

**THE MAGELLANIC STREAM AT
20 KPC:
A NEW ORBITAL HISTORY FOR
THE MAGELLANIC CLOUDS**

LUCCHINI , D'ONGHIA ,^{1,2} & FOX 2021

**SUMMARY BY NICK JULIANO
FOR INTERGALACTIC MEDIUM**

1) INTRODUCTION

Magellanic System

- Essential to our understanding of the ongoing formation and evolution of the Local Group
- Consists of:
 - Large Magellanic Cloud (LMC)
 - Small Magellanic Cloud (SMC)
 - Magellanic Stream

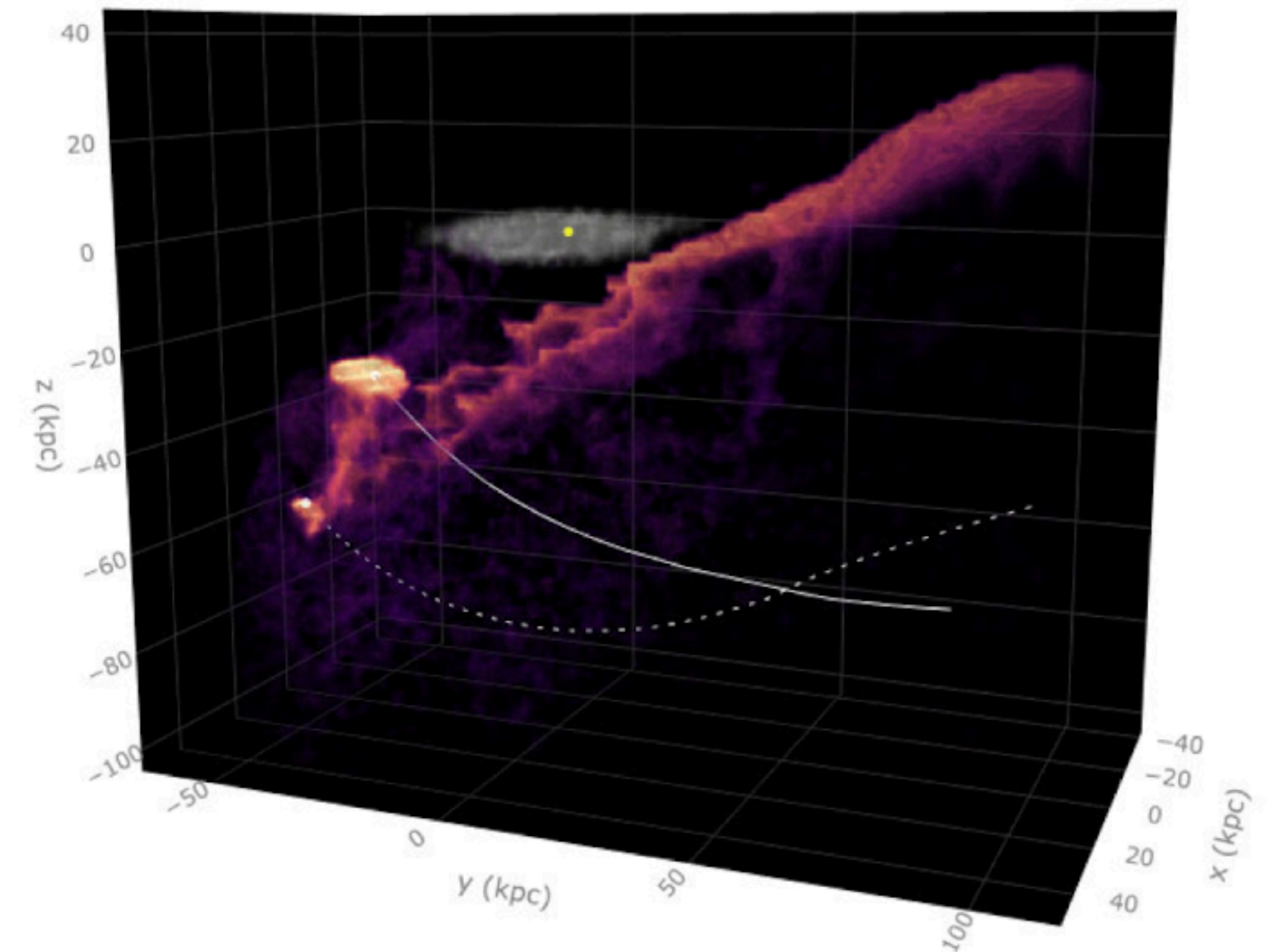
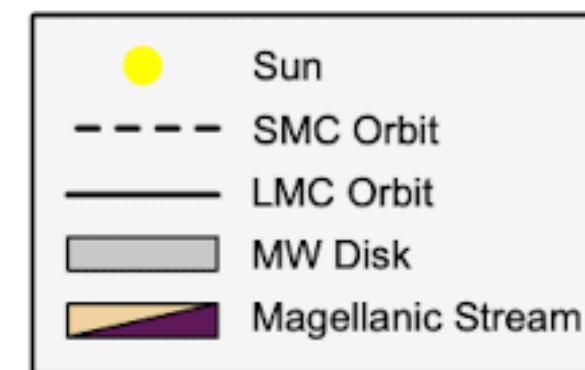


