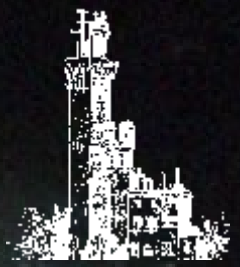
Michela Mapelli

INAF-OAPD



LIFE and DEATH of RING GALAXIES

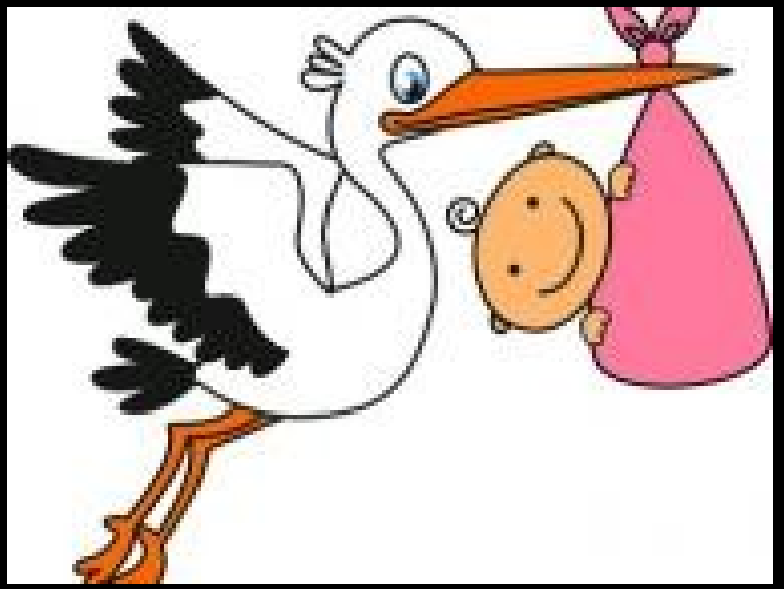
L. Mayer, A.A. Trani, E. Ripamonti, D. Fiacconi, M. Colpi, L. Coccato, L. Morelli, E.M. Corsini, et al.

GEE2, November 7th-9th 2011

OUTLINE

1 – INTRODUCTION: WHY RING GALAXIES?

2 – BIRTH of RING GALAXIES



3 – DEATH of RING GALAXIEs

1 – INTRODUCTION: WHY RING GALAXIES?

1. Why ring galaxies?

~ 200-300 in catalog by Arp & Madore 1987

~1 ring galaxy per 10^4 spiral galaxies

~ 60 % thought to have collisional origin (knotty rings, nearby companions)

1. Why ring galaxies?

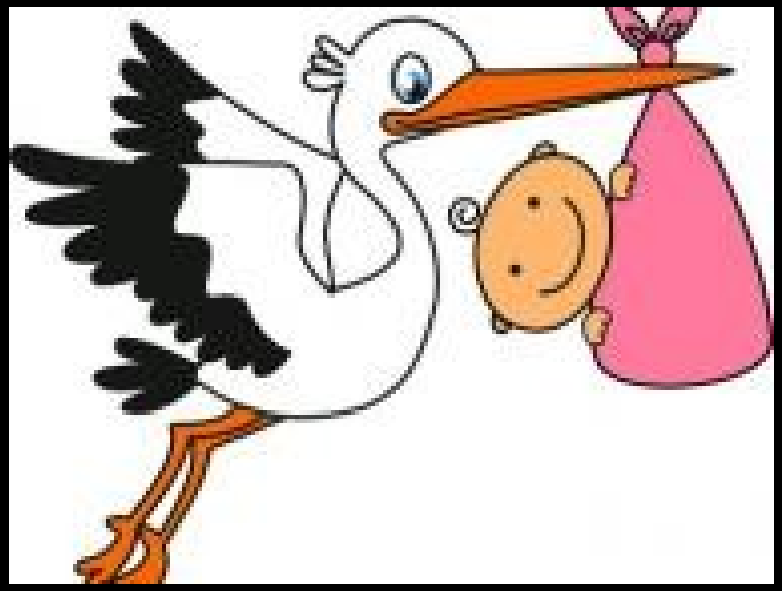
GALAXY COLLISION LAB.: simple geometry!

STAR FORMATION LAB.: HOW INTERACTIONS TRIGGER SF

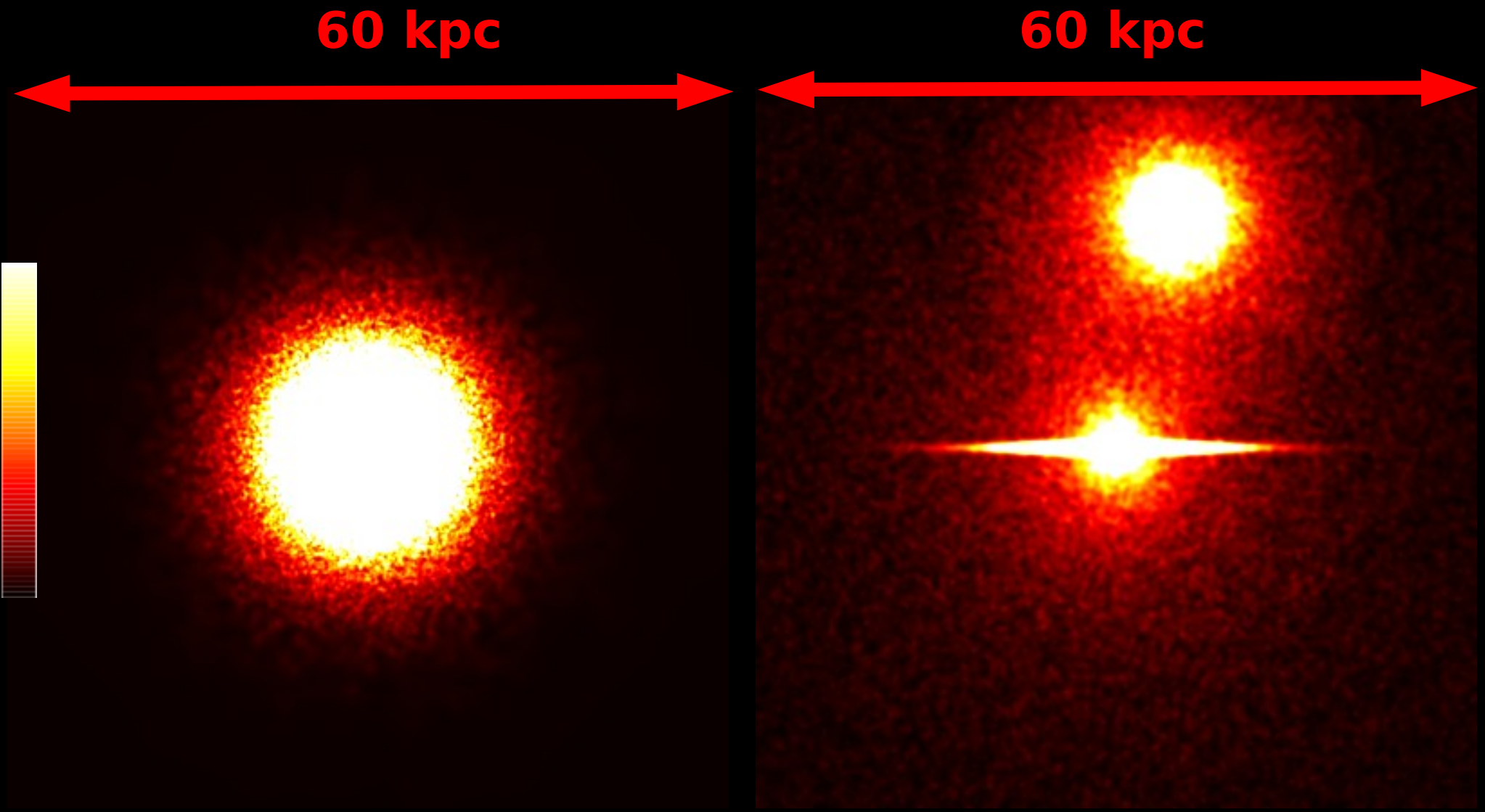
LOW METALLICITY STAR FORMATION

HOW DO THEY EVOLVE?

2 – BIRTH of RING GALAXIES



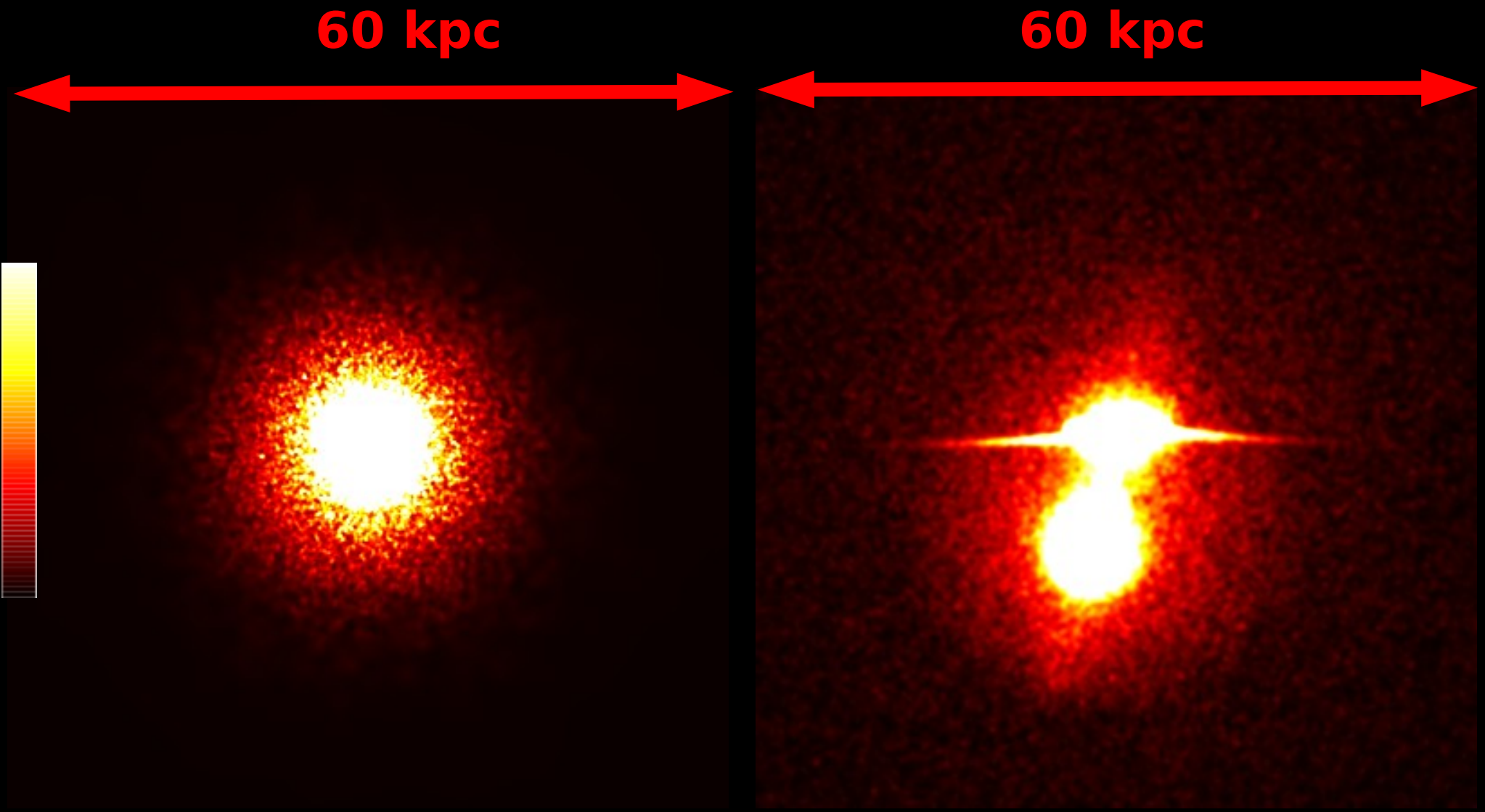
2.1 Simulations of Cartwheel-like CRG:



