scale of the present study (25deg), these distortions can be significant and affect the analysis as the kernel does not encompass the same area in southern and northern parts of the field. A more rigorous treatment would involve for example a van Mises-Fisher kernel density estimate.*

  Following the referee comments, we investigated options to make our treatment more rigorous.

  The von Mises-Fisher Kernel is not implemented in scikit-learn, but other kernels can be used, in combination with a non-Euclidean metric. The 'haversine' distance metric represent distances on a curved surface, and can be easily set in scikit-learn.

  One can further notice that in the paper the kernel sizes are smaller than $\sim$ 1 deg (0.017 rad). For small angles the von Mises-Fisher kernel becomes approximately:

$$f(\rho, \kappa) = \frac{e^{\kappa}}{\pi I_0(\kappa)} \exp(-\frac{\kappa}{2}\rho^2).$$

  For a value of 1 degree, $\kappa \sim 3200$, and therefore very large, in which case:

$$I_0(\kappa) \sim \frac{e^{\kappa}}{\sqrt{2\pi\kappa}}.$$

  Hence the Kernel becomes:

$$f(\rho, \kappa) \sim \sqrt{\frac{2\kappa}{\pi}} \exp(-\frac{\kappa}{2}\rho^2).$$

With $\kappa = 1/\sigma^2$ the kernel becomes:

$$f(\rho, 1/\sigma^2) \sim \frac{1}{\sigma}\sqrt{\frac{2}{\pi}}\exp\left(-\frac{1}{2}\left(\frac{\rho}{\sigma}\right)^2\right),$$

which is a Normal distribution within a factor of 2. Thus, using the haversine metric in combination with a Gaussian kernel solves the projection issues the referee pointed out.

We modified all the figures accordingly and we computed new significance levels. Note that when using the entire *Gaia* DR1, these are slightly different from before. Especially surrounding λ Ori (Col 69), the over-density we point out are less significant than in the first version of the manuscript (around S = 1 and not S = 2). However the main density enhancements towards the field centre remain unchanged.

3 Figures

- *Many readers will probably not be as familiar with Orion as the authors. I would therefore recommend to display the position and names of the various groups in all the maps (Figs. 1, 3, 4, 6, 8, 11, 12, 13, 14) as you do in Fig. 2. Some figures might need to be rescaled, but the added readability is worth the extra space.*

  We added labels in all the figures, ~~a part form~~ Fig. 1.

- *The region between $-30 < b < -25$deg is empty. I suggest to remove it from the analysis, and rescale the figures accordingly. The increased scale will be appreciated and make the figures more readable.*

  We scaled all the figures.

- *Figs. 1 & 2 could probably be merged.*

  We think it is better to keep them separated for clarity.

- *Fig. 3: The parallax bin of the upper-right panel is awkward. It covers 0.5mas, when all the other panels cover 1.5mas. It does not really bring any special information with respect to the upper left panel. I would suggest to merge the two upper panels into a single panel of background stars, unless you have a particular reason to show this bin.*

  Fig. 3 was re-made, with three (instead than four) parallax intervals. More specifically, the new parallax intervals are:

  1. $0. < \varpi < 2.$ mas;
  2. $2. < \varpi < 3.5$ mas;
  3. $\varpi > 3.5$ mas.

  In this way we are dividing the sources in background - interesting sources - foregrounds.

- *Fig. 5: These histograms are very interesting and probably allow you to go beyond the simple mean parallax quoted in the text: local peaks are visible at 2.4mas, 2.8mas and possibly 3.0mas and seem to be significant. These happen to correspond to the estimated distances of the ONC (2.4mas) and of the foreground populations reported in several previous studies. I would recommend to compute the confidence intervals for this histogram using e.g. bootstrapping. Even better, using KDE (and bootstrapping for the confidence intervals) would give a more robust result. It might reveal that these local peaks are indeed statistically significant, which would be a nice result and confirm that Orion includes groups from at least 300 to 415pc!*

  Following the referee's suggestion, we did the KDE (Gaussian Kernel, bandwidth = 0.03 mas) and used bootstrapping to compute the confidence intervals. The result is shown in the figure below. The three peaks are washed away by the bootstrapping, due to the large parallax errors (around 0.3 mas).

