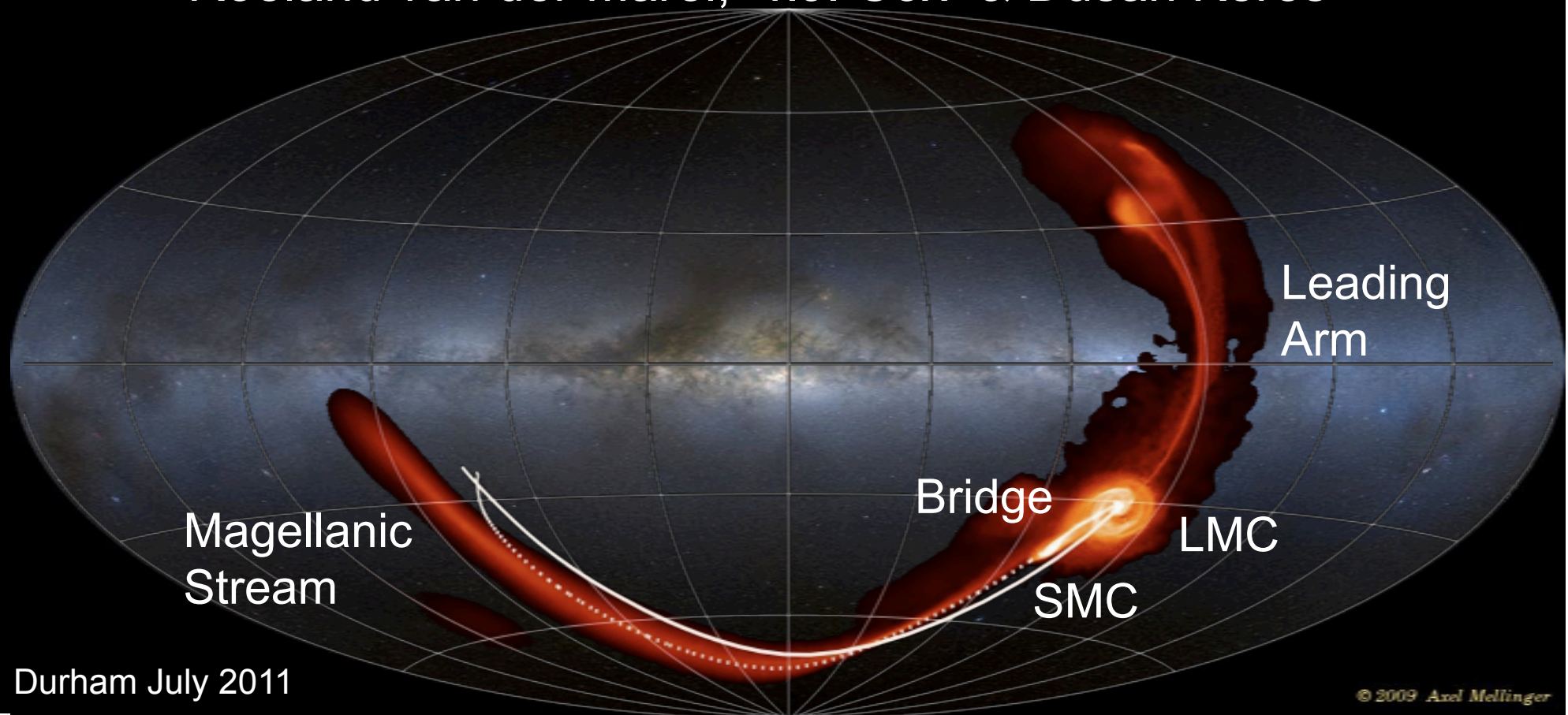


The Evolution of the Magellanic Clouds in a First Infall Scenario

Gurtina Besla

Harvard CfA

Lars Hernquist, Nitya Kallivayalil,
Roeland van der Marel, T.J. Cox & Dusan Keres



Durham July 2011

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outline

The interaction history of the LMC and SMC can answer a number of fundamental questions about the morphological evolution of dwarf galaxies

- Orbital History of the Clouds
 - Large Scale Gas Structure
- Structure (gas, stars) of the LMC
- Structure & kinematics of the SMC

No Feedback, no Ram Pressure

New Orbital History

NFW potential for the MW

$V_{\text{LMC}} = 380 \text{ km/s}$

Kallivayalil et al. 2006

Besla et al. 2007

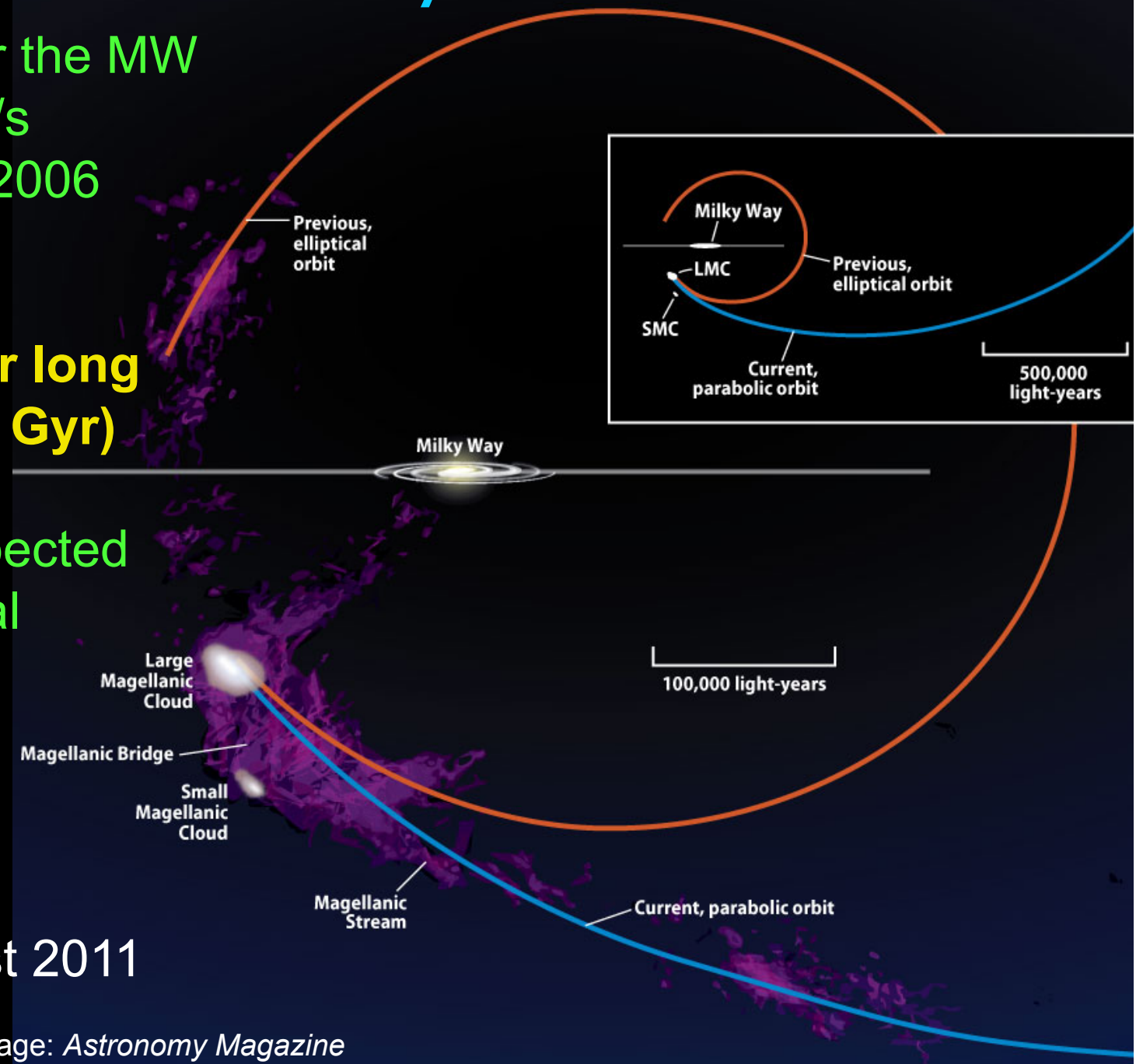
First passage, or long period orbit (> 6 Gyr)

