

Milky Way Mergers and Stellar Streams with Gaia

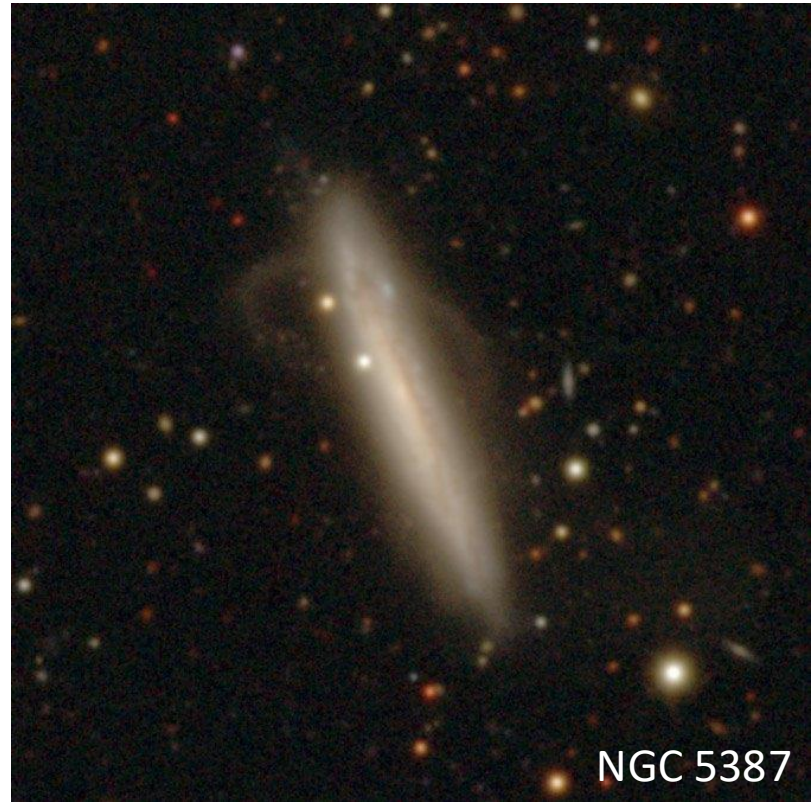
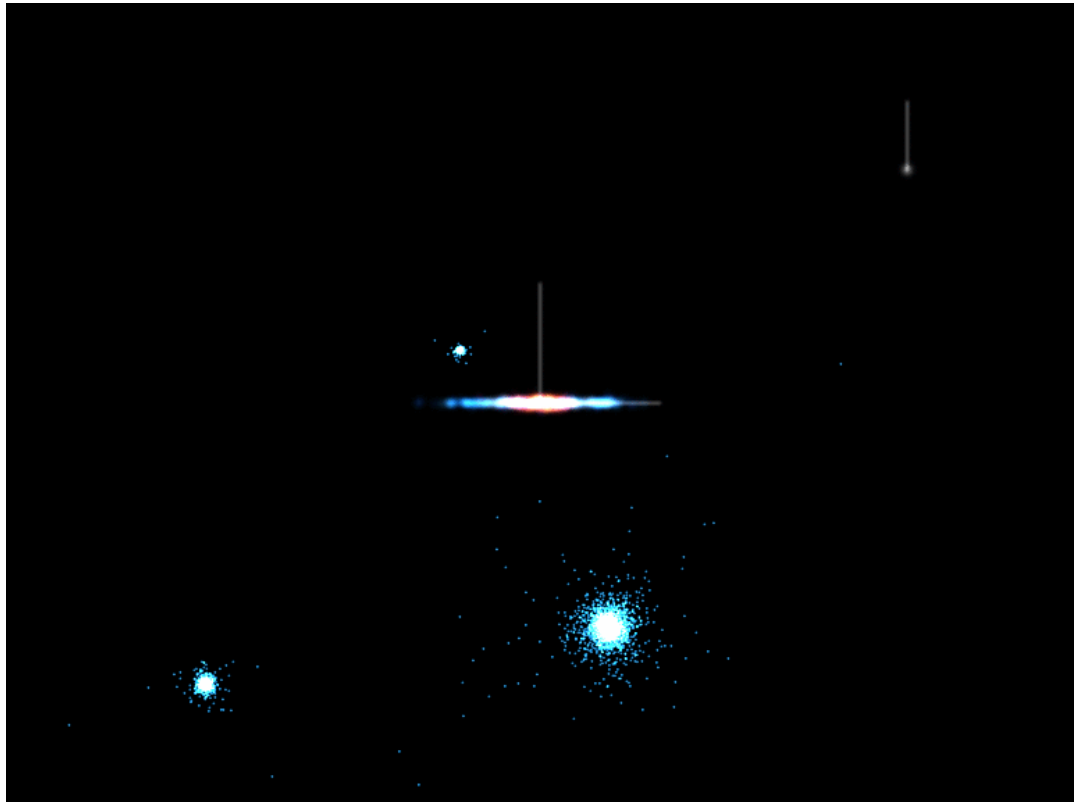
Noah Kaijser & María Eugenia Redondo González

Thursday, March 26th 2026

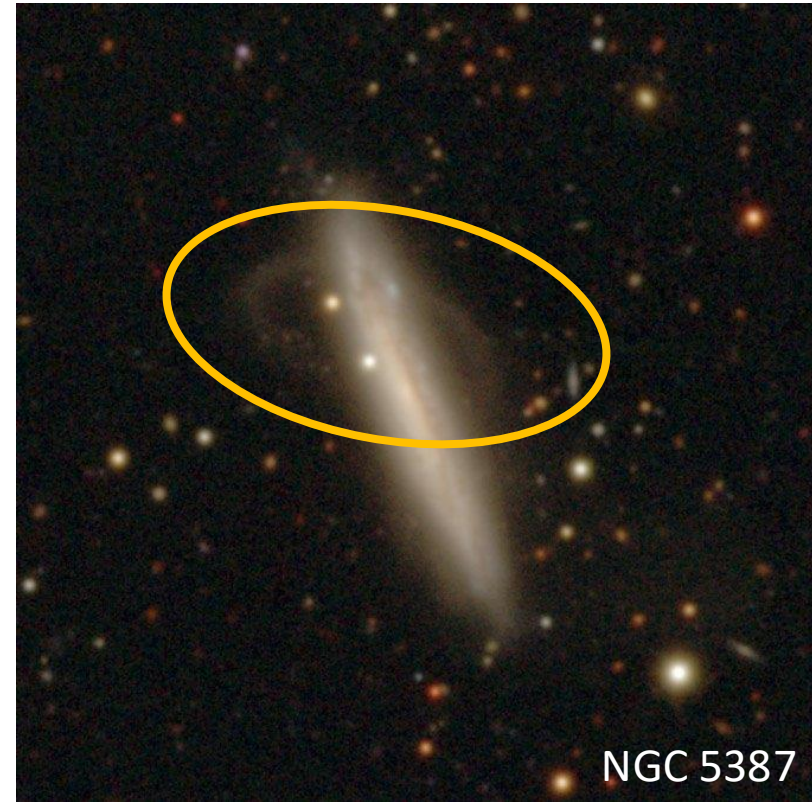
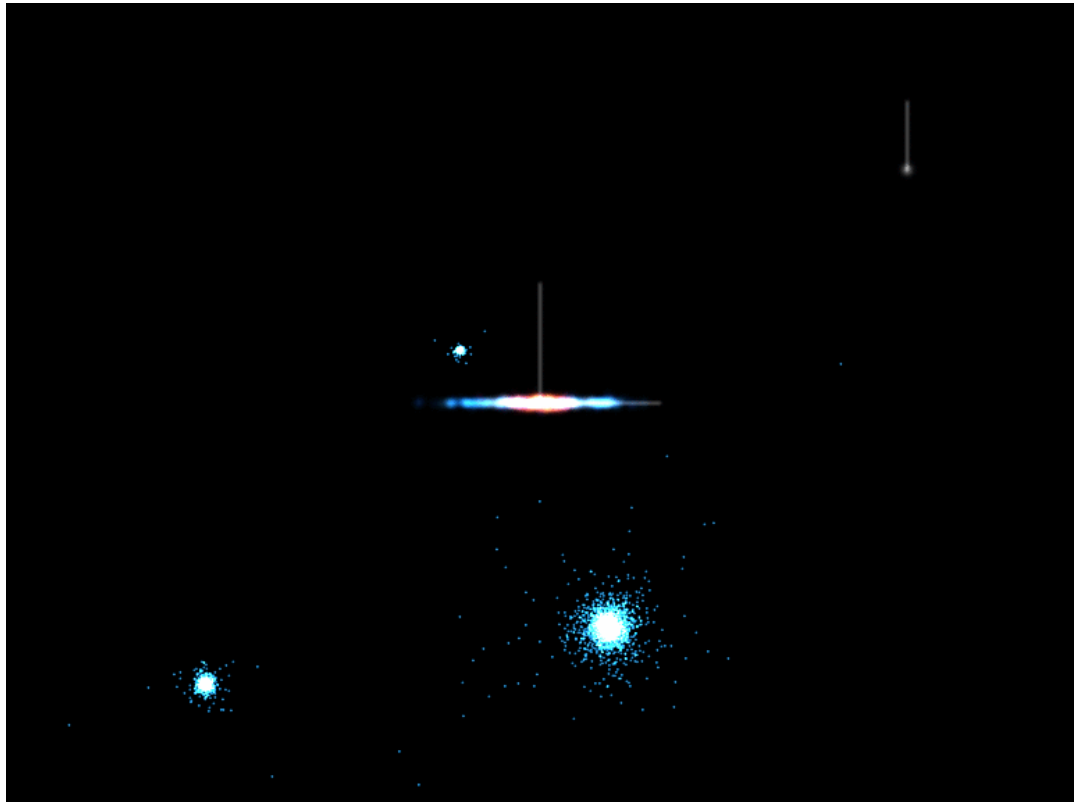


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Introduction	Antoja 2018		Bonaca 2025			
Stellar Streams	Methods	z-Vz projection	Discovery and characterization	Kinematics	Structures	Future outlook



