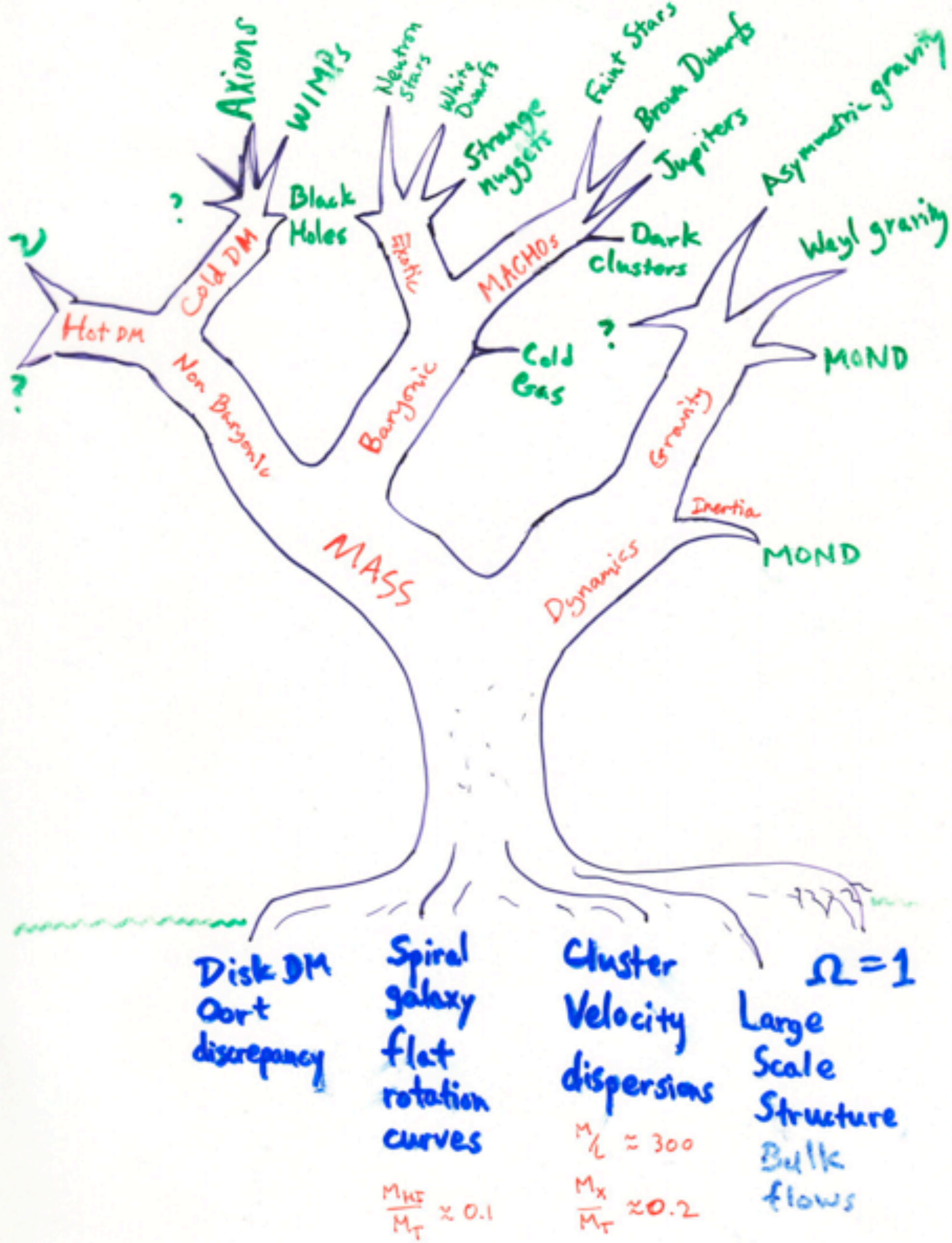
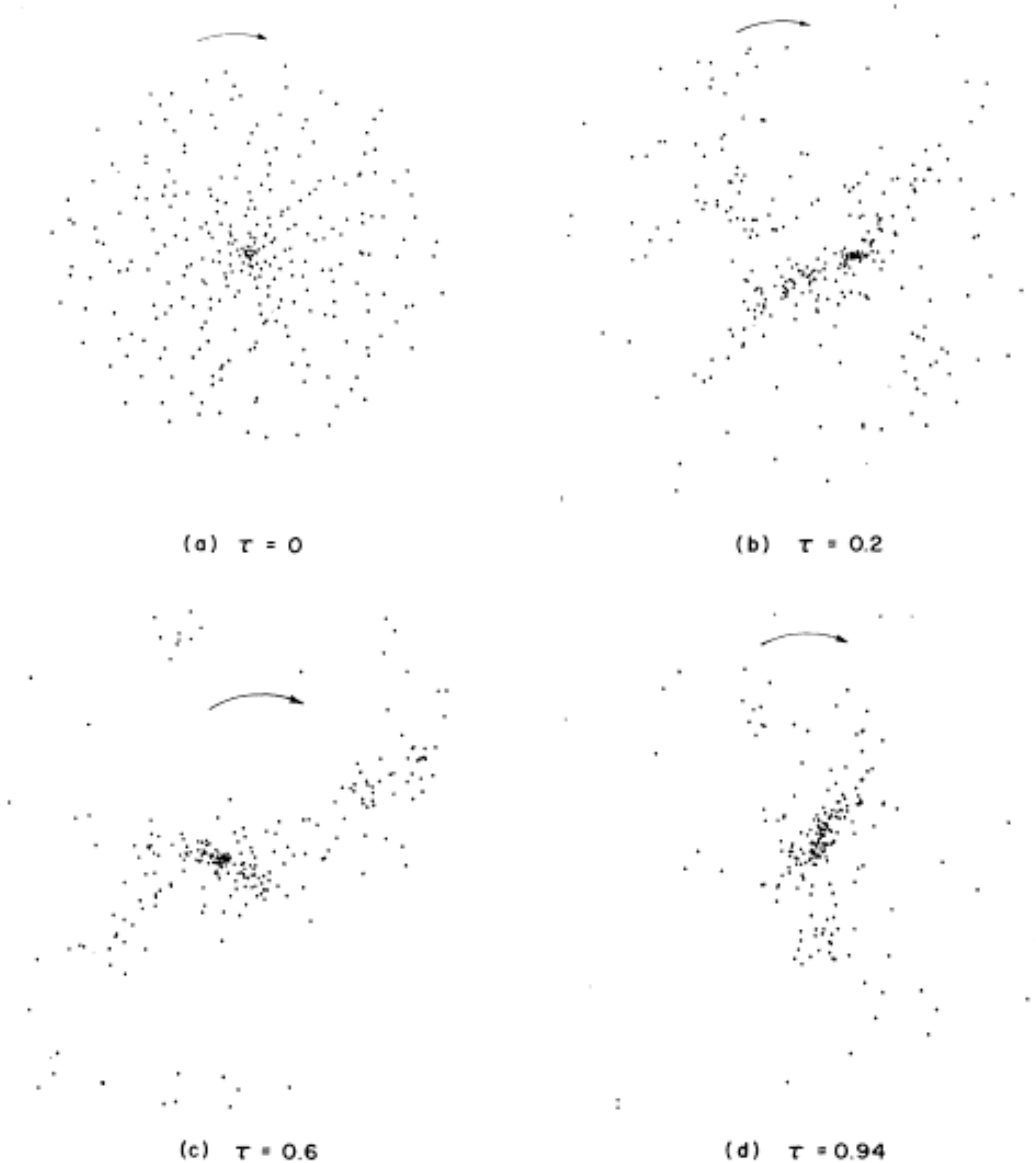
DARK MATTER

