Untangling the Galaxy

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What are clusters?
Most clusters do not survive past 10 Myr
Few make it to 100 Myr
Orion Molecular Cloud Complex

- Multiple stellar populations
- Age range from < 1 to >10 Myr
Pleiades
Low mass stars younger than 20 Myr
Hierarchical clustering

- Measure distance between all points
- Construct a minimum spanning tree
- Determine the appropriate place to cut the branches
Hierarchical clustering

- Different clustering algorithms may have differences in outputs, but trace the same underlying structure.
- Data processed by the clustering algorithm != physical clusters are found.
The Orion Complex

Orion A  Orion B  Orion C  Orion D  λ Ori

Kounkel+18
Orion Complex
Proper Motions
Most SFR are extended and dynamically cold

Sco-Cen, Damiani+19

Vela, Cantat-Gaudin+18

Taurus, Luhman 18
Nearby Moving Groups

Riedel+17
New structures found with Gaia

Castro-Ginard+19
Several dozen compact open clusters

Meingast+19
Pisces–Eridanus stream
HDBSCAN

- Clustering in 5d space \((l,b,\pi,v_\alpha,v_\delta)\)
- Proper motions in lsr and in units of km/s
- Clustered in various distance slices and stitched together
Identified Structures

This Work
Cantat-Gaudin+2018
$8.5 < t < 9 \text{ dex}$
Origin of extended structure

• Not tidal stretching
  – Present ubiquitously in younger regions
  – Frequently not associated with a cluster at a center

• Primordial!
  – Remnants of the filamentary molecular clouds
  – Slowly dissolving over time
  – Only those that have been incredibly massive to begin with will survive for more than a few hundred Myr
Young strings are preferentially oriented perpendicularly to the Local Arm, parallel to one another.
Galactic view

<100 Myr

Stream 1
Galactic view

<100 Myr

Stream 1

<500 Myr

Stream 2
<100 Myr

Stream 1

<500 Myr

Stream 2

>500 Myr

Stream 3

Stream 4
Summary

- ~300,000 stars within 1 kpc with ages
- Stars commonly form in extended string-like structures, not just in clusters
- Some of the strings can remain coherent for >Gyr timescales
- Can be used as tracers of the evolution of the Galactic structure