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Introduction

Antoja 2018

Bonaca 2025

Stellar Streams

Methods

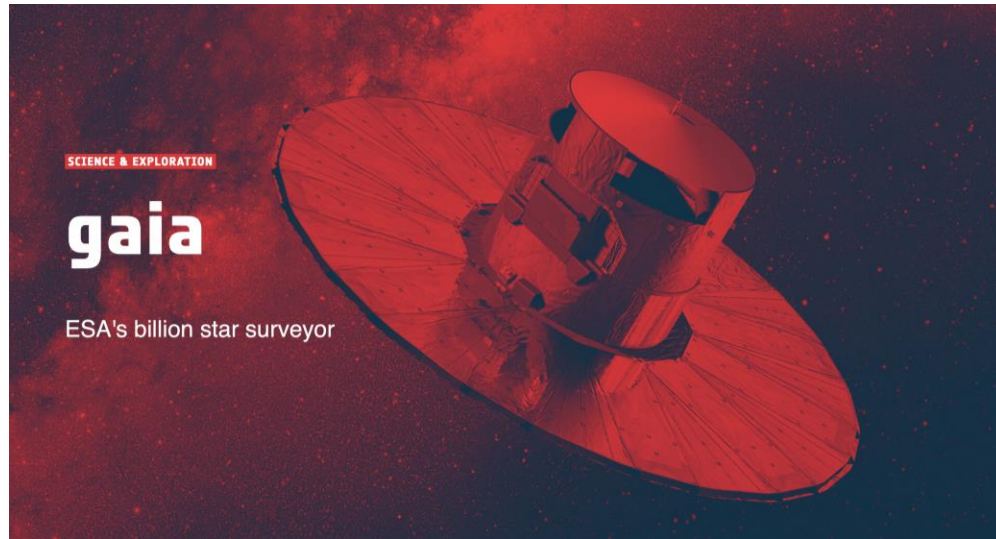
z - V_z projection

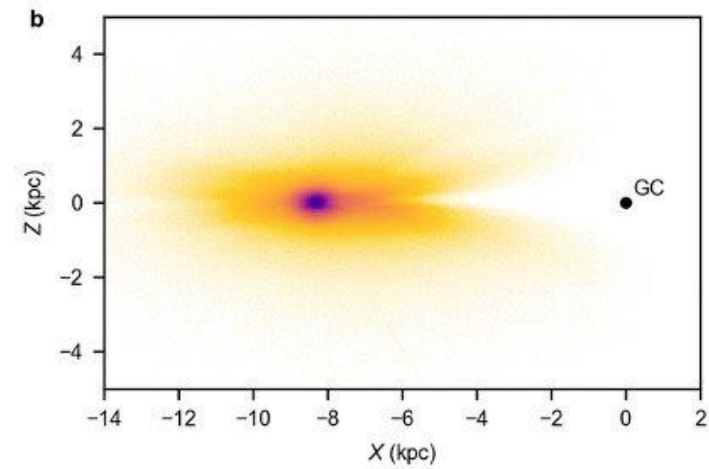
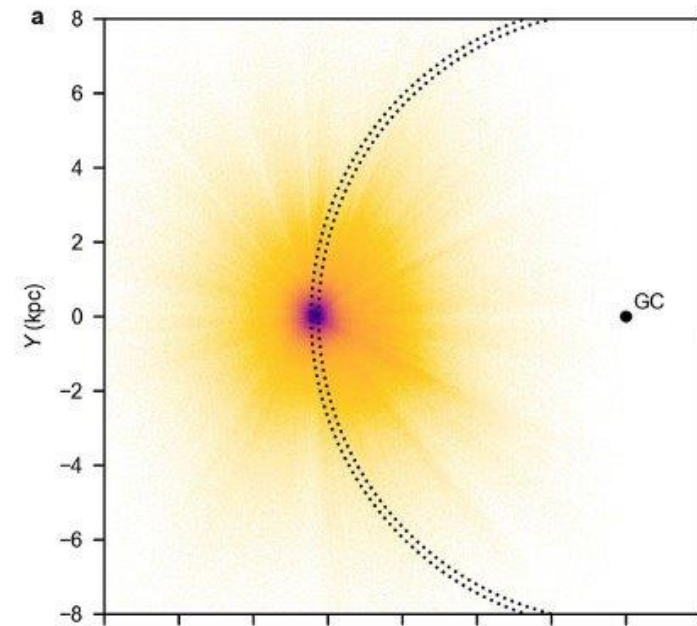
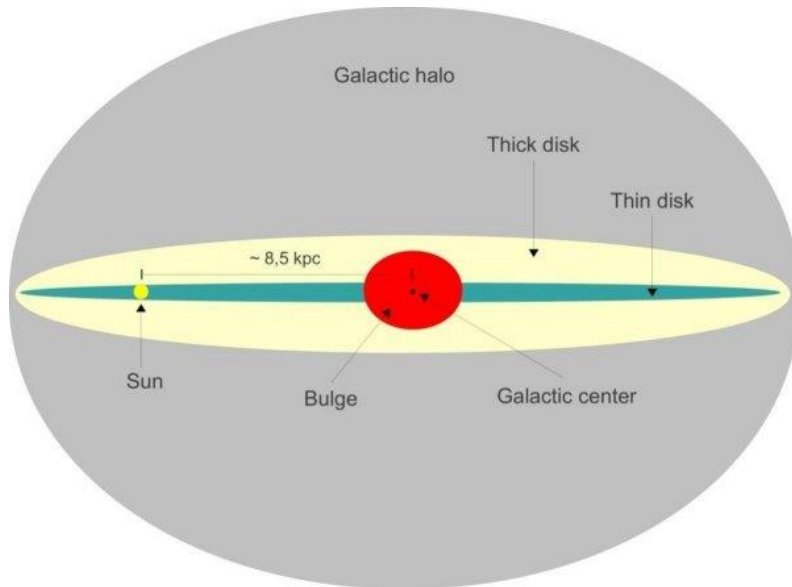
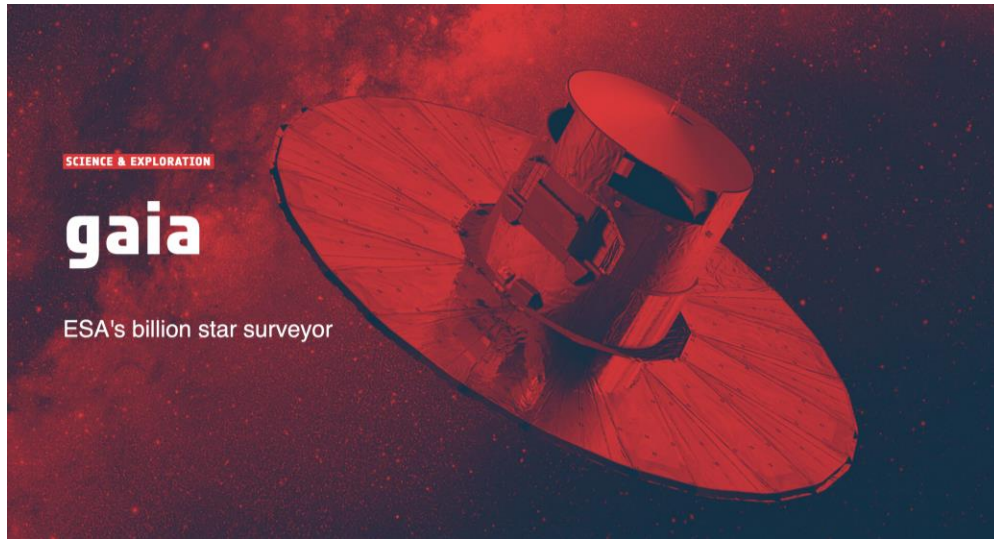
Discovery and characterization

Kinematics

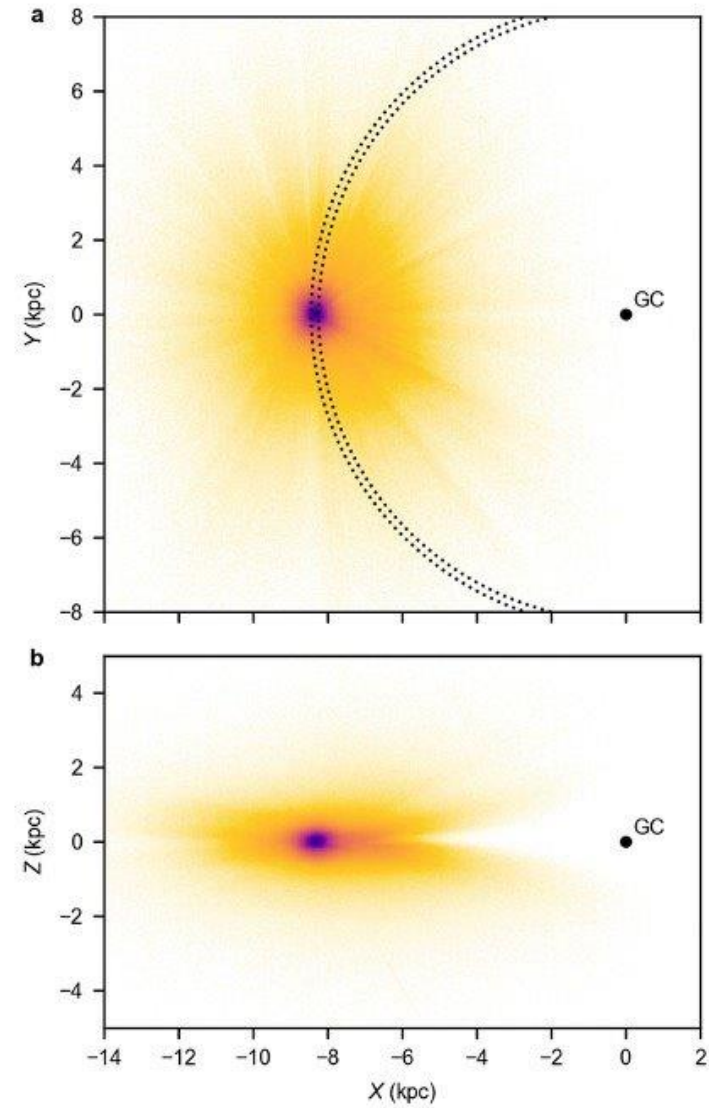
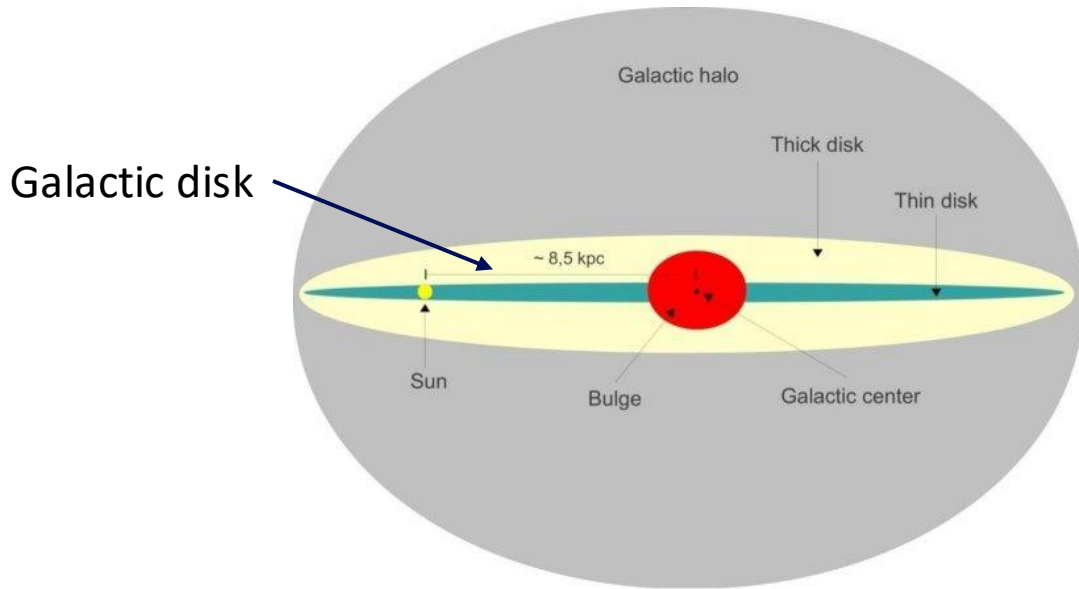
Structures

Future outlook

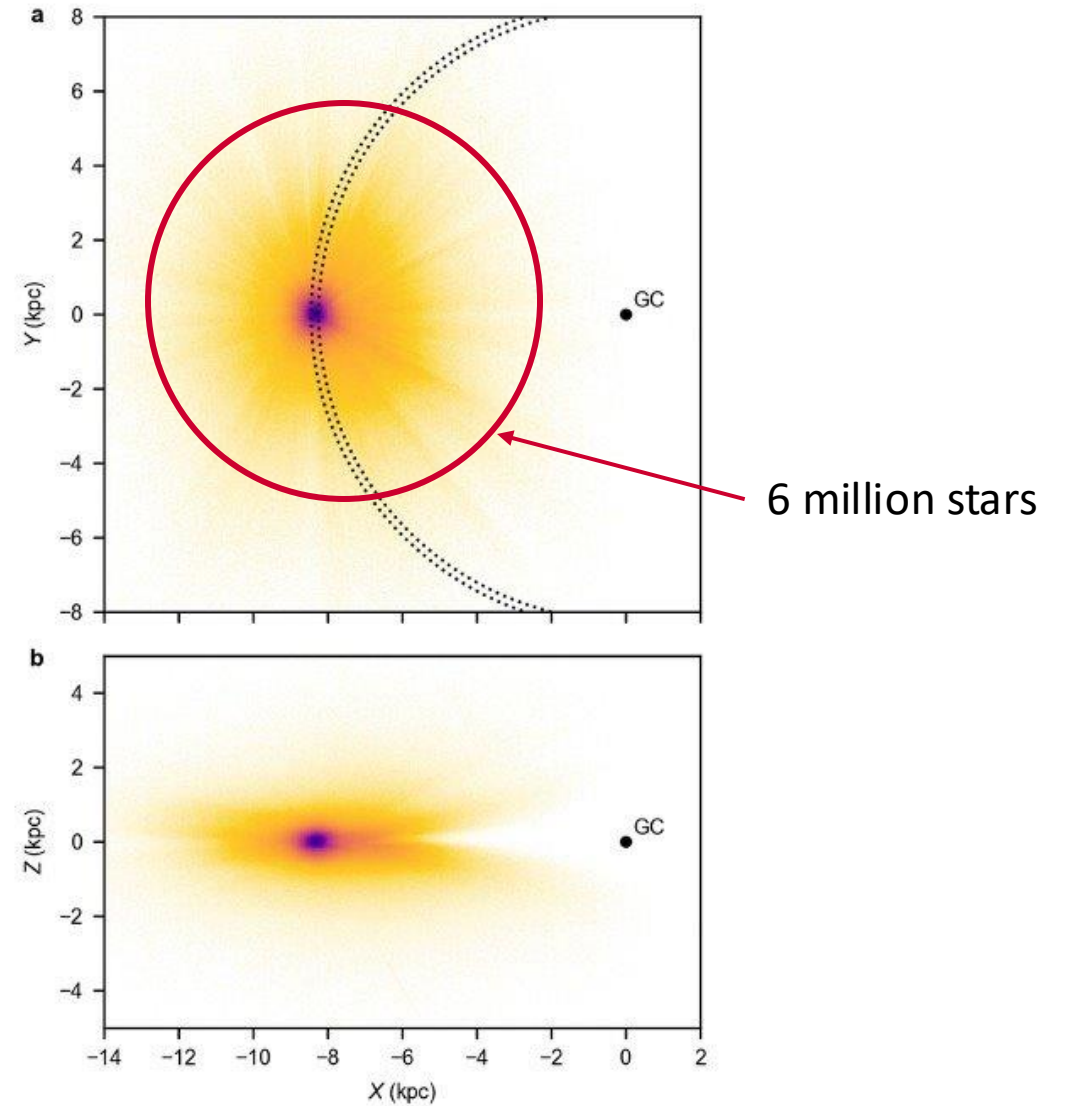
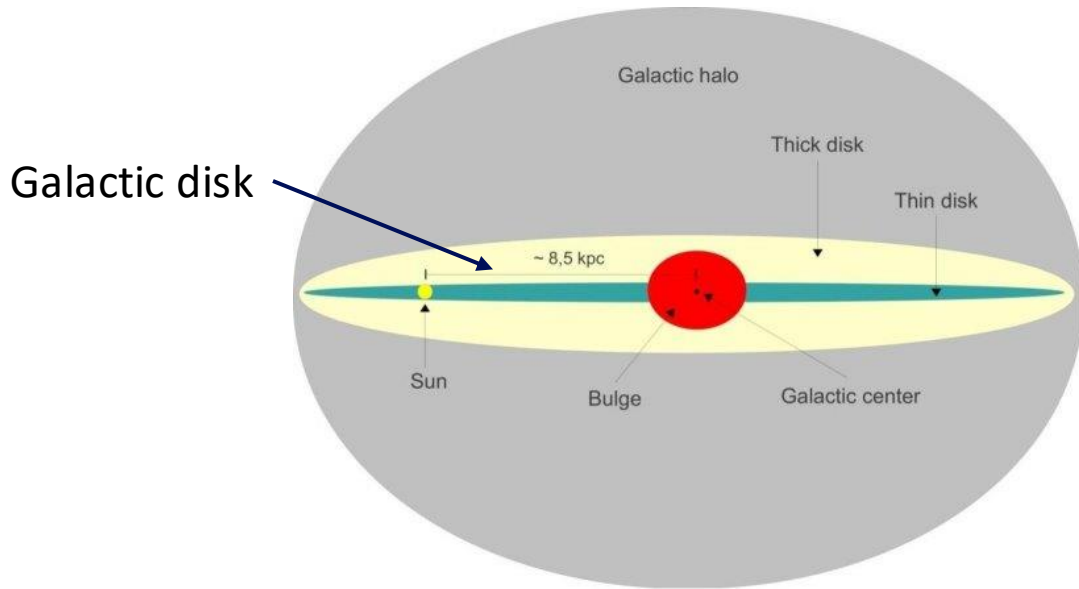