Fig. 2

1) INTRODUCTION

Former Efforts to Model

- **1977: Simple Analytical Models**
- **1994: hydrodynamics, self-gravity**
- **2012: N-body models**
- **2020: Ionization explanations**

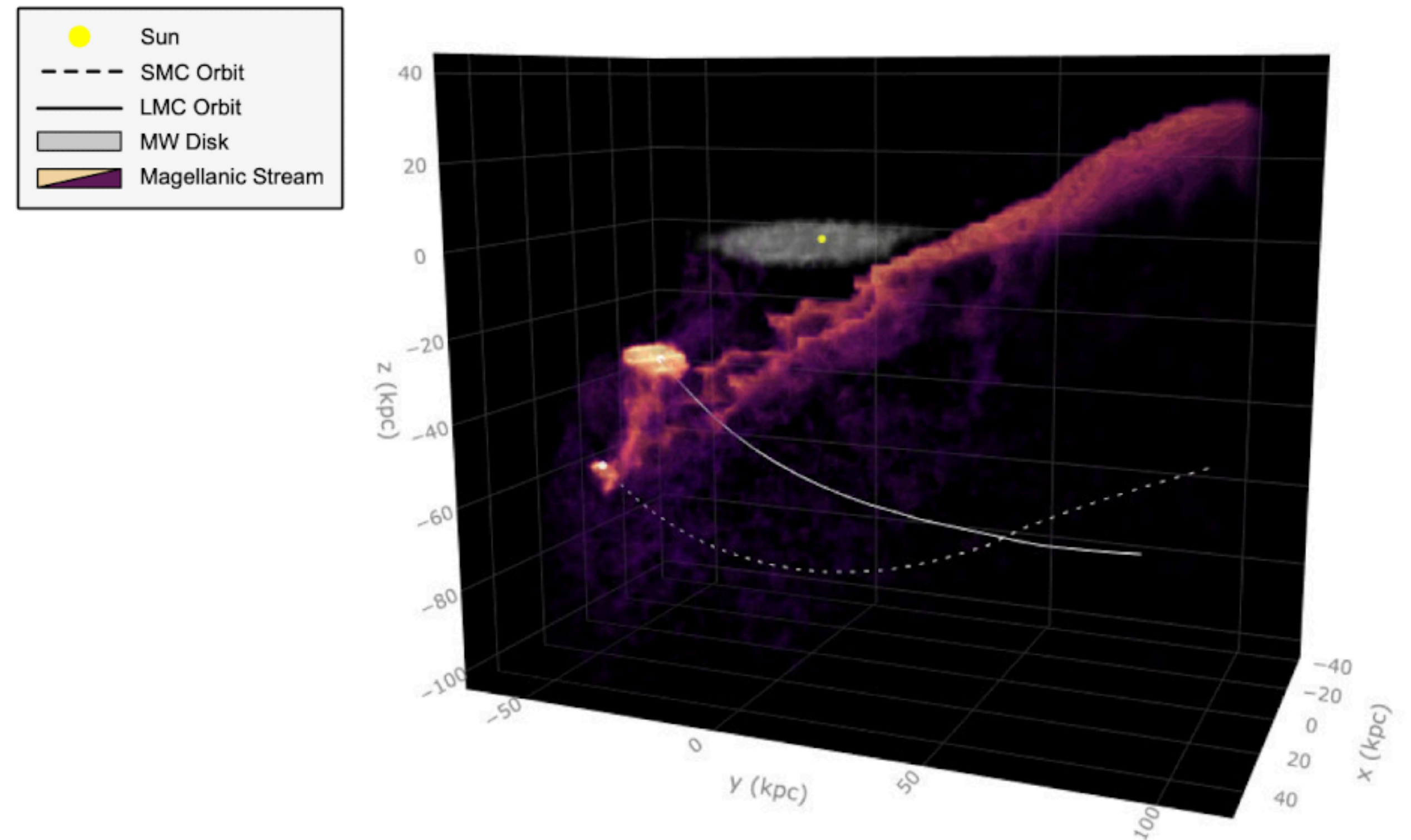


Fig. 2

1) INTRODUCTION

Former Efforts to Model

- 1977: Simple analytic models
- 1994: hydrodynamic self-gravity
- 2012: N-body simulations
- 2020: Ionization simulations

