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A Dynamical Mass Estimate from the Magellanic Stream

CRAIG ET. AL. 2021

Outline

Introduction

Methods

Results

Discussion

Magellanic Stream

- Origins:
 - Tidal interactions between LMC and MW
 - Ram pressure stripping gas
- Orbital History of LMC/SMC
 - First-infall with MW => stream must contain material from LMC and SMC

Can you use Hubble proper motions to derive orbits for LMC and SMC and see if the Magellanic Stream can be produced by ram pressure stripping of diffuse gas in the MW halo?

Numerical Approach

- Create simulations using GIZMO Meshless Fine Mass code.
 - Dark Matter
 - Stars
 - Gas Particles (cooling, dissipation)
 - Star Formation
 - Feedback Algorithms

GIZMO, Meshless Fine Mass

- Advantageous for modeling hydrodynamic computations
- Solves Riemann problem between adjacent particles
- Movable cells, maintain constant mass
- Conserves total mass, linear momentum, energy
- Adaptable, “goes with the flow”, no preferred directions
- Integrates well with N-body methods

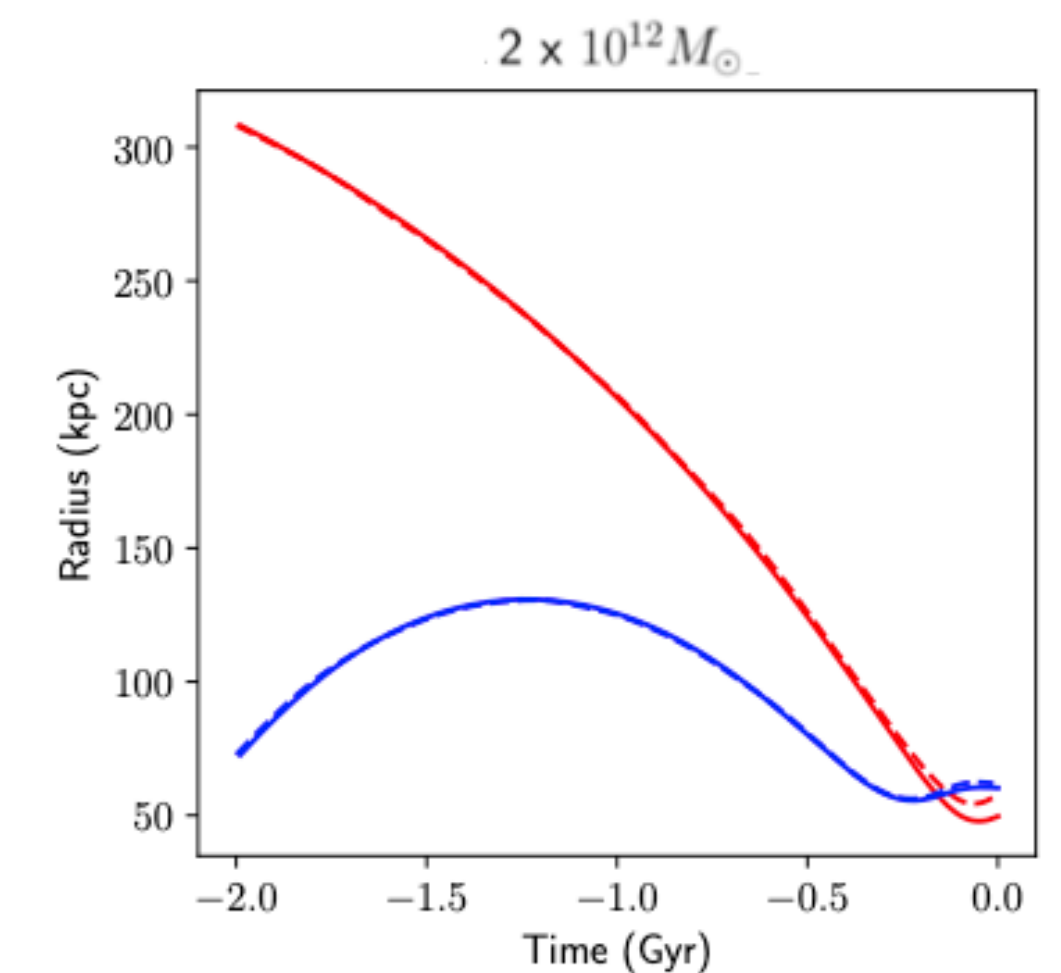
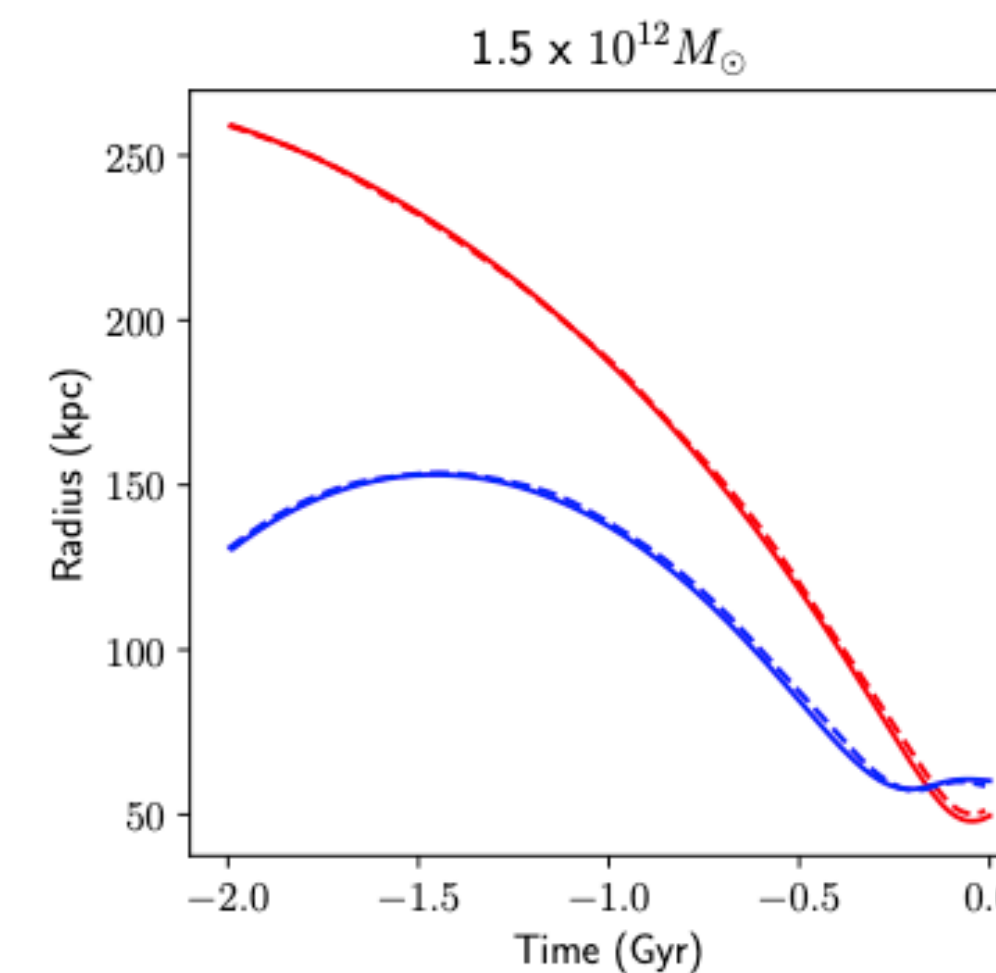
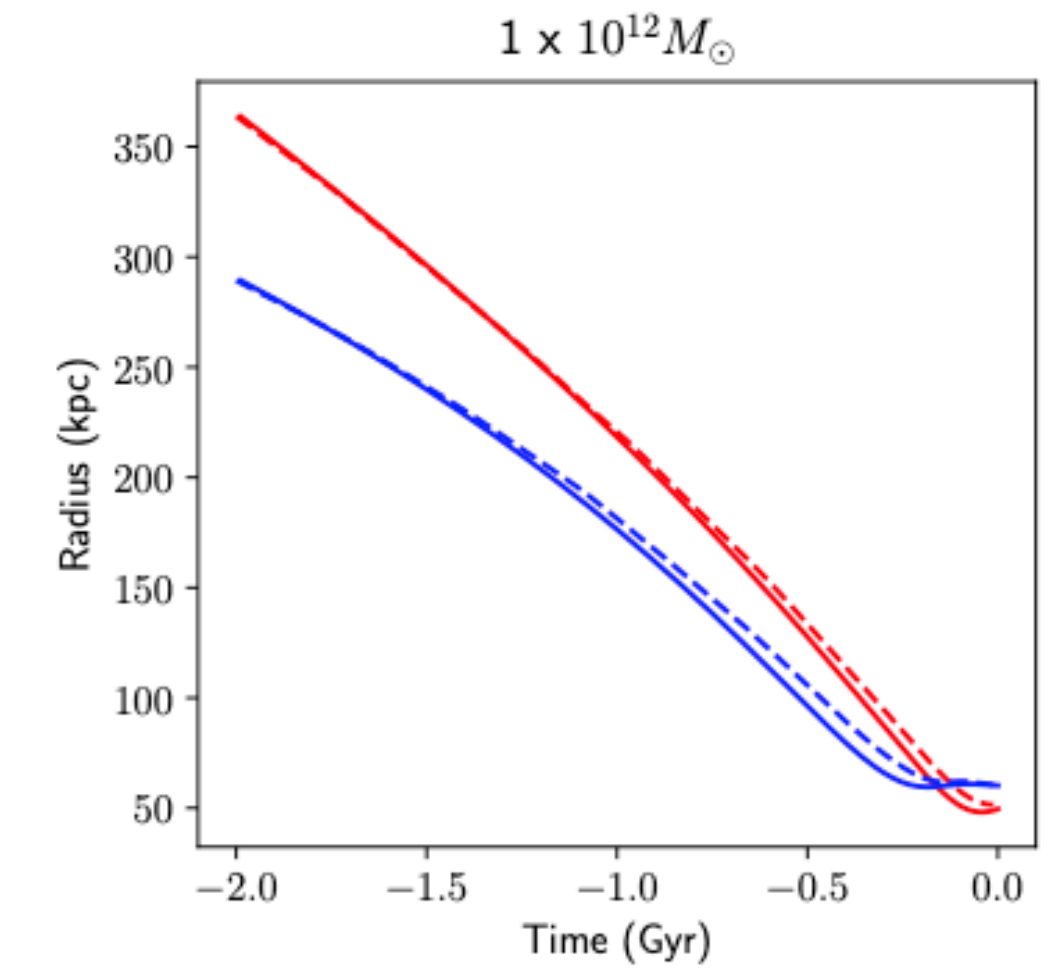
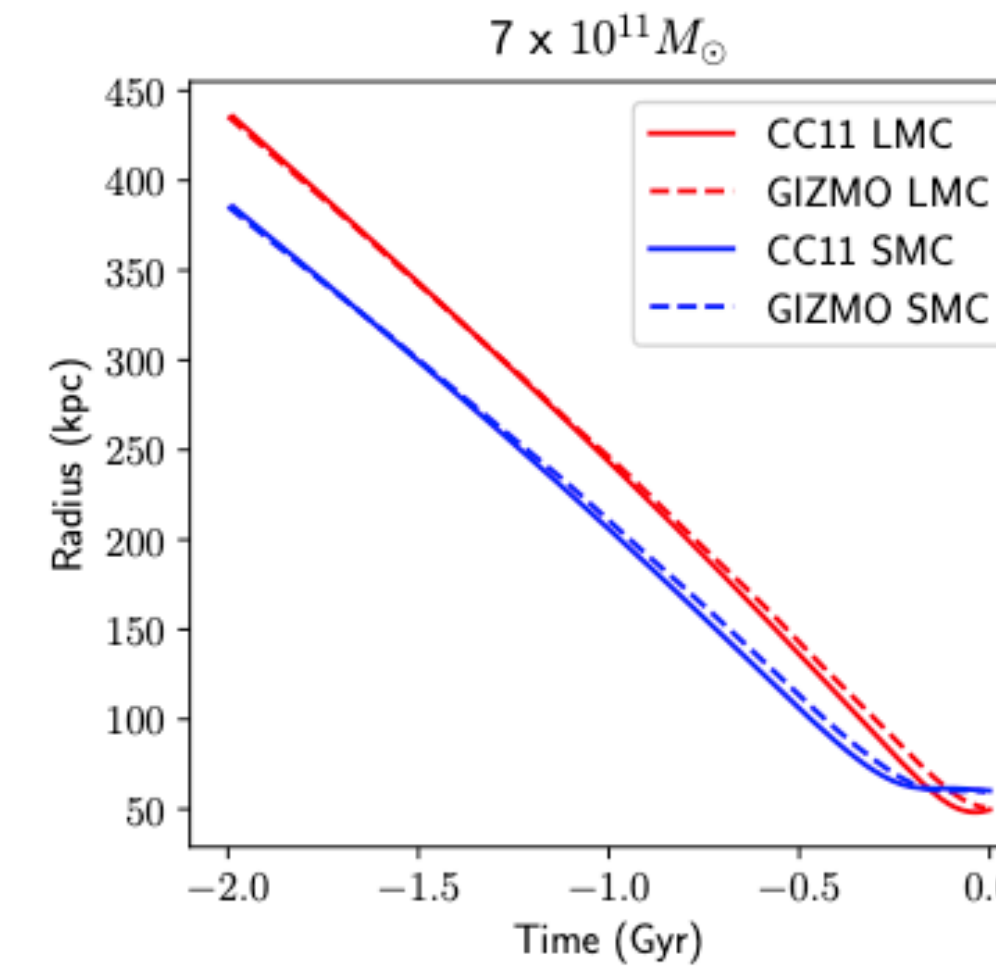
Initial Conditions