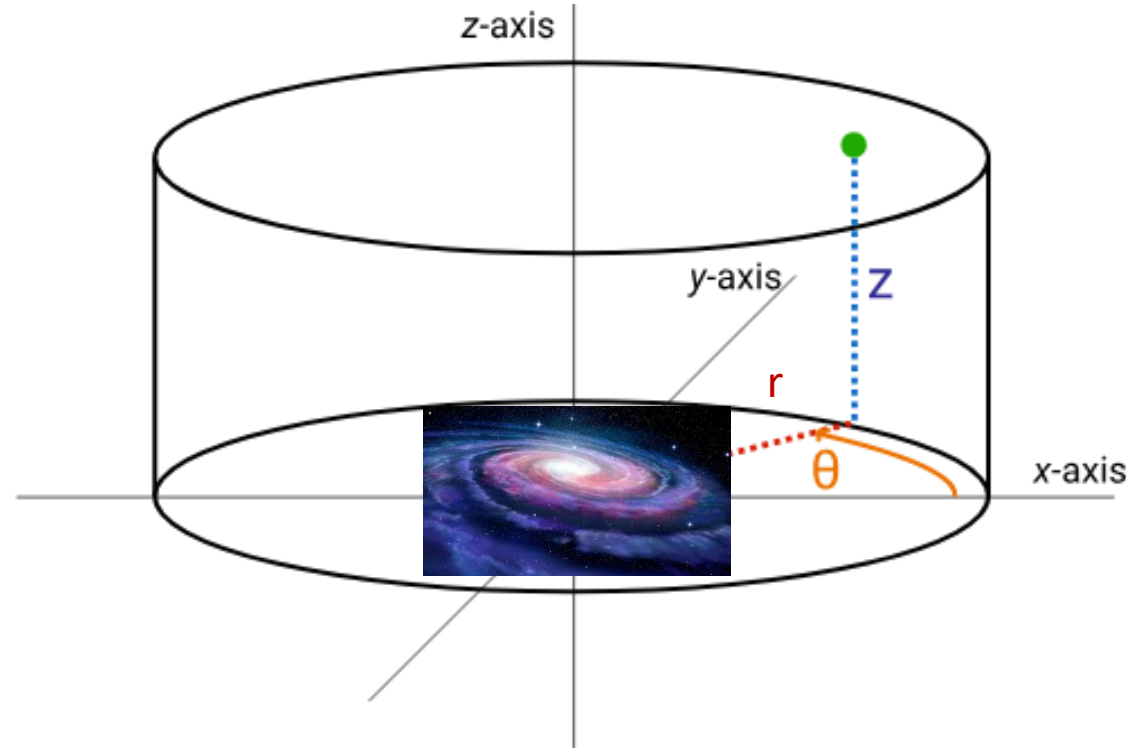
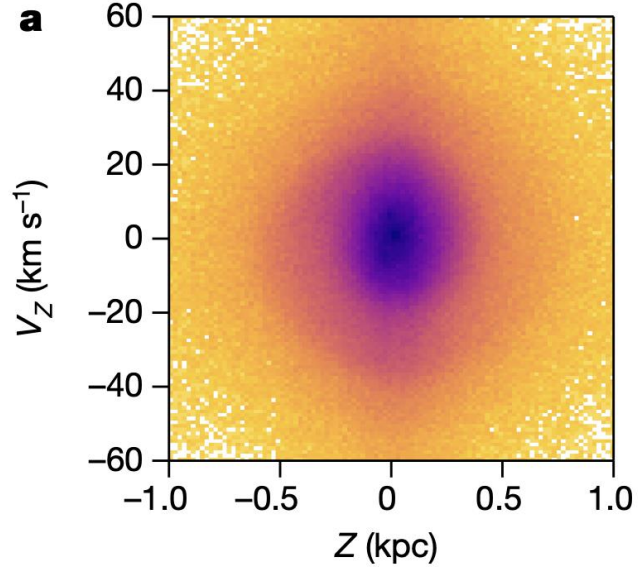
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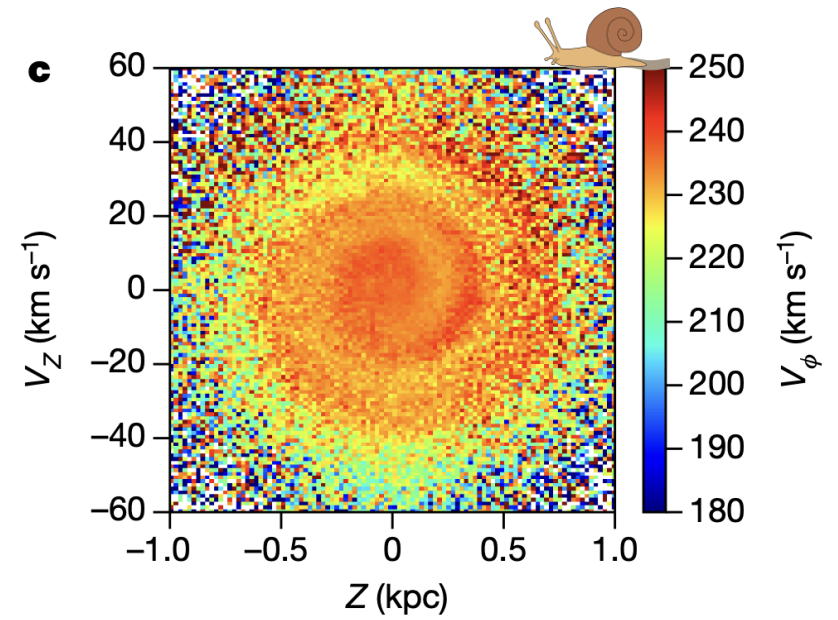
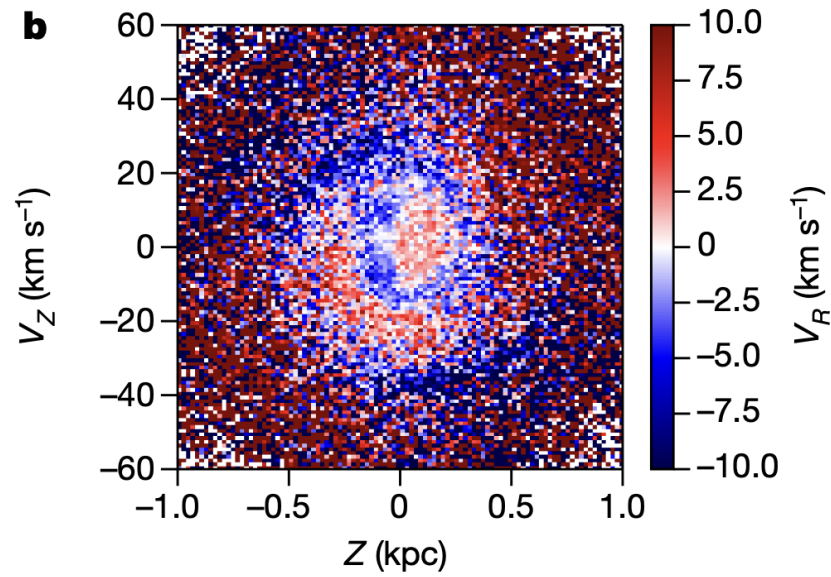
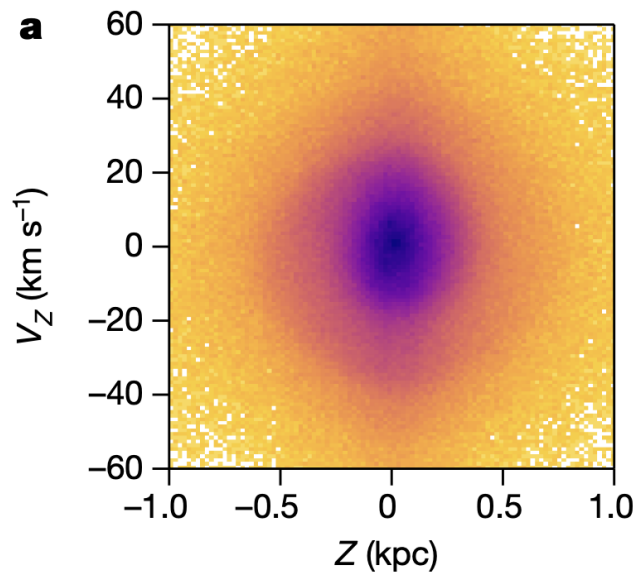
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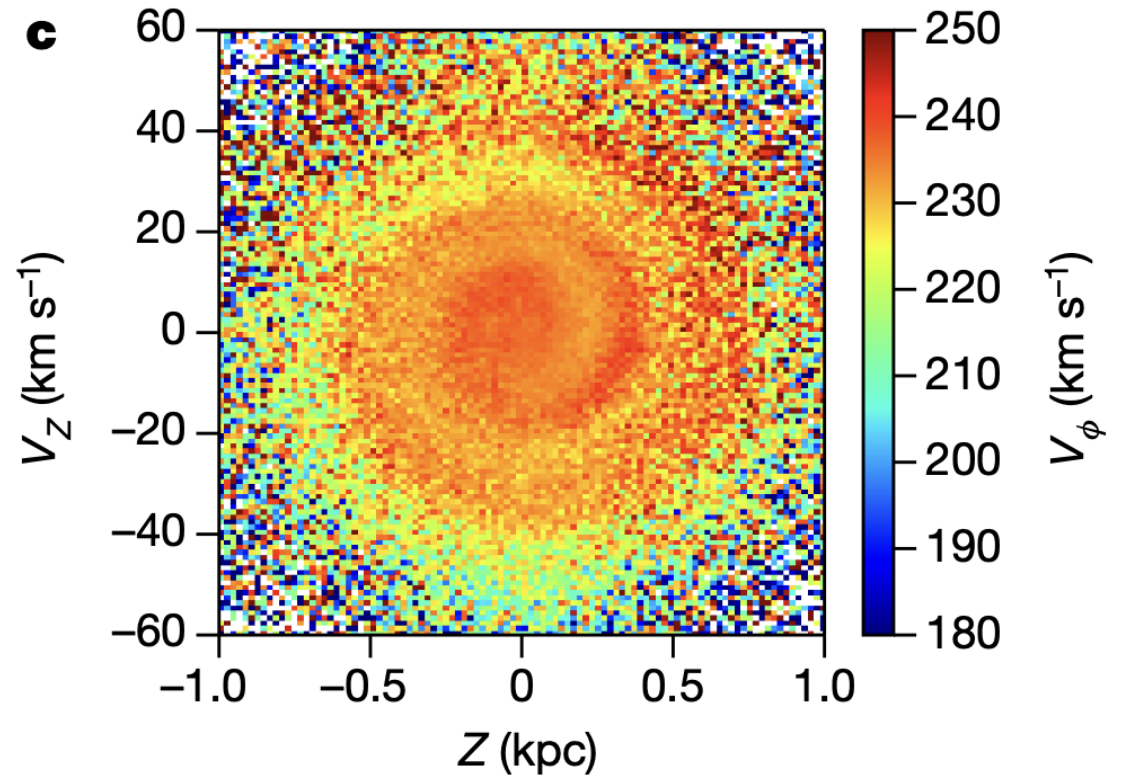
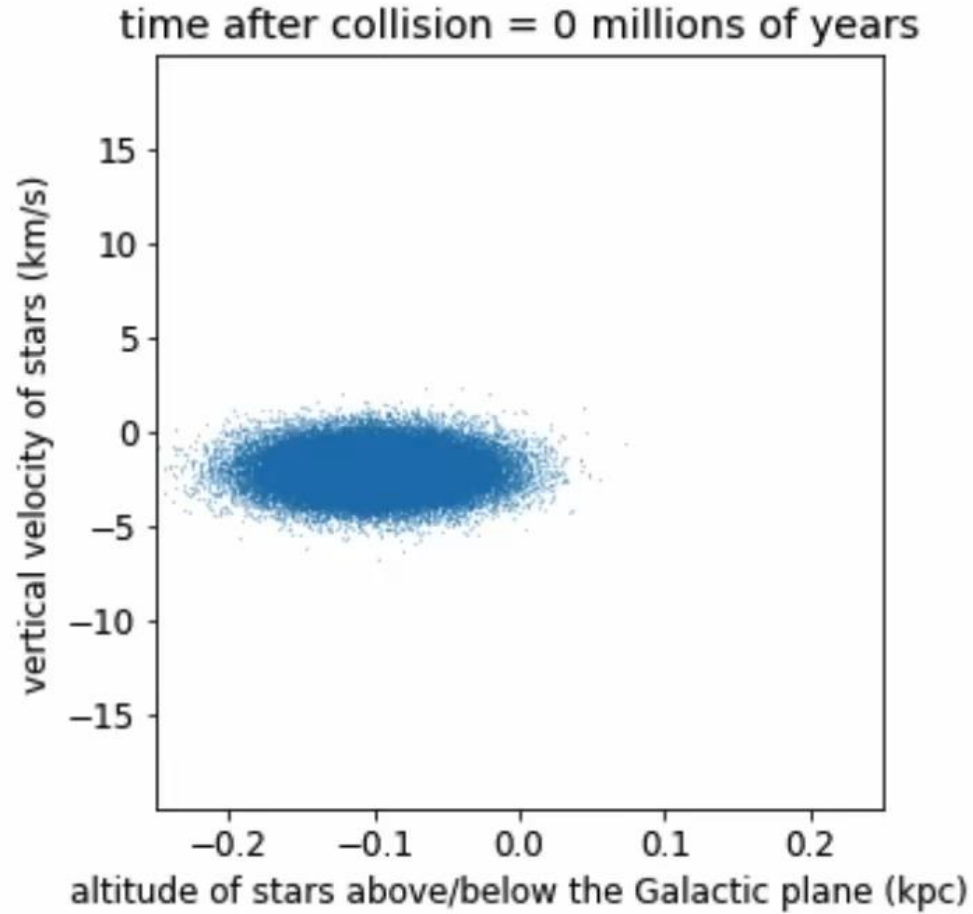
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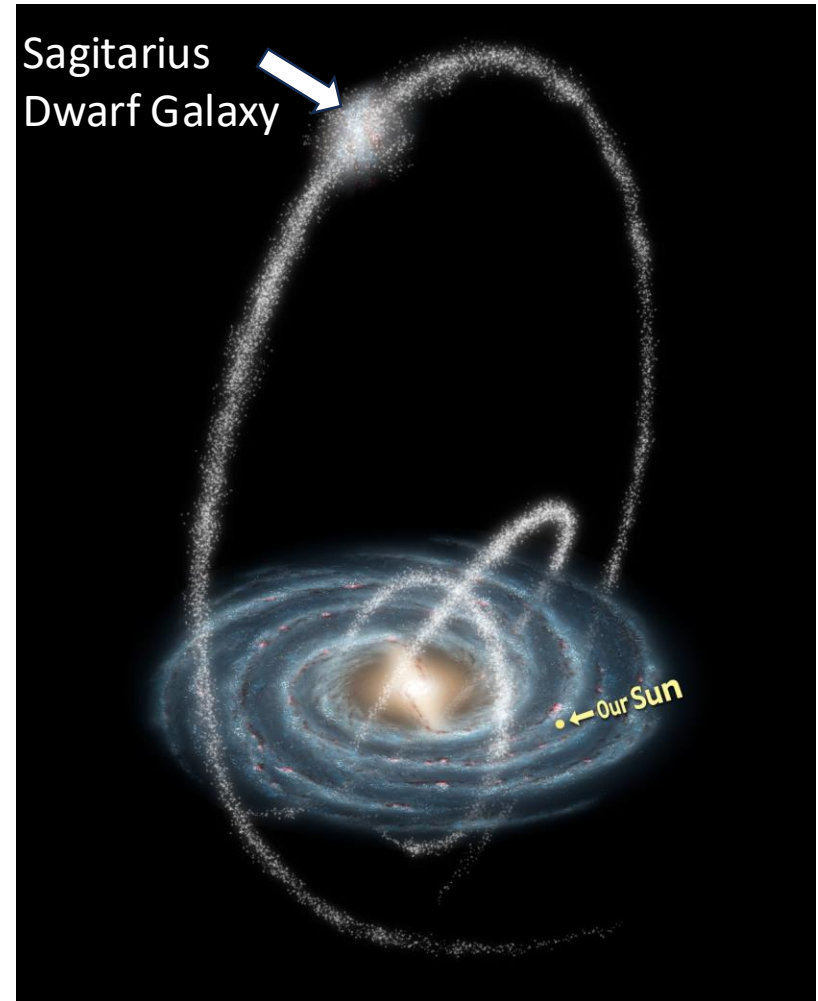