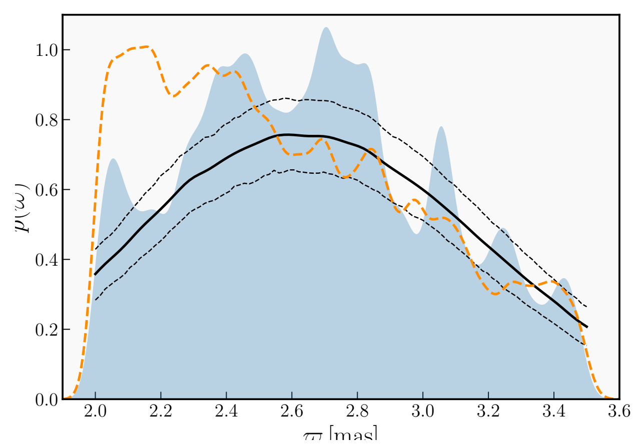


Figure 1: The black thick line is the average of the KDE's of the bootstrapped histograms, the black dashed lines represent the 16th and 84th percentile. The blue area represents the KDE of the parallax distribution of the sources within the S=3 levels, and the orange dashed line represents the KDE of the parallax distribution of the sources with $2 < \varpi < 3.5$mas. We used a Gaussian Kernel with bandwidth = 0.03 mas

  Hence we conclude that the peaks are not statistically significant. The population average parallax is ~ 2.65 mas and the spread is ~ 0.5 mas. We note however that the spread is larger than the average parallax error, therefore we can hypothesise that the spread is due to the presence of an actual spatial structure and not only to the dispersion induced by the errors. With Gaia DR2 we will be able to draw firmer conclusions!

- *Fig. 6: I think the two panels are redundant, and the right panel is much more informative than the left. The 2D distribution shows not only a gradient in longitude but also structures along the latitude axis which cause confusion and extra noise in the 1D projection presented in the left panel. This is unnecessary and so I suggest to keep the right panel only, indicating the location of the various groups. In the text, rather than* *dividing the left panel in three subsets to estimate the distances towards 25Ori, ONC and eps Ori, I would use the values given in the 2D figure around these associations. It should give less dispersion and be more accurate.*

As the referee suggested, the left panel in the figure was removed. We also used the parallax values in 2×2 degrees boxes around 25 Ori, ϵ Ori and the ONC to estimate the distances to these three groups. We obtained:

- ONC $\varpi = 2.42^{+0.2}_{+0.22}$ mas,
- ϵ Ori $\varpi = 2.76^{+0.33}_{-0.35}$ mas,
- 25 Ori $\varpi = 2.81^{+0.46}_{-0.46}$ mas,

where the quoted values are the median, the $16th$ and the $84th$ percentile.

- *Fig. 7 / Section 3.2: the sequence mentioned by the authors is not obvious in the figure as it is now. One must zoom greatly to see the field stars. Maybe you could draw contours of the field distribution, rather than tiny dots? and/or increase the figure size. Also, this sequence has been reported by several authors for several years now (some of whom you copied/pasted). So it is not a discovery nor a surprise, but rather a confirmation. I suggest to rephrase accordingly.*

  To make the figure clearer, we used the unsharp masking technique, and we updated the figure in the text.

  We also rephrased the sequence mentioned by the referee as:

  This sequence (also reported for example by Alves & Bouy 2012) indicates the presence of a population of young stars.

- *Figs. 11 & 12: in the text, you say by comparing Figs. 11 and 12, one can immediately notice that the same groups appear in the same age intervals, except for the Ori cluster, which does not show up clearly in any of the PanSTARRS1 age maps". I do not understand: I can see clearly the density enhancements associated with the clusters of the Lambda Ori star forming region (B30, Col69 and LDN1588, see comments below).*

  The sentence reported by the referee is indeed not correct, and probably refers to a previous version of the maps. It was therefore removed from the text.

