

# Ultraluminous X-ray Sources in Globular Clusters

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# Ultraluminous X-ray Sources and Globular Clusters

- **ULXs:** X-ray sources with  $L_X > 10^{39}$  erg/s.
- **Motivation:**
  - Exceed Eddington luminosity for stellar-mass black holes.
  - Offer insights into extreme accretion physics.
  - nature and formation channels still uncertain

## Research Objectives:

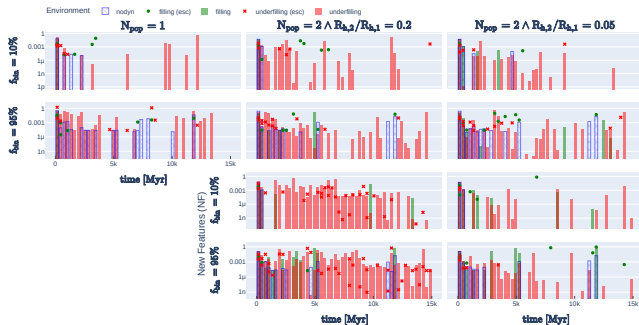
- **Aim:** Explore ULX formation in GCs.
- **Methodology:**
  - Used **MOCCA** code for simulations.
  - Examined effects of:
    - Binary fraction ( $f_{\text{bin}}$ ).
    - Cluster density (tidally filling vs. non-tidally filling).

# Key Findings

## ● Dynamical Effects Enhance

### ULX Formation:

- **Binary Hardening:**  
Encounters tighten binaries, promoting mass transfer.
  - **Stellar Exchanges:**  
Partner swaps create new ULX progenitors.
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- **Negative effect of dynamics:**
    - disruption of potential progenitors.
    - enhances hardening leading to early mergers.



## Cluster Properties Matter

### ● Non-Tidally Filling Clusters:

- Denser cores.
- Longer retention of massive stars.
- Higher ULX populations.

### ● Tidally Filling Clusters:

- Early loss of massive stars.
- Fewer ULXs over time.

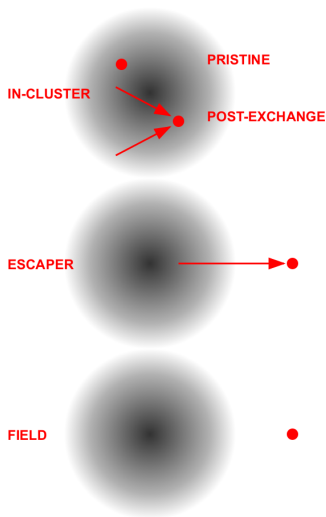
# Discovery of "Escaper" ULXs

- **Escaper ULXs:**

- Progenitors formed in GCs, but ejected into the field.
- Contribute to observed field ULX population.

- **Implications:**

- Links GC dynamics to field observations.
- Alters understanding of ULX origins.



# Conclusions

- ULX Population Studies:
  - Need to account for GC contributions.
  - Dynamics play a crucial role in formation pathways.
- Dynamical interactions in globular clusters significantly influence ULX formation.
- Non-tidally filling clusters produce more ULXs due to dense environments and prolonged interactions.
- "Escaper" ULXs suggest that some field ULXs originate in GCs, reshaping our understanding of their populations.
- The scarcity of ULXs in GCs is likely due to their older stellar populations, highlighting the impact of cluster dynamics and age on these phenomena.

**Thank you!**