

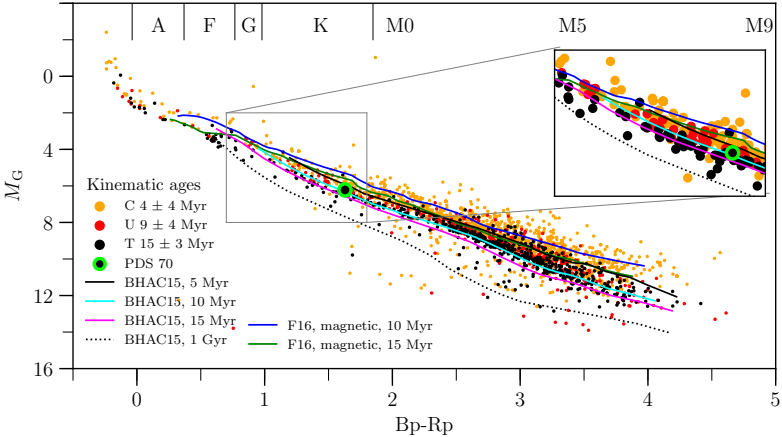
Kinematic age and substructure of the Scorpius-Centaurus association

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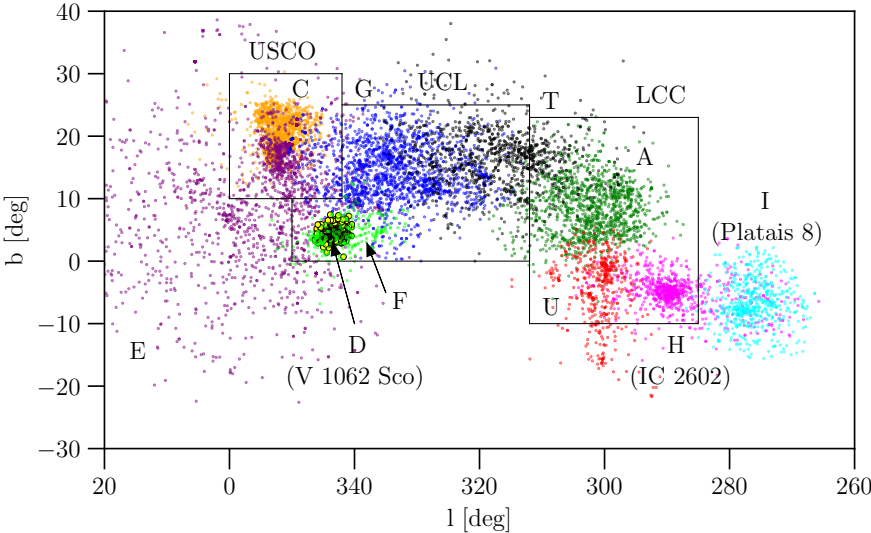
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Scorpius-Centaurus association (Sco-Cen) as the nearest massive star formation site is a local laboratory ideally suited to the study of a wide range of astrophysical phenomena. However, its vastness and complex structure make kinematic analysis of its traditional three regions, Upper Scorpius (USCO), Upper Centaurus-Lupus (UCL) and Lower Centaurus-Crux (LCC), challenging.

We use **Chronostar** - a robust Bayesian method for kinematic age determination of young stellar associations - and Gaia DR2 data to construct a 6-dimensional kinematic model of the Sco-Cen association. **Membership selection relies purely on the kinematics** and completely neglects stellar age, location in the colour-magnitude diagram, or any other youth indicators.



Kinematic selection identifies young overluminous stars.



Kinematic age

ID	Members			T_{age}	ΔT_{birth}
	p>0.5	p>0.8	p>0.9	Myr	Myr
UCL Components					
● T	1056	755	586	15	3
● G	1713	1037	649	13	8
● D	512	422	360		
● F	298	219	187	15	2
LCC Components					
● A	1264	883	639	7	5
● U	490	410	374	9	4
USCO Components					
● C ^a	1444	1253	1119	4	4
● E ^a	1926	1233	887	11	4
Total	8703	6212	4801		
Known clusters (not part of Sco-Cen)					
● H	843	798	777		
● I	545	481	442		

^aComplex, multi-population component.
p: membership probability

Results

1. The Sco-Cen model with Chronostar identifies 8 kinematically distinct components. It consists of nearly 9,000 stars distributed in dense and diffuse groups. Upper Scorpius-Lupus and Lower Centaurus-Crux are split into two parts.
2. **Each of the components has an independently-fit kinematic age that is consistent with the isochronal age from the literature.** This is the first time the kinematic age in a complex association is determined reliably. The kinematic age of the two Upper Scorpius Lupus components is 15 ± 3 Myr and 13 ± 8 Myr. Lower Centaurus-Crux with 7 ± 5 Myr and 9 ± 4 Myr appears to be kinematically younger.
3. **An exoplanetary host PDS 70** is found to have a 97% membership probability in component T of Upper Scorpius-Lupus. The kinematic age of this component with only a small spread in luminosity is 15 ± 3 Myr.

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References

Žerjal et al. 2021, in preparation
Chronostar: Crundall et al. 2019, *MNRAS*, 489, 3625
Gaia DR2: Gaia Collaboration et al. 2018, *A&A*, 616, A1