time = -30 Myr

MM et al. 2008a

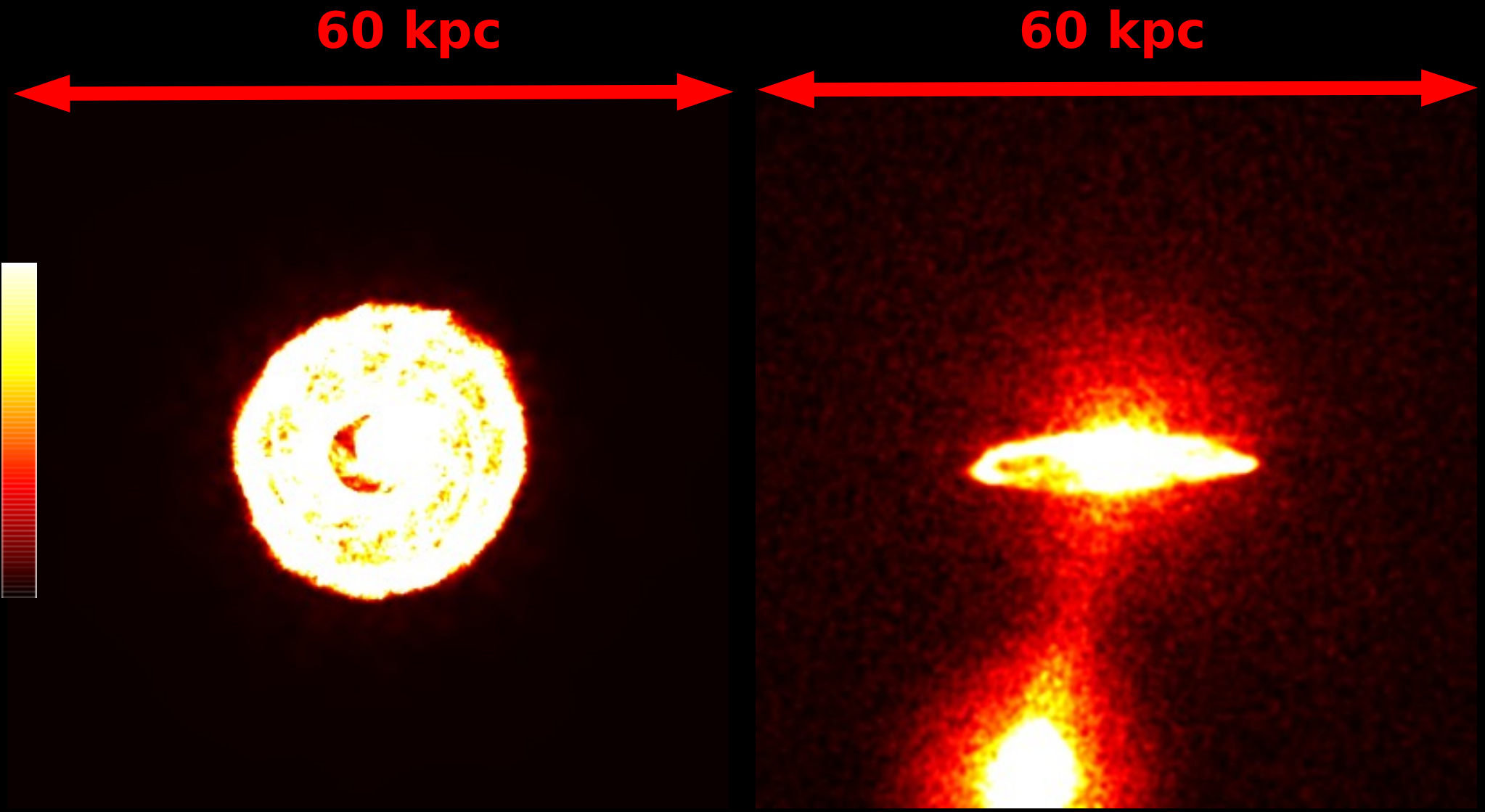
2.1 Simulations of Cartwheel-like CRG:



time = 10 Myr

MM et al. 2008a

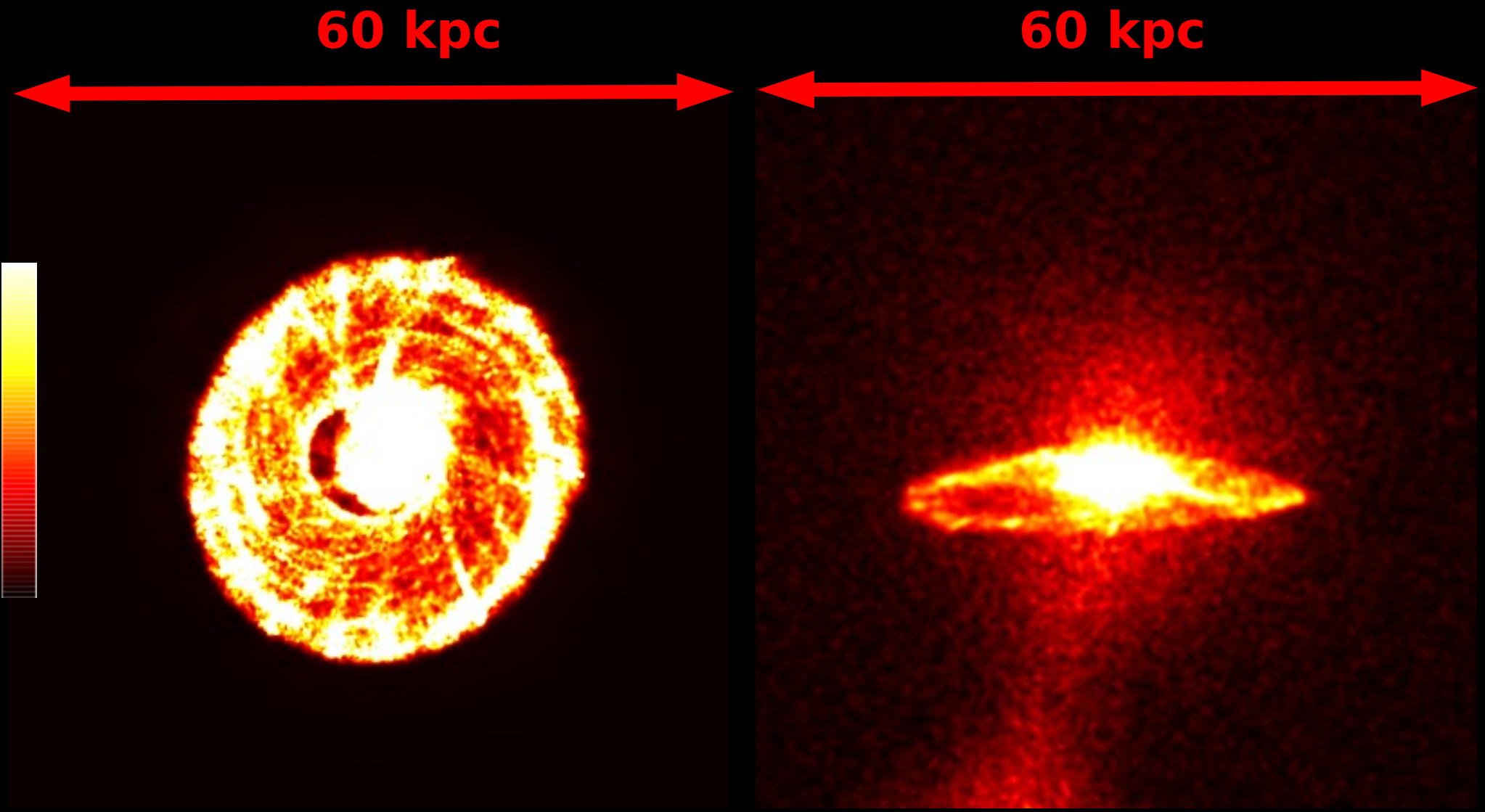
2.1 Simulations of Cartwheel-like CRG:



time = 50 Myr

MM et al. 2008a

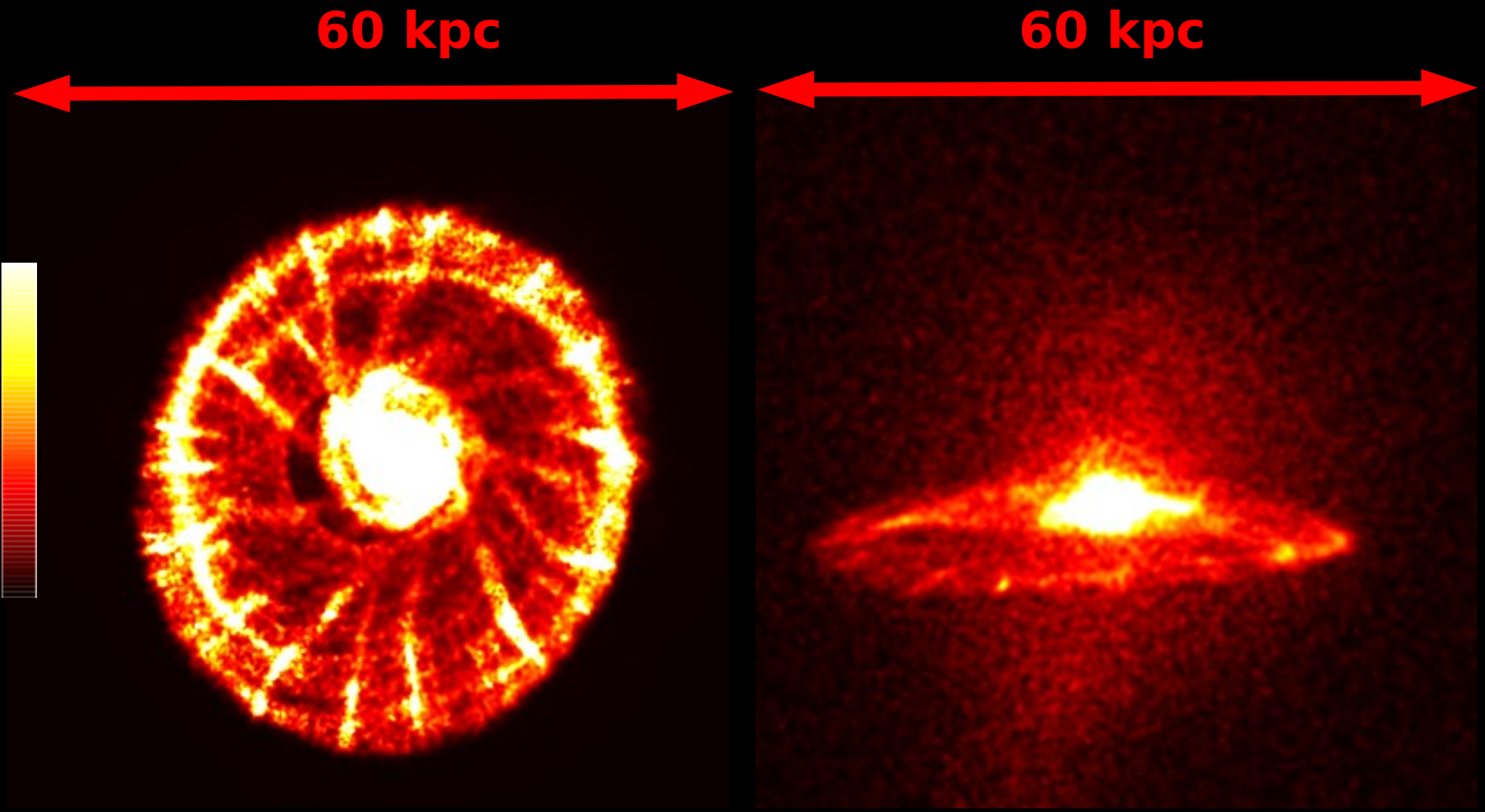
2.1 Simulations of Cartwheel-like CRG:



time = 90 Myr

MM et al. 2008a

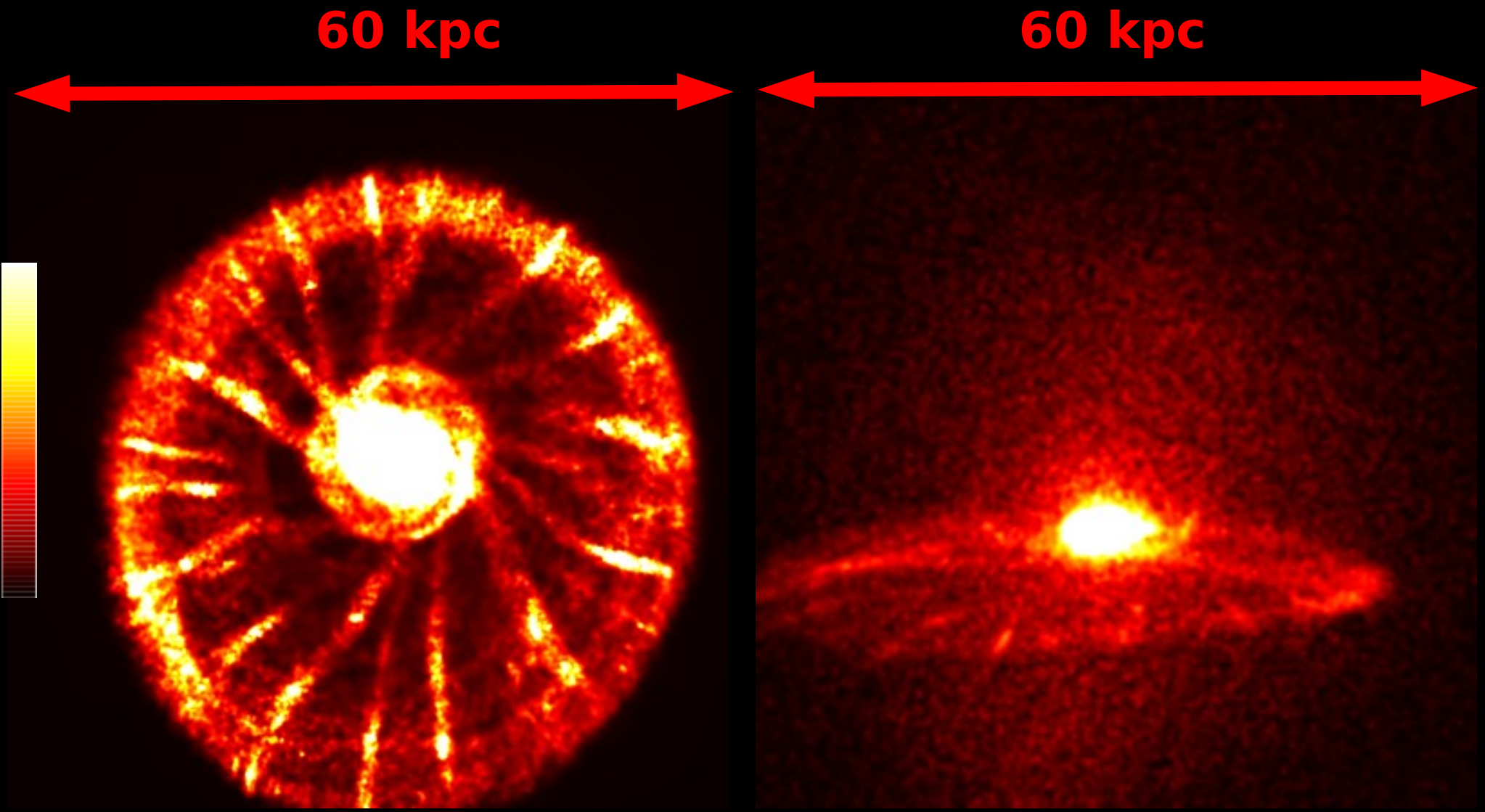
2.1 Simulations of Cartwheel-like CRG:



