

## Scientific report: Galaxy Morphometrics

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### Description and aims

The goal of this workshop was to bring as many as practical of the experts in galaxy morphometrics together to discuss both ways to convert the complex appearance of galaxies in astronomical imaging into a few simple numbers and how to interpret these. The aim was realized in that not just representatives from a single scheme to generate morphometrics were attending, but practically all. There were 22 participants and four walk-in attendees (for a day or so), which proved to be the right size for both lively discussions and a close atmosphere.

### Format

The discussions started during the first talk by Chris Conselice (going overtime by 30min at least) which set the tone for the workshop. The participants started setting some of the questions we should think about:

1. What do we define as a merger?
2. Do we define a source and how? (+surface brightness dimming and color correction effects?)
3. Mergers: what are the time-scales (for both pairs of galaxies and morphological features)?
4. Clumpy galaxies; mergers vs star-formation?
5. Do one component galaxies even *exist*?
6. What do we call a bulge?

Subsequently, we loosely stuck to the program but did not enforce time limits since every scheduled talk sparked (welcome) discussion and thus ran typically over. The one exception was by Marc Huertas-Company who had to give his excellent talk on deep-learning techniques via remote/Skype call.

For the hack day a very large range of topics was suggested:

- What physics can we get from morphology?
- Creation of a unified code "WikiFit", inclusive and open-source.
- Automatic detection of clumps & compare to visual classifications of clumps (and quality check for both).
- Can we identify the kinematically most "compact" feature.
- What features of usual classifications are of interest across redshifts (epochs)?
- Bulge/Disk fit code; a demonstration of "ProFit".
- How can we compare Sersic codes?
- Overview paper of Galaxy Morphometrics.
- Build your own zooniverse project in 1hr.
- Bar profile fitting into galfit.
- Test the number of arm predictions with GalaxyZoo2.
- GalaxyZoo for atomic hydrogen observations with radio astronomy.

On Wednesday afternoon we had the hack day. To decide which topic was the most interesting to work on, we used the wall in the coffee corner. The workshop split into three groups to tackle a) clump-finding, b) code standards/comparisons and c) combining morphometrics and kinematic information. The results from these hack sessions and the talks were discussed on our final session on Friday afternoon.

We had to make some accommodations and Jeyhan Karteltepe gave her keynote on Thursday. Brooke Simmons gave an un-scheduled, but excellent tutorial on how to start a Zooniverse citizen science project (something we did not get to on the hack day).

The sessions were furiously tweeted by the participants (myself included). These can be found under the hashtag #galmorph and are summarized here:

<https://storify.com/BenneHolwerda/snellius-lorenz-center-workshop-galaxy-morphometri#publicize>

### **Scientific developments**

The workshop was in our estimation an unqualified success and sparked several future projects and collaborations on publicly available (and publicly maintained community-effort) software packages. There was also discussion about a possible follow-up workshop or conference at another location to continue to tackle the galaxy morphometrics of all the coming future surveys (e.g. LSST, EUCLID & WFIRST).