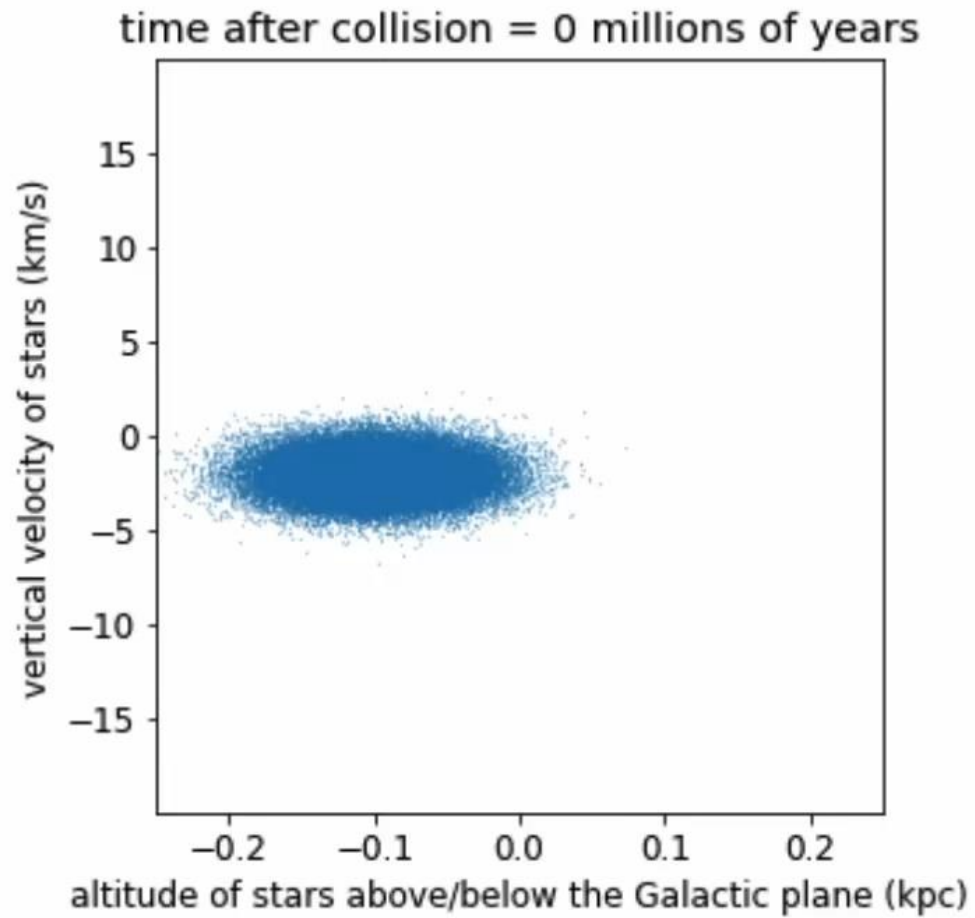
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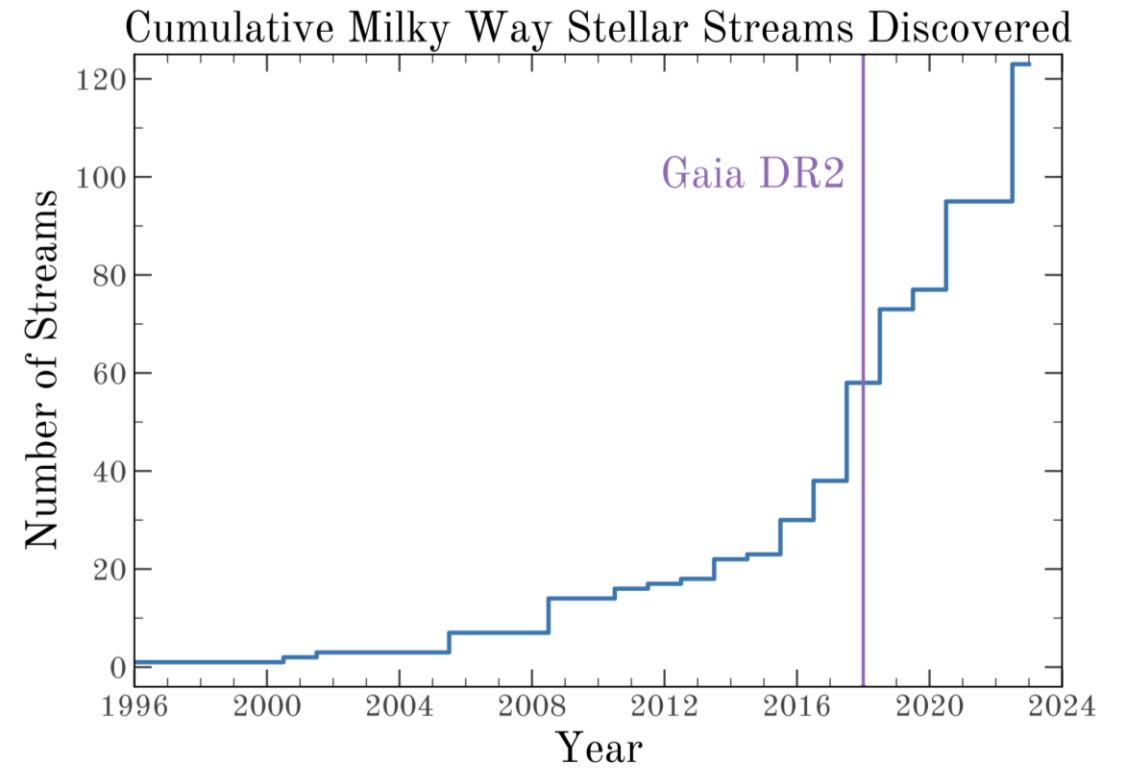
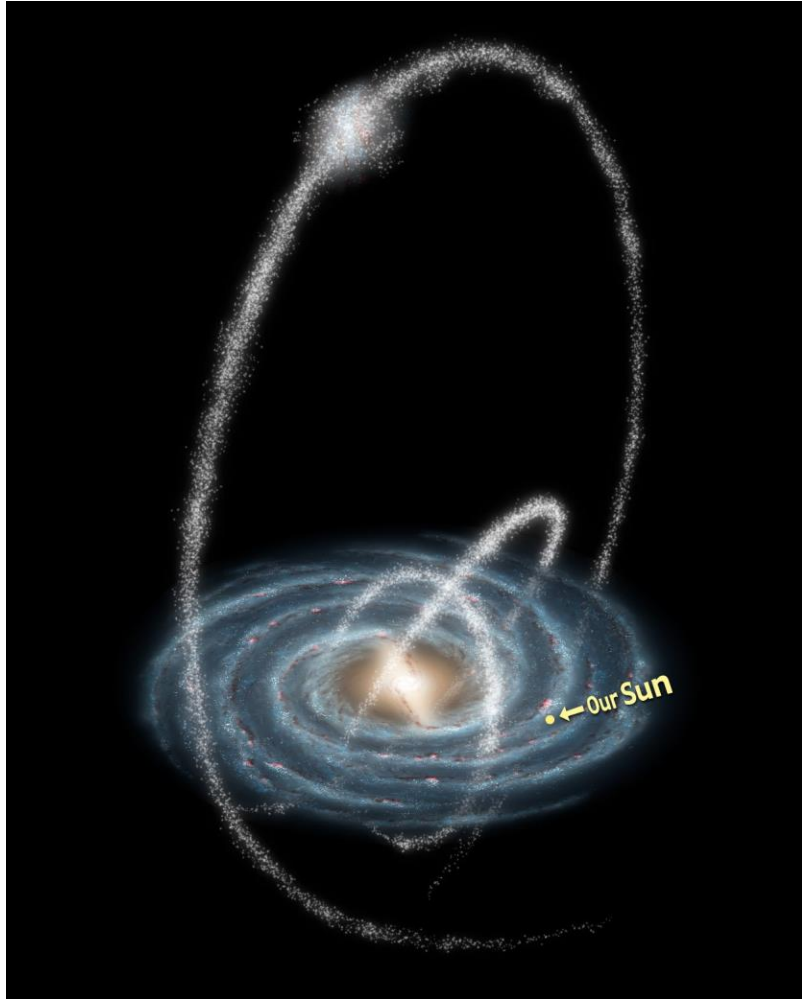
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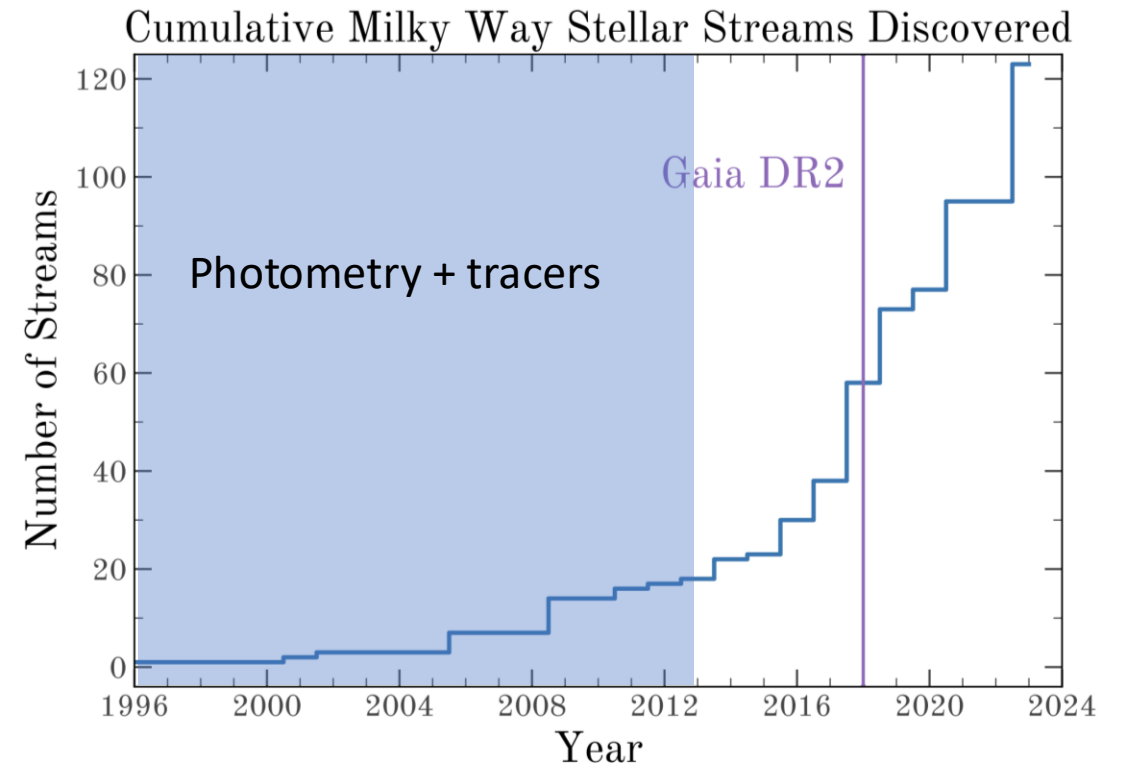
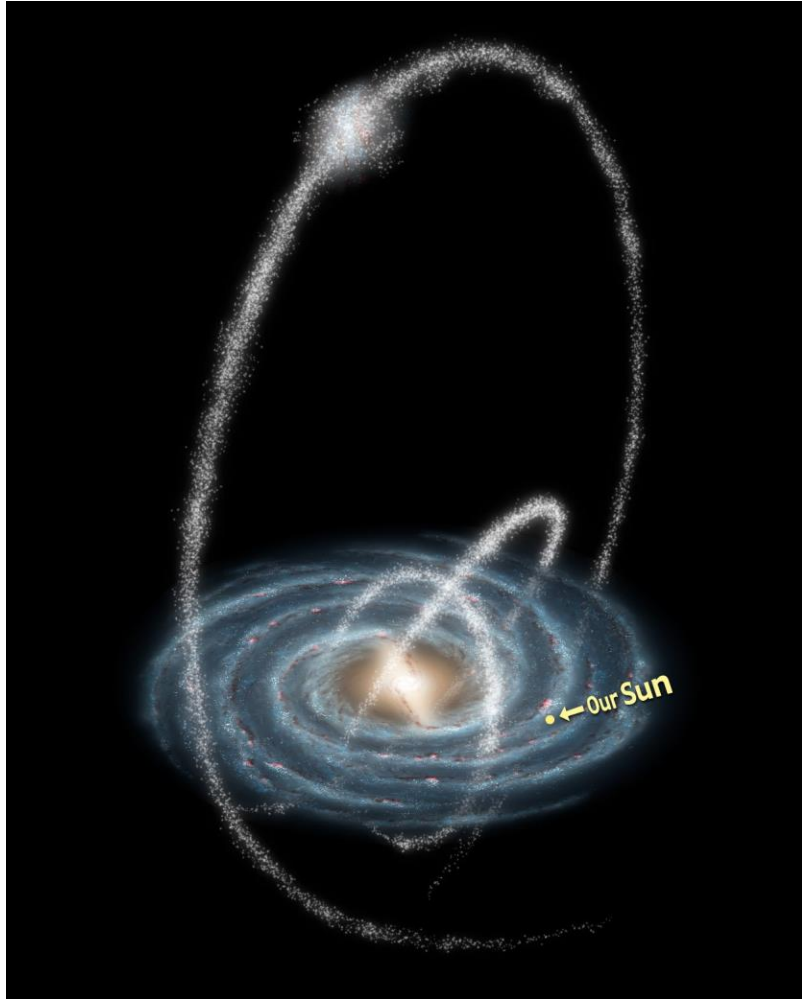
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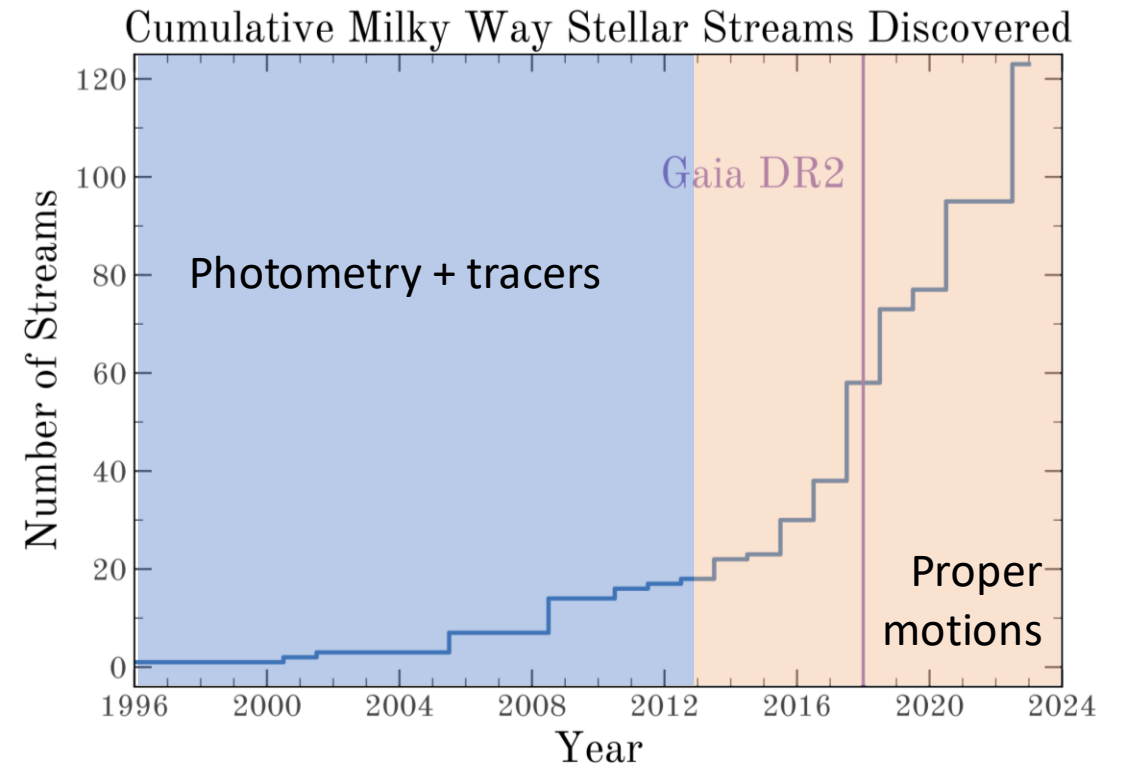