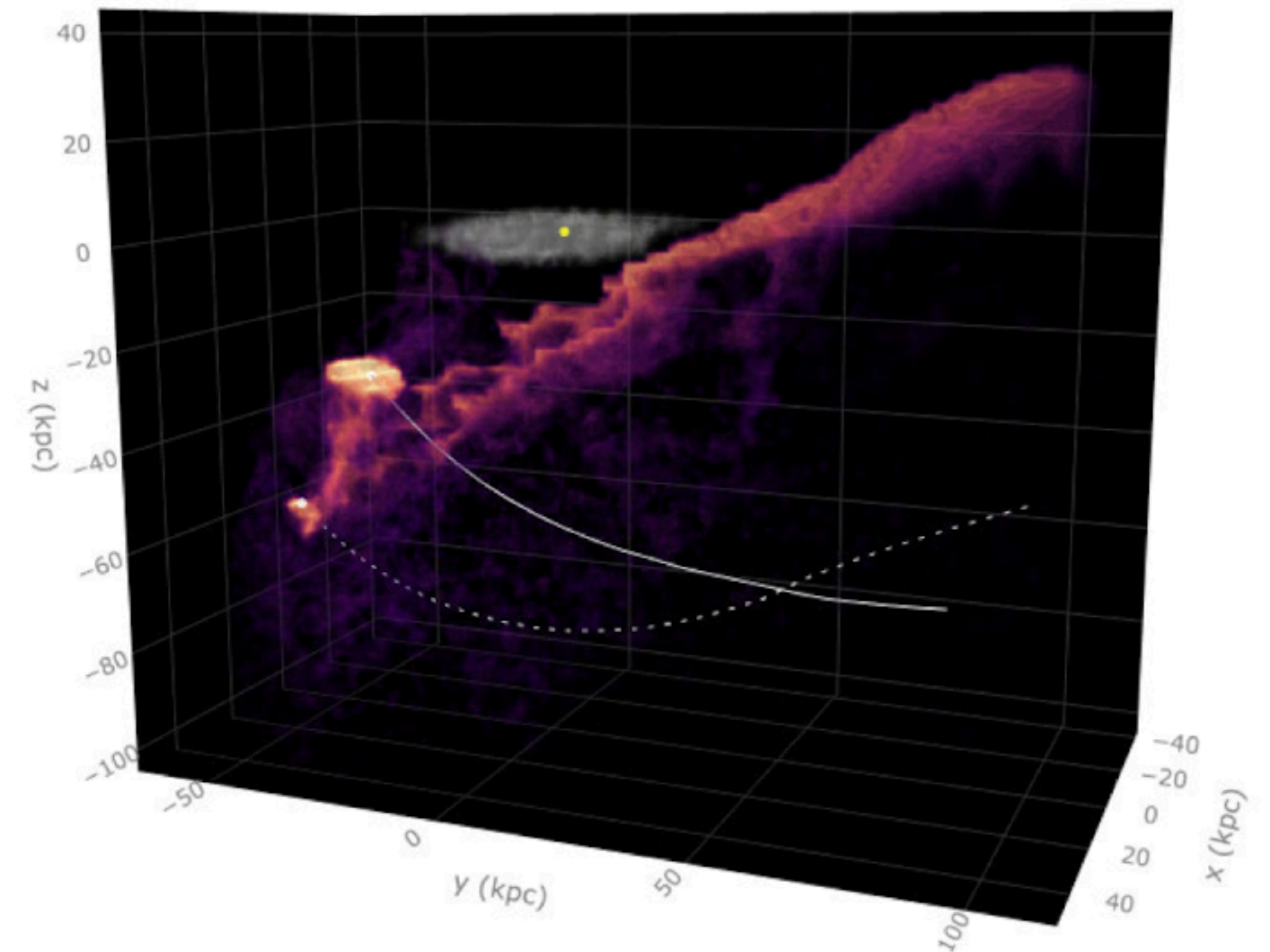
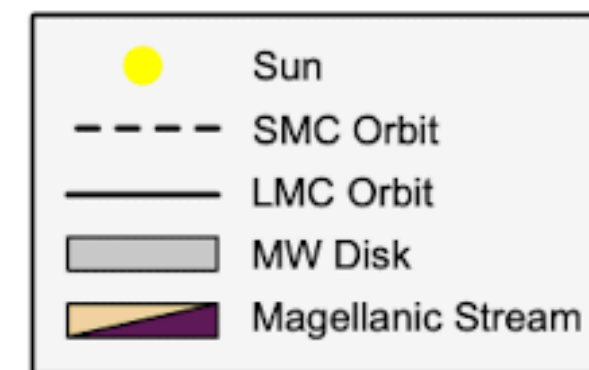


Fig. 2

NONE MODEL THE EXACT PAST ORBITS OF LMC AND SMC

1) INTRODUCTION

Past Orbits of LMC and SMC

- ✓ Precise proper motion measurements
- ✗ Total Mass of LMC and Milky Way

Explore large-scale structure and location of the Magellanic Stream resulting from an alternate first-passage interaction history between the LMC and SMC.

2) METHODS

Simulation

- ***GIZMO* massively parallel, multiphysics code, a Lagrangian meshless finite-mass**
- **Initial conditions as defined in Table 1**
- **Unable to reproduce the velocity profile of the Stream unless total mass was increased to $4 \times 10^{10} M_{\odot}$, which solved the kinematic discrepancy**

2) METHODS

Orbits

- Analytically integrated the orbits of the LMC, SMC, and MW backward in time starting from their present-day observed positions and velocities.
- 1458 possible orbits (obtained within bounds of observed errors)
- Chose 10 of these orbits to run full hydrodynamical simulations, 1 showed promise to match observations.