4 Age estimates

The age maps produced by the authors are extremely interesting and one of the most important results of the article. I propose here a few modifications to the analysis that should be easy to implement for a potentially significant improvement of the results and conclusions.

A major source of confusion comes from the use of a single parallax for the entire sample in the Bayesian analysis. It leads to unreliable and confusing age estimates in associations significantly closer or further away (e.g Lambda Ori), and in general adds a lot of unnecessary noise to the age distribution. A difference of only 0.2mas in ϖ (e.g. between 385 and 415pc typical of the regions considered here), can lead to age differences of several Myr.

Given the very nice effort of the authors to characterize the distance distribution of the various populations in Section 3, I see a great potential for improvement for the age analysis. The authors mention that they tried to use their (ϖ vs longitude) relation as input for the Bayesian analysis, without any clear improvement. But as mentioned earlier, the spatial distribution of distances shows a complex 2D structure that the 1D analysis along longitudes misses, resulting in a rather noisy (poor) model for the age distribution. I would rather suggest to use the right panel of Fig. 2 to define the distance towards each source for the Bayesian analysis. Statistically, it should be closer to the real distance than assuming $\varpi =$ 2.64 for all sources, and should be significantly better than using the longitude gradient. It should lead to less dispersion in the final age distribution, and at least will solve the issue for Lambda Ori and save a lot of confusion for the readers.

First of all one should notice that the figures slightly changed due to the modifications introduced to address the comments regarding the KDE analysis. As mentioned above, most of the sources related to the λ Ori group are not any more within the S=2 levels. Since we decided to include in the analysis only the sources corresponding to the most significant contour levels, the λ Ori groups is almost entirely excluded from the age estimation. However, the density enhancements towards λ Ori are within S = 1, therefore if some new groups actually exist, they will be characterized next year with DR2.
We followed the referee suggestion and we use Fig. 6 (we think here the referee meant Fig. 6 and not Fig. 2) to define the distance towards each source in the Bayesian analysis. For the sources falling within the TGAS density enhancements we used the parallax value of the TGAS map. For the sources outside the TGAS S = 3 levels, we decided to either fix the parallax at $\varpi = 1$ mas, or at $\varpi = 2.65$ mas, and we explored this two cases separately.

- $\varpi = 2.65$ mas. In this case the results are almost identical to those obtained by fixing the parallax for all the sources at $\varpi = 2.65$ mas.

- $\varpi = 1$ mas. Here instead the old open cluster NGC 2112 falls in the first age panel, dominating the density contrast for ages $1 < t < 3$ Myr. The other panels are substantially equivalent to the constant parallax case.

These results lead us to the conclusion that the age ordering is in general robust, and that it does not strongly depend on small parallax variations.

Now since the authors make the effort of using a Bayesian framework for their analysis, I would suggest to go even further and add the distance as a free parameter, and use the 2D spatial distribution of distances from Fig. 6 as prior. The age would then be estimated by marginalizing along the distance. This simple improvement might lead to a better estimate of the ages and of their significance and uncertainties.

To follow the referee suggestions, we decided to use a uniform, normalized prior, of the shape:

$$\phi(x) = \frac{1}{a-b} \quad \text{for } a \leq x \leq b$$
$$\phi(x) = 0 \quad \text{for } x \leq a \text{ and } x \geq b$$

where x is the parallax, a = 2. mas and b = 3.5 mas. The posterior will then be:

$$\mathcal{P}(\varpi, m, t) = \frac{1}{\sqrt{2\pi}\sigma_{G-J}} \frac{1}{\sqrt{2\pi}\sigma_G} \times$$
$$\exp\left[-0.5\left(\frac{5\log(\varpi) - c_1(G, m, t)}{\sigma_G}\right)^2\right] \times \exp\left[-0.5\left(\frac{c_2(G-J, m, t)}{\sigma_{G-J}}\right)^2\right] \xi(m)\phi(\varpi),$$