ASTR 333/433
FALL 2013
M T 4:00-5:15PM
SEARS 552

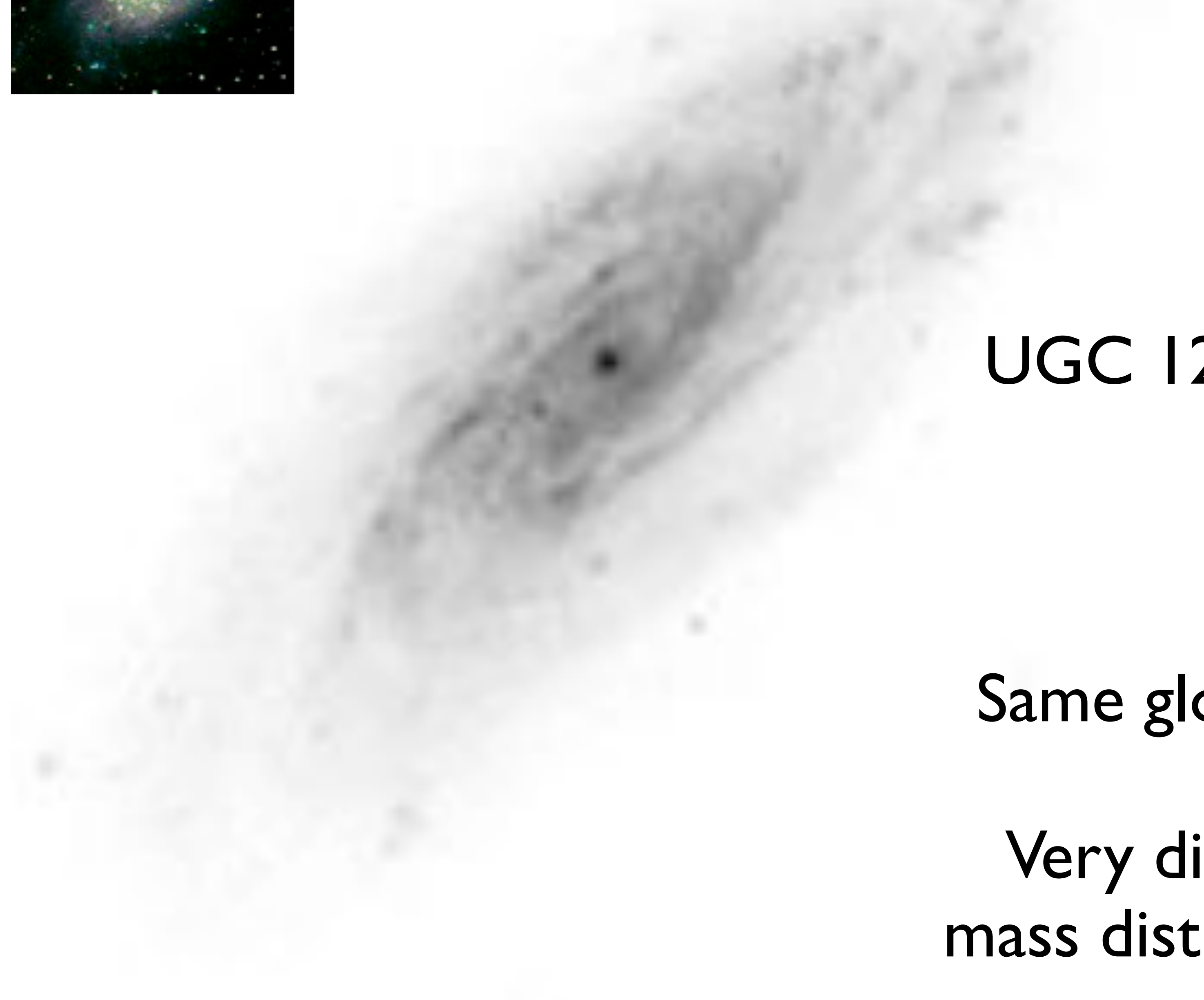
PROF. STACY MCGAUGH
SEARS 573
368-1808
stacy.mcgaugh@case.edu