time = 130 Myr

MM et al. 2008a

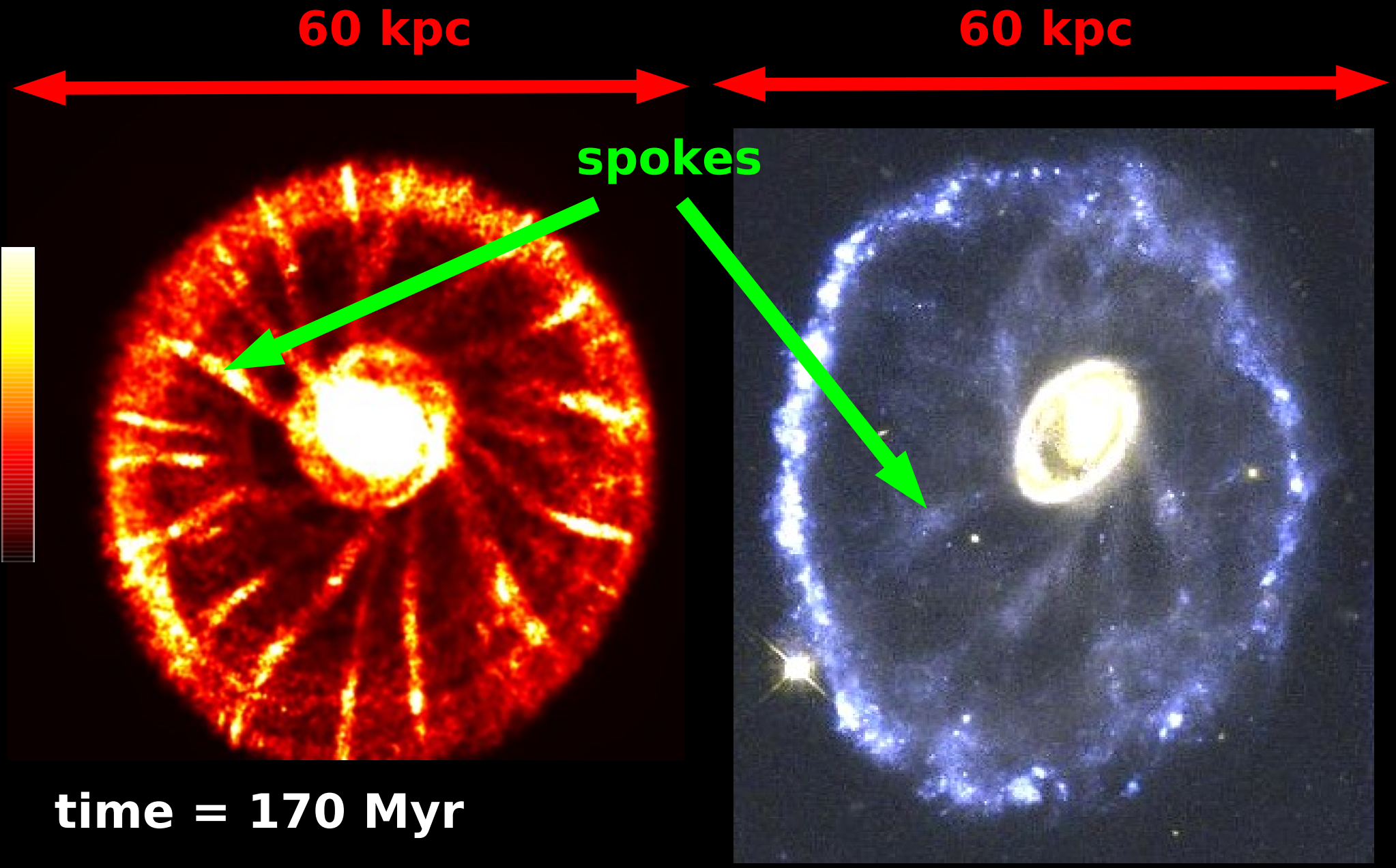
2.1 Simulations of Cartwheel-like CRG:



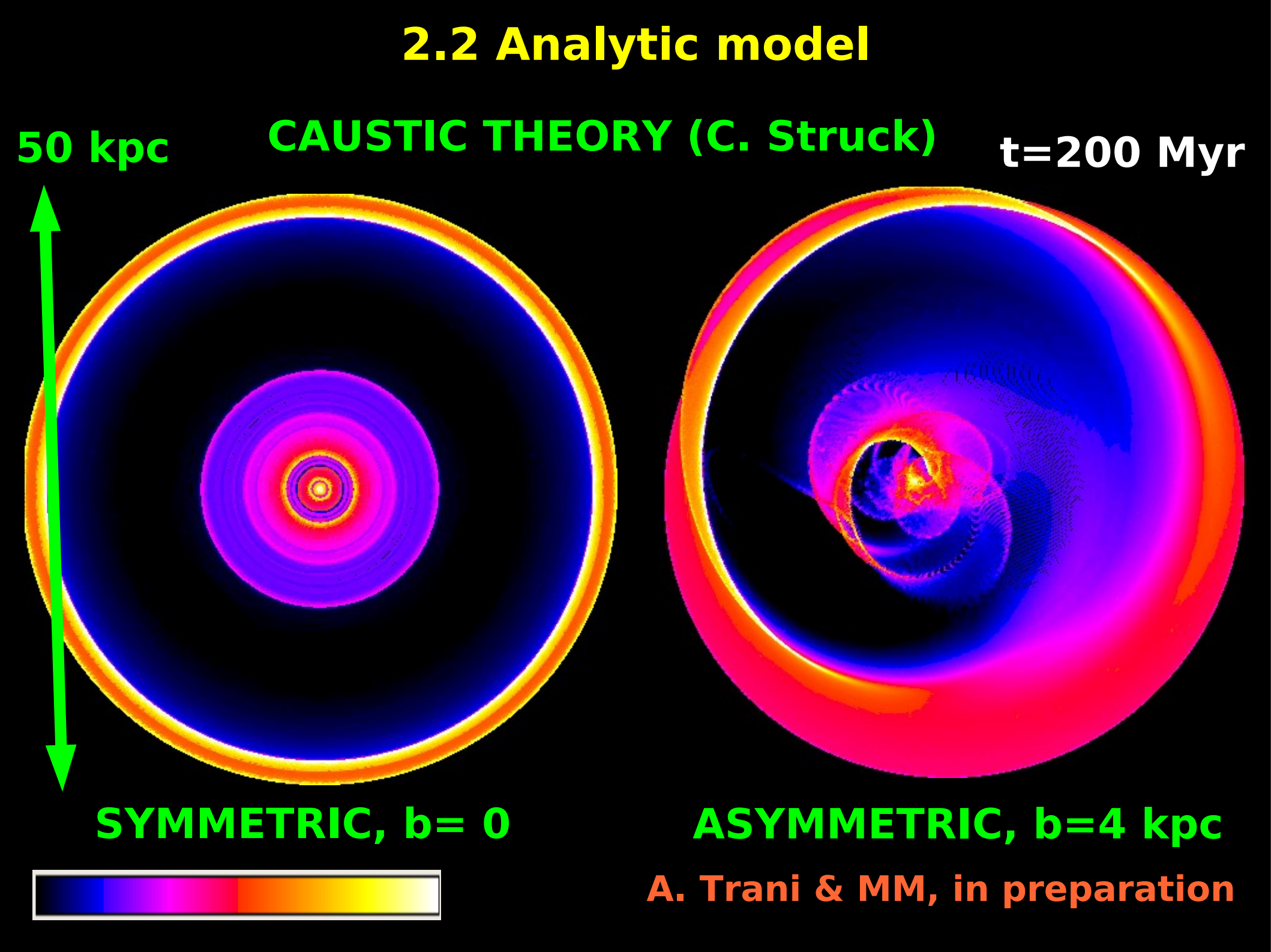
time = 170 Myr

MM et al. 2008a

2.1 Simulations of Cartwheel-like CRG:



2.2 Analytic model



2.2 Analytic model

LIMITS of CAUSTIC THEORY

Only stars, circular orbits, impulse approximation

-no velocity dispersion

-no gas !!!

-no vertical displacement

-only small amplitudes (perturbation)

A. Trani & MM, in preparation

2.3 SIMULATIONS: GAS & SF

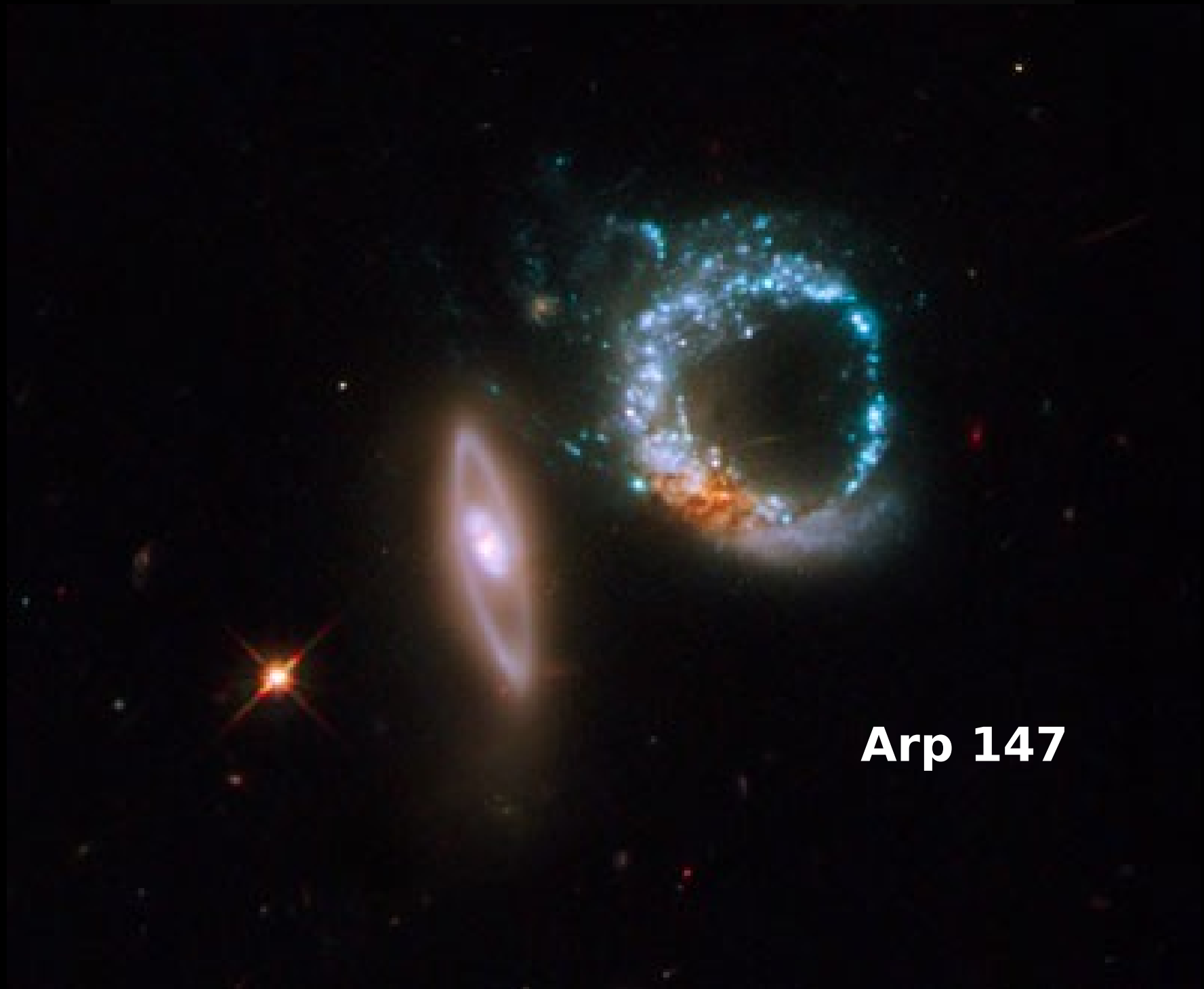
New version of gasoline
(Stinson et al. 2006)