where $\xi(m)$ is the prior on the IMF reported in the text, and:

$$c_1 = M_G - G + 10^1,$$
$$c_2 = M_{G-J} - (G - J).$$

[[1]Note that the parallax unit is "mas".] Then to obtain $\mathcal{L}(t)$ one must integrate the posterior first in ϖ and then in m.
The integral on the parallax reads like:

$$\mathcal{P}(m, t) = \frac{1}{\sqrt{2\pi}\sigma_{G-J}} \exp\left[-0.5\left(\frac{c_2(G-J, m, t)}{\sigma_{G-J}}\right)^2\right] \xi(m) \times$$
$$\frac{1}{b-a} \times -0.230259 \exp\left[0.460517\, c1(G, m, t) + 0.106038\, \sigma_G^2\right] \times$$
$$\left[erf\left(\frac{0.707107 c_1(G, m, t) + 0.325635\sigma_G^2 - 1.53546\log(\varpi)}{\sigma_G}\right)\right]\Bigg|_{\varpi=2.}^{\varpi=3.5}$$

Finally, $\mathcal{P}(m, t)$ needs to be integrated on the mass. For this we applied the same formula as in Jorgensen & Lindegren (2005) paper.

As already mentioned above, there are some differences in the estimated ages for the groups, however the general conclusion we can draw from the age analysis (e.g. presence of an evolved population towards the ONC, confirmation of the presence of a young population towards ϵ Ori, general age ordering, ...) are substantially unchanged.

Therefore we decided to modify the paper as follows:

- We decided to use in the text the constant parallax value;
- We discuss in two appendixes the results obtained using Fig. 6 to estimate the parallax to each sources and those obtained introducing the uniform parallax prior.

Finally, I also wonder whether the authors tried to do the age analysis on the TGAS sample? Having the individual parallax might compensate the smaller sample size. In fact, they should probably combine TGAS and Hipparcos to extend the age analysis towards more massive stars (see recommendation below).

We tried to do the age analysis on the TGAS sample, however there are mainly two problems we run into:

1) the errors on the parallaxes are at least one order of magnitude larger than those on the photometry and dominate the age determination (leading to very broad posteriors), and
2) the bright stars are generally on the main sequence. For this reason is difficult to say which group is younger or older than the others.

One could compute the posteriors using the parallaxes as fixed values (so without errors): then the posteriors would only account for the errors on the photometry in G and G - J. Note that in practice this is what we do when fixing the parallax at $\varpi = 2.65\,\mathrm{mas}$ or at the TGAS median value of Fig 6.
Finally, introducing Hipparcos is possible when studying the distribution of the sources in the sky, but of course the bright stars that are only in Hipparcos can not be used in the age estimate because they lack *Gaia G* band photometry.

5 Overlooked features in the density maps

Overlooked features in the density maps Figs 4 and 8. & 9 are very interesting figures, and to my opinion deserve much more discussion than there is currently. A number of important features are not discussed, and have potentially a great impact on our understanding of the region. A discussion about their existence and nature is required to fully interpret this complex region and the interplay between the various groups

5.1 Center of the Orion Dust Ring

A number of over-densities are present, and not associated to any known associations or groups (to the extent of my knowledge) around the center of the Orion Dust Ring discovered and described by Schlafly & collaborators. I have represented (roughly) the position of the dust ring on your Fig. 9 below. These overdensities (marked with question marks) appear in the TGAS, Gaia and PS1 analysis and thus call for more scrutiny, as they could be the remnant associations responsible for this bubble/ring!!! Your age analysis indeed suggests that the stars making these over-densities are 20+ Myr old, which is consistent with the age expected for the SN and massive stars that must have powered this bubble. I suggest to add a discussion about these overdensities in the context of the dust ring. Eventually you could try to see whether the stars located in these overdensities have properties (distance, proper motions, Rvel if available in the literature, etc..) that could give additional clues about their origin.