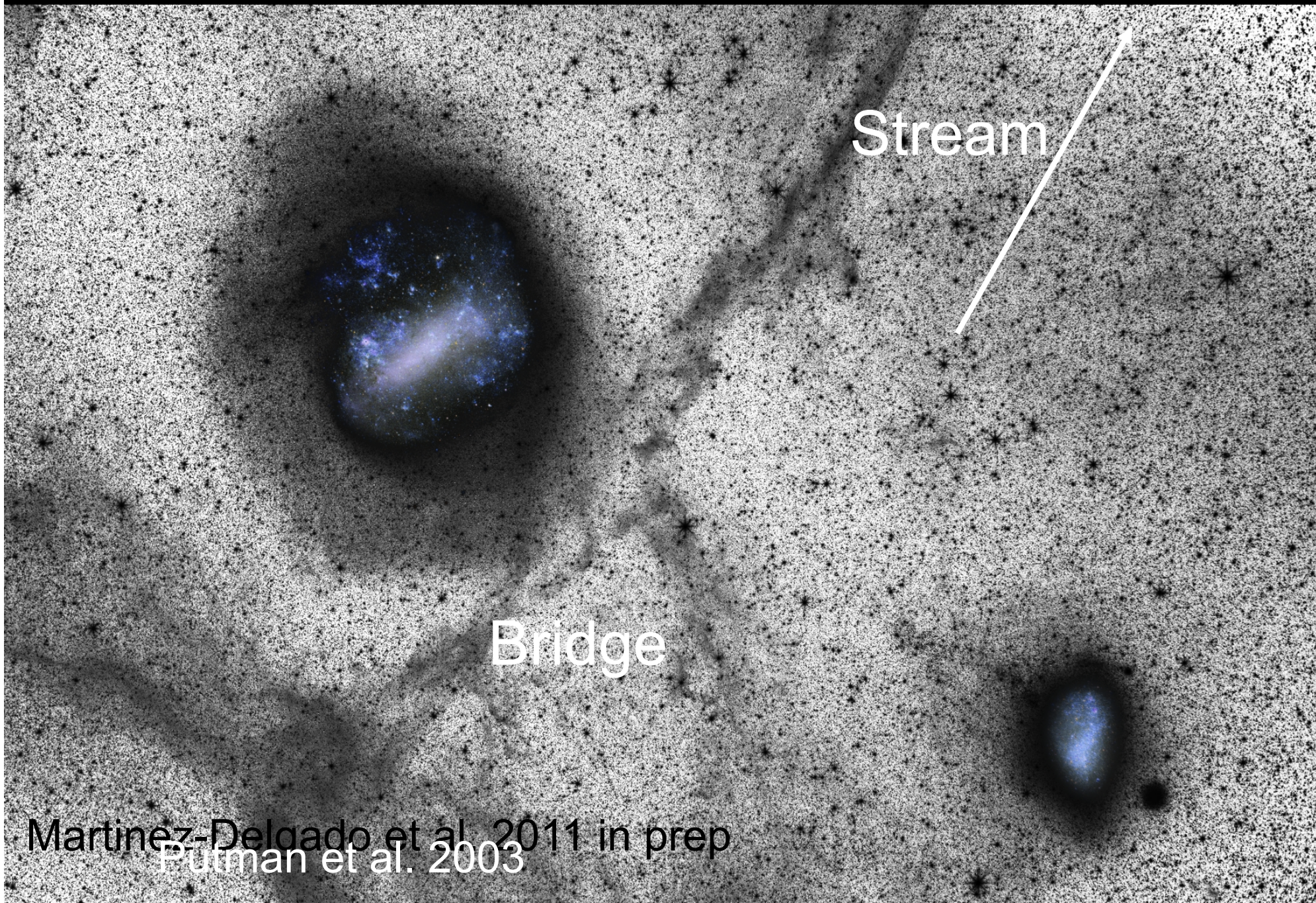
A first infall is expected from cosmological simulations

Busha et al. 2011 (Bolshoi)

Boylan-Kolchin, Besla & Hernquist 2011 (Millennium II)

Image: *Astronomy Magazine*





Stream

Bridge

Martinez-Delgado et al. 2011 in prep
Putman et al. 2003



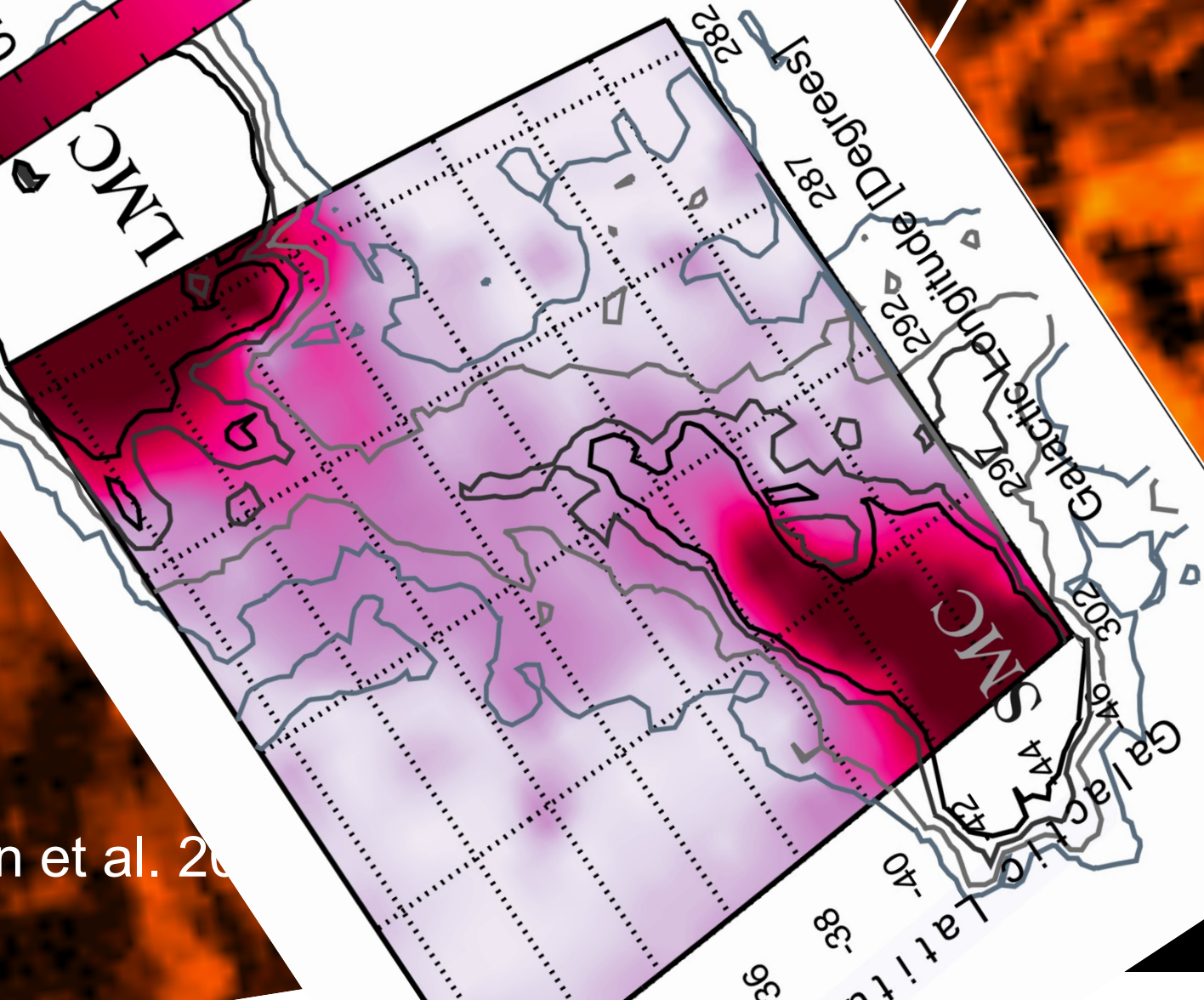
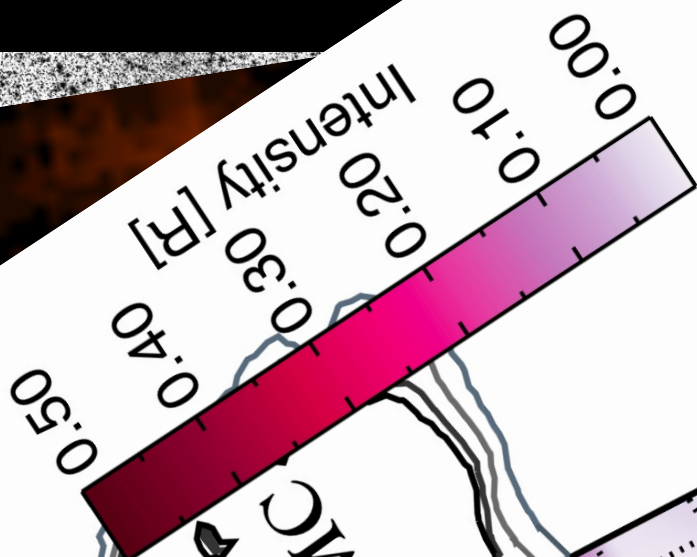
Stream