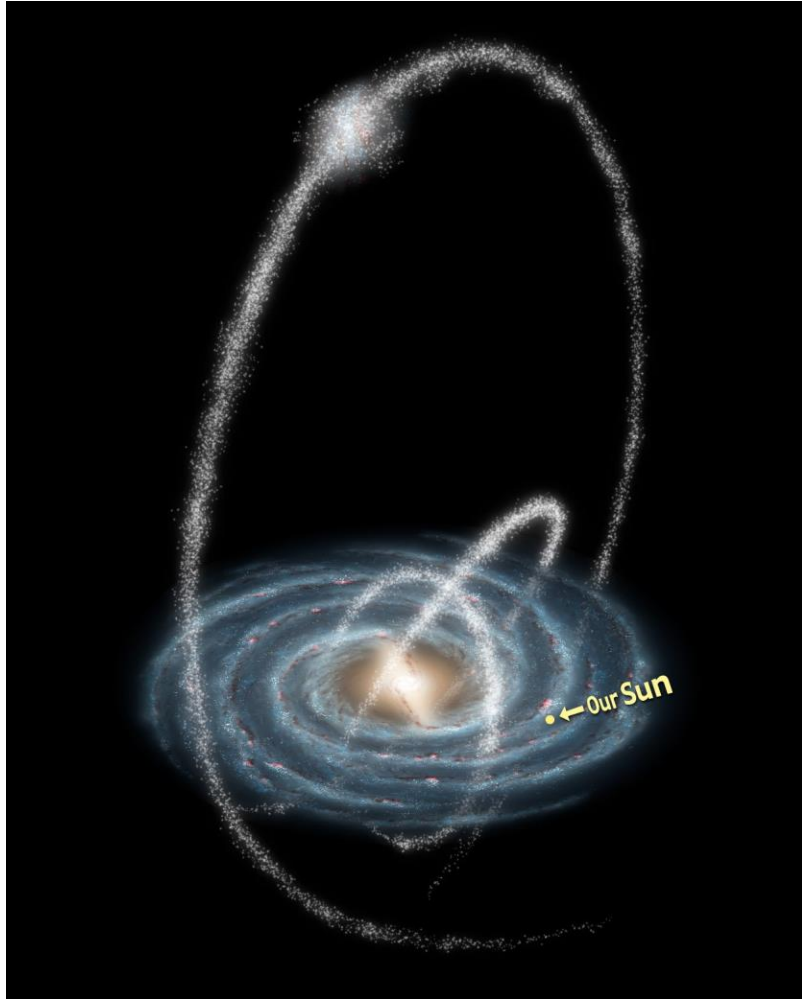
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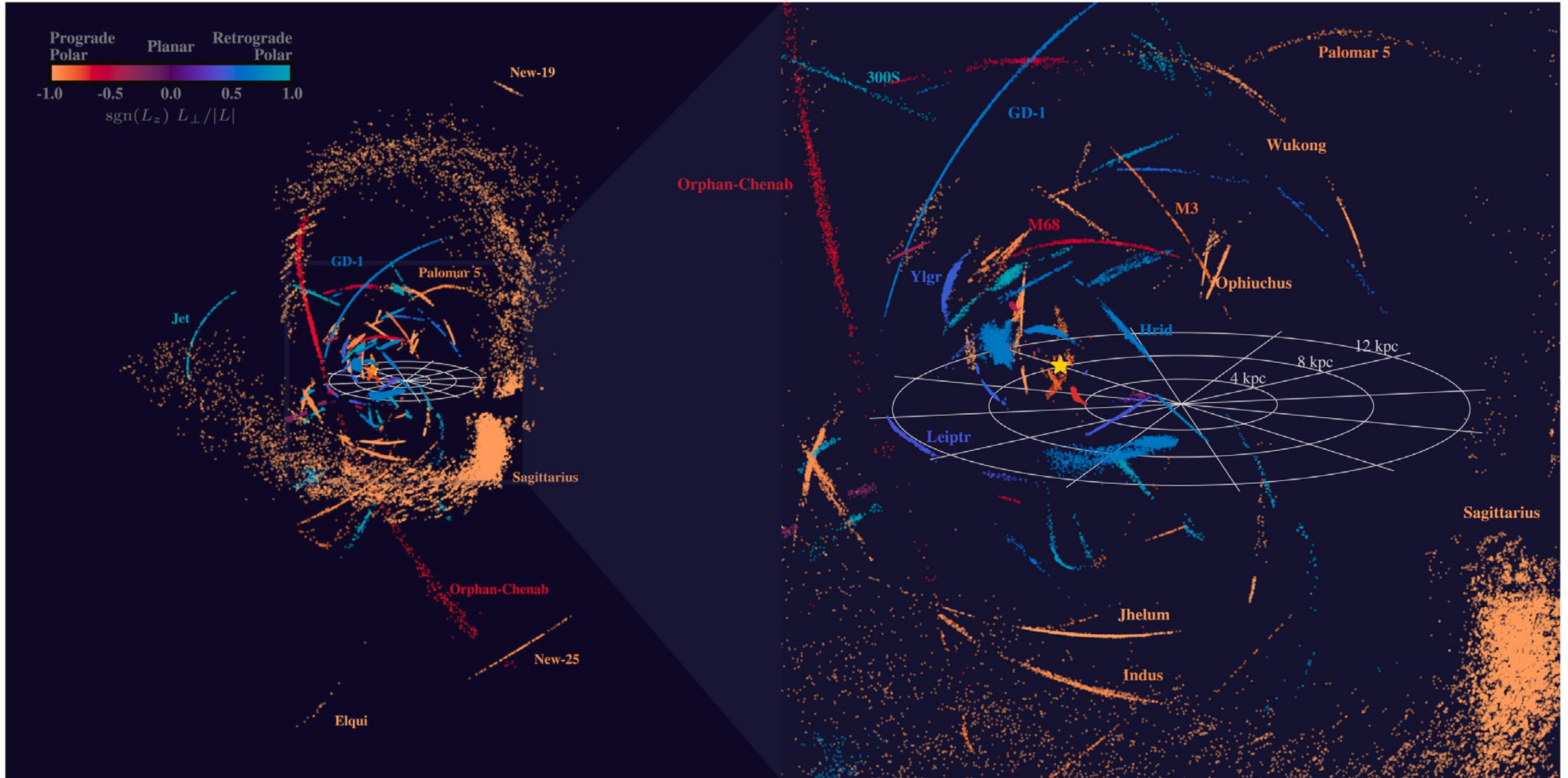
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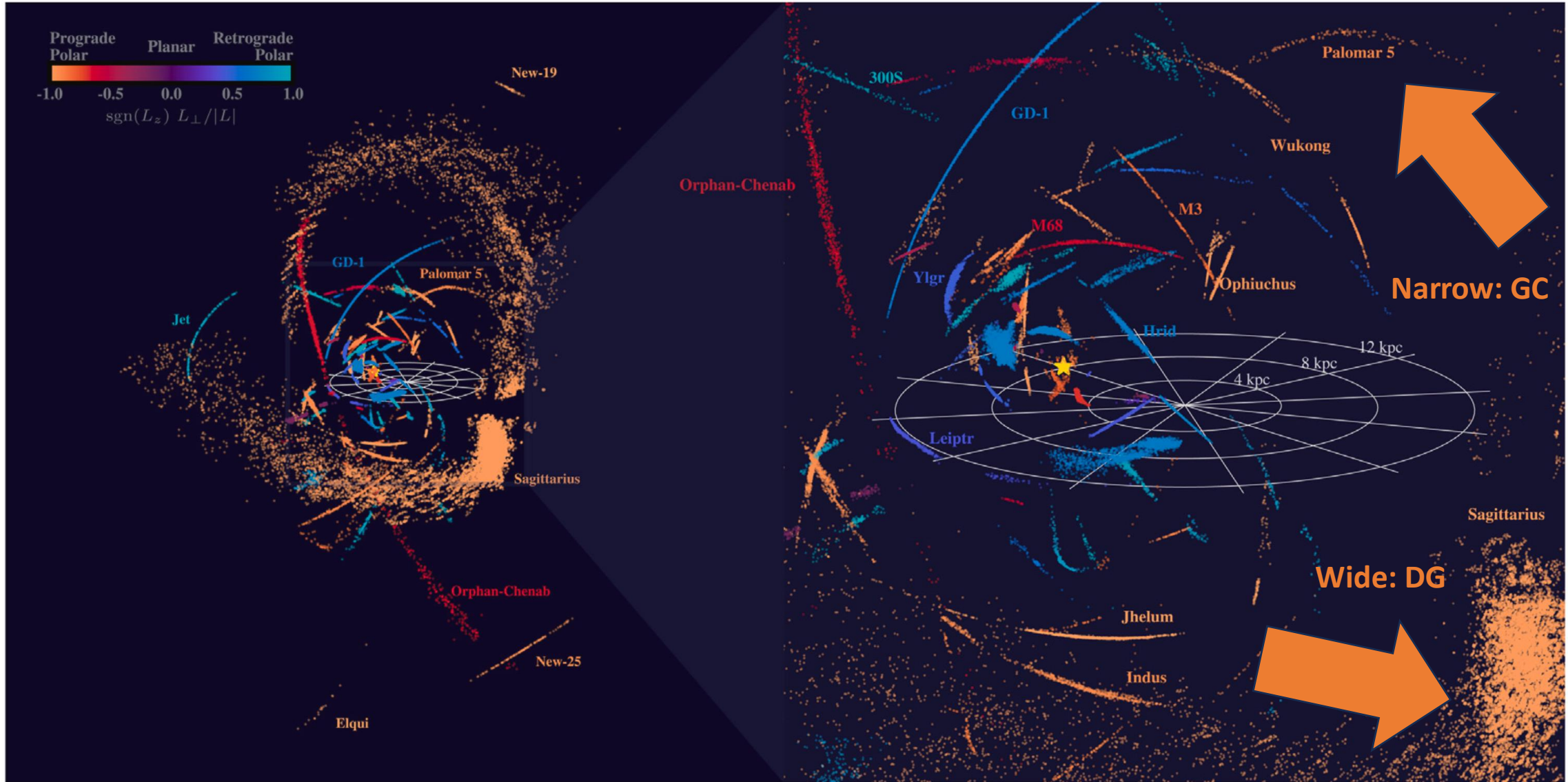
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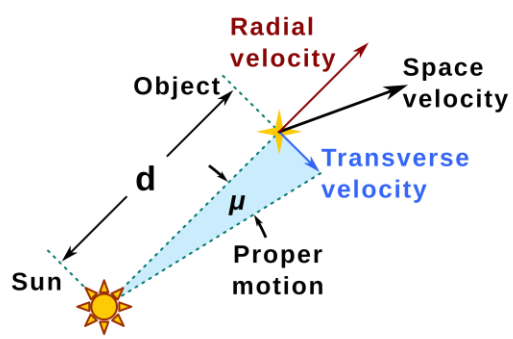
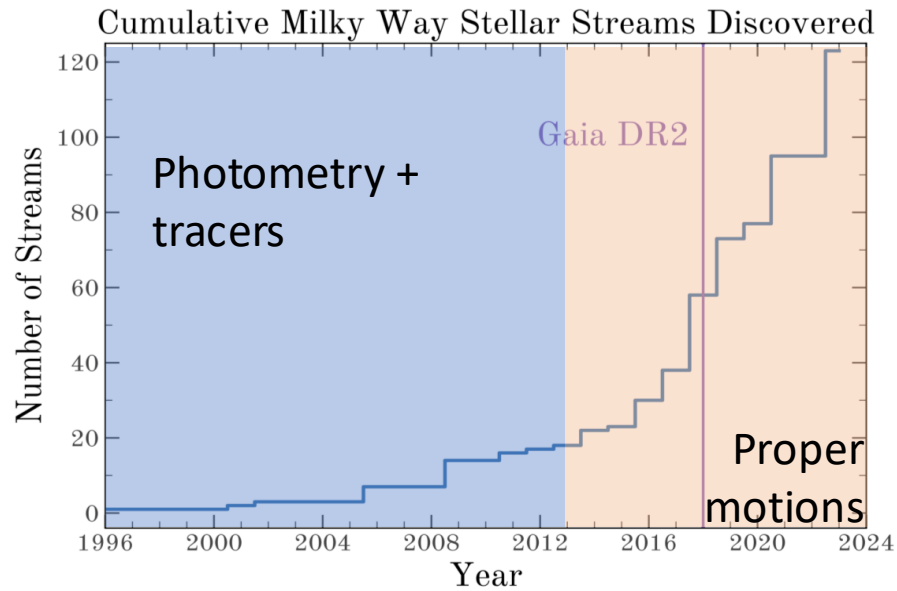
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6D: 3 positions \vec{x} +
3 velocities \vec{v}