-stochastic SFR based on local Jeans mass

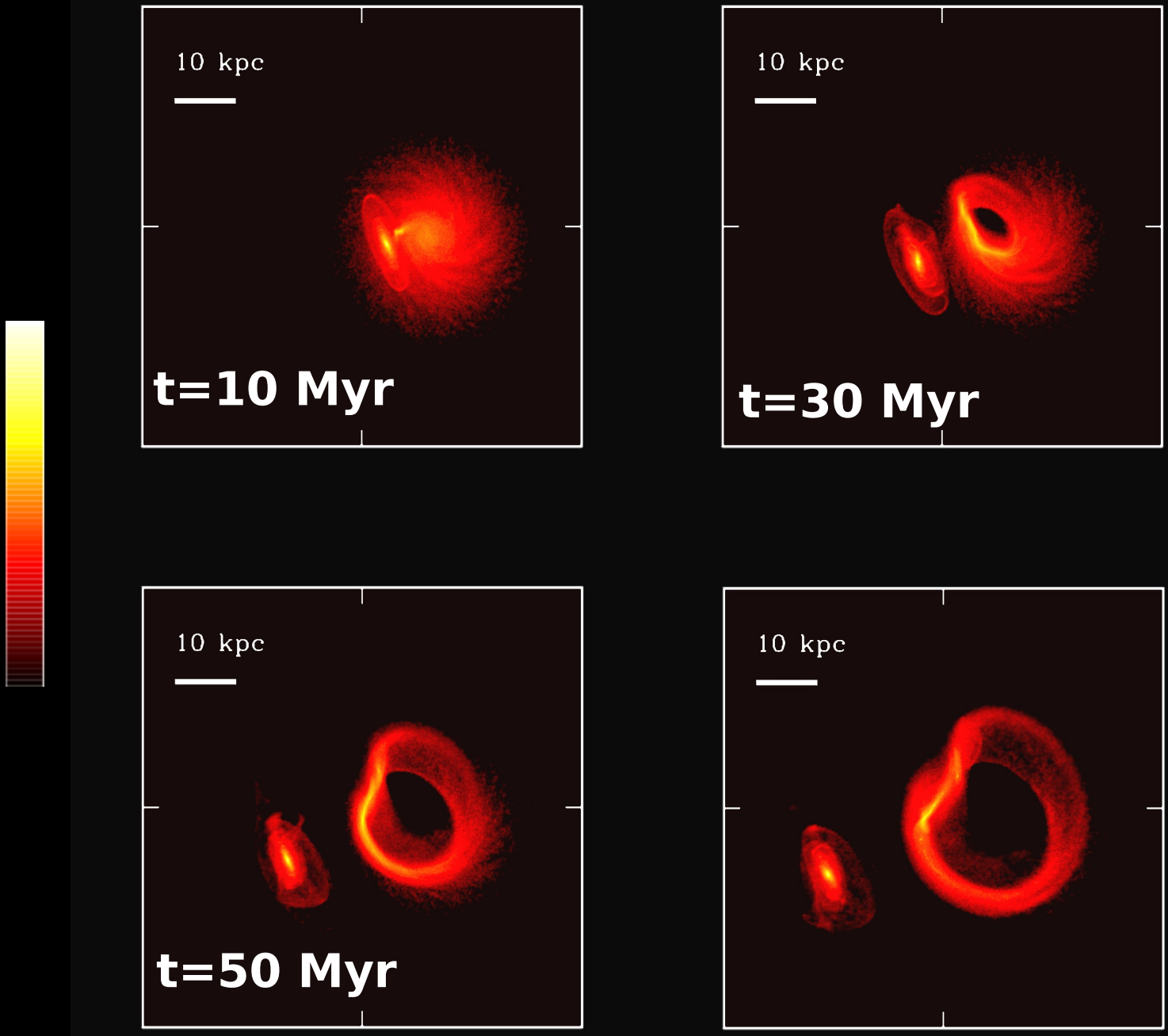
-new cooling down to 300 K

-switch off cooling for timescale after type II SNae: prevents overcooling

2.3 SIMULATIONS: RE galaxies



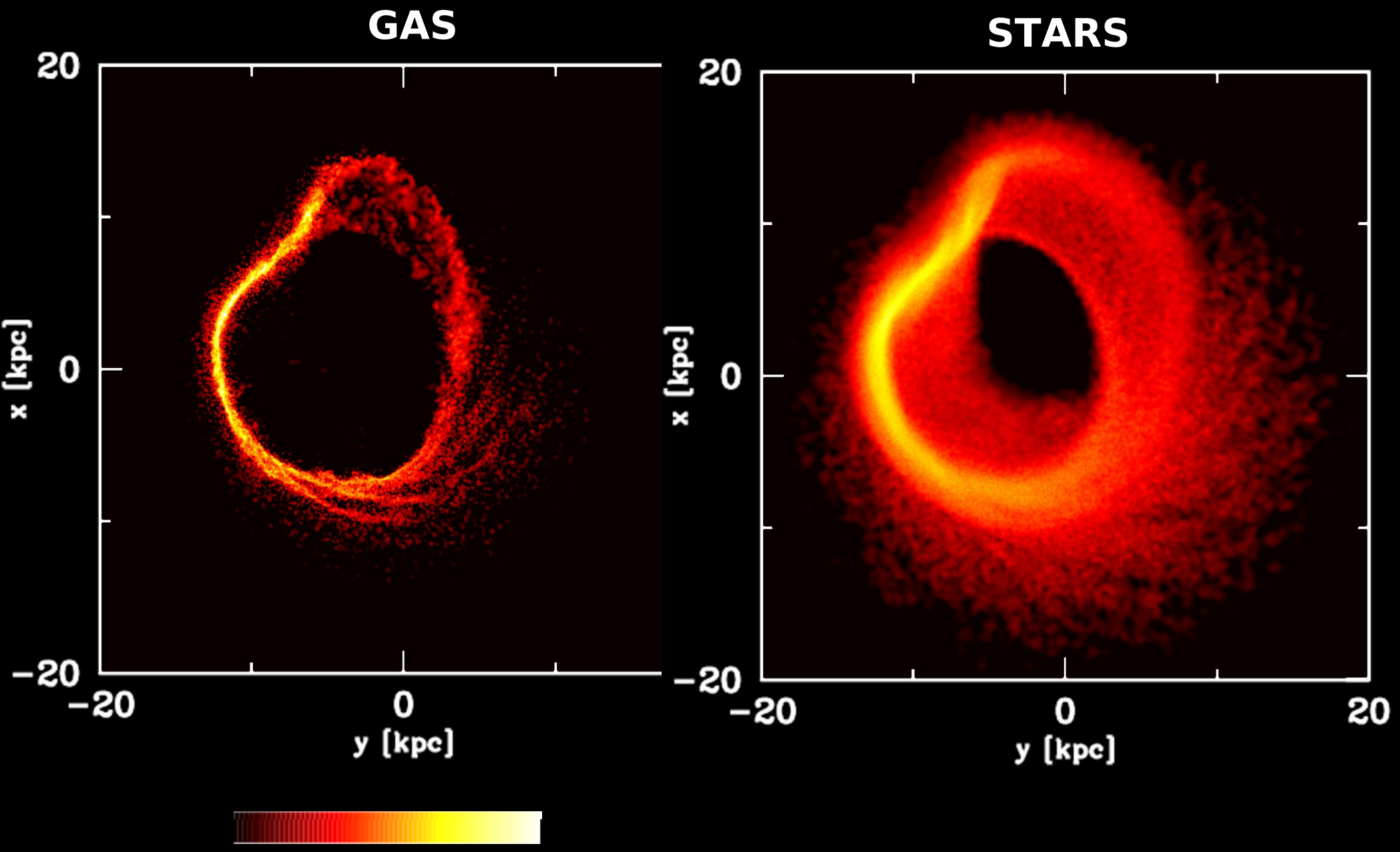
2.3 SIMULATIONS: RE galaxies



MM & L. Mayer 2011

2.3 SIMULATIONS: RE galaxies

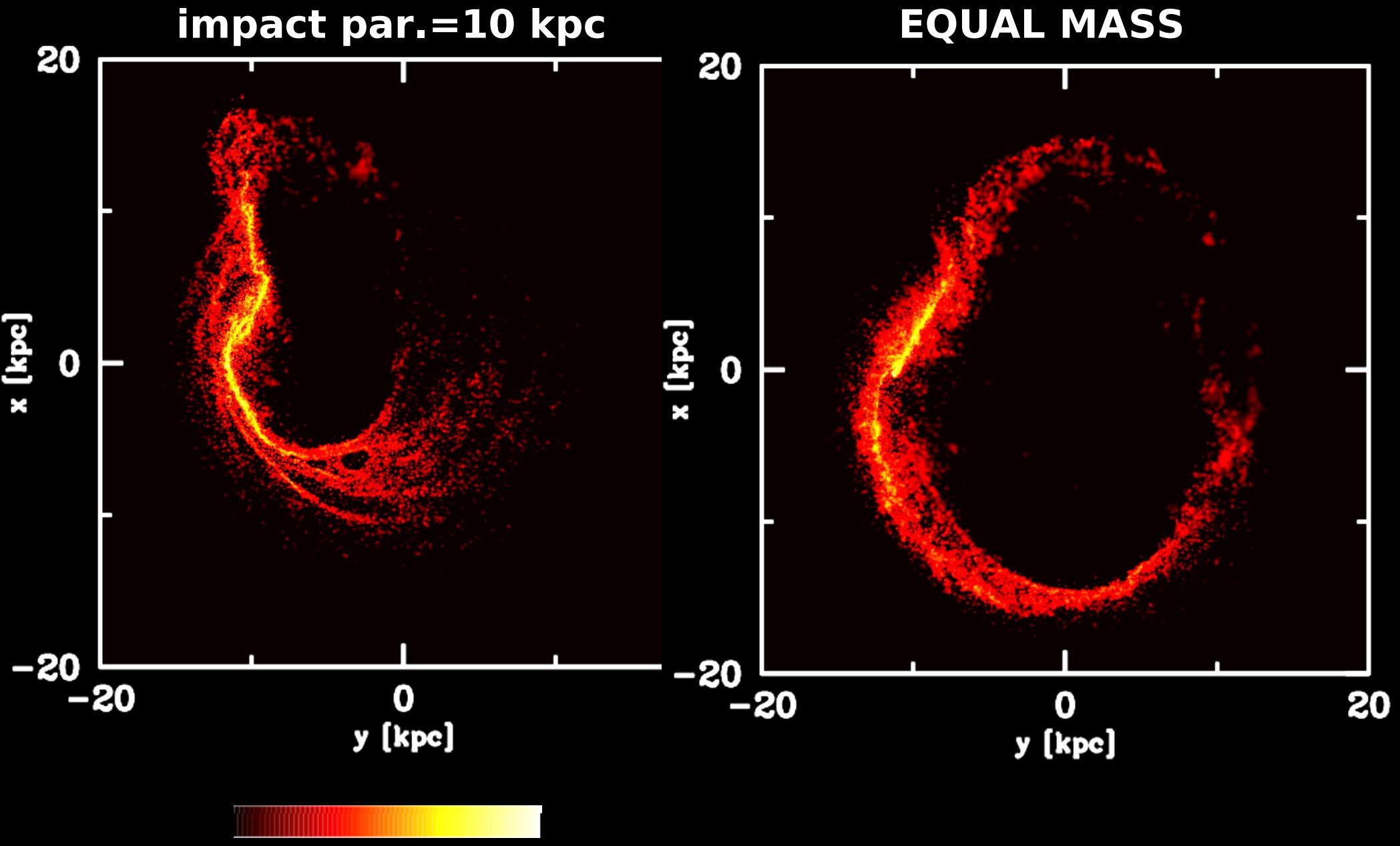
t=50 Myr



MM & L. Mayer 2011

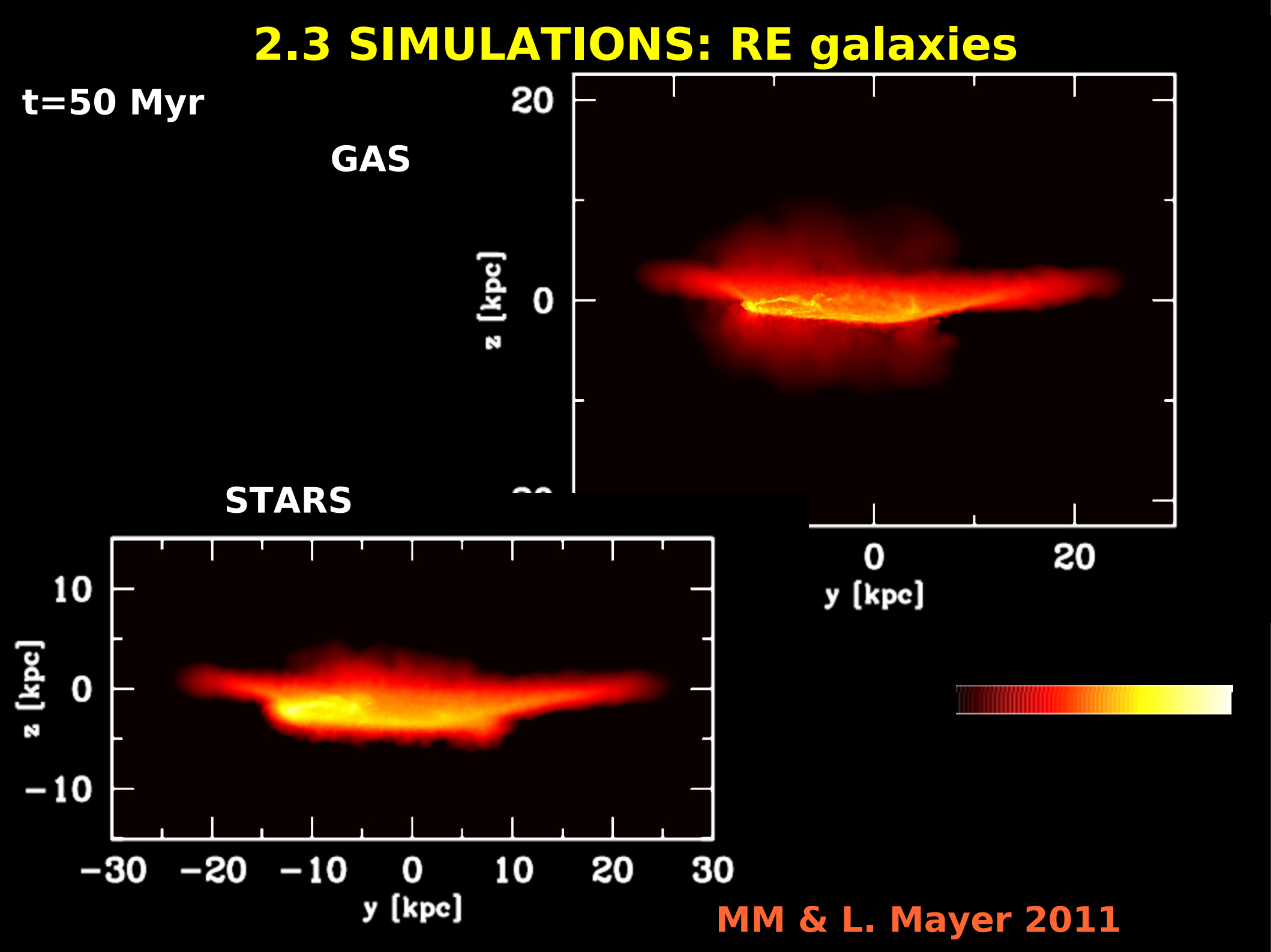
2.3 SIMULATIONS: INCOMPLETE RINGS

t=50 Myr



MM & L. Mayer 2011

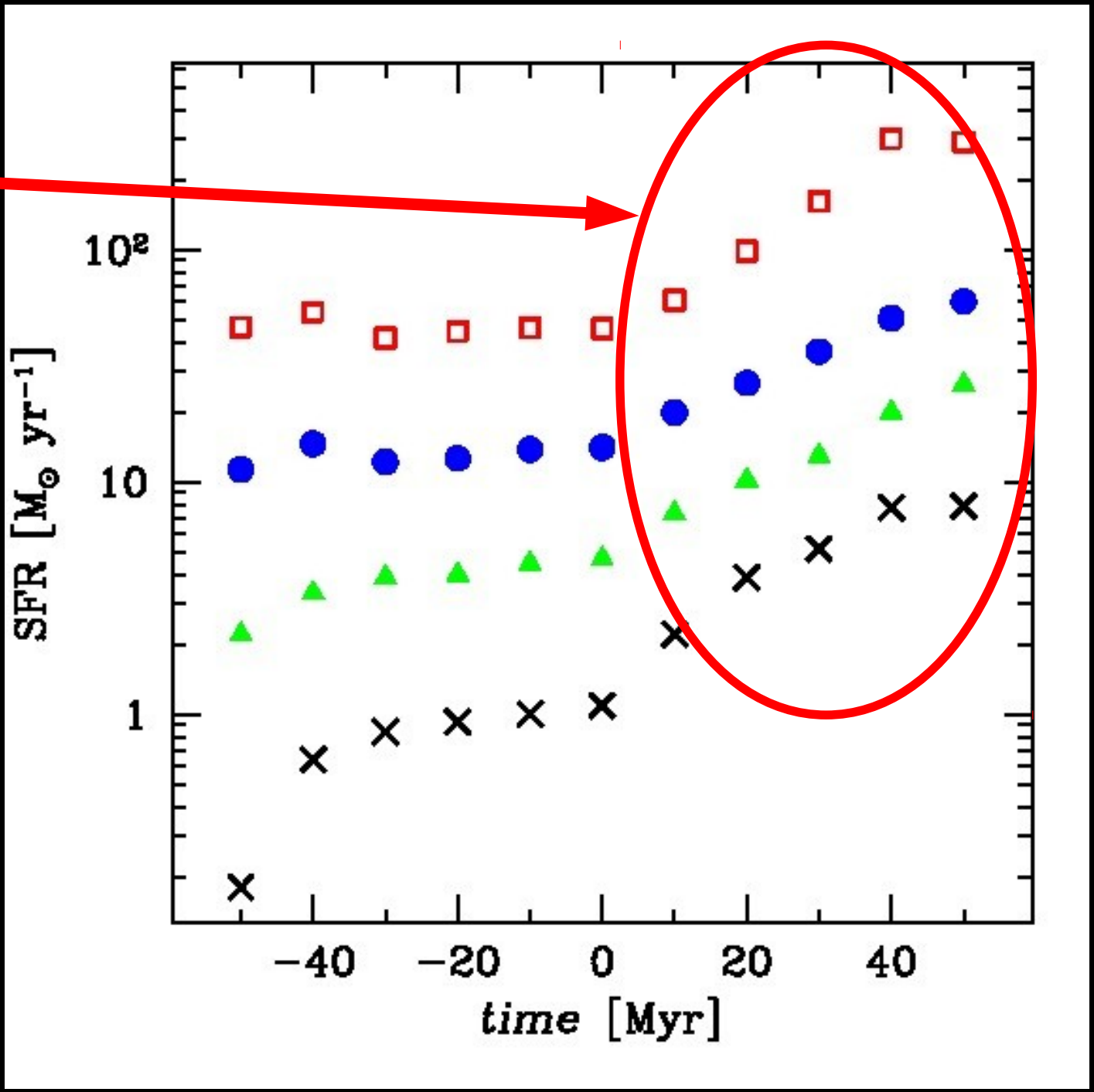