CASE WESTERN RESERVE UNIVERSITY EST. 1826




(a) τ = 0
(b) τ = 0.2
(c) τ = 0.6
(d) τ = 0.94

NGC 2403

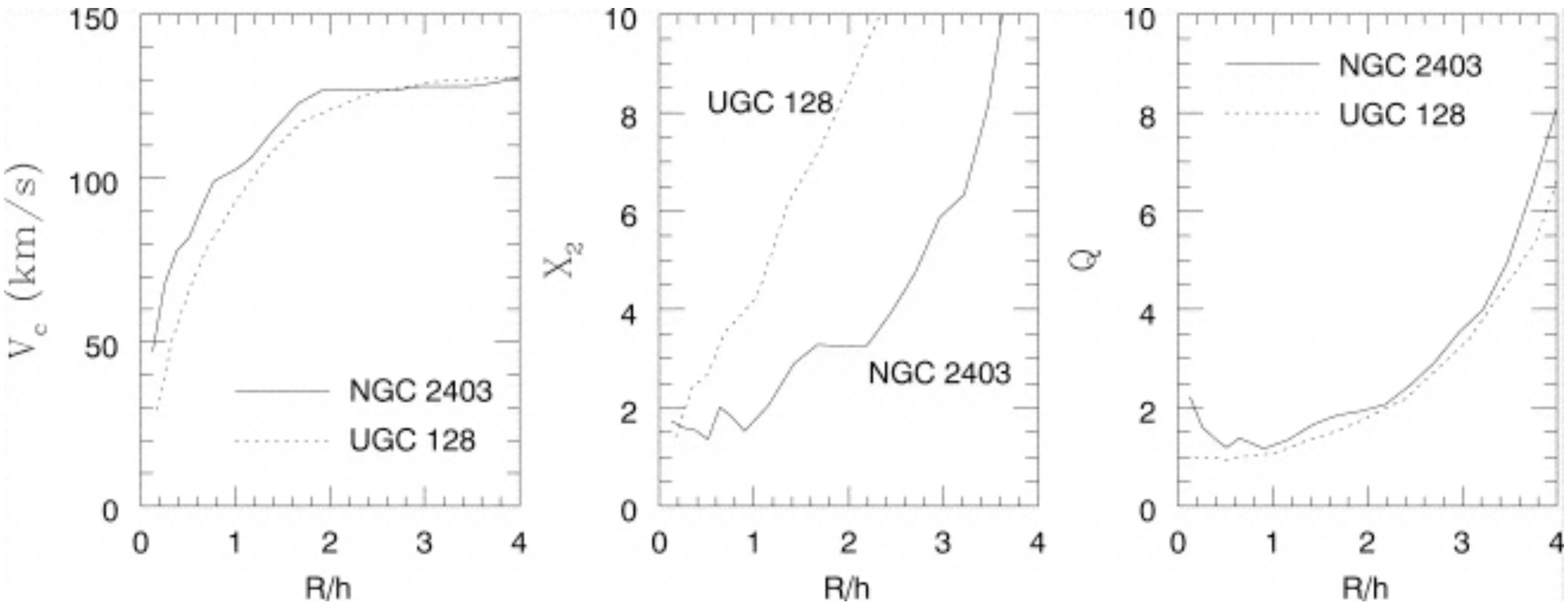


UGC 128

Same global L,V

Very different mass distributions

NGC 2403: high surface brightness
UGC 128: low surface brightness