We added the following in Section 3.3:
Around the centre of the Orion dust ring ($\sim 214°, -13°$) discovered by Schlafly et al. (2015) a number of densities enhancements are present. These over-densities are visible also in the TGAS map of Fig. 4, but here they are more evident.

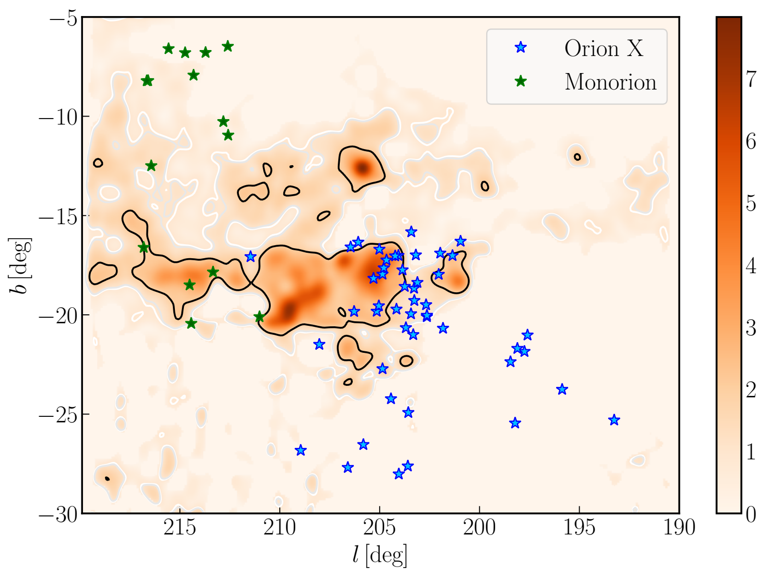
And in Section 5:
As already mentioned in Sec. 3.3, a number of over-densities are present towards the Orion dust ring discovered by Schlafly et al. (2015). The age analysis is not conclusive since many

over-densities are not within $S = 2$. Unfortunately, there are no proper motions and/or parallaxes available for these sources (nor in *Gaia* DR1 nor in other surveys), and their distribution in the color-magnitude diagram is not very informative. Additional clues about their origin will be hopefully provided by *Gaia* DR2.

5.2 Orion X, the Orion Blue Stream and the Orion-Eridanus Superbubble

I see a significant over-density that seems to coincide with the position of the Orion X group discovered recently by Bouy & Alves 2015 (see Fig. below with added comments). It is in fact one of the largest (in size) over-density present in the maps. The age analysis indicates that this group of stars is evolved, in agreement with Bouy & Alves results, and providing an additional clue that you might have found this new group in the Gaia data. An independent confirmation of the existence of this new group would be a very important and exiting result, and allow you to revise and extend your discussion and conclusions. therefore would like to ask you to investigate further this possibility:
1. First by over-plotting the list of candidate B star members of B&A2015 Table 3 onto Fig. 9 to ensure that they indeed coincide.

The plot is shown below.



The list of members associated to Orion X does not overlap completely to the over-density we find, however it is difficult to argue that these stars are not related to the young population we analysed in this study. The figure was included in the paper.

2. Second by checking the distance distribution for the Hipparcos + TGAS stars in that region: according to Bouy & Alves, Orion X starts as close as ∼200pc. Fig. 6 indicates that the stars around (l,b)∼(205,-20) are indeed closer. For the specific study of this group, I would *recommend to merge the lower left and right panels of Fig. 3, so as to include the closest stars of Orion X, and eventually improve the contrast of the corresponding overdensity.*