Bridge

Mart

Putman et al. 2003

WHAM survey
Barger poster 1.1 m



Putman et al. 2001

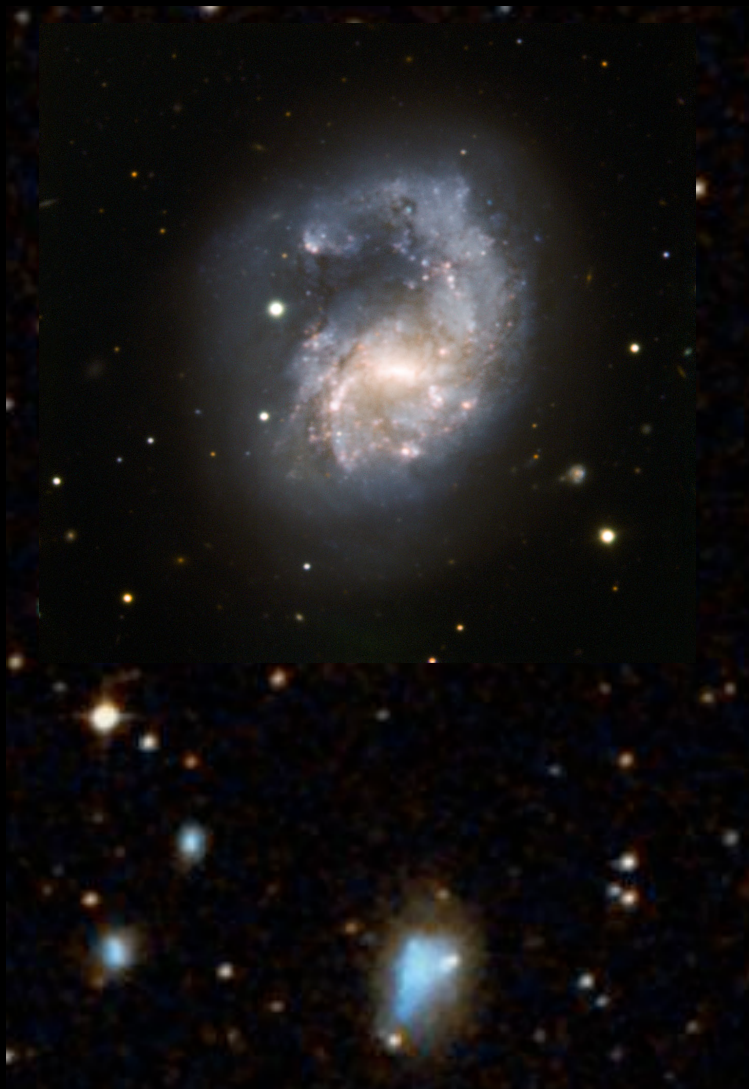
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Carlos Milovic F. - PixInsight Team
<http://www.pixinsight.com/>
Biomedical Imaging Center - PUC

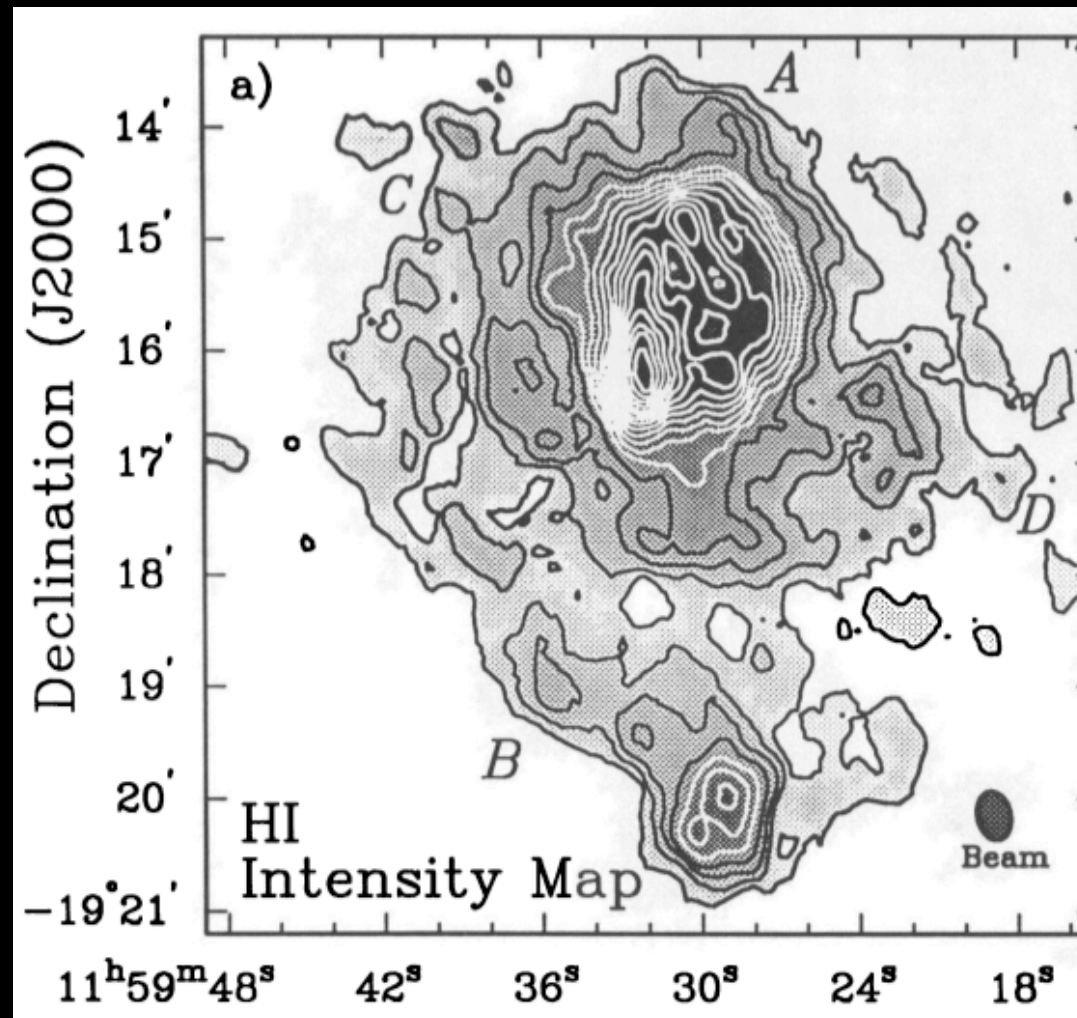
“The Magellanic Clouds
are not 'oddities' of
Nature, but **typical of a
definite stage of the
barred spiral sequence**
characterized by a
specific kind of
asymmetry”
- de Vaucouleurs &
Freeman 1972



Magellanic Irregular NGC 4027 & 4027A (Arp 22)