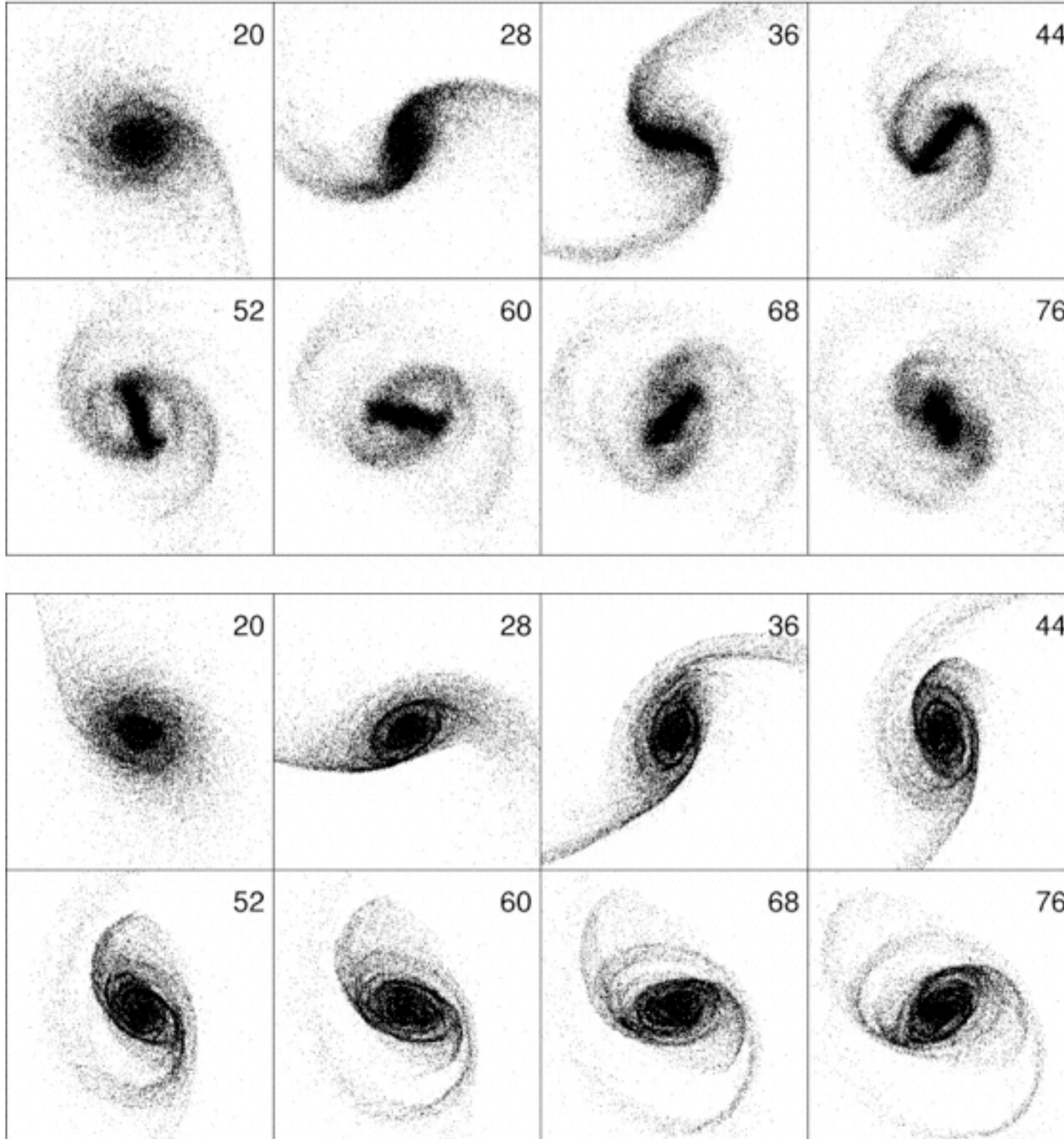


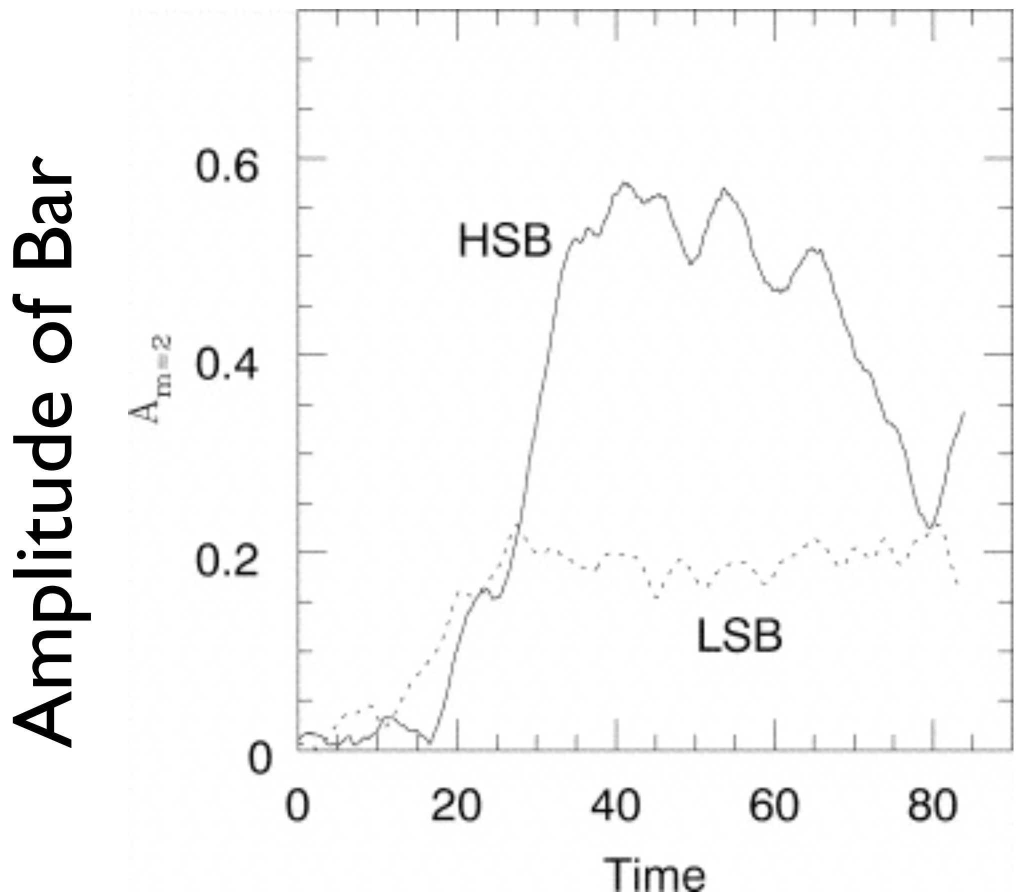
Same rotation curve when radius normalized by scale length

LSB looks more fragile but should be more stable against bar formation because of low surface density