- Static MW model, with physical constraints justified in previous literature
- Initial positions, velocities of Magellanic bodies found by integrating backwards from Hubble proper motions (similar to Gaia data).\
- Integrate over 2Gyr

Orbits of the LMC and SMC

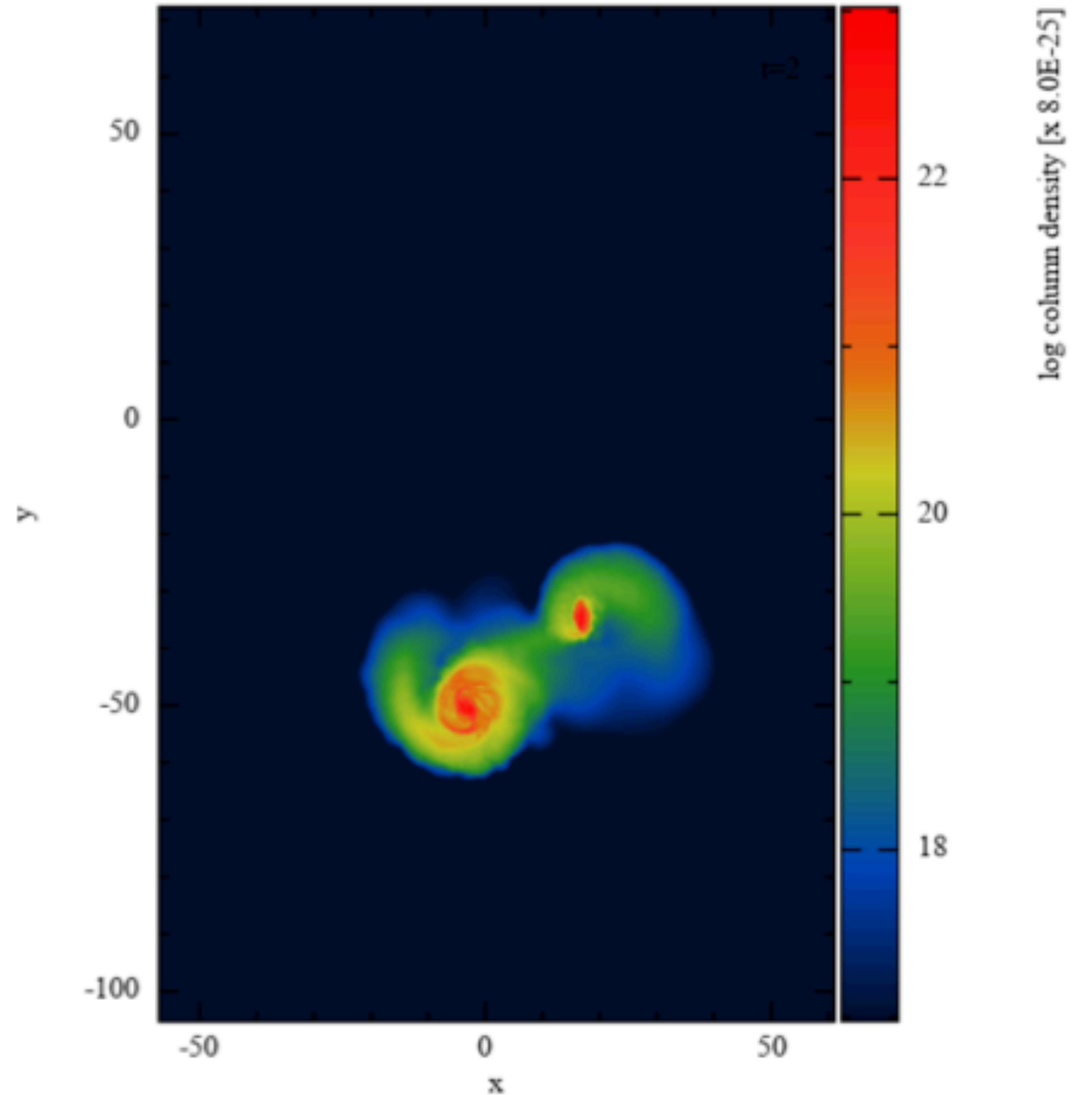
Four main MW mass cases, corresponding to simulations M70, M100, M150, and M200.