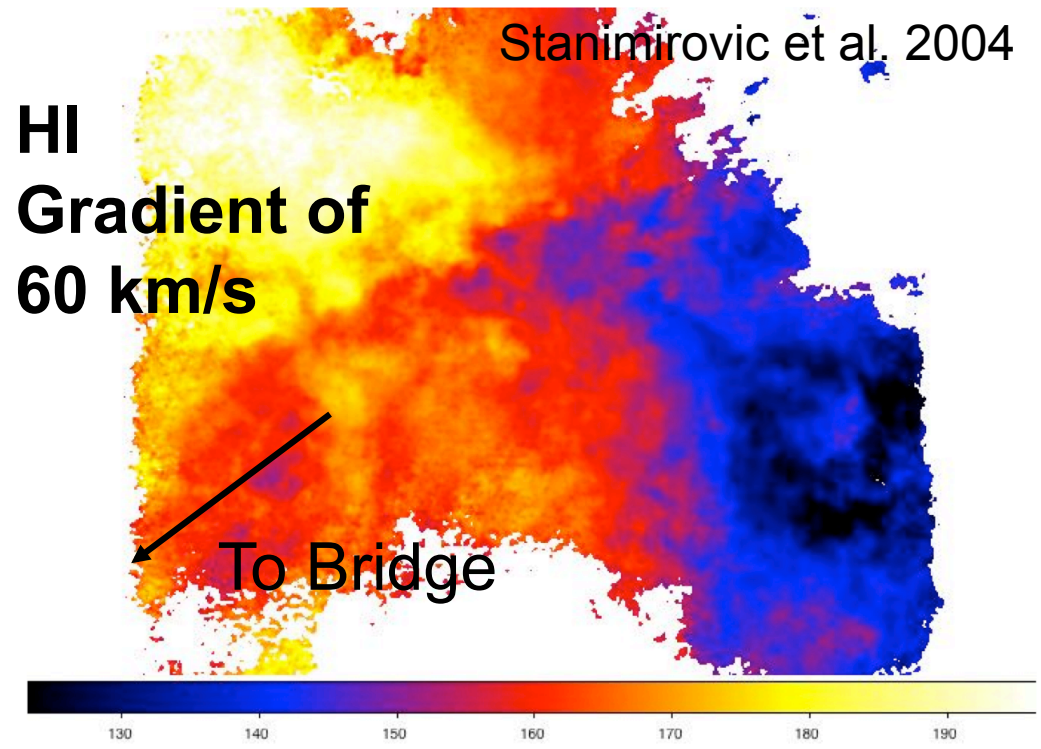
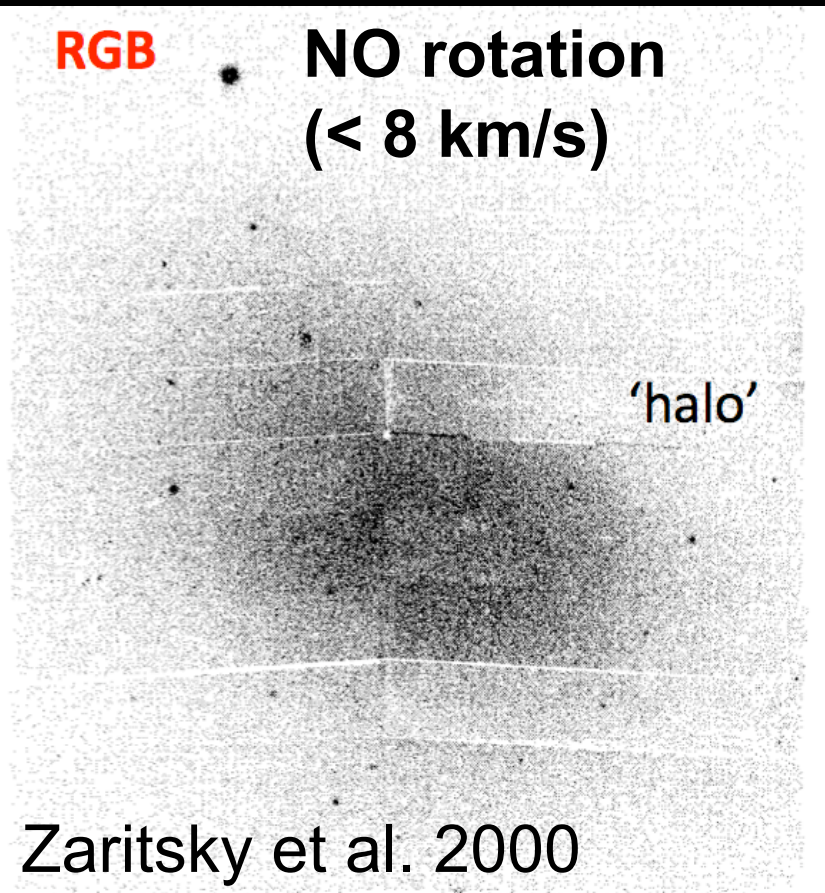


ESO B,V,R wikisky



Phookun et al. 1992

SMC

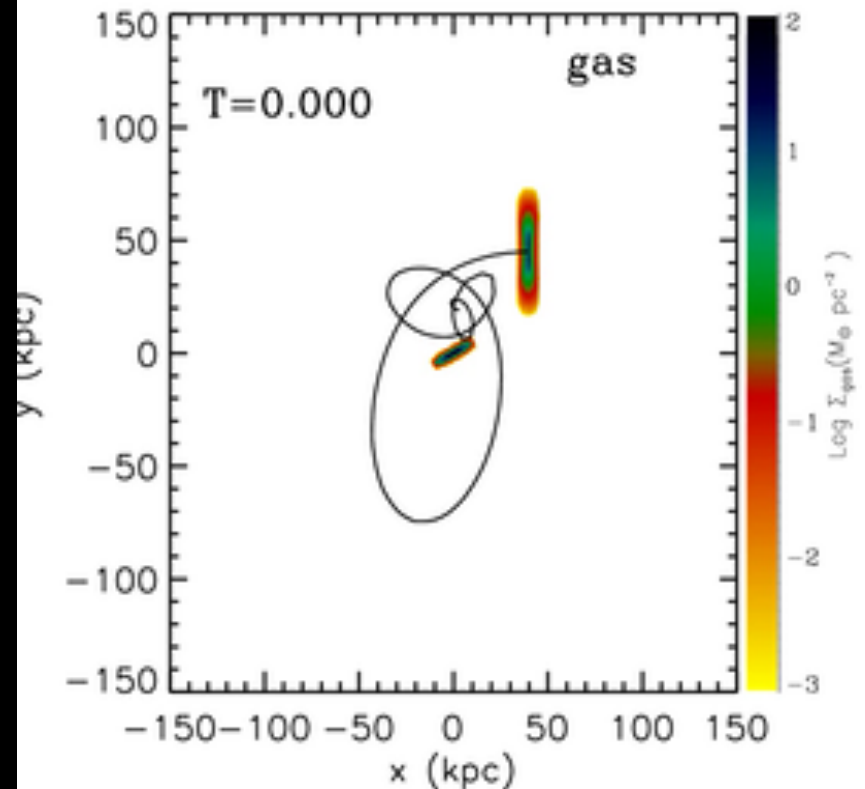
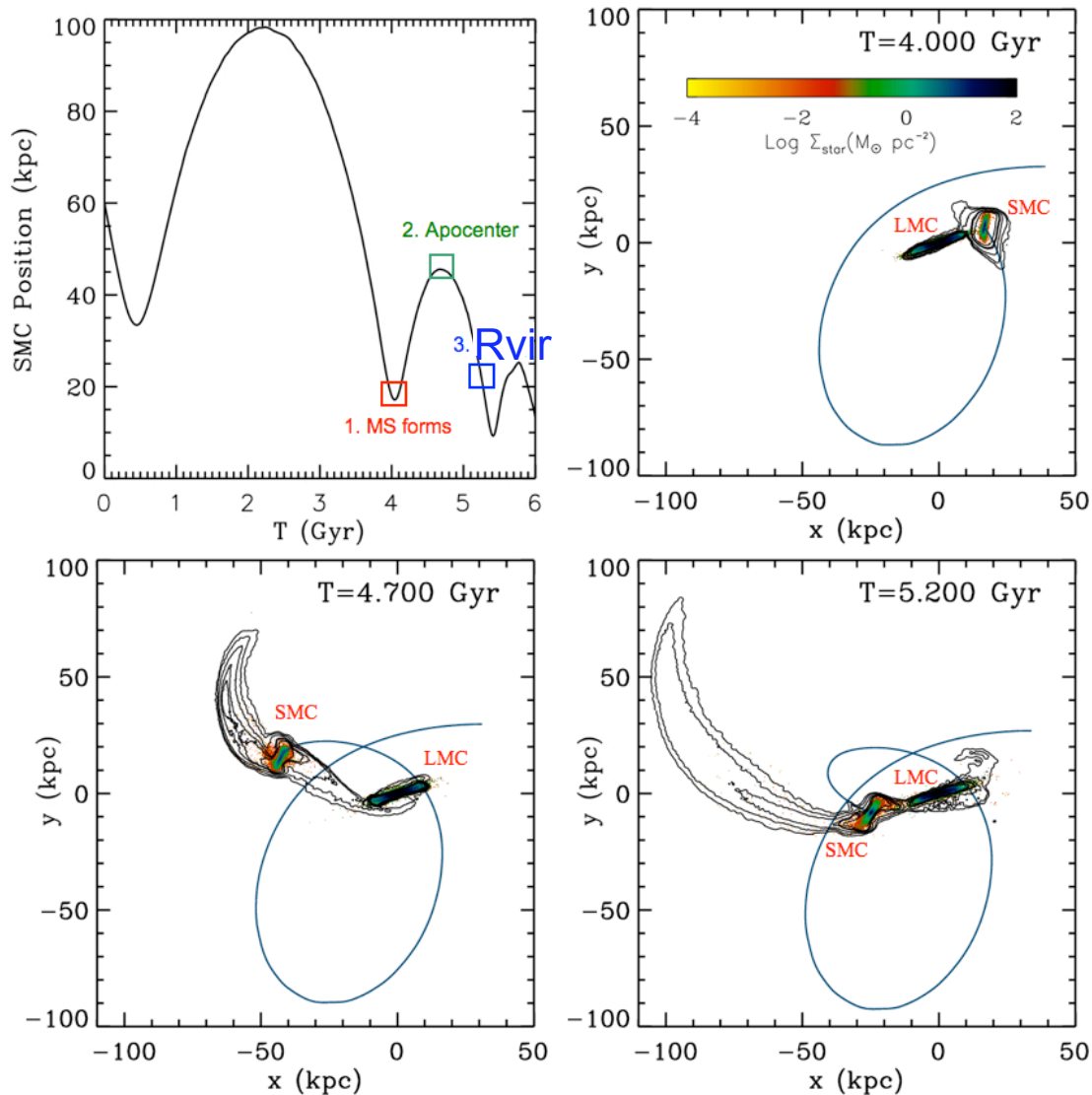


Big Picture

- By studying the structure of the LMC:
What is the dynamical state of the class of galaxies known as Magellanic Irregulars?
- By studying the structure of the SMC:
What is the evolutionary relationship between gas rich, disk-like dwarfs and gas poor dwarf spheroidals?

