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# Chimera: A Mission of Discovery to the First Centaur

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## Abstract

Chimera is a mission concept to visit the highly active Centaur, 29P/Schwassmann-Wachmann 1 (SW1), which has been submitted to the NASA 2019 call for Discovery mission proposals. Chimera will study evolution, chemistry, and mechanisms driving activity of an icy planetesimal beyond Jupiter. New Horizons taught us about the most primitive type of icy planetesimal and many missions from Giotto to Rosetta have visited highly evolved comets: Chimera will explore the evolutionary middle ground between Trans Neptunian Objects (TNOs) and Jupiter Family Comets (JFCs) (Figure 1).

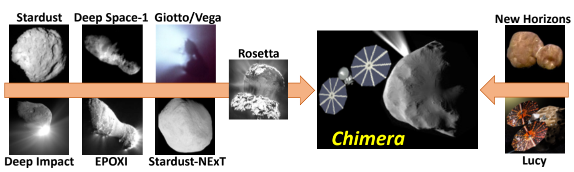


Figure 1: The mission legacy to which Chimera will contribute.

## 1. Why Centaurs?

Comets, Centaurs and TNOs are believed to be cryogenically preserved samples of the gas and grains of the proto-solar nebula out of which the solar system formed. Having been dynamically perturbed to large heliocentric distances early in the history of the solar system, their composition and structure retain information that can be used to quantify the conditions and mixing in the disk from which they formed.

The Centaurs themselves exist in a relatively short dynamical phase (Figure 2): they have been disturbed out of the scattered disk of the Kuiper Belt back into the region between Jupiter and Neptune where they likely originally formed. From here, interactions with the giant planets can either scatter them out of the solar system or inwards to become the JFCs. It is in the Centaur region that these objects develop nascent activity, modifying them for the first time since giant planet migration sent them into cold storage. Centaurs are *chimeric* objects, with properties in common with both TNOs and JFCs. Understanding their structure, chemistry, and processes that drive their activity are key to understanding the evolution of icy planetesimals and how the planetesimals we observe today, especially the most accessible JFCs, inform us about the origin of the solar system.

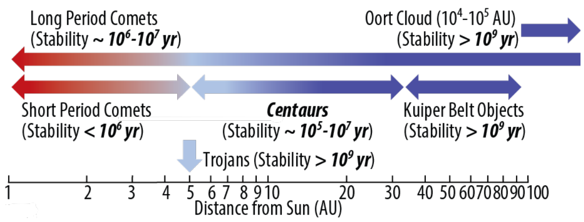


Figure 2: The modern family of icy planetesimals.

## 2. Why SW1?

While ~20% of Centaurs are known to be at least sporadically active [1], SW1 stands out in multiple ways. Discovered during an outburst in 1927, SW1 was the first object other than the giant planets found to occupy a heliocentric orbit entirely beyond Jupiter. Its persistent coma and photometric variability while in a near-circular orbit at 6 AU was considered enigmatic, making it a favorite target of study. From the resulting 90-year observational baseline, we now know that SW1 maintains a near-constant background level of activity in all phases of its orbit. This quiescent activity is frequently interrupted by large outbursts that brighten by 1-5 magnitudes [2]. The modern outburst cadence is ~7 events/year with little evidence of seasonal variability (Figure 3).

The persistence and magnitude of SW1's activity is greater than that observed from any other Centaur and comparable to that observed from similar-sized long period comets (LPCs) at the same heliocentric distance (Figure 4). Combined with the known long-term consistency of its activity, this makes SW1 uniquely positioned to address the most fundamental questions of planetesimal formation, volatile composition, and evolution.

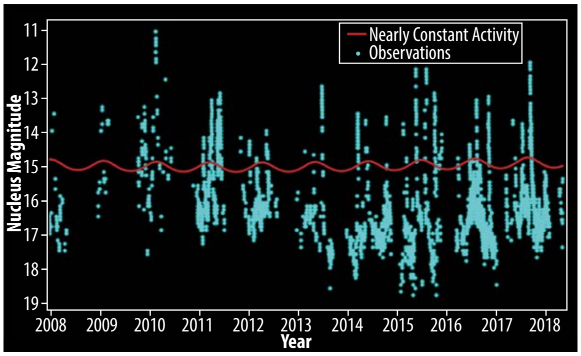


Figure 3: A decade of outburst detections from SW1.

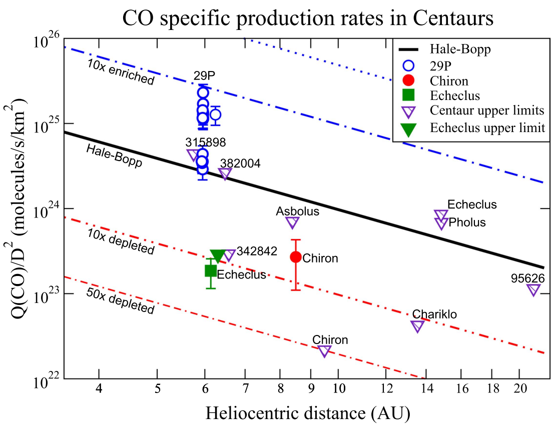


Figure 4: The area-averaged production rate from SW1 is larger than that of other Centaurs [3].

## 3. Summary and Conclusions

The 2013 decadal survey identified the Centaurs as an important target for future exploration. Chimera will deliver a capable suite of remote sensing instruments to SW1 that will characterize its activity, search for signatures of evolutionary processing, measure the composition volatiles and ices on the surface and in the coma, and determine the physical characteristics of the nucleus.

## Acknowledgements


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## References


[1] Jewitt, D.: The Active Centaurs, The Astronomical Journal, Volume 137, Issue 5, pp. 4296-4312, 2009.

[2] Miles, R.: Discrete sources of cryovolcanism on the nucleus of Comet 29P/Schwassmann-Wachmann and their origin, Icarus, Volume 272, pp. 387-413, 2016.

[3] Wierzchos, K., Womack, M. and Sarid, G.: Carbon Monoxide in the Distantly Active Centaur (60558) 174P/Echeclus at 6 au, The Astronomical Journal, Volume 155, Number 5, pp. 230-243, 2017.


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