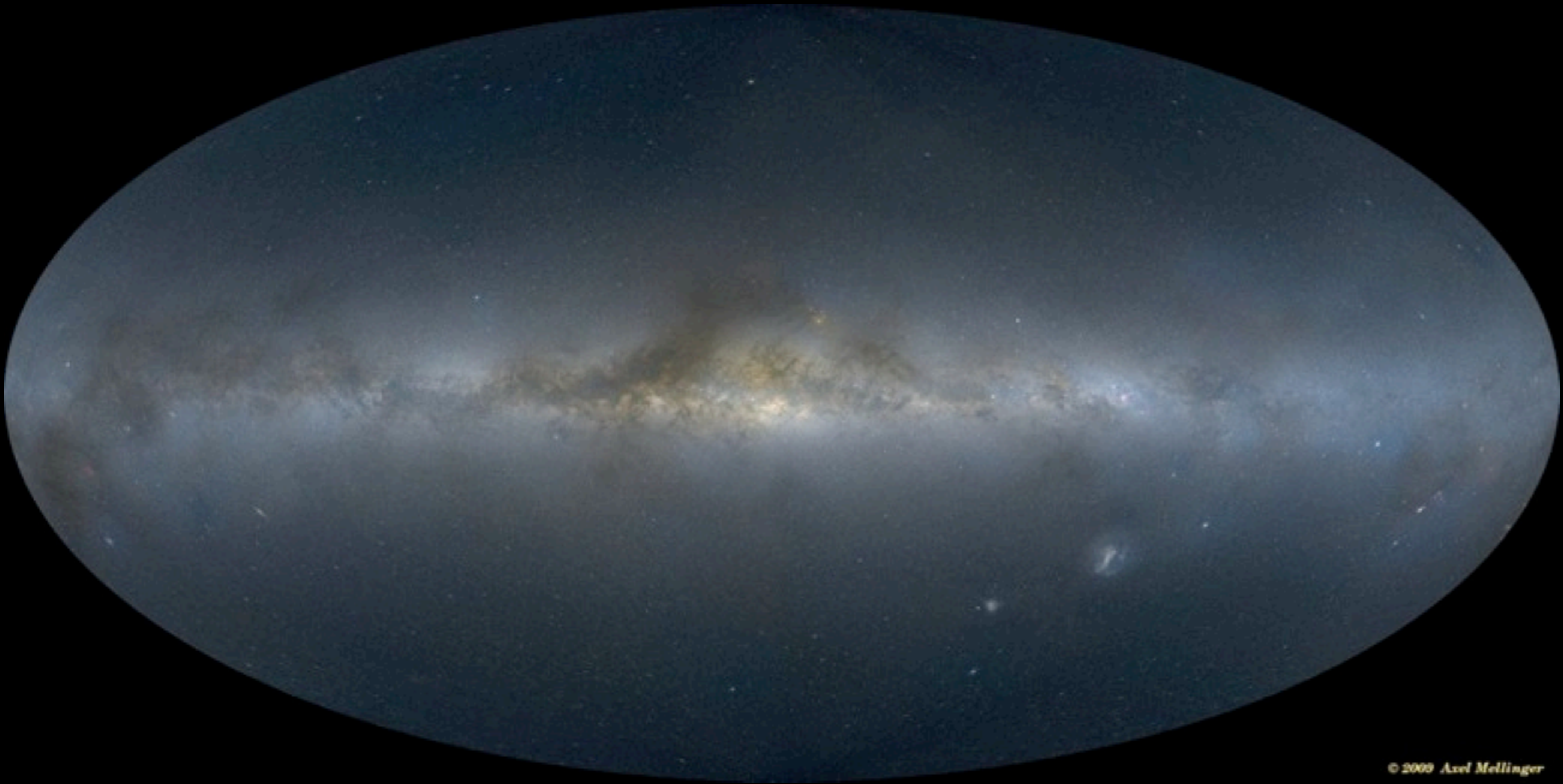
High surface density

Low surface density

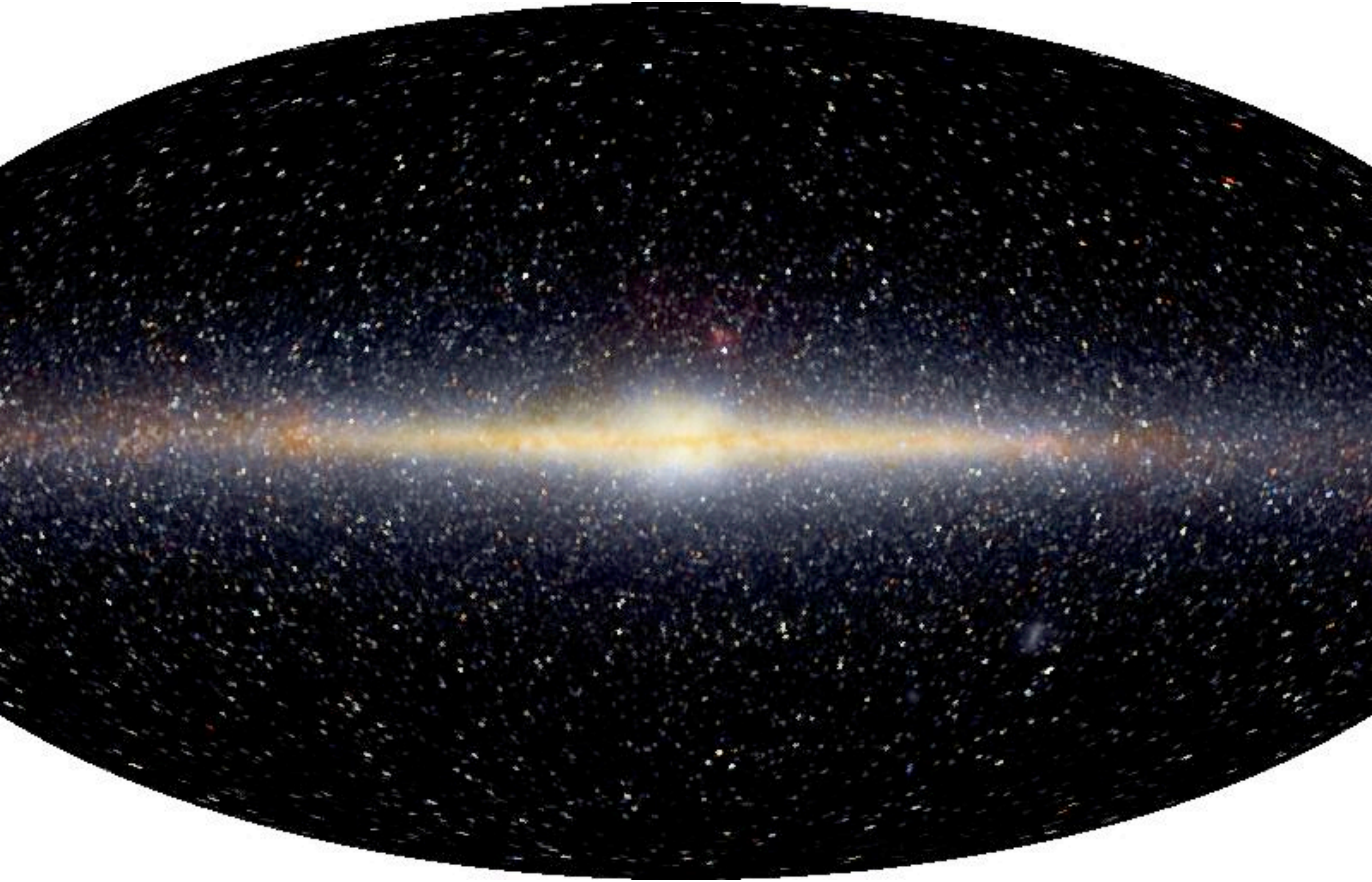



Amplitude of Bar
A_{m=2}
0.6
0.4
0.2
0
HSB
LSB
0
20
40
60
80
Time

The Milky Way (all sky projection)



Milky Way in the near-infrared



Multi-wavelength Milky Way

radio (21 cm)
HI gas

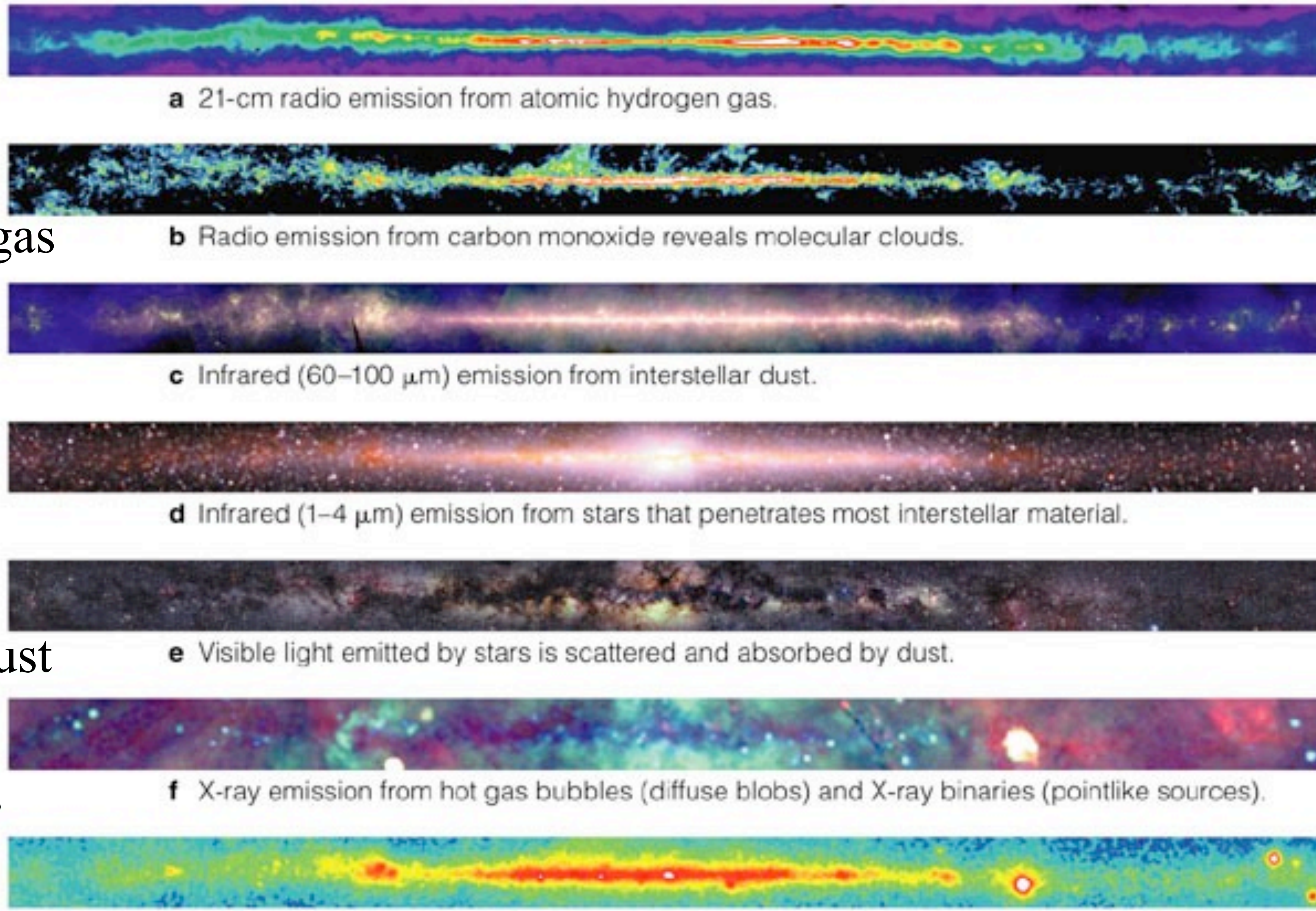
radio (CO)
molecular gas

far-IR
dust

near-IR
stars

Optical
stars & dust

X-ray
hot gas



a 21-cm radio emission from atomic hydrogen gas.

b Radio emission from carbon monoxide reveals molecular clouds.

c Infrared (60–100 μm) emission from interstellar dust.

d Infrared (1–4 μm) emission from stars that penetrates most interstellar material.