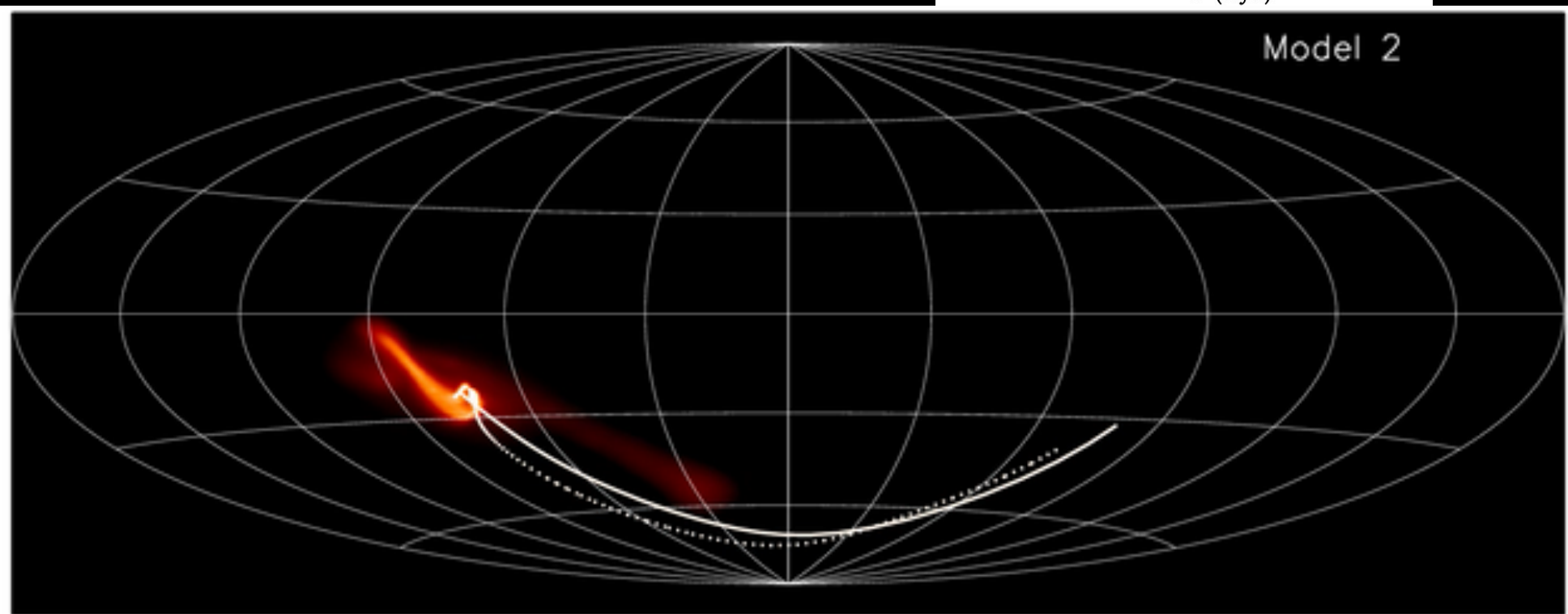
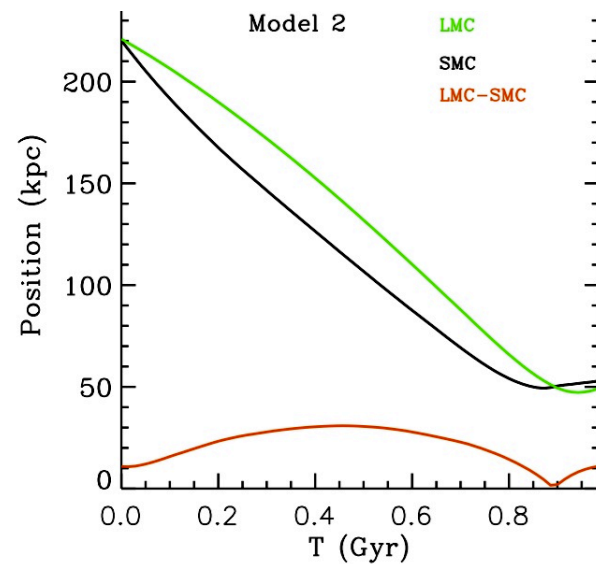
SMC in orbit about the LMC (no MW)

GADGET2
(Springel 2005)
SPH simulations



LMC tides remove an extended tail of gas from the SMC without the aid of MW tides (Besla et al. 2010)

L/SMC in Orbit about the MW



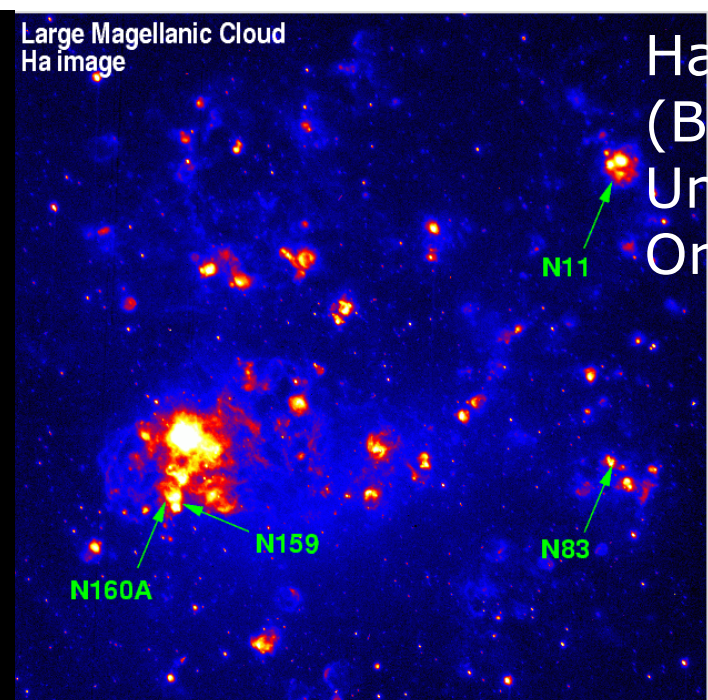
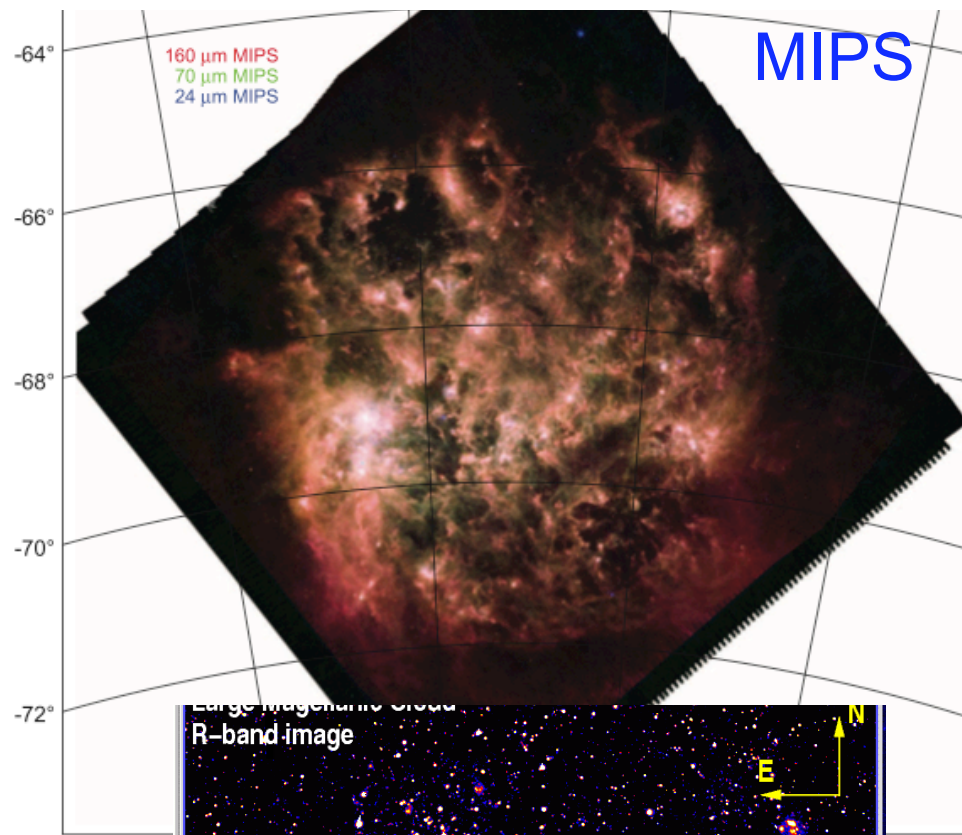
17