2) METHODS

Differences from previous attempts

- Interactions: 4 vs 2
- length of the simulation: 7 versus 3.5 Gyr
- Maximum Clouds separation(100 versus 150 kpc)
- Sense of the SMC's orbit around the LMC (see next slide)

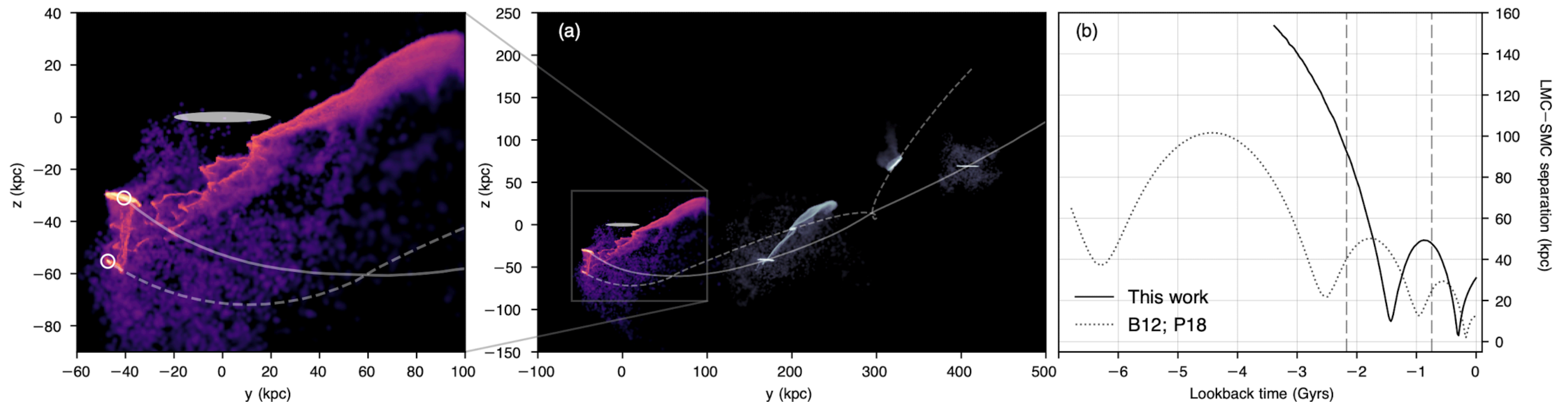


Fig 1

2) METHODS

Orbital schematics and distance to the Magellanic Stream compared for two different models