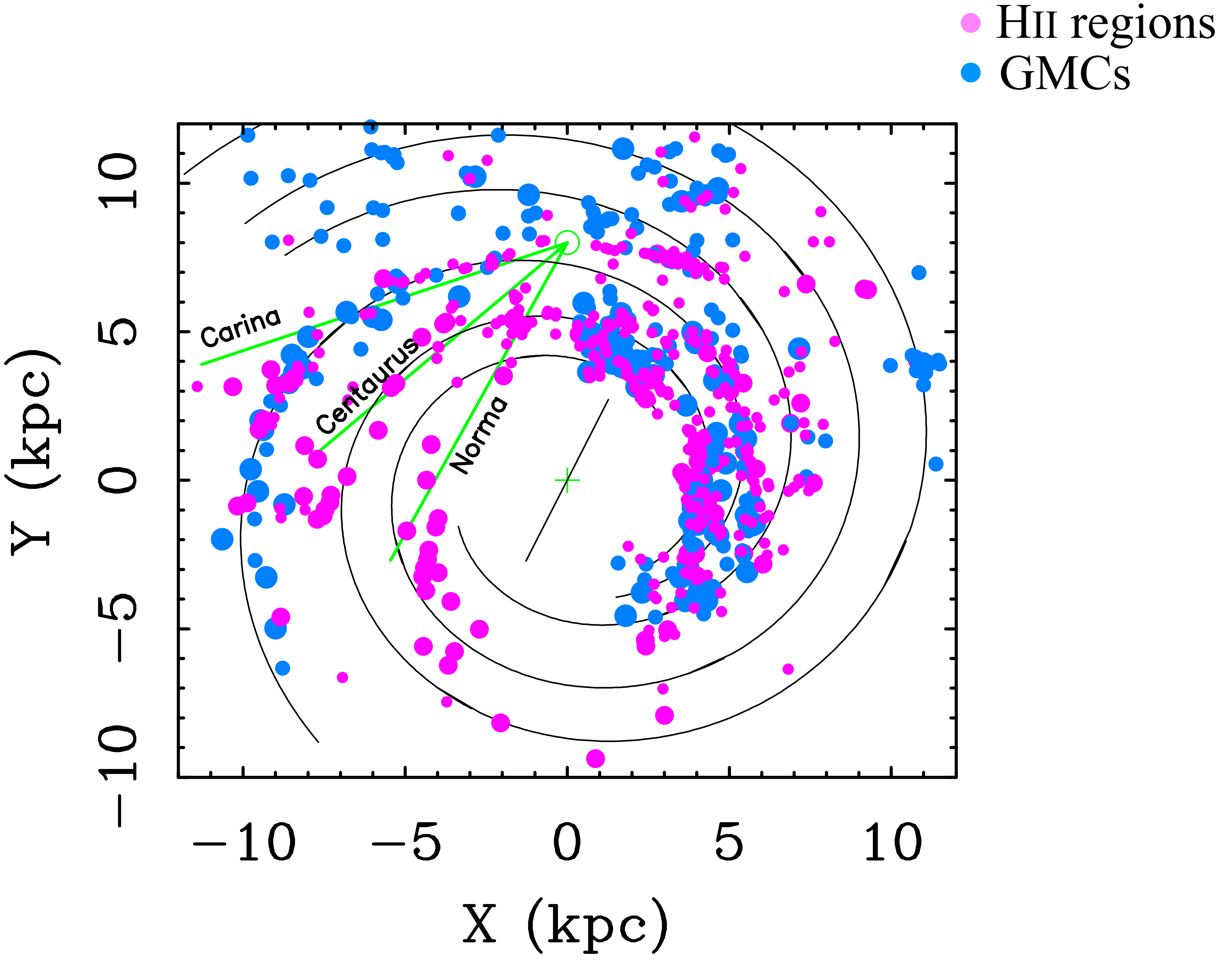
e Visible light emitted by stars is scattered and absorbed by dust.

f X-ray emission from hot gas bubbles (diffuse blobs) and X-ray binaries (pointlike sources).

g Gamma-ray emission from collisions of cosmic rays with atomic nuclei in interstellar clouds.