2.3 SIMULATIONS: RE galaxies



MM & L. Mayer 2011

2.3 SIMULATIONS: RE galaxies

SFR ENHANCED BY INTERACTION

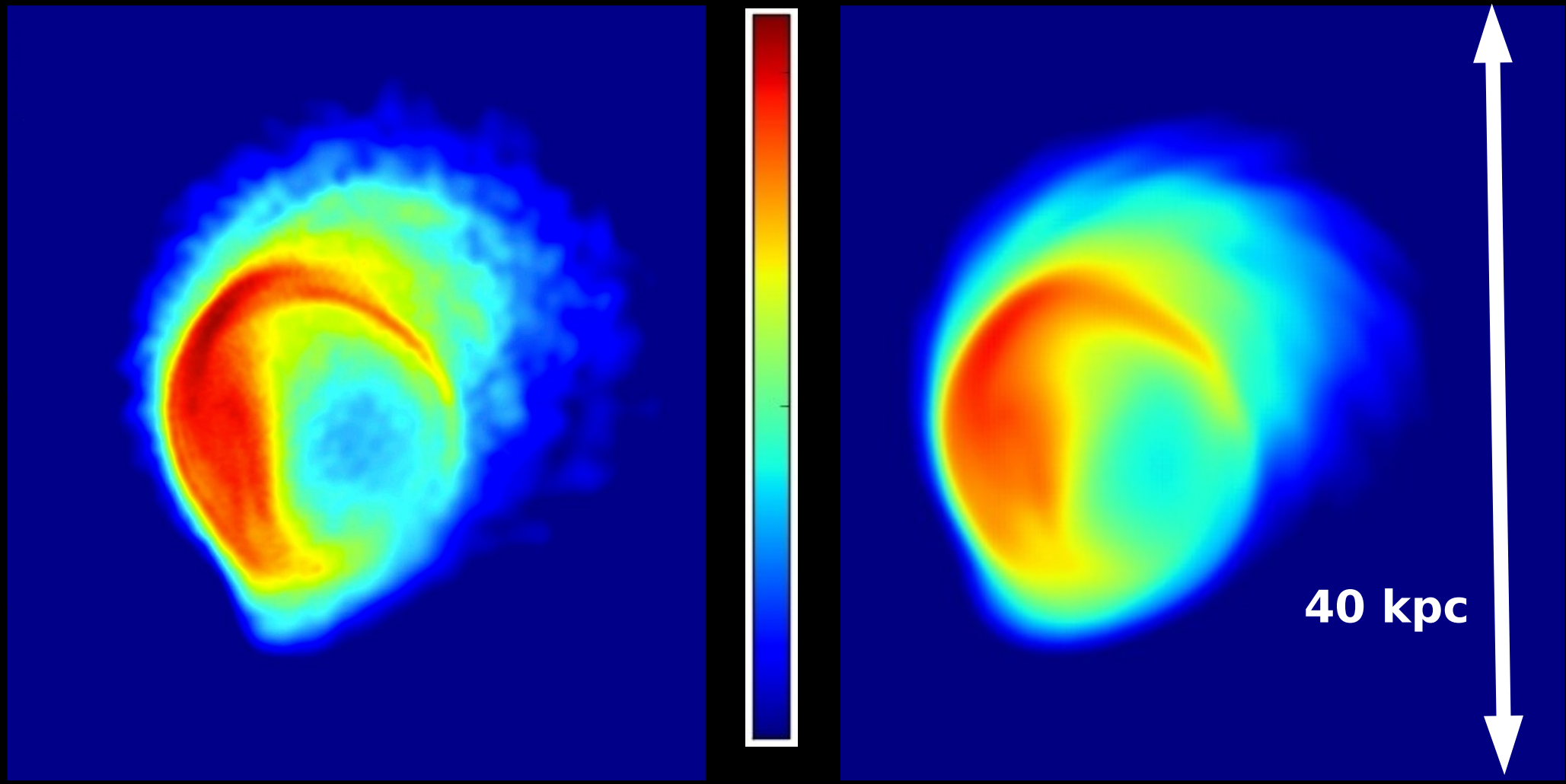


MM & L. Mayer 2011

2.4 IMPACT of NUMERICAL METHOD

SPH

AMR

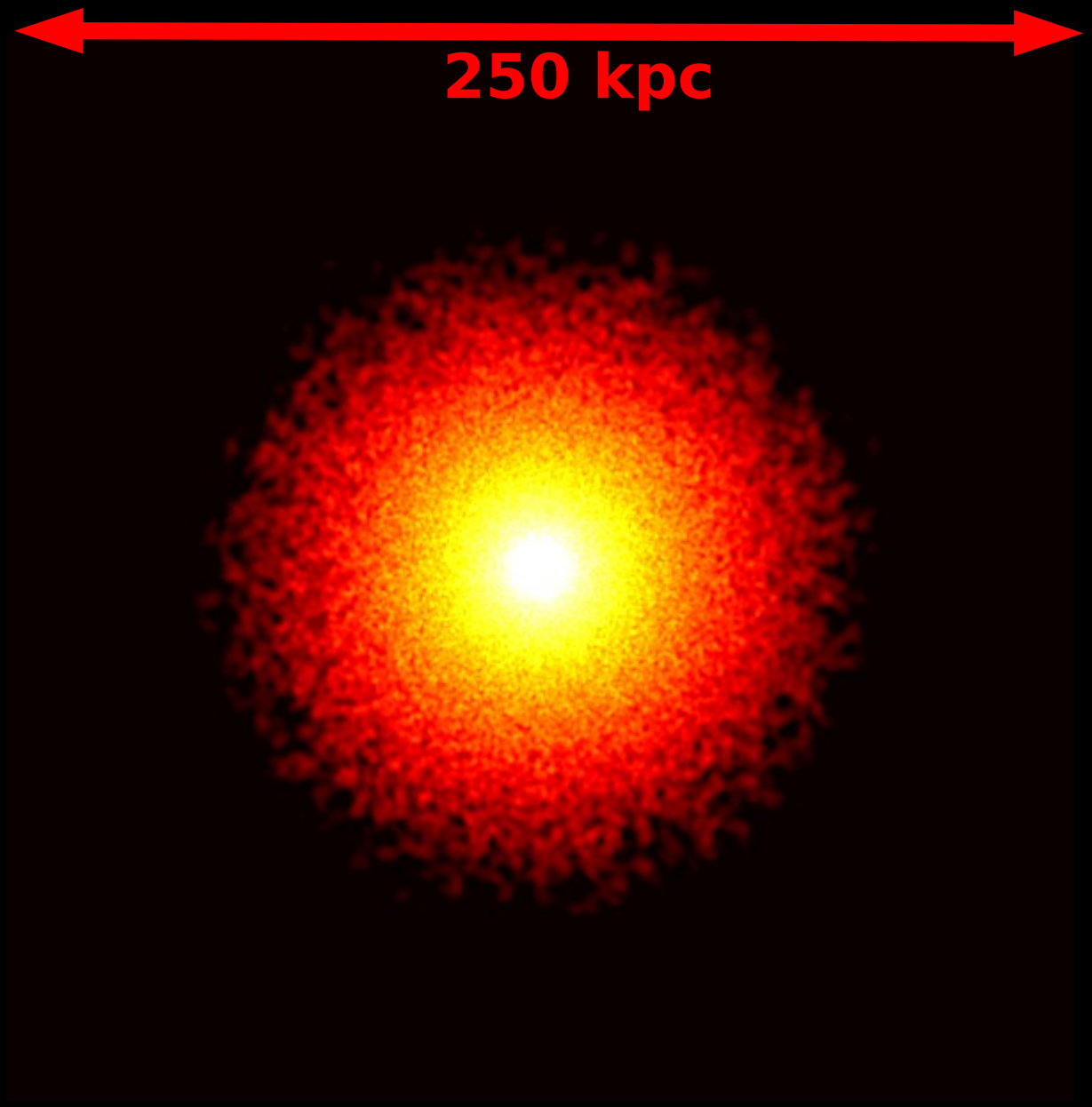


WORK IN PROGRESS

D. Fiacconi, MM et al., in preparation

3- DEATH of RING GALAXIES

3.1 The fate of ring galaxies



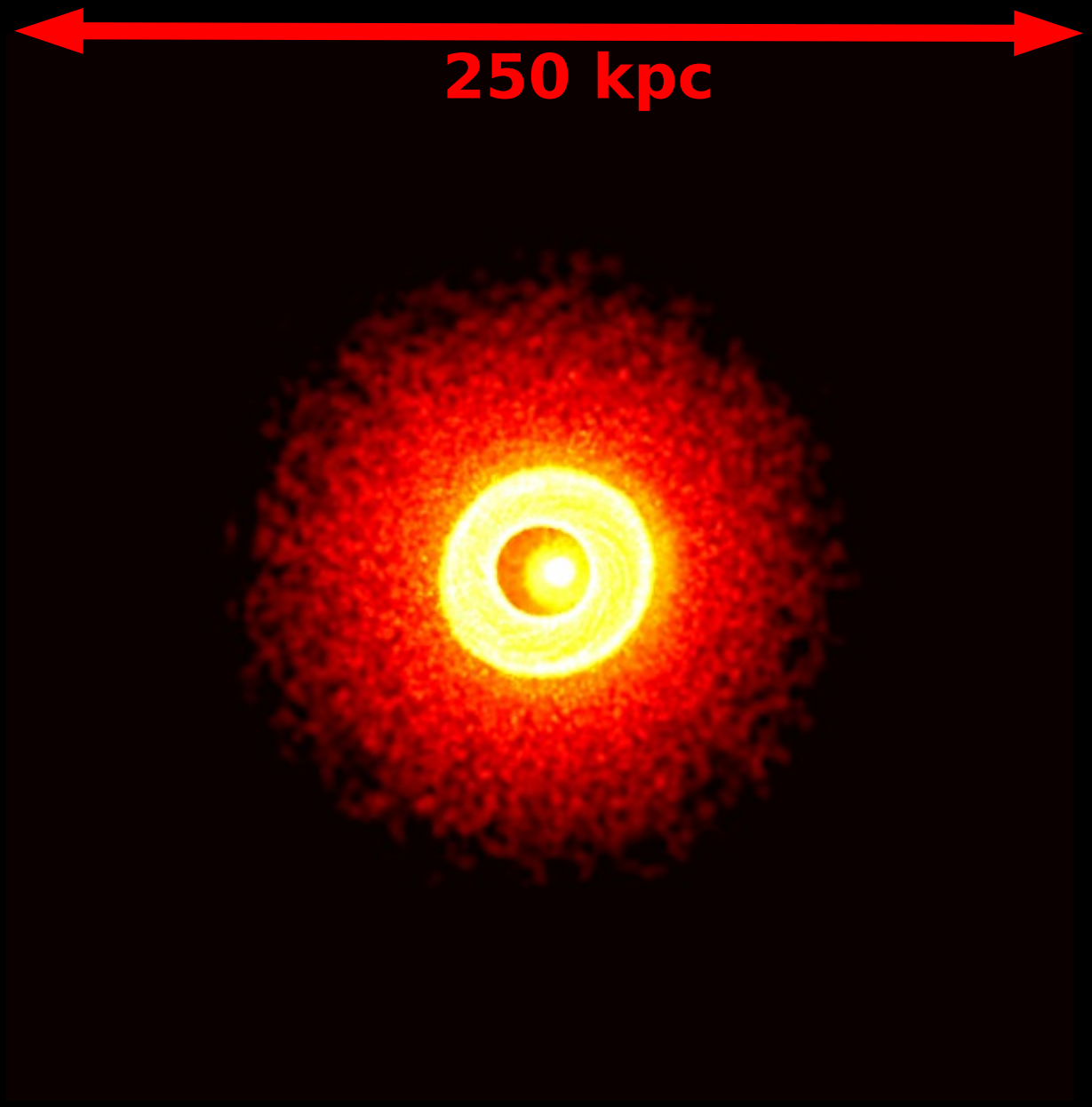
time = -100 Myr

initial conditions

face on stars+gas of the target galaxy

MM et al. 2008b

3.1 The fate of ring galaxies