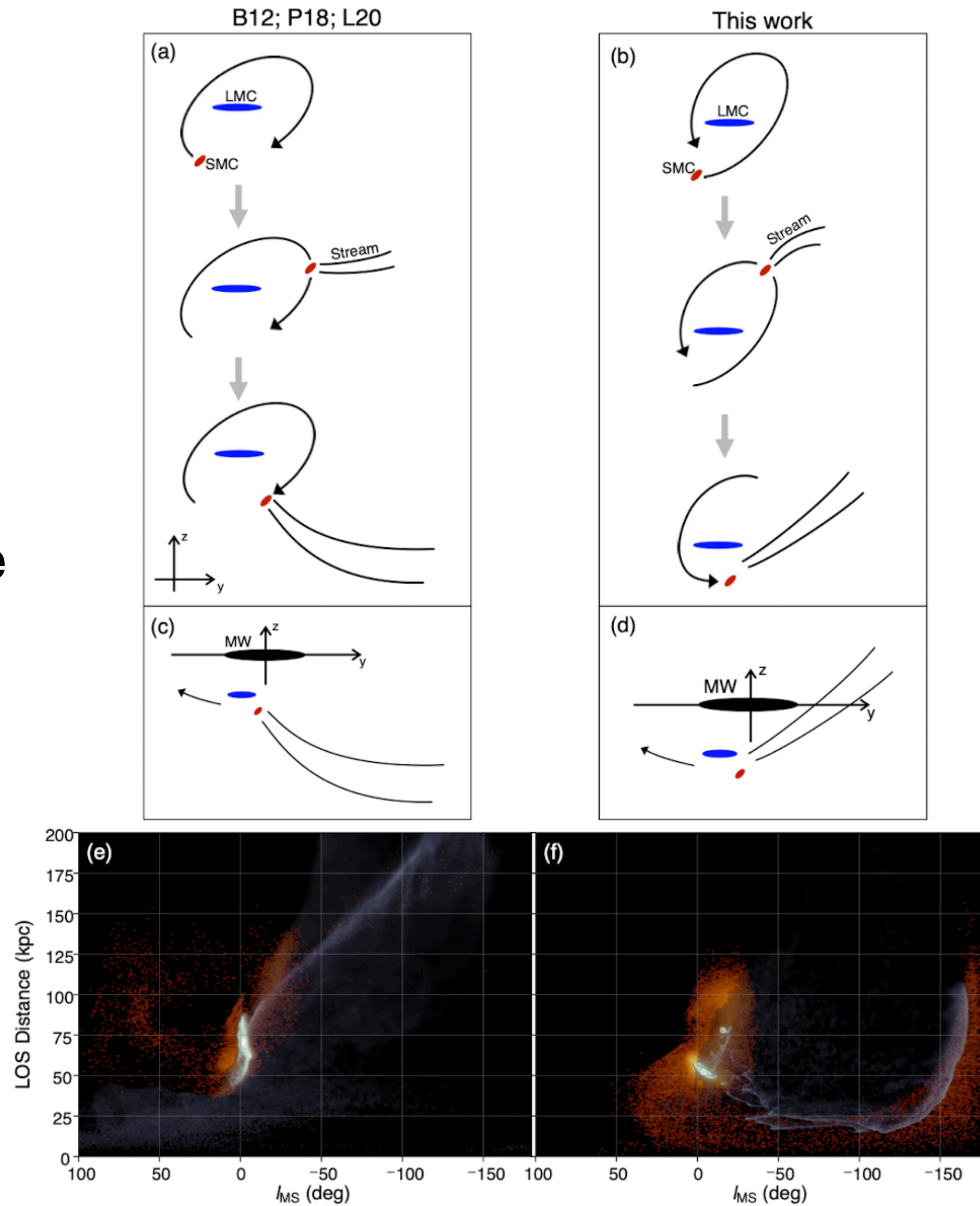


Fig. 4

3) RESULTS

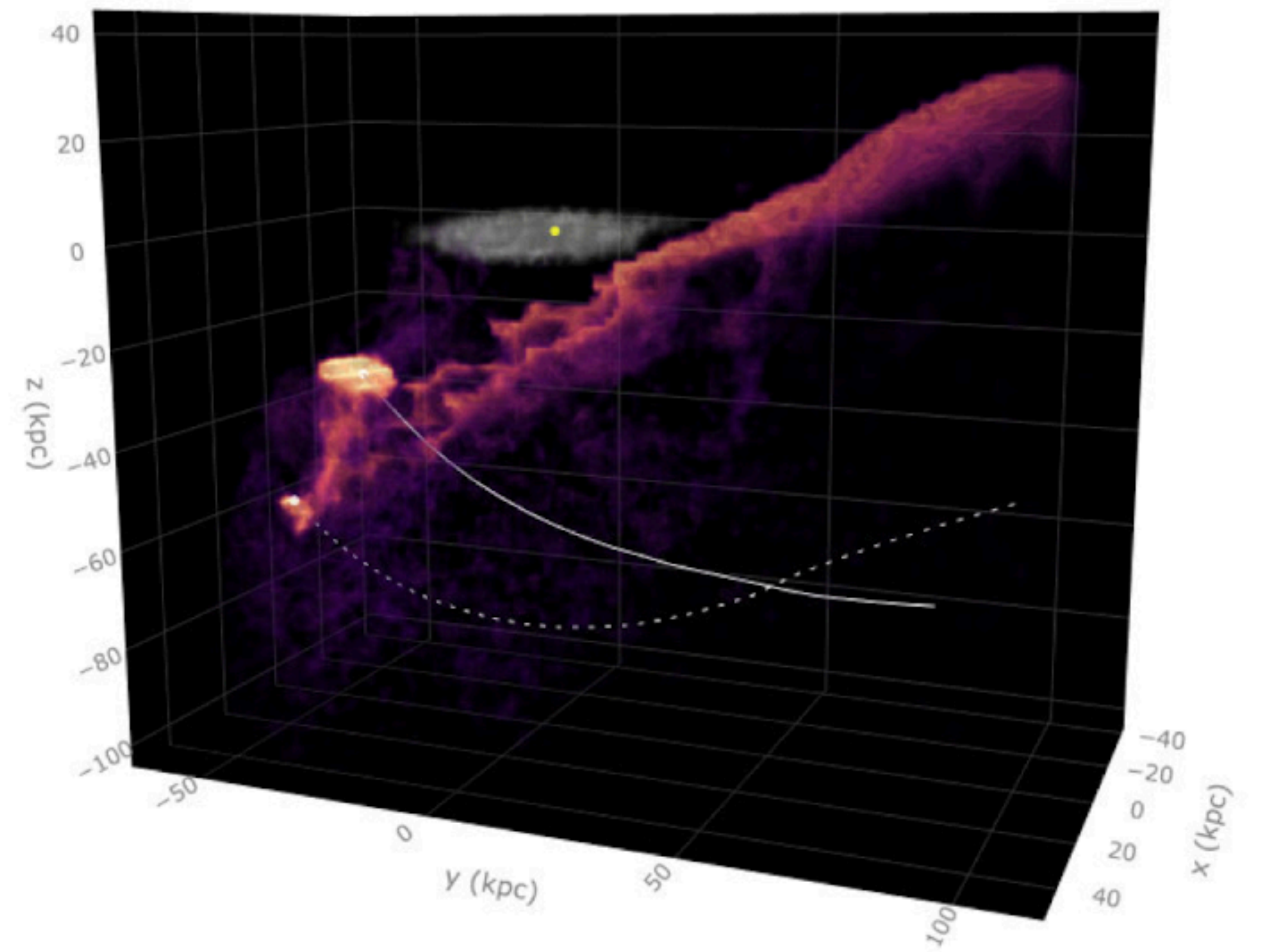
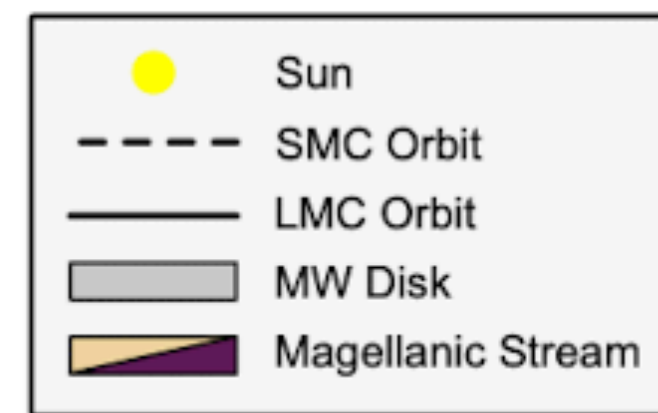


Fig. 2

4) DISCUSSION

- ★ Stream is significantly closer to us than previously thought (~20 kpc)
- Dramatically different 3D spatial positioning of the Stream, because:
 1. a qualitative difference in the SMC's orbit around the LMC
 2. the inclusion of the Galactic and Magellanic Corona
- Continued searches for the Stream's stellar component are worthwhile since they may be closer
- Interaction between the Stream and the MW CGM may be enhanced
- Test: UV or optical spectroscopic studies
 - Look for absorption at Magellanic velocities toward distant MW halo stars (Gaia)