At any time t , one can describe the collective positions and velocities for stars in a dynamical system by a distribution function $f(\mathbf{x}, \mathbf{v}, t)$

$$\frac{\partial f}{\partial t} + \vec{\nabla} \cdot (f \vec{w}) = 0$$

Collisionless Boltzmann Equation
"Vlasov Equation"

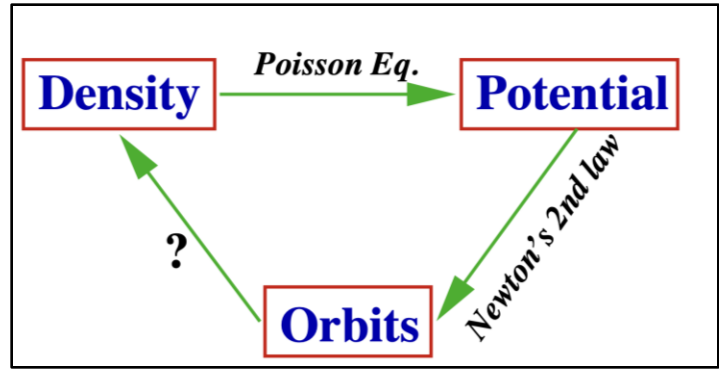
$$\frac{\partial f}{\partial t} + \sum_{i=1}^3 v_i \frac{\partial f}{\partial x_i} - \frac{\partial \Phi}{\partial x_i} \frac{\partial f}{\partial v_i} = 0$$

or

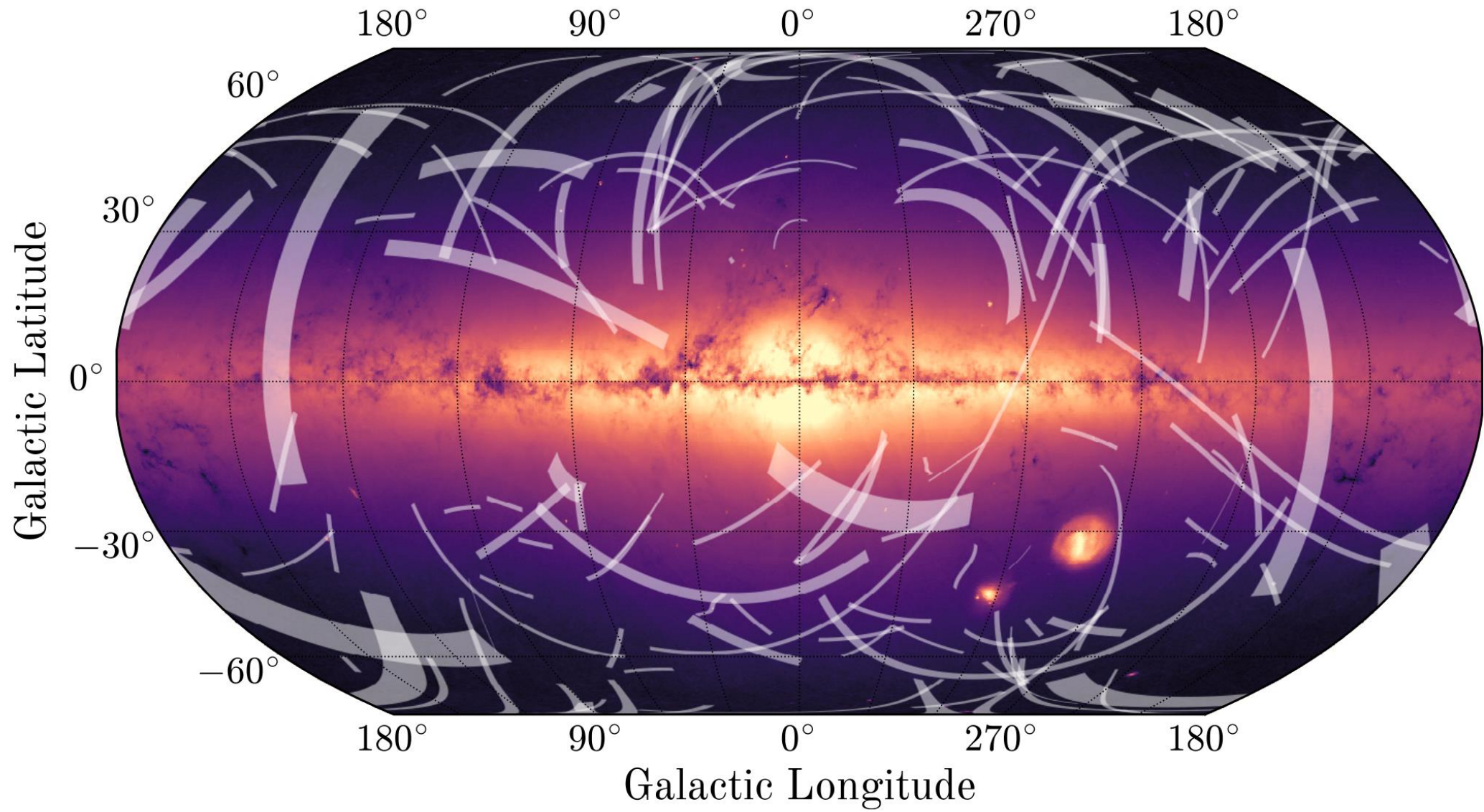
$$\frac{\partial f}{\partial t} + \vec{v} \cdot \vec{\nabla} f - \vec{\nabla} \Phi \cdot \frac{\partial f}{\partial \vec{v}} = 0$$

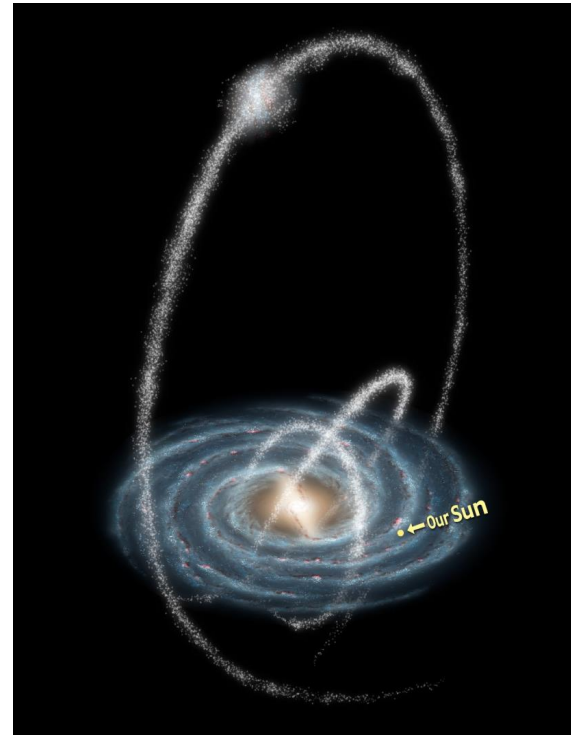
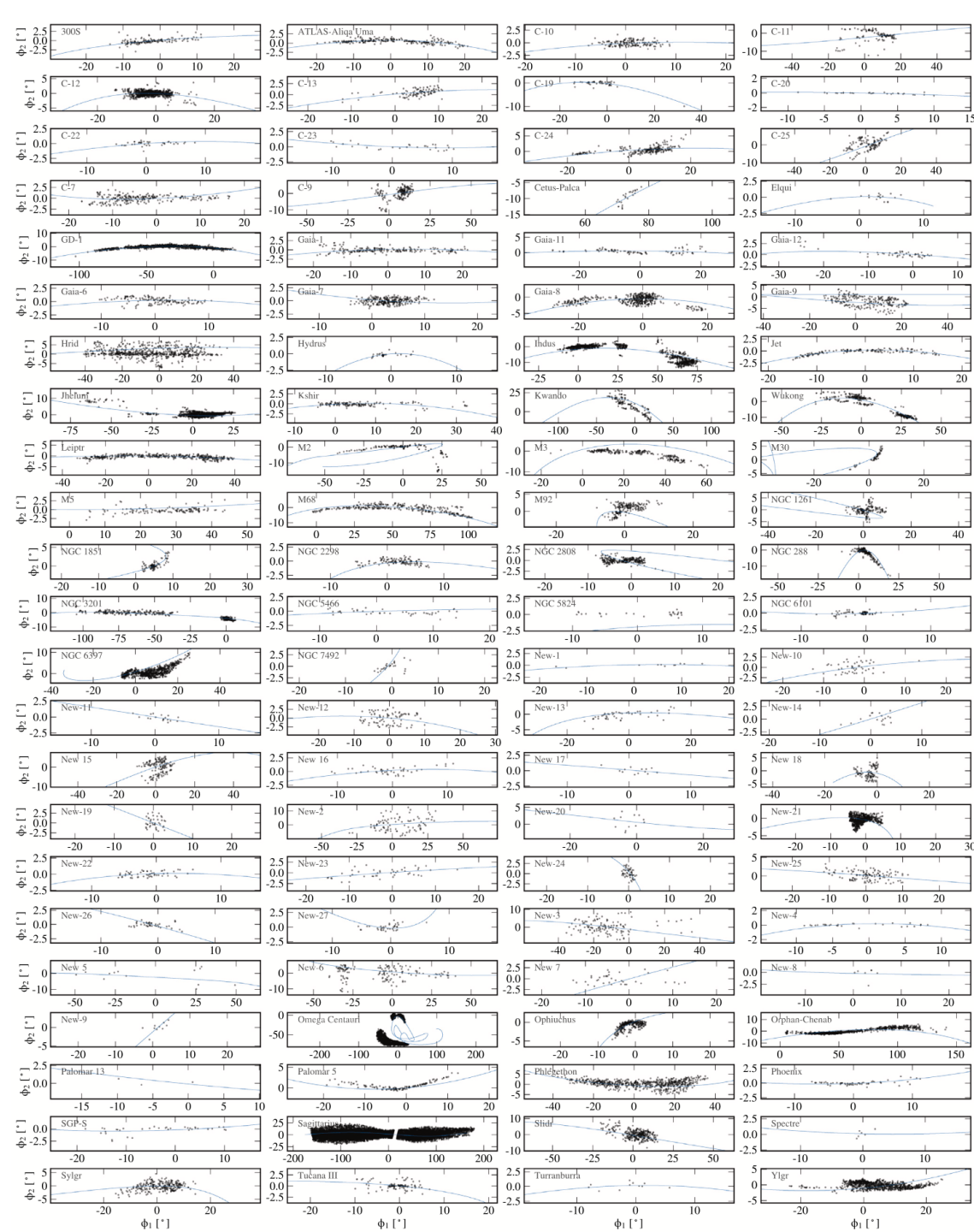
also can write as $\frac{df}{dt} = 0$