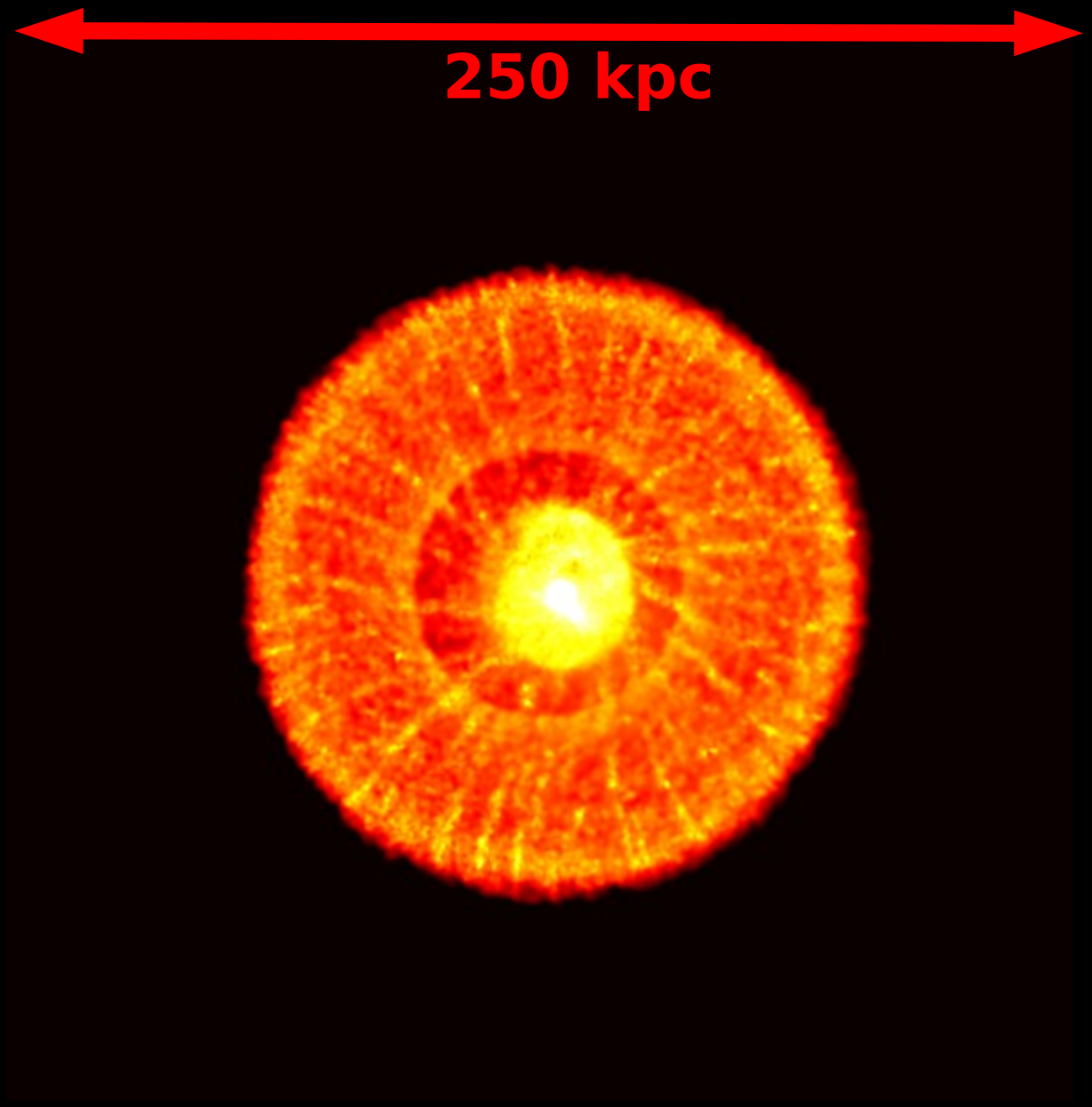


time = 100 Myr

ring galaxy phase

MM et al. 2008b

3.1 The fate of ring galaxies



time = 500 Myr

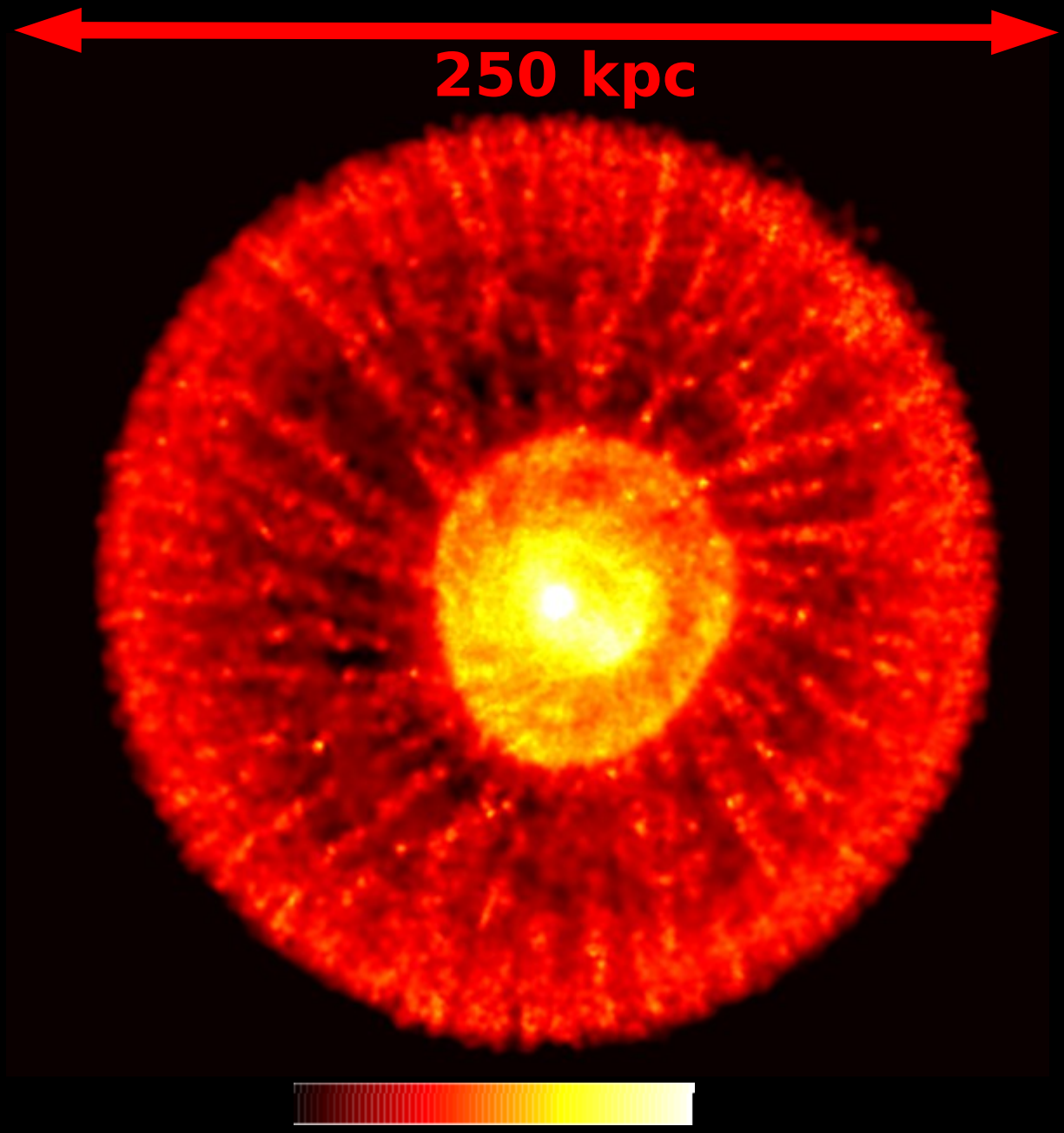
the ring fades

the disc becomes
faint and
very large (80 kpc)

normal bulge

MM et al. 2008b

3.1 The fate of ring galaxies



time = 1 Gyr

the ring fades

the disc becomes even
fainter and larger
(100-150 kpc)

normal bulge

MM et al. 2008b

3.1 Giant low surface brightness galaxies (GLSBs)

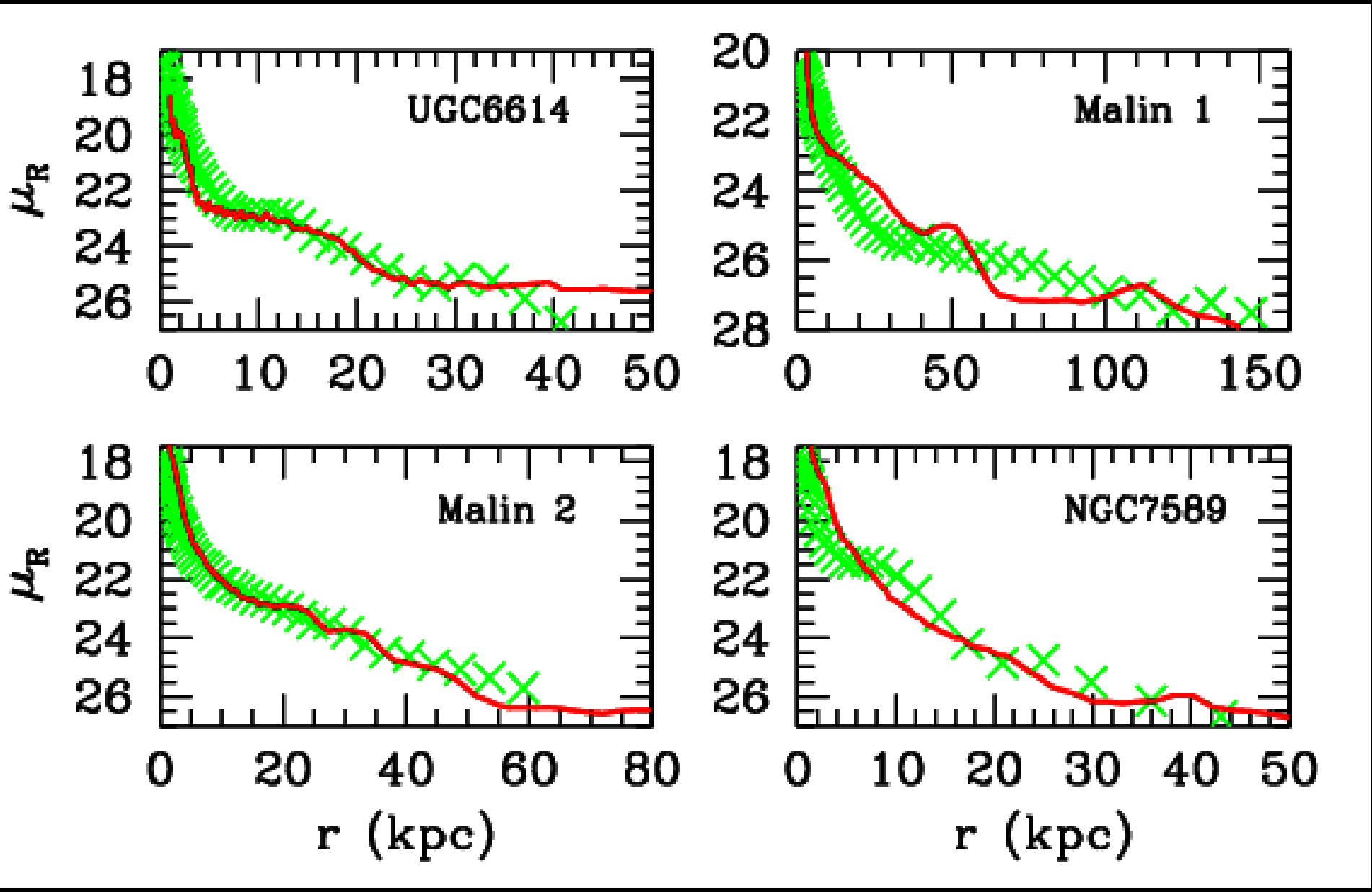
- low surface brightness

- huge and FLAT discs (<~100kpc)