18

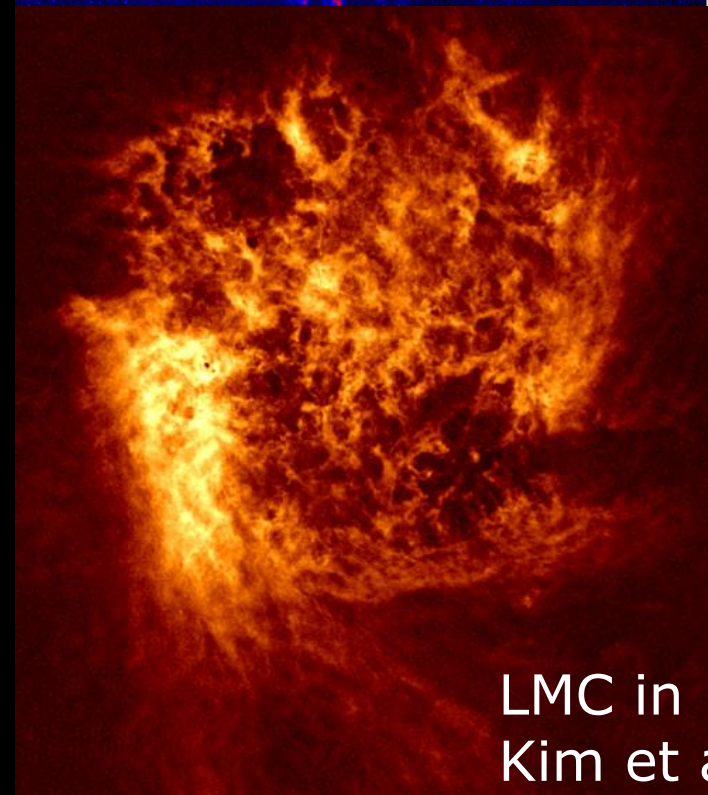
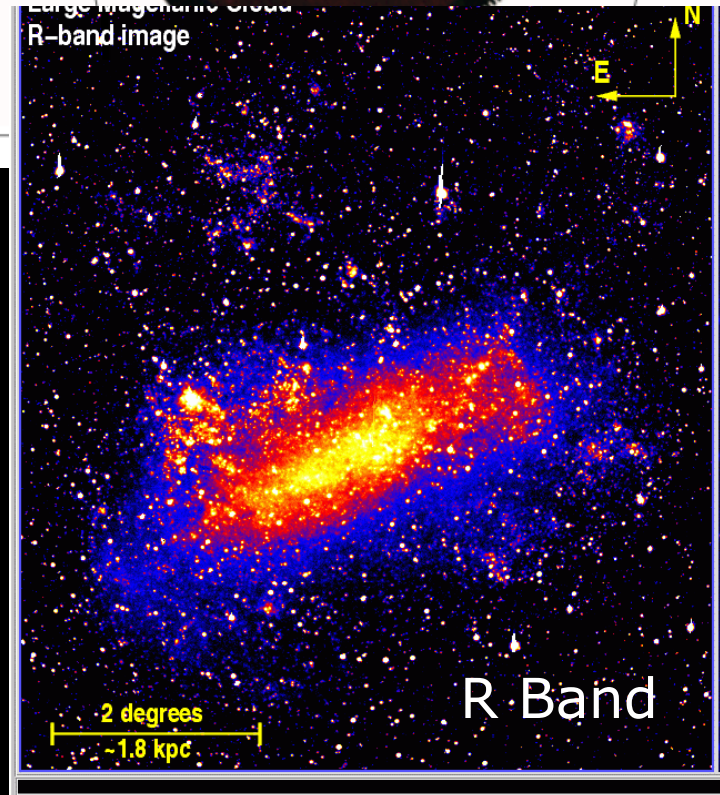
19
Log ($N_{\text{gas}} \text{ cm}^{-2}$)