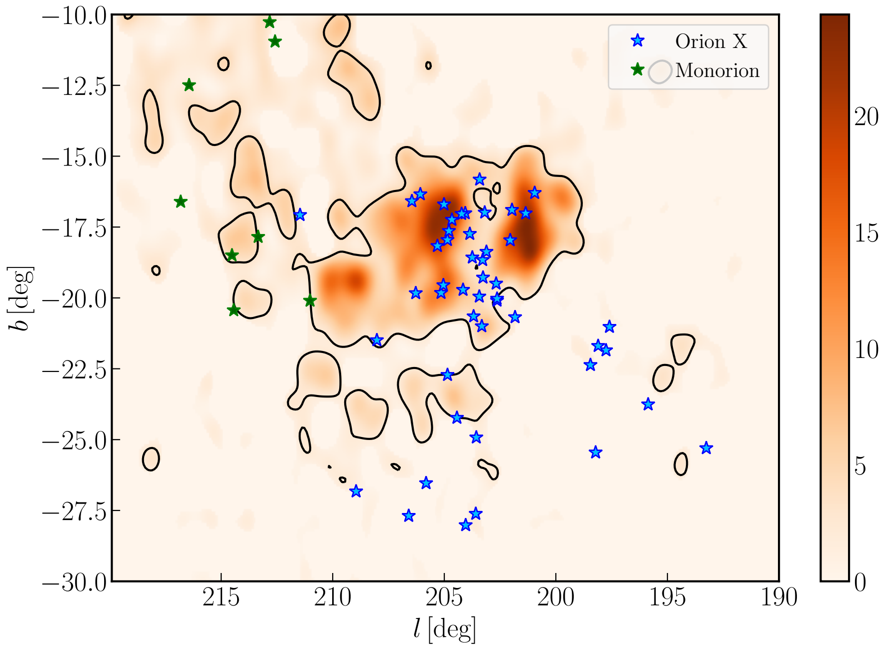
We studied the source distribution in the sky (combining TGAS and Hipparcos stars) of the sources with:

$$2 < \varpi < 7\,\mathrm{mas}$$

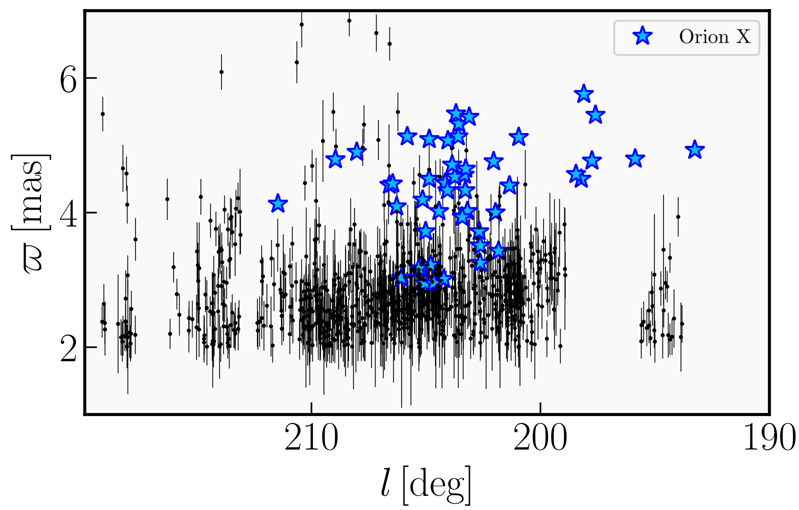
and

$$(\mu_\alpha - 0.5)^2 + (\mu_\delta + 1)^2 < 25\mathrm{mas/yr},$$

and we selected the stars within the S = 3 levels (as defined in the text of the paper). The figure below shows the density of sources together with the Orion X candidate members.



The parallax distribution of the TGAS + HIP stars within the density enhancements as a function of Galactic Longitude is shown below, together again with that of the Orion X stars. Some of the members of the Orion X group are directly related to the 25 Ori and Belt groups, while the majority of them are in the foreground.



3. Third by discussing the age distribution of these stars, computed as suggested above

The figure below on the left shows a color-magnitude diagram of the sources in the density enhancements with $3.5 < \varpi < 7$ mas (orange) and of the sources in the density enhancements with $2. < \varpi < 3.5$mas (blue). Note that here the Hipparcos sources are not included any more.