- normal bulge

It is a PUZZLE for cosmological model to explain huge flat discs of GLSBs

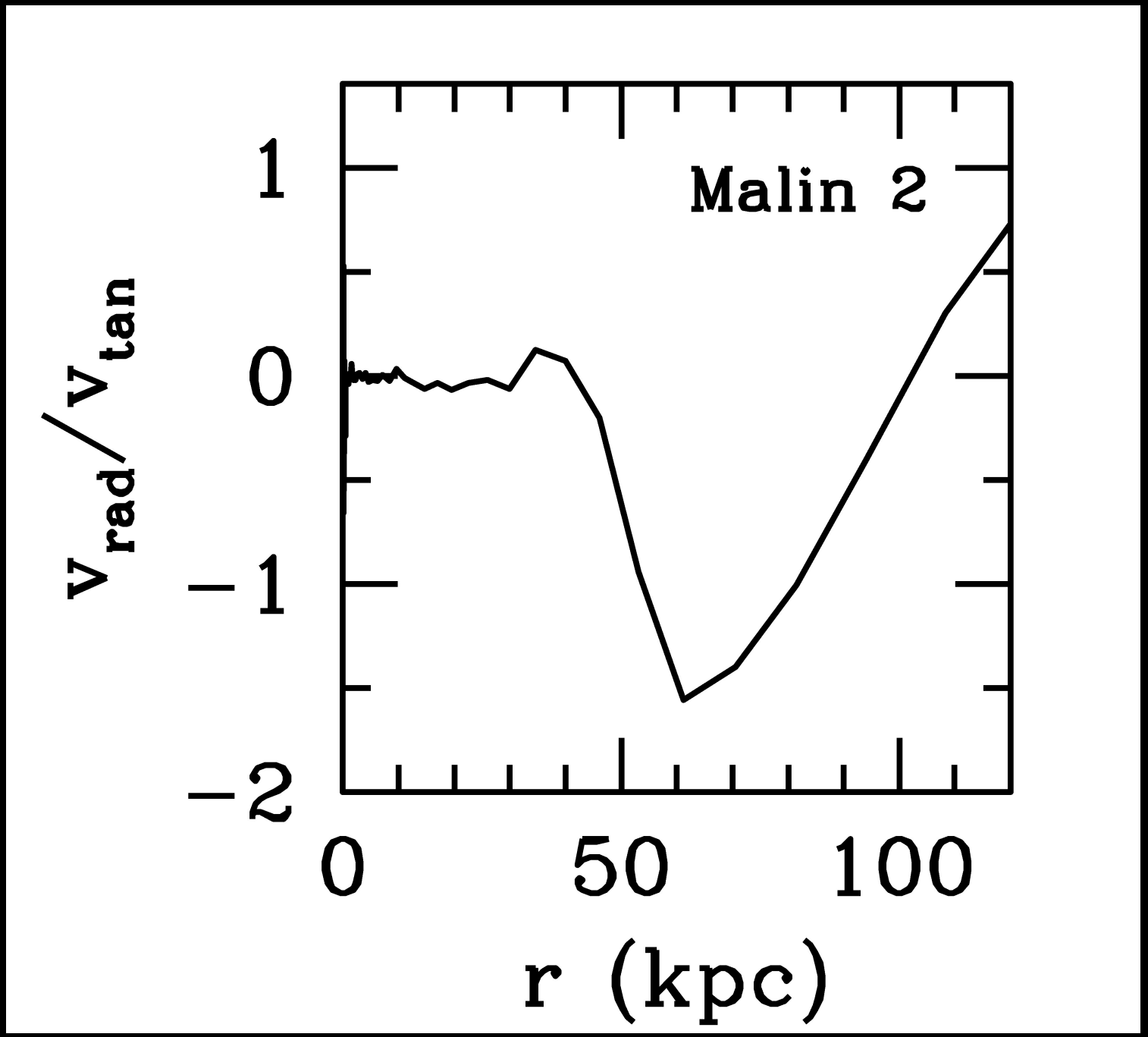
3.1 The fate of ring galaxies



Pickering et al. 1997

MM et al. 2008b

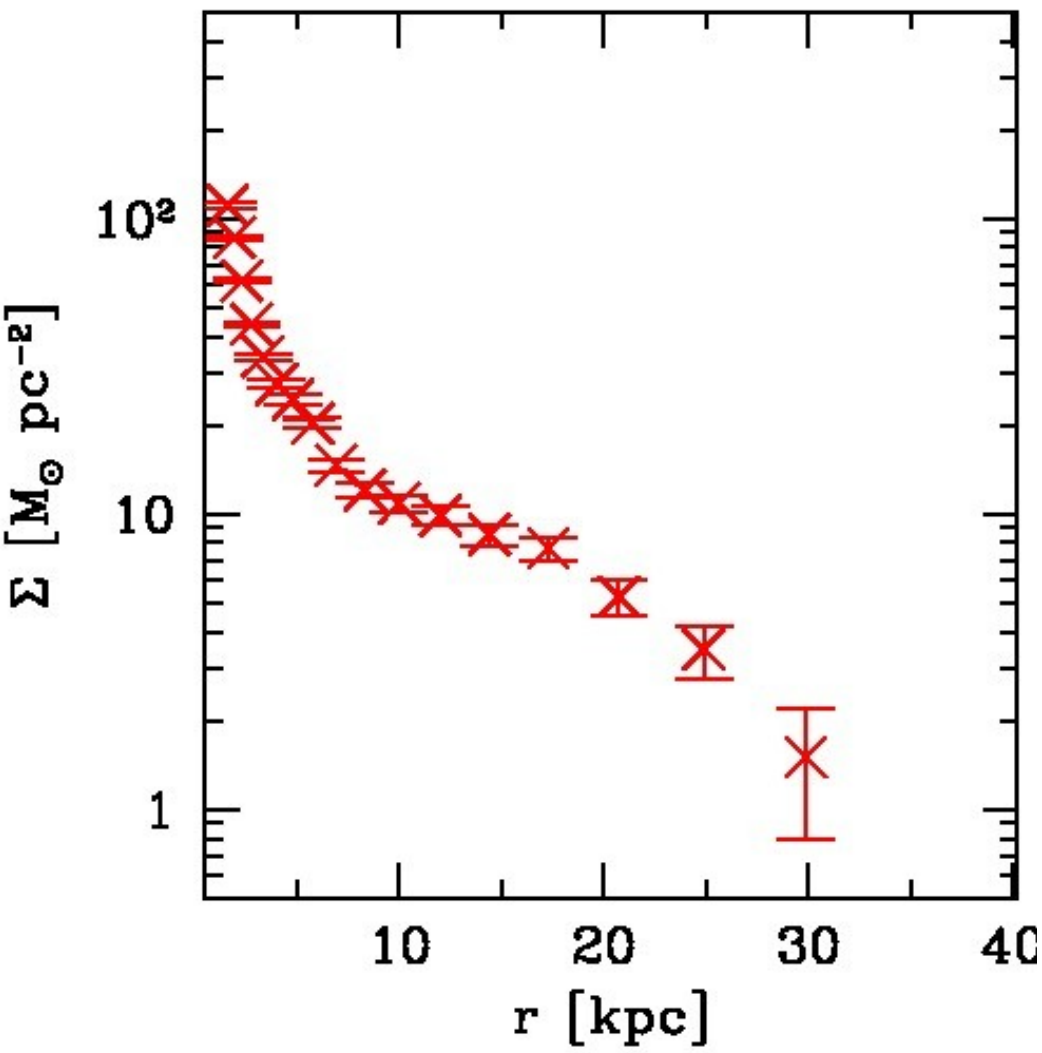
3.2 Predictions: vrad/vtan

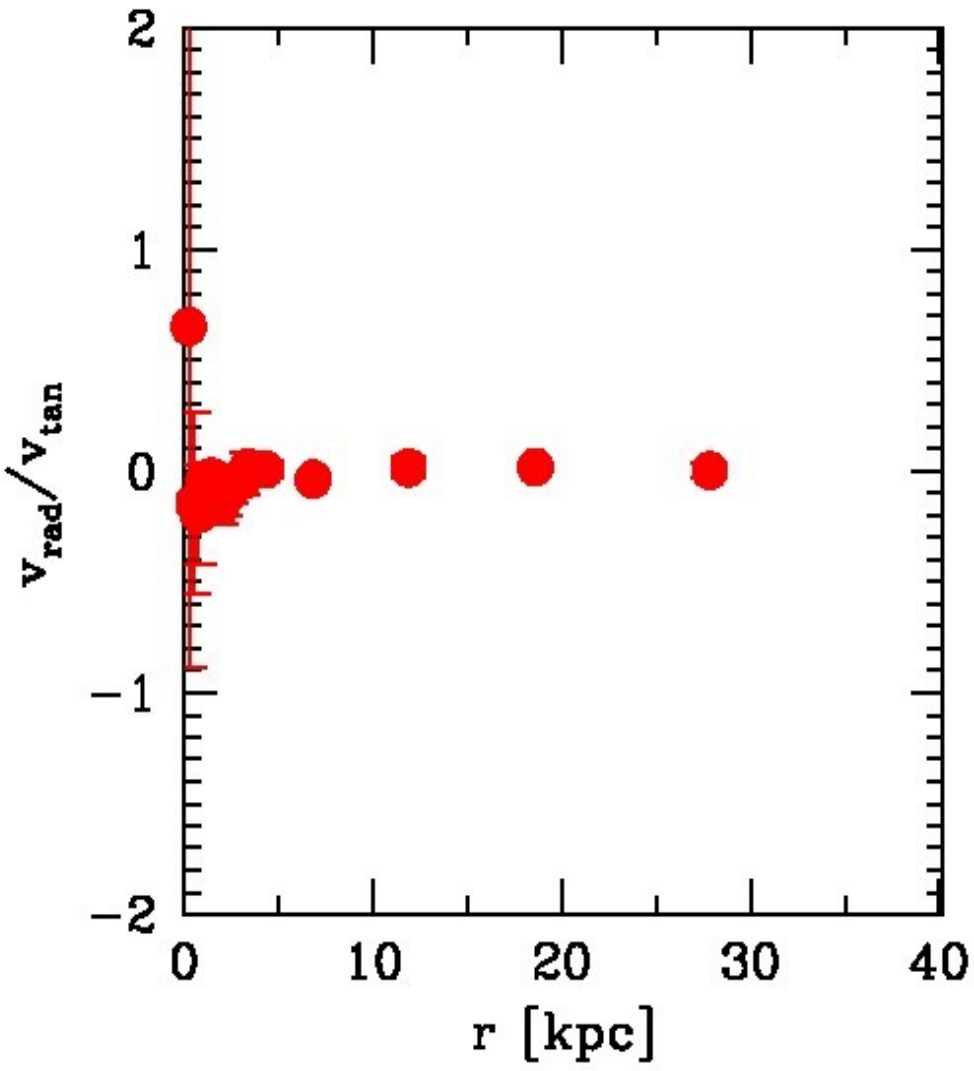


MM et al. 2008b

3.3 Observations: ESO 323-G064

VLT observations

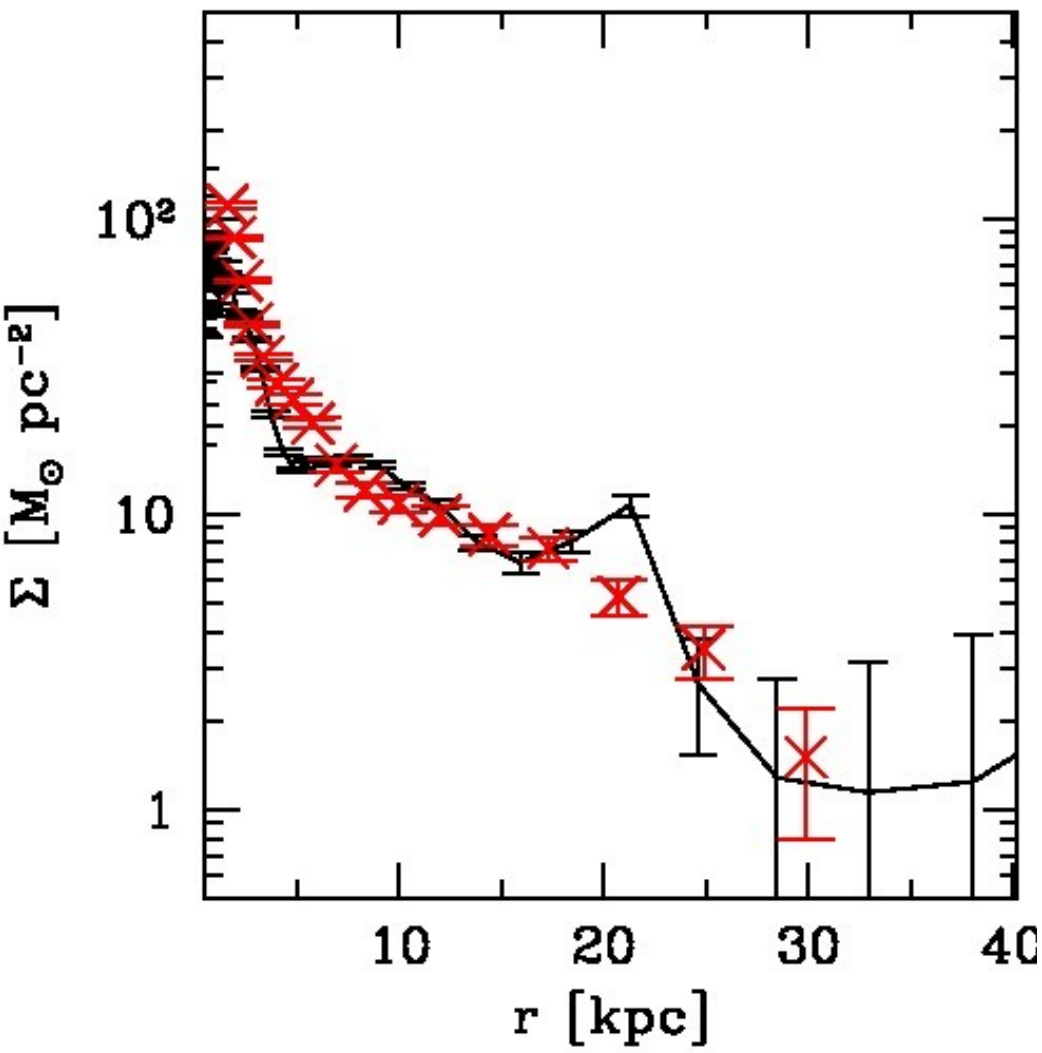


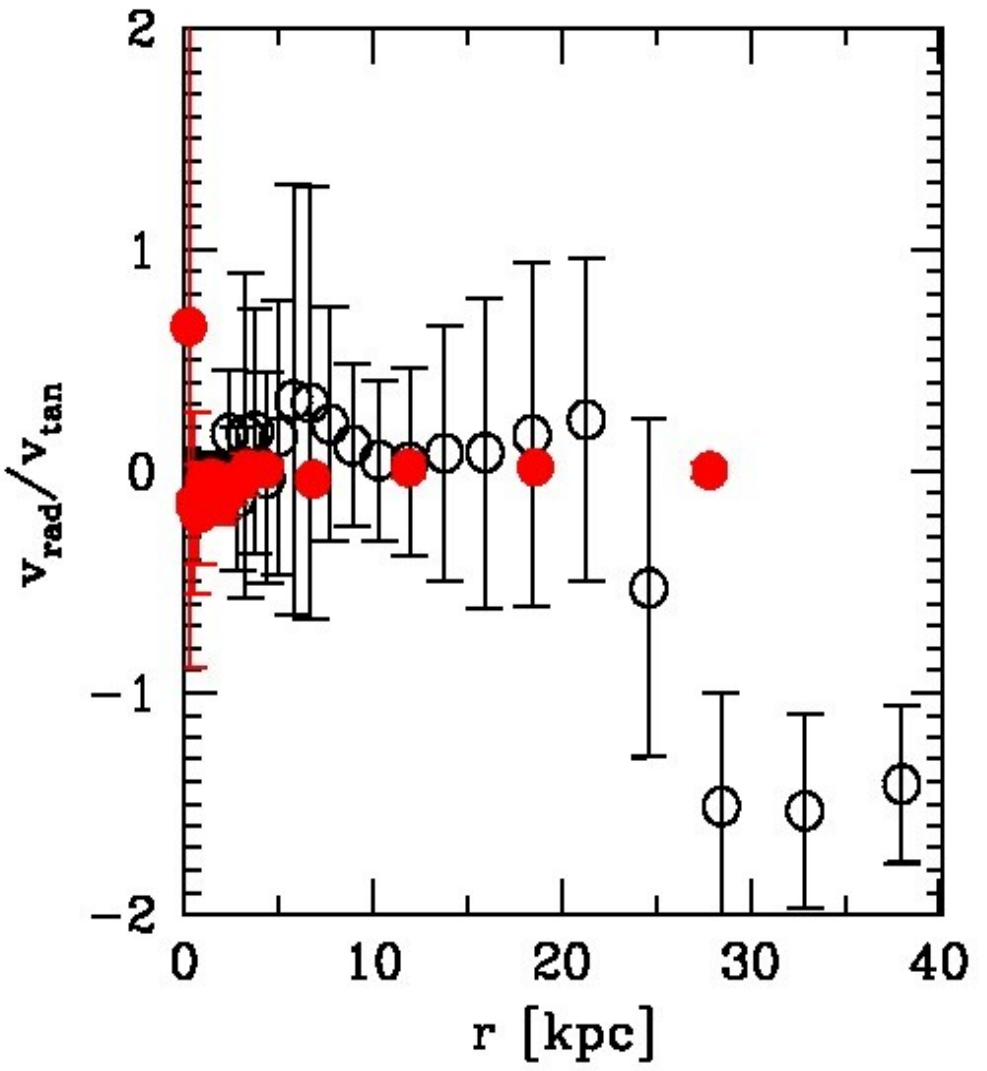


L. Coccato, E. M. Corsini, MM, L. Morelli, A. Pizzella et al., in preparation

