









**Figure 3.** Example of the UAT Sorting Tool in use, concept "Exoplanet formation" is being moved to "Exoplanet dynamics."

Should a concept be deemed unnecessary, it can be moved to the "orphans" node, indicating that the user believes that this concept does not belong in this particular section of the UAT and should be considered for deprecation. Finally, by using the "Add Concept" input box, the new Sorting Tool lets users suggest new concepts. The new concepts will appear on the "orphans" node, and can then be dragged wherever in the hierarchy a user thinks they may belong. (see Fig. 3)

Once a user has finished re-arranging the concepts and has made all of the suggestions that they believe are necessary, they are asked to include some personal information, such as name, email address, and institution. We ask for this information so that we may verify the validity of the suggestions and reach out for questions if needed. A radical suggestion sent from a respected specialist in the field would garner more weight than a similar suggestion from an unknown user. Lastly, there is also a space provided for additional comments, should the user wish to make note of anything in particular or give an explanation for their suggestions. At that point they simply need to click the "submit" button and an email is sent to the Curator for the Unified Astronomy Thesaurus.

## 5 Tracking Suggestions to the Unified Astronomy Thesaurus

Throughout each revision of the UAT, we have been accepting and incorporating feedback, most of which was received via email. In addition to feedback generated by the Sorting Tool, we would also receive unstructured emails, often containing multiple suggestions. Although many of these suggestions were clear and easily incorporated, some suggestions were complicated, requiring further thought and consideration. Tracking which suggestions from which emails had been enacted and which were still pending quickly became very difficult. Additionally, by holding the suggestions in the personal email inbox of the UAT Curator, we noticed that we were essentially creating a "dark archive" of feedback that only one person could see, act upon, or reference.

Since we had already been using GitHub to publish release versions of the UAT, we decided to use GitHub Issues, the associated platform for managing suggestions for software updates, as our web-based platform for tracking feedback. We opened the first Issue on GitHub on November 18, 2016 by copying the contents of emailed suggestion into the web-based platform. One benefit of using GitHub

was that each suggestion now has an open discussion forum. Not only can users search Issues to see if their feedback has already been submitted, they can create an account to add to the discussion. GitHub also has functionality to collect Issues together into a "milestone," which can then be linked to a release. This helps to create and maintain a log of changes, showing the provenance of the UAT as new versions are released.

## 6 The Future of the Unified Astronomy Thesaurus

In addition to the pending feedback that has already been received, the Curator for the Unified Astronomy Thesaurus has identified concrete areas that need improvement in order to move the UAT forward. Specifically, the UAT has some obvious gaps in content surrounding the topics of publishing, astronomical modeling, and software. Each of these subjects stands out as something that will only become more important in the future, and yet none are well covered in the UAT. Work has already begun on a comprehensive examination of these topics to draw out relevant concepts that can be used as a starting point for building new sections within the UAT.

To make full use of its linked data capabilities, we need to build connections between the UAT and other existing vocabularies. These would include general linked data sources such as Wikidata, specific vocabularies such as the Space Object Behavior Sciences taxonomy, helmed by the University of Arizona, and a potential taxonomy of astronomical instrumentation.

Another goal for improving the UAT is to include definitions and examples for concepts that are new to the field of astronomy or somehow ambiguous.

As for soliciting feedback in the future, GitHub Issues has created a fantastic springboard for launching conversations. Many of the suggestions are not trivial, meaning that to accept the change as stated might have broader implications over the UAT as a whole. These things require conversation, discussion, and contextualization. As we have learned from our work on the Unified Astronomy Thesaurus over the last few years, the most comprehensive feedback we have received came out of these types of discussions. To that end, we will be piloting focus groups with the aim of hashing out some of the thornier suggestions for the UAT. It is our expectation that these discussions will yield not only reasonable solutions, but also additional suggestions and feedback which will need to loop back into future focus groups.

In order to remain relevant as new discoveries are made in astronomy, the UAT must be considered a continual work in progress.

## References

- [1] *Astronomical Subject Keywords* (2013), <http://journals.aas.org/authors/keywords2013.html>
- [2] *IAU Thesaurus* (1995), <http://www.mso.anu.edu.au/library/thesaurus>
- [3] *IVOA Thesaurus* (2009), <http://www.astro.physik.uni-goettingen.de/~hessman/rdf/IVOAT/index.html>
- [4] *Physics Astronomy Classification Scheme* (2010), <http://journals.aps.org/PACS>
- [5] A. Accomazzi, N. Gray, C. Erdmann, C. Biemesderfer, K. Frey, J. Soles, *The Unified Astronomy Thesaurus*. (2014), Vol. 485 of *ASP Conference Series*, vol. 485
- [6] *The UAT Sorting Tool* (2017), <http://uat.altbibl.io/>