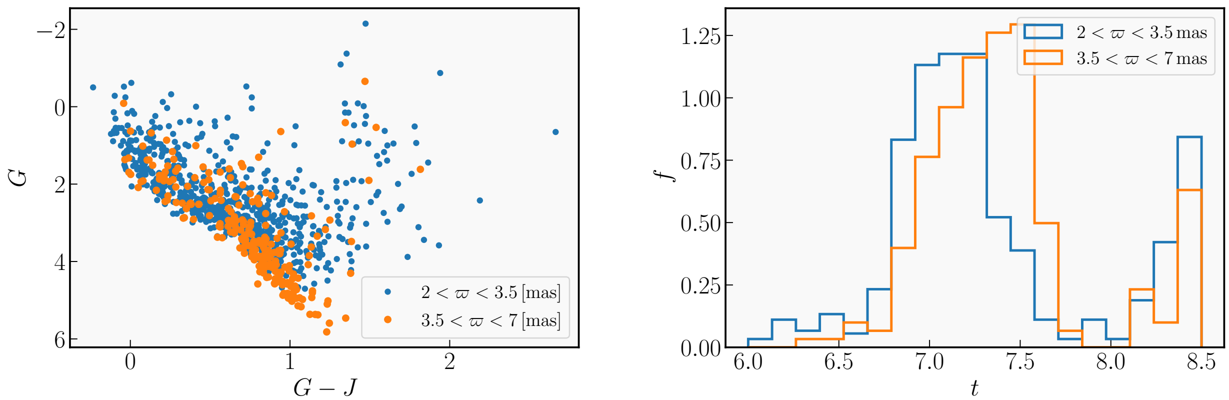
The foreground population looks slightly older than the one with $2 < \varpi < 3.5$ mas. The peaks of the age distributions are respectively at ~15 Myr and ~20 Myr. The histogram is also shown in the paper. We incurred however in the same issues with the parallax errors as explained above. [Note also that to fit the ages of the foreground we used isochrones with $A_V = 0.1$ mag].

To conclude it looks:

a) there is a foreground population, but

b) it is still too early to precisely characterize it.

We however have some hints that suggest that the foreground population is older than that that with $2 < \varpi < 3.5$ mas.



Finally, one should note also that out of the 48 candidate Orion X members, we have (only) 22 in common in TGAS. The final sample we are using to probe the foreground population (orange points and histogram) is of N = 242 sources. Unfortunately we are not able to estimate the ages for all the 48 candidate Orion X members since we do not have (*Gaia* DR1) photometry.

Finally, a number of over-densities to the east of the map might coincide with the Monorion group discovered by Bouy & Alves as well. Unfortunately their Table 3 includes only few stars, spread over a large area of the sky. But it would be worth over-plotting this list on the figure, and see whether you can confirm the existence of Monorion. You will also certainly note that they seem to fall on Schafly dust ring, which calls for a comment as well!

We over-plotted the Monorion candidate members on our KDE (as shown in the figures above). In this case the statistics is really too small. *Gaia* DR2 will improve our understanding of the region, and clarify the spatial distribution of Monorion.

5.3 25Ori

The shape of 25Ori is also calling for a discussion. Are the northern and southern extensions part of it, or have you found new groups in the Orion OB1 complex? They seem real and are present in all your figures, including those made with TGAS. It could be a very exiting discovery, adding the the general picture (and confusion!) of Orion. Here as well you could study the age and distance distribution of these two blobs, and compare to 25Ori and the other groups.
We studied the parallax and age distribution of the North-South extensions, and there are not significant differences between the two groups. The two groups however seem real, as they also appear in Fig. 15 of Lombardi+17! We added to the paper the following (Sec. 5):

As pointed out in Sec. 3.3 the 25 Ori group presents a northern extension ($\sim 200°, -17°$) visible in the TGAS, Gaia DR1 and Pan-STARRS1 density maps. The northern extension parallax is only slightly larger than that of the 25 Ori group, and the age analysis suggests that the groups are coeval. With a different approach, Lombardi et al. (2017) find evidence of the same kind of structure (see their Fig. 15). *Gaia DR2* will be fundamental in discerning the properties of this new substructure of the 25 Ori group.