3.3 Observations: ESO 323-G064

Simulation at t=600 Myr

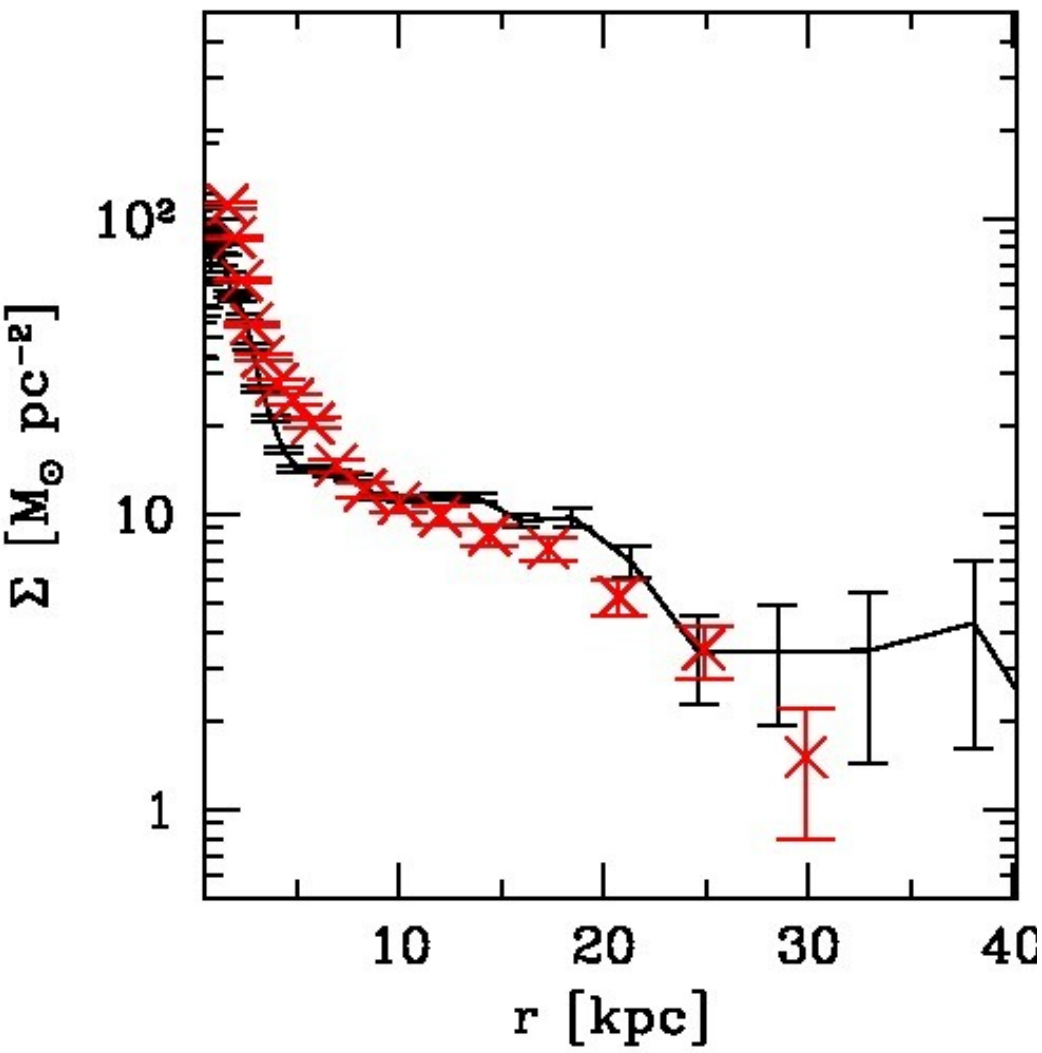


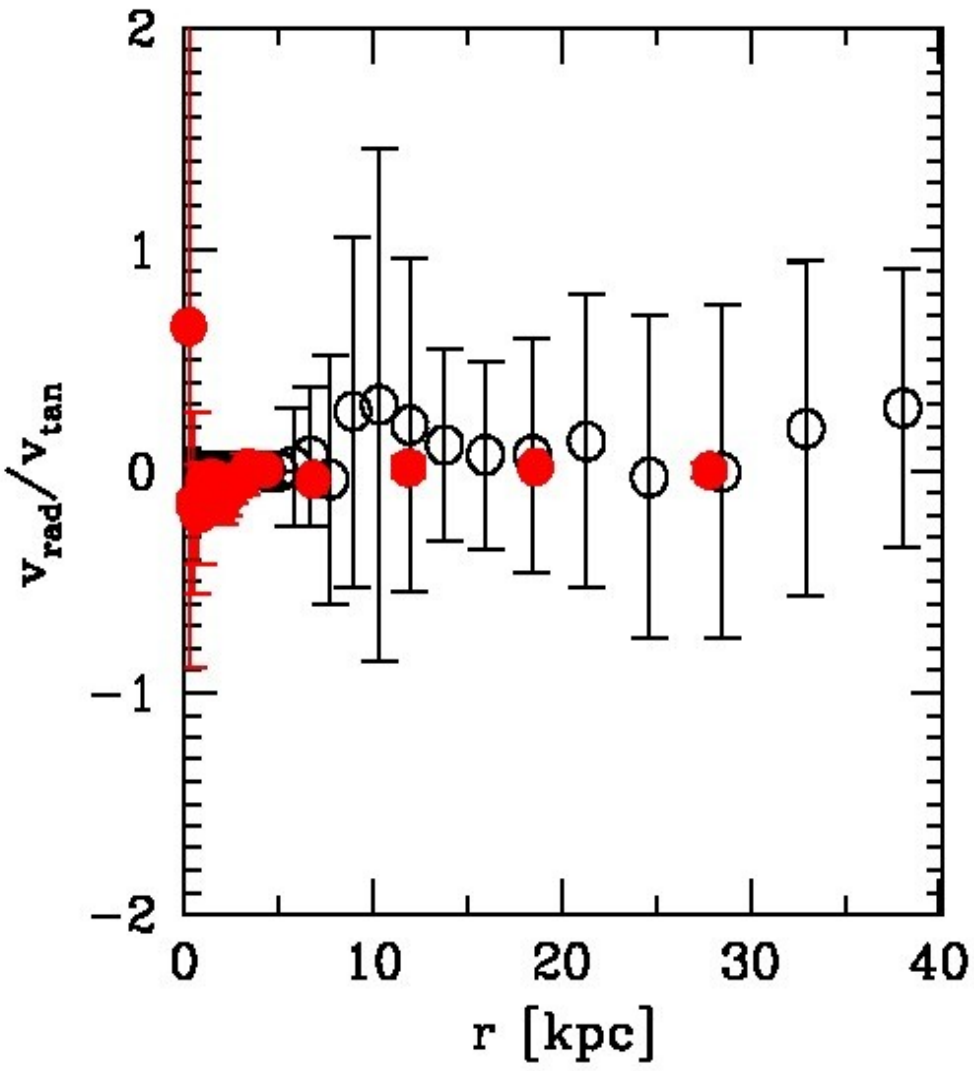


L. Coccato, E. M. Corsini, MM, L. Morelli, A. Pizzella et al., in preparation

3.3 Observations: ESO 323-G064

Simulation at t=1 Gyr





L. Coccato, E. M. Corsini, MM, L. Morelli, A. Pizzella et al., in preparation

Conclusions

- Ring galaxies as SF laboratory

- Simulations with new recipes for subgrid physics → SFR

- Fate of ring galaxies → GLSBs?

NEED COMPARISON WITH OBSERVATIONS
(work in progress)


THANKS