All simulations show satellites arriving at observed locations.



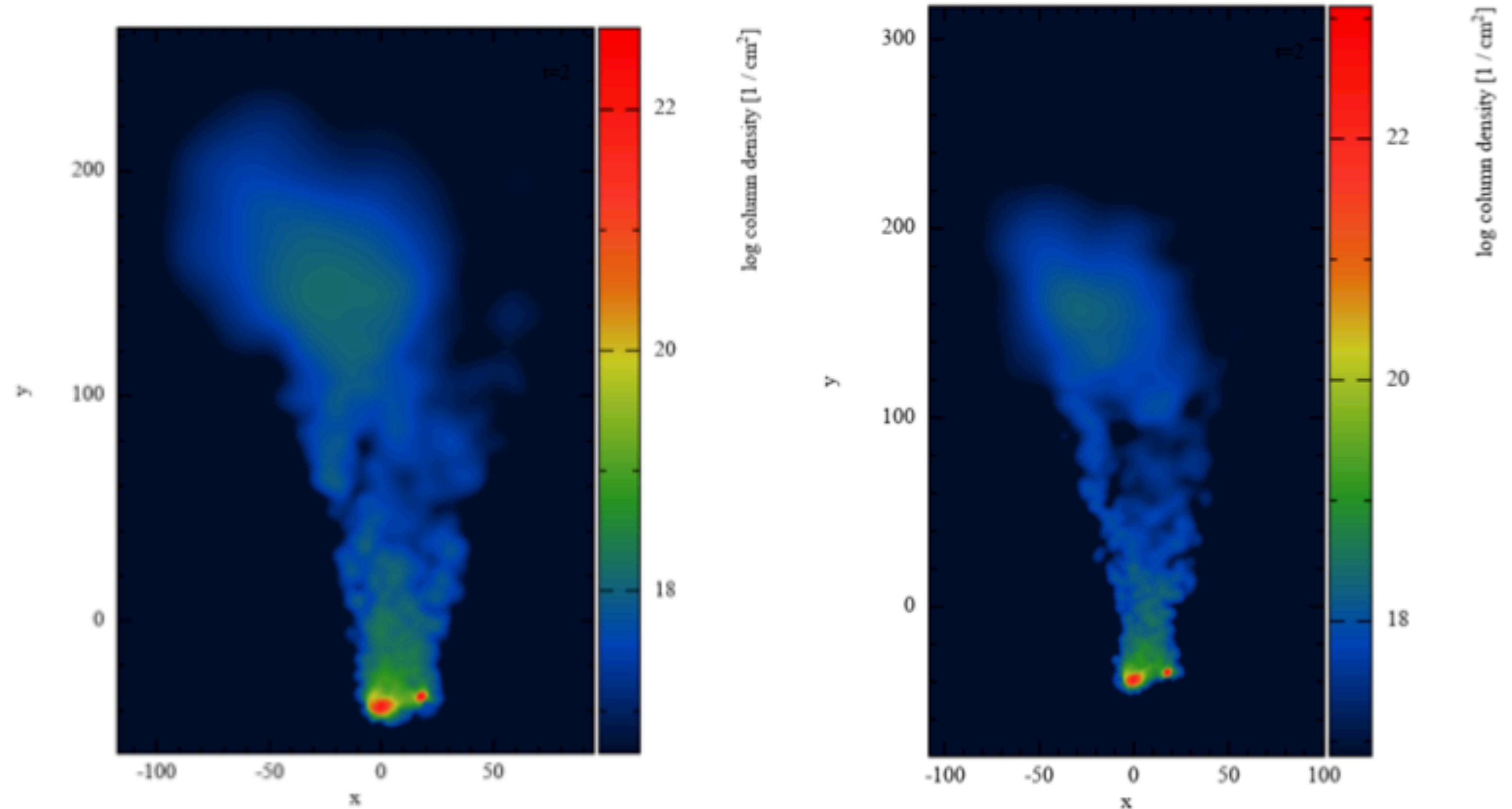
No Halo Gas

- Dependent on tidal stripping
- ***Do not produce stream***
- Previous versions of this model use longer integration time, but isolate Magellanic Clouds as an isolated pair.



Number Densities of Material Stripped

- Different halo gas masses in each panel
- Halo gas has significant effect on stream width



Conclusions

- Successful in producing the Magellanic Stream through ram pressure stripping of gas by the diffuse halo gas within the Milky Way.
- Better match than tidal models.
- Pulsar timing observations of pulsars within Magellanic Clouds could provide constraints on potential of the Milky Way.