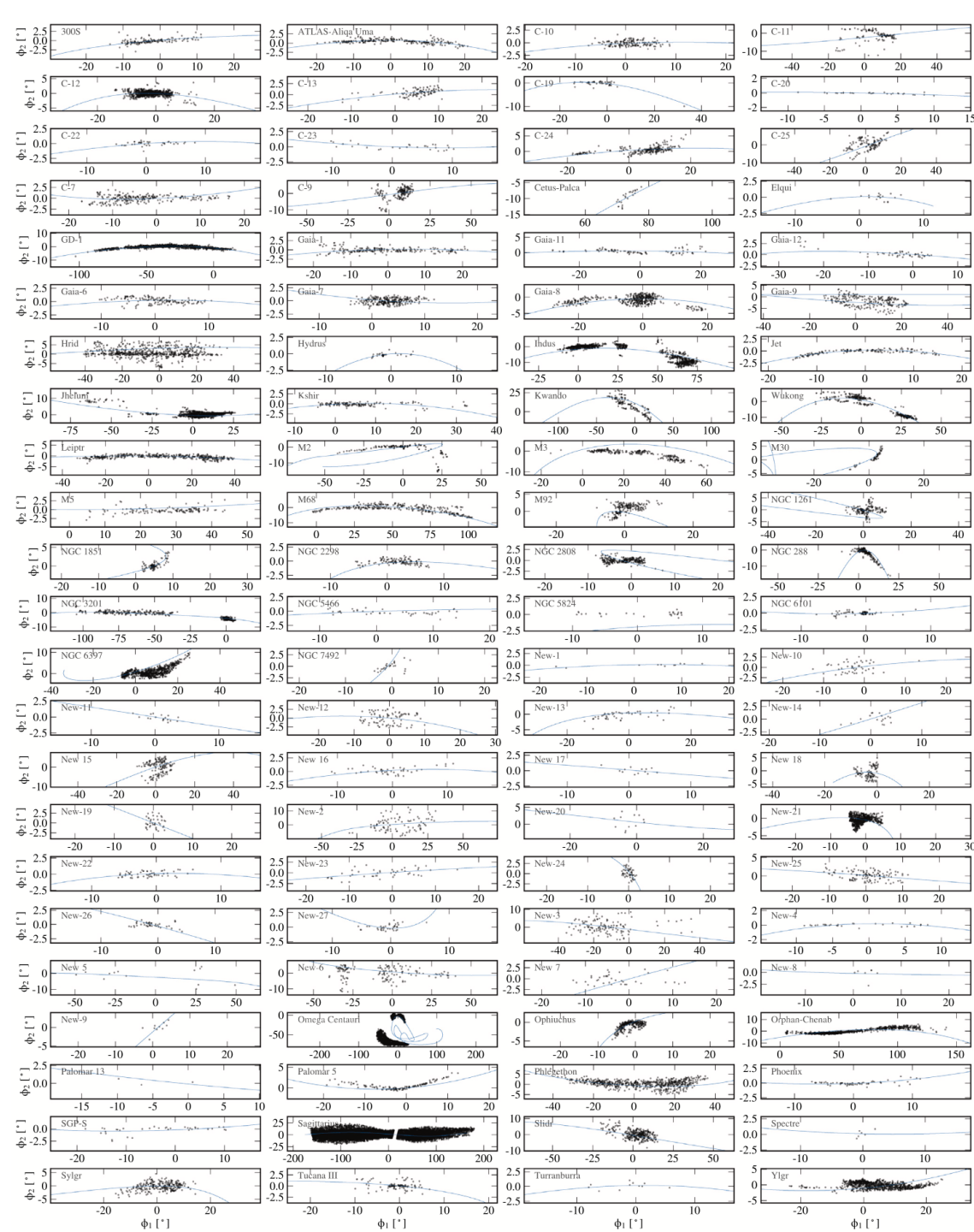
+ Integrals of motion



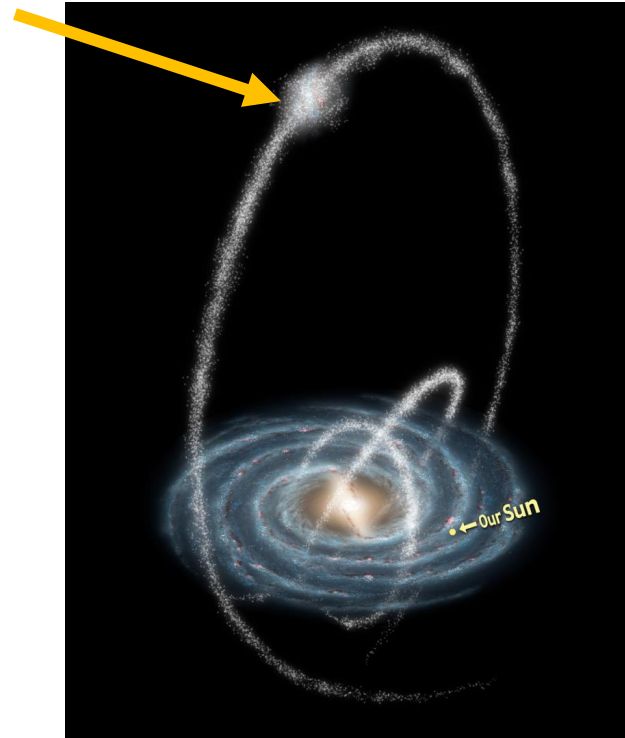
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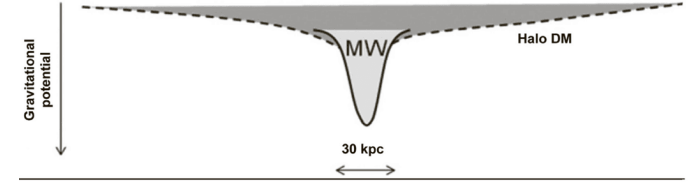
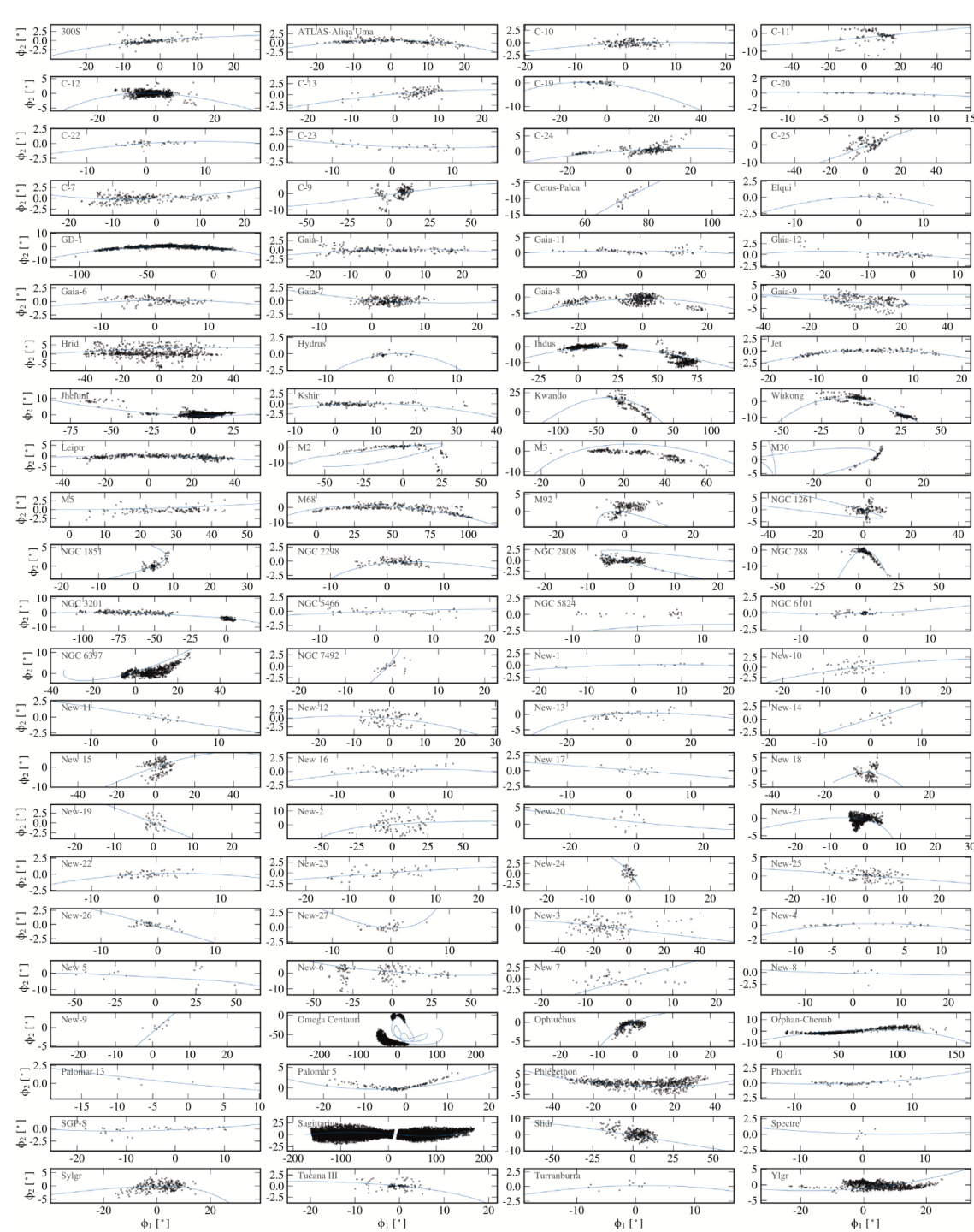




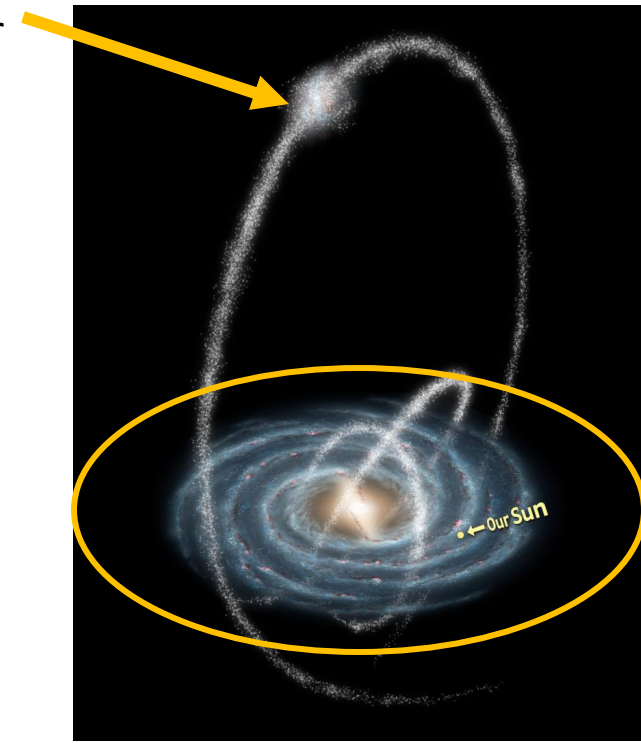


Dynamics progenitor

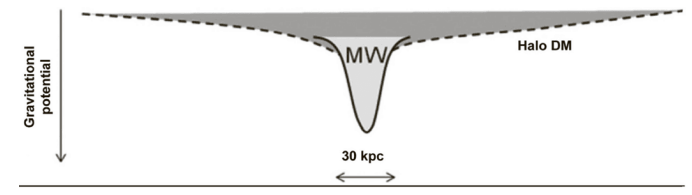
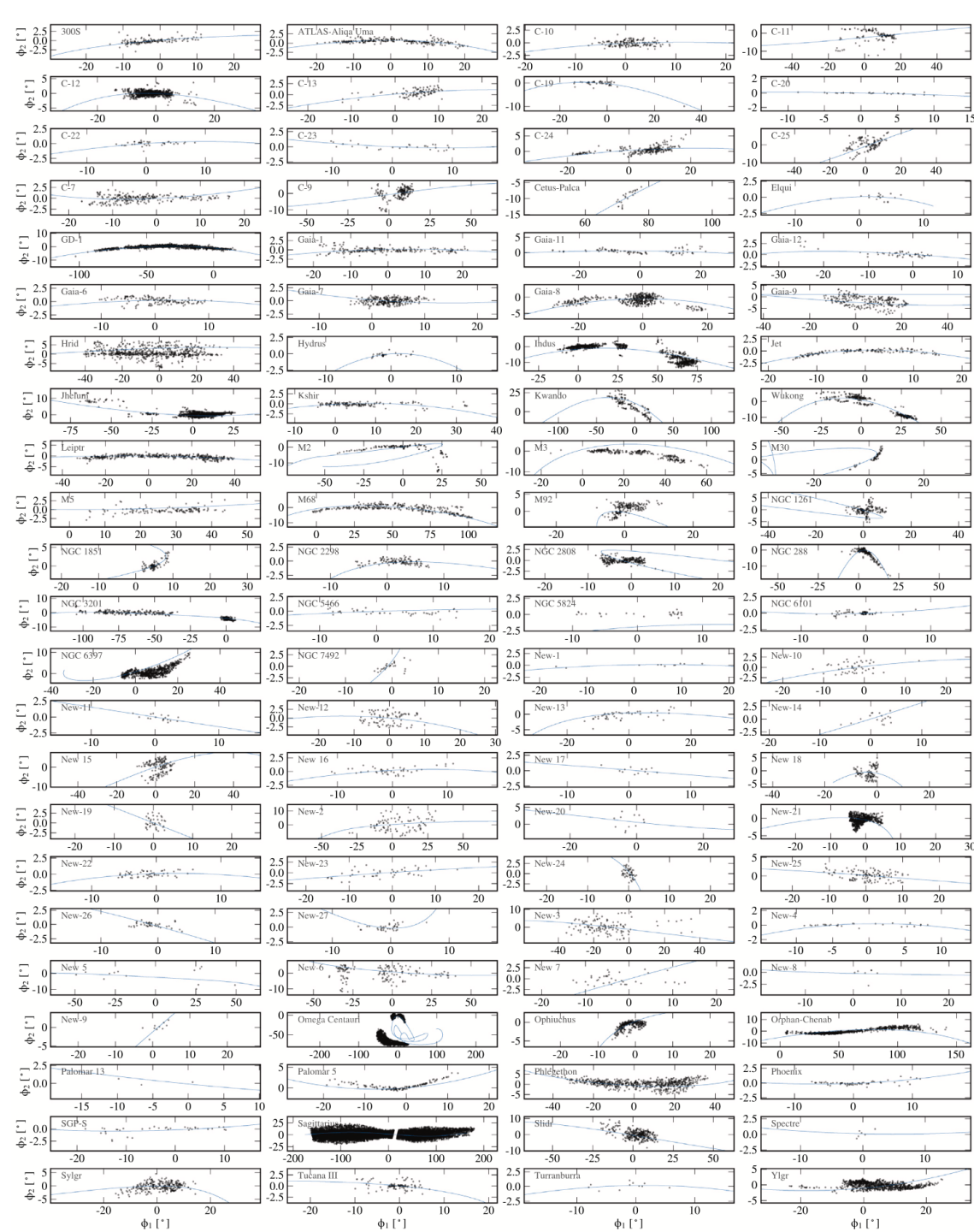