5.4 Lambda Ori star forming region

The Lambda Ori Star Forming Region (LOSFR) is a very rich complex made of several clusters. Your analysis refers only to the central cluster, centered on the star -Ori, and also called Collinder 69. But the density enhancements seen in your analysis also include Barnard 30 (around 192,-11.5) and LDN1588 (around 194.5, -15.8). Below is a snapshot of your Fig. 9 with new labels indicating the position of all 3 clusters. They are all approximately at the same distance, but span a rather large age range, Col69 around 5$\sim$10Myr, B30 around 3$\sim$5Myr, and LDN1588 $<$ 1 Myr, that you might confirm with the age analysis. I refer you to the works of Dolan & Mathieu or Barrado y Navascues. Since they clearly appear in your analysis and because the LOSFR is such a rich and interesting complex, I encourage you to include the 3 of them in all the discussions, rather than Col69 only. In fact, the small over-density located on the H bubble to the left of LDN1588 and the size of the over-density around B30 are new to me and should probably be discussed/investigated! It might be an exiting discovery of a new group in the LOSFR.

With the new density maps, B30 and LDN1588 do not lie any more within the S = 2 contour levels. They are however still visible in the subtracted density map of Fig.8 (B30 in particular is within S = 1) along with many other over-densities that might be related the Schlafly dust ring.
It is difficult to characterize these groups precisely (e.g. with distances and ages), as the field contamination is large and we lack parallaxes and proper motions. However we added a short discussion in Sec. 5:

In Sec. 3.3 we pointed some over-densities located on the Hα bubble surrounding λ Ori, which are not related to known groups (to our knowledge). We further investigated the stars belonging to these over-densities, however there are no parallaxes nor proper motions available for these sources and it is difficult to draw firm conclusions from the photometry only (also combining *Gaia* DR1 and Pan-STARRS1). In this case as well, we have to conclude that hopefully *Gaia* DR2 will clarify if this groups are real or not.

6 Other minor comments and corrections

In the following I make a number of additional minor comments and corrections that I hope can help improve the manuscript.

- *The abstract and introduction refer to a comprehensive census of all the associations in Orion, but the selection process described in Section 2 rejects some of the youngest and embedded groups. The authors should rephrase the abstract and introduction (and everywhere else in the manuscript where it applies) to make clear that their analysis concerns objects (resp. associations) with low extinction and low excesses within*

Orion (for example L1641 is largely missed in this analysis), which in general are more evolved.

We rephrased the abstract:
In this work we use the first data release of the *Gaia* mission to explore the three dimensional arrangement and the age ordering of the many stellar groups towards the Orion OB association, aiming at a new classification and characterization of the stellar population **not embedded in the Orion A and B molecular clouds.**

And the introduction:
In this study, we use the first *Gaia* data release (Gaia Collaboration et al. 206a,b), hereafter *Gaia* DR1, to explore the three dimensional arrangement and the age ordering of the many stellar groups **between the Sun and the Orion molecular clouds, with the overall goal to construct a new classification and characterization of the young, non-embedded stellar population in the region**.

- *I appreciate the great care and caution with which the authors describe the effect of binarity. Binary should affect all populations in the same way (because the multiplicity properties seem to be roughly independent of environment and age after 1Myr), so that is an additional argument in favour of the robustness of your relative age ladder.*

  A sentence was added in the discussion. [BUT it needs a reference]

- *Section 4: for the sake of reproducibility, can you describe the cut performed in the (r,r-i) diagram?*

  The cut performed is:
  $r < 5 \times (r - i) + 12\text{mag}$,
  and was reported in the text.

- *Section 4: "We fixed the metallicity to* $\mathrm{Z}_\odot$ *and we applied the usual extinction correction of* $A_V = 0.5$ *mag." But previously you used 0.25mag?*

  Yes, it was a typo that has been corrected.

- *The comparison with Brown (1994) is inconclusive, and could probably be spared. Many studies have superseded Brown (1994).*

  The comparison was removed.