20

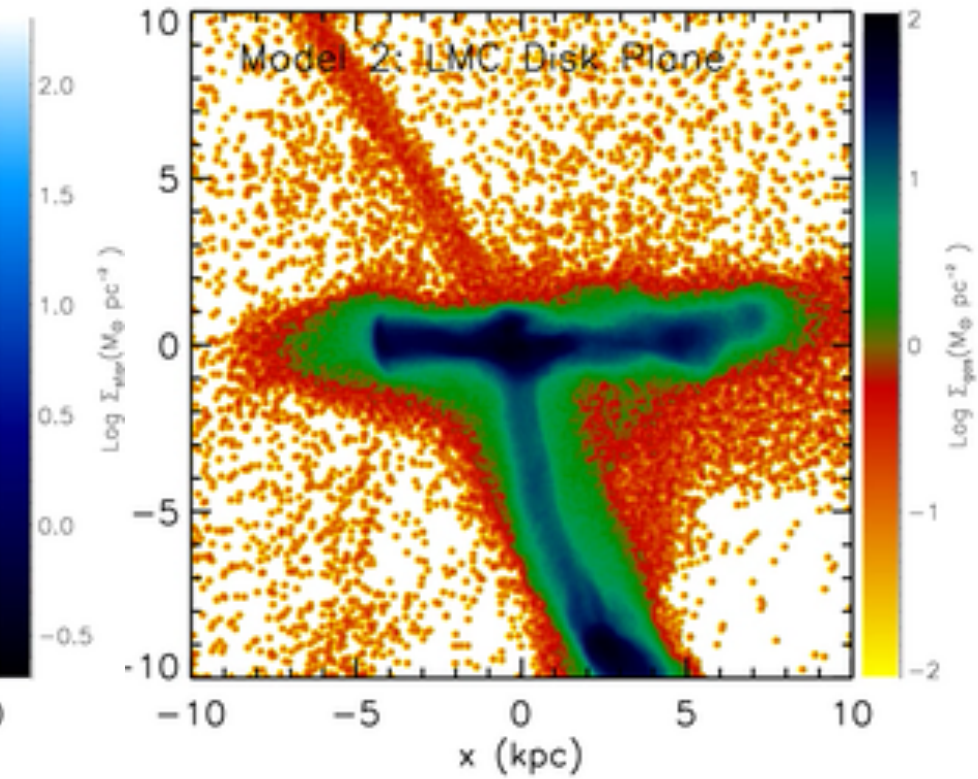
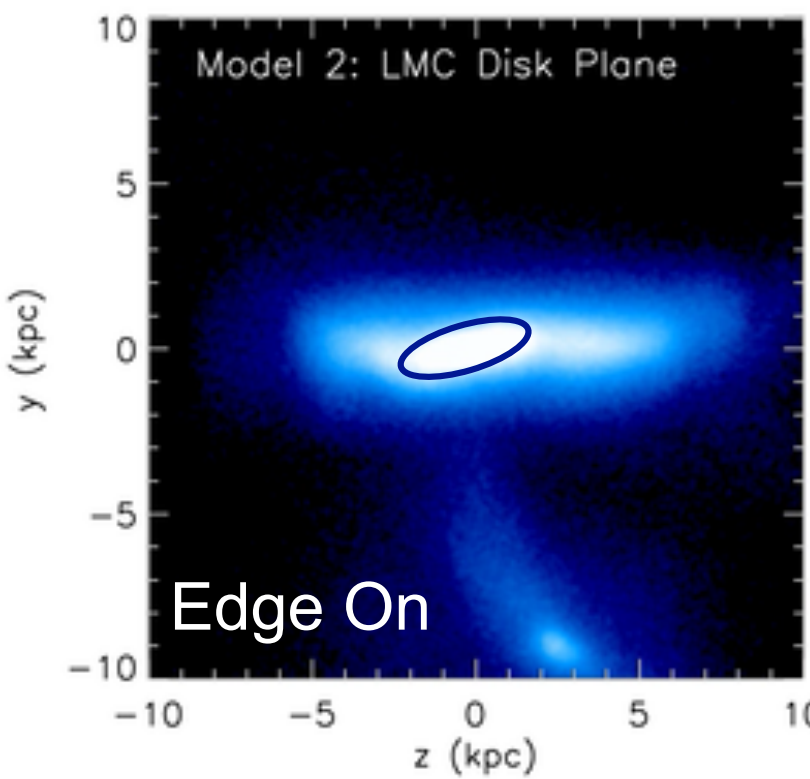
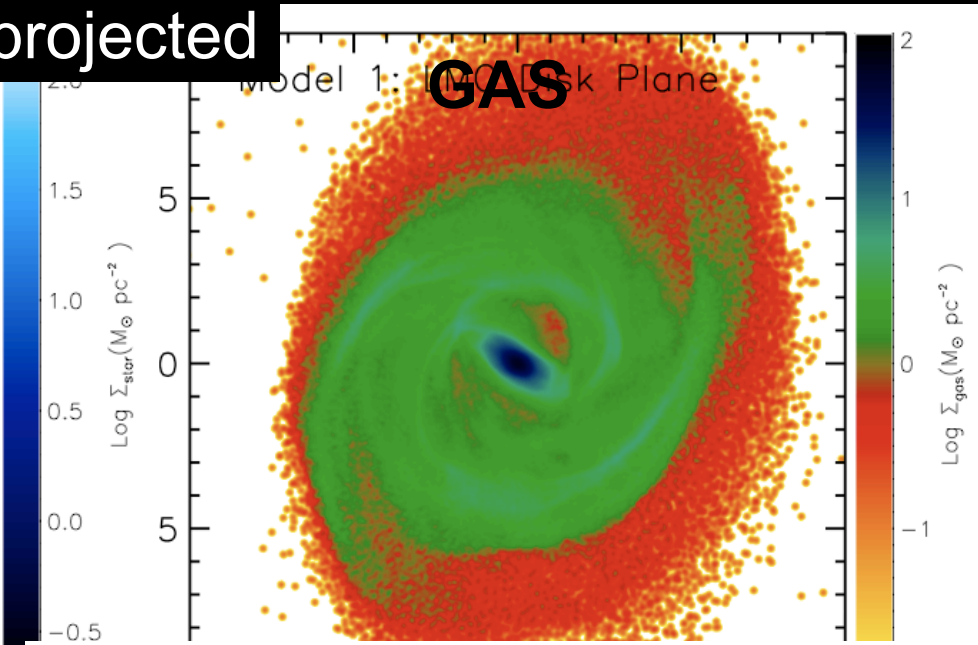
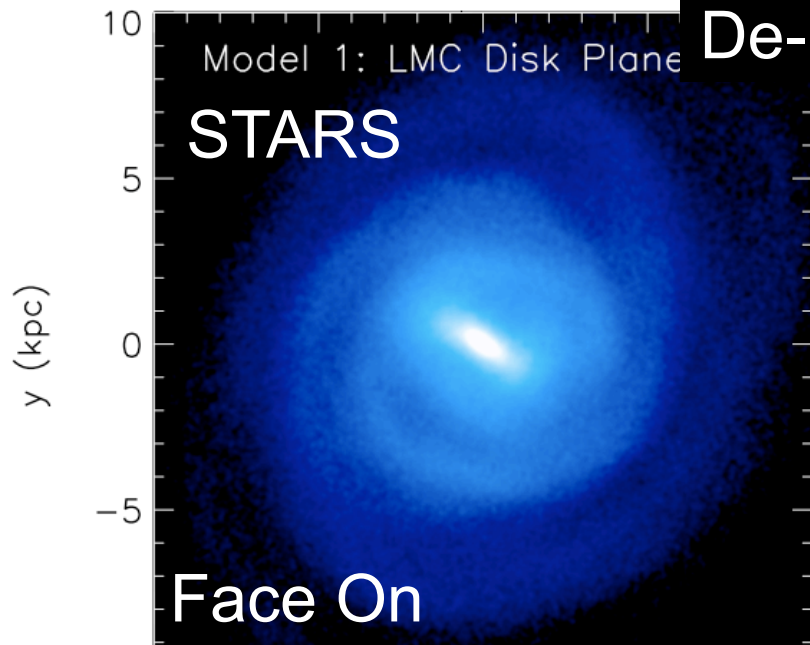
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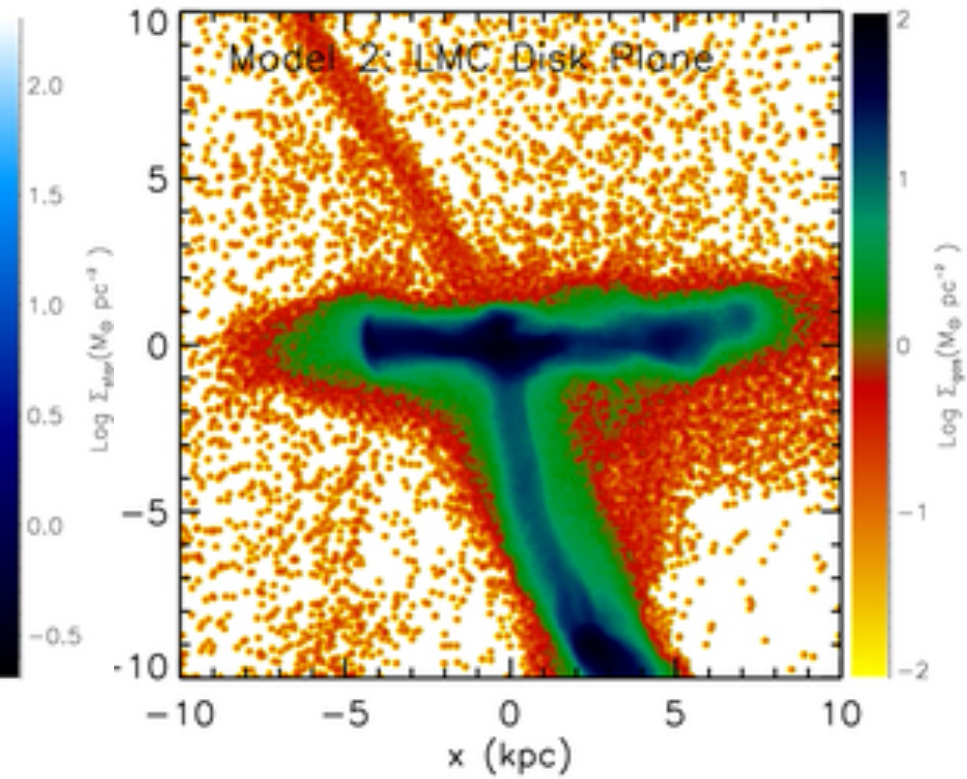
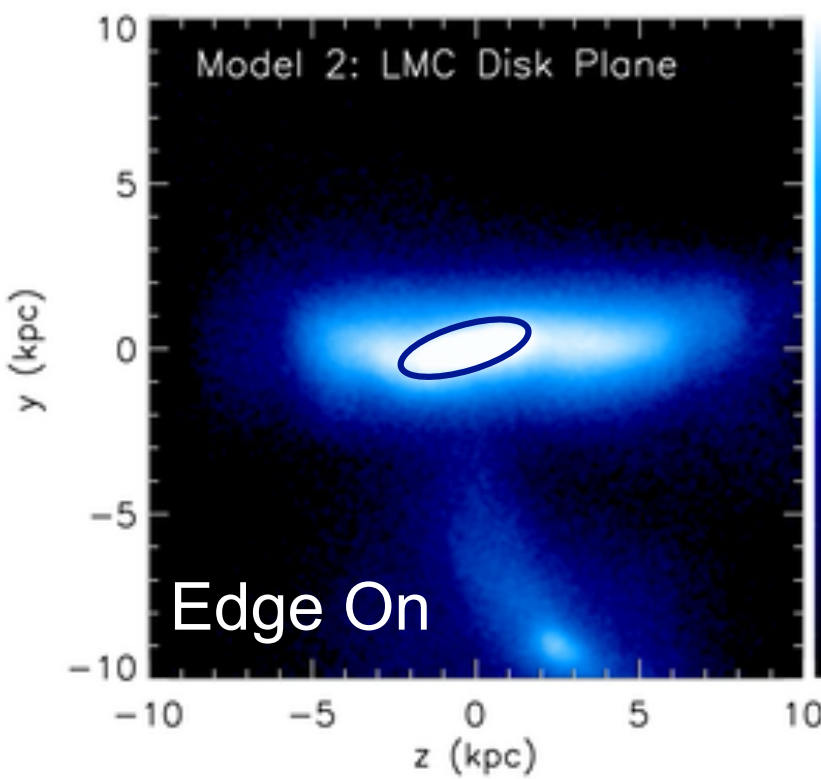
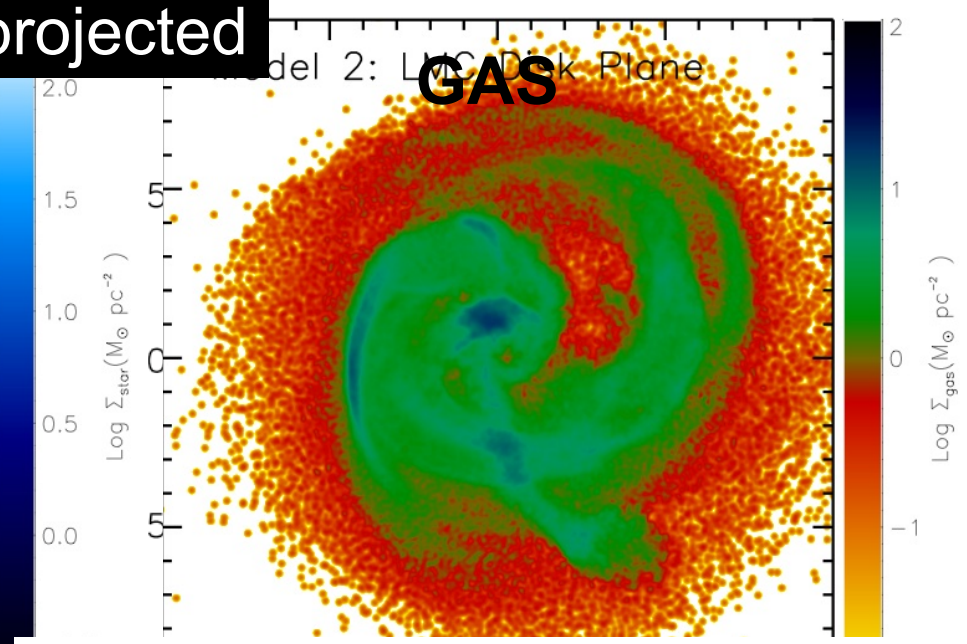
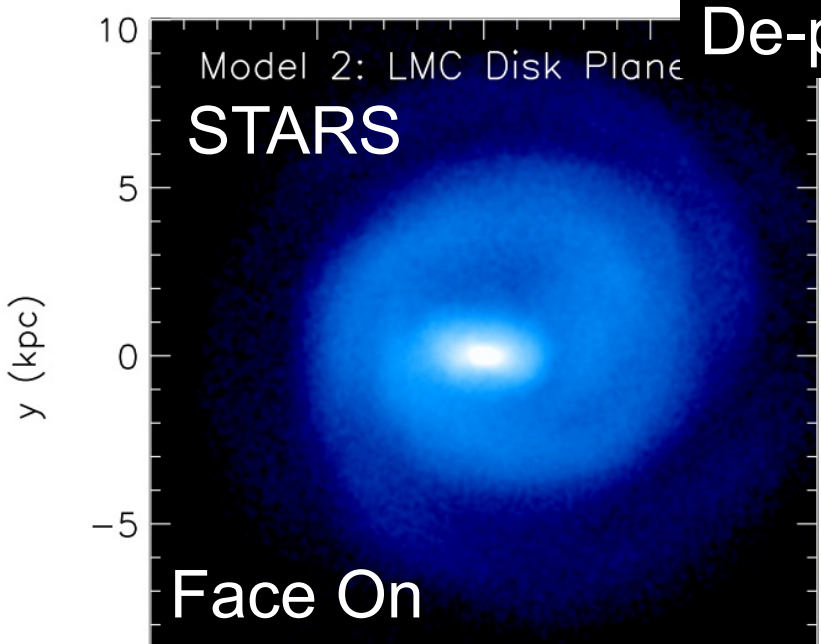
H α
(Bothun,
Univ.
Oregon)