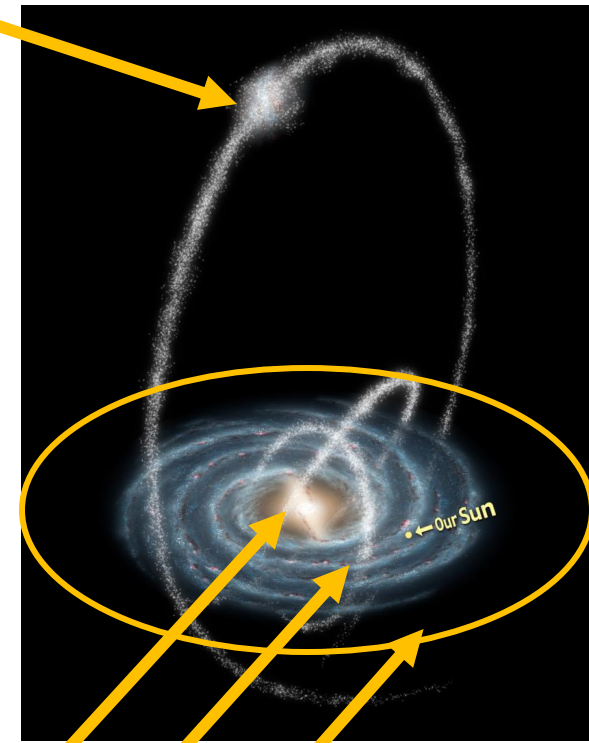
Dynamics progenitor



Gravitational potential MW



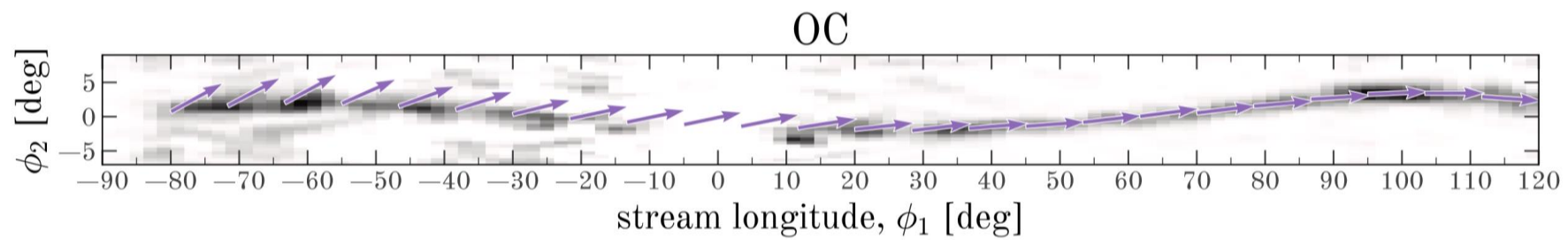
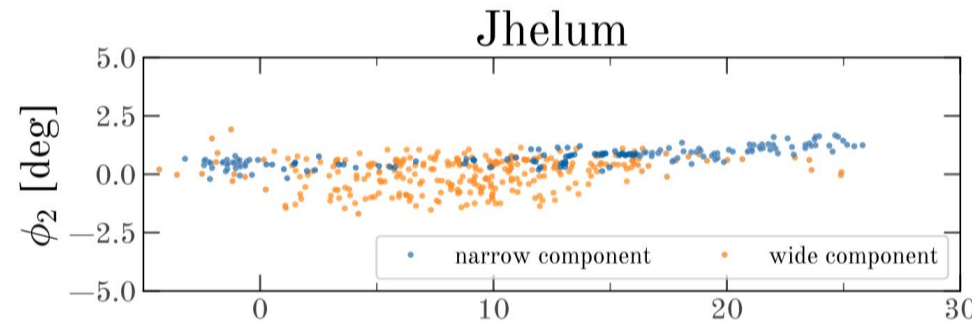
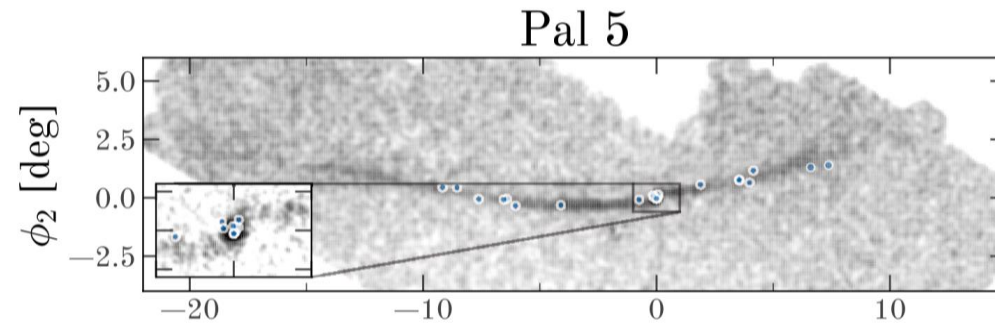
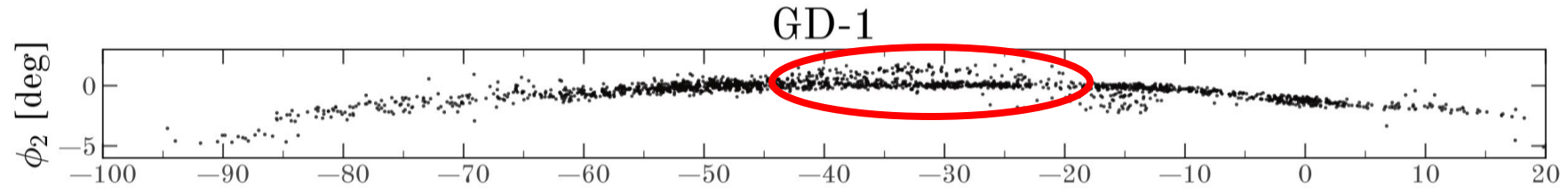
Dynamics progenitor



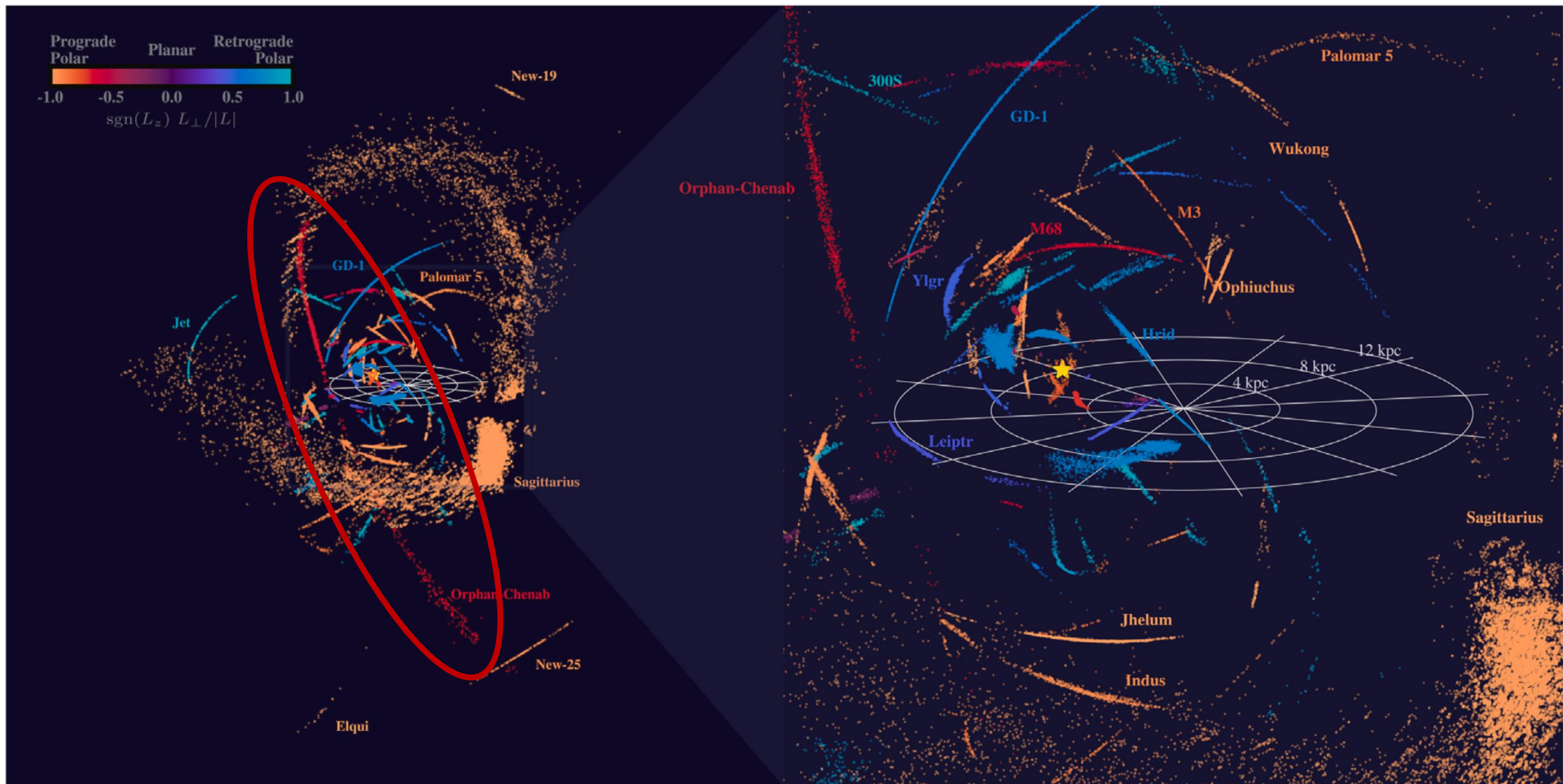
Gravitational potential MW

Structures: bar, arms, DM subhalos

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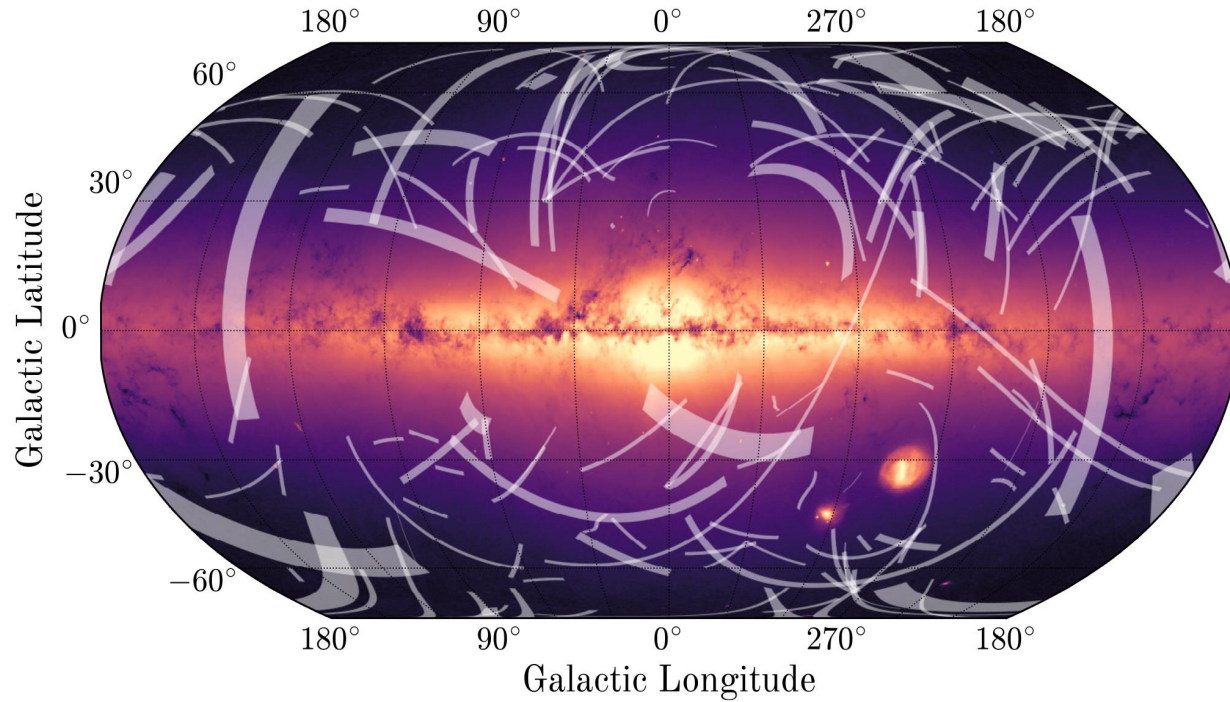


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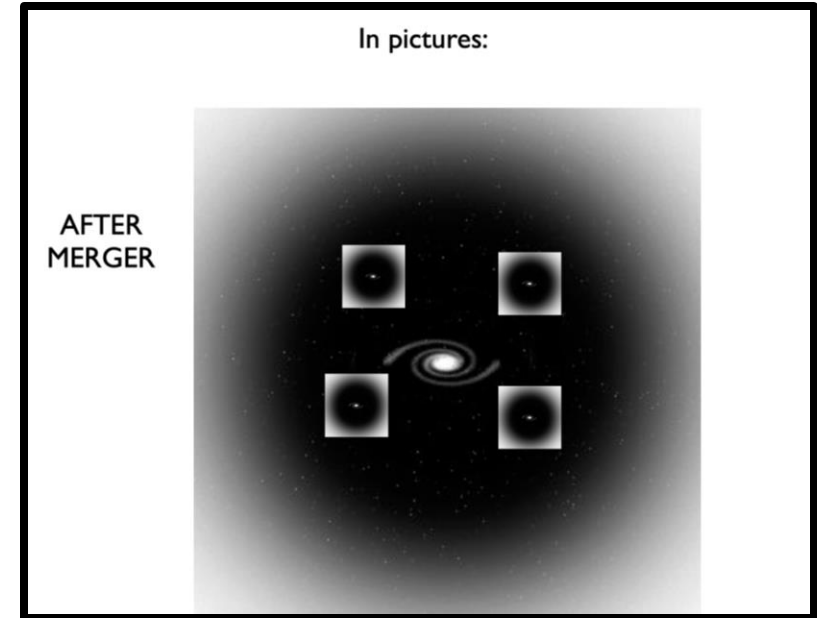
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1. Data



Full mapping of streams, especially MW halo

2. Models and simulations



Presence of Dark Matter subhalos below $10^5 M_{\odot}$

Thank you for your attention!



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