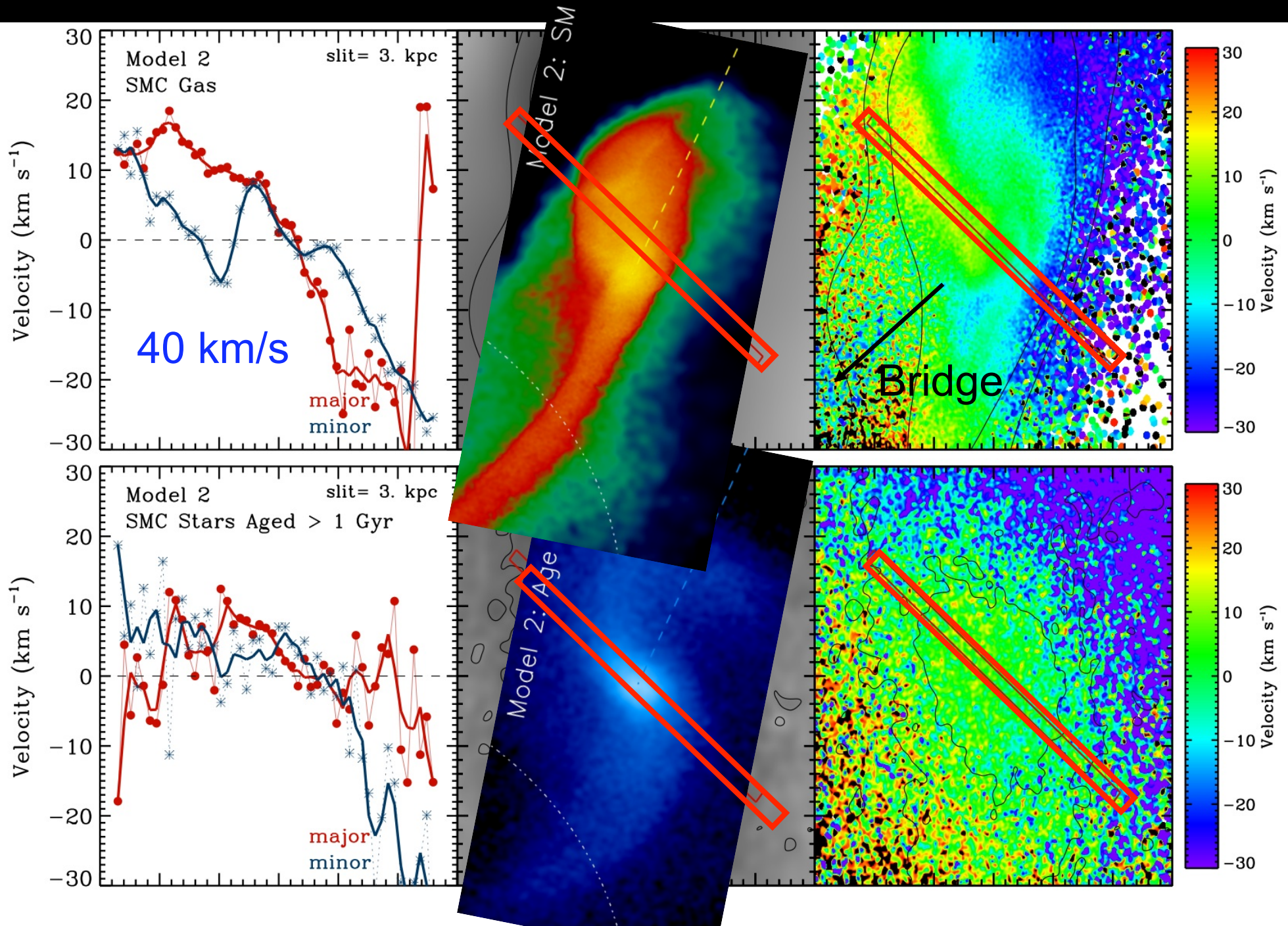
De-projected



De-projected



SMC Kinematics: Simulation Results



Summary

The LMC has recently (100-300 Myrs) experienced a direct collision with the SMC.

This collision distorted the bar of the LMC disk, causing to be offset and warped by some 10-15 degrees relative to the LMC disk plane. Gas is thus inefficiently funneled along the bar.

Such warped bars/asymmetries are expected for Magellanic Irregulars with a nearby small companion.

The SMC is an object in transition from an Irregular (disk like) dwarf galaxy to a spheroid.

This transition is facilitated by interactions with the LMC. A recent direct collision with the LMC caused the older stellar disk to be tidally heated, wiping out the velocity gradient.