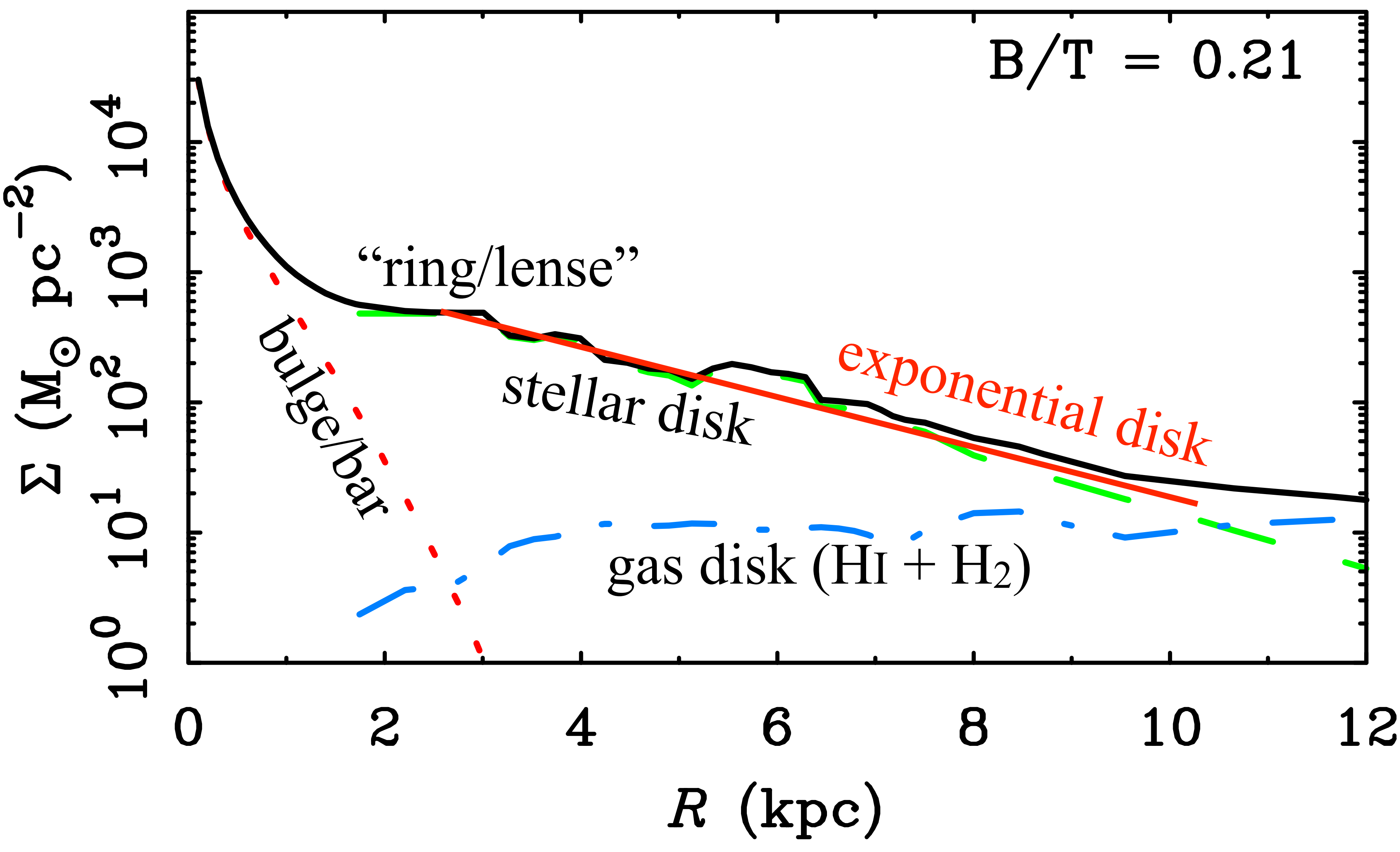
Face-on Milky Way

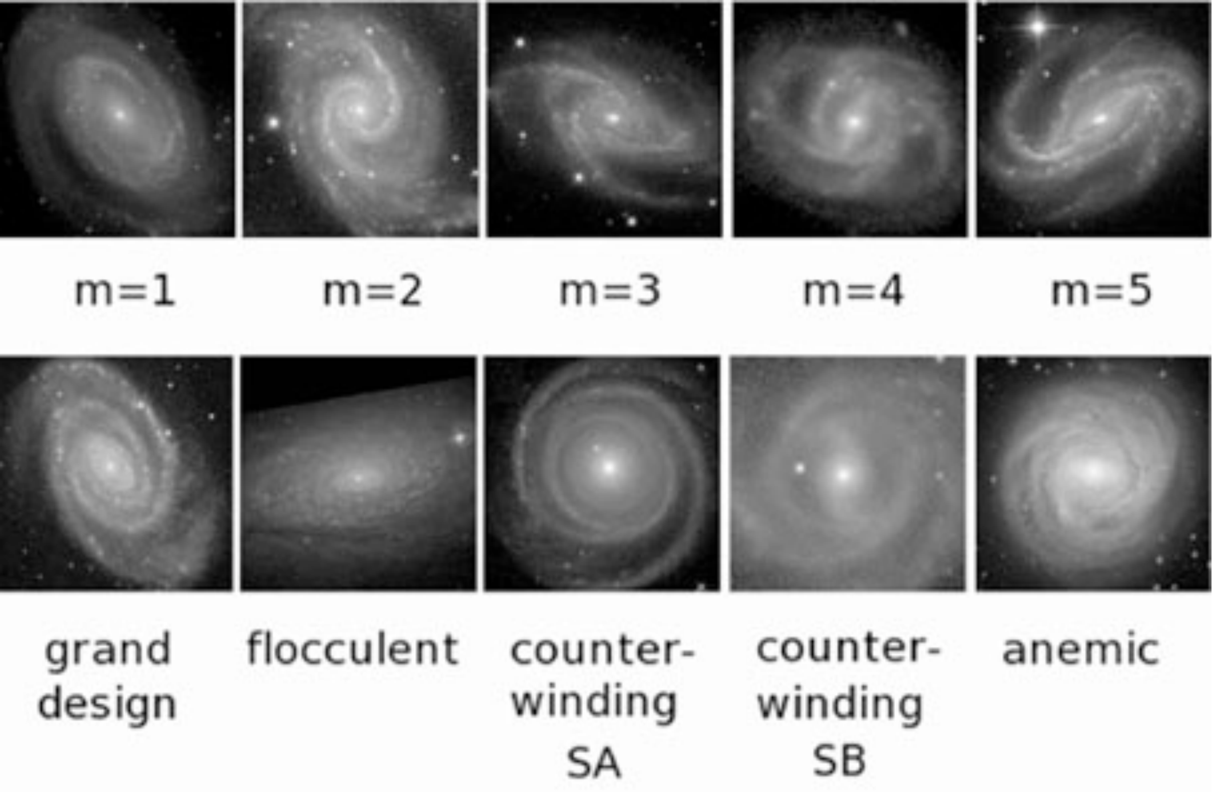
(artist's conception)



HII regions
GMCs
Carina
Centaurus
Norma
Y (kpc)
X (kpc)
−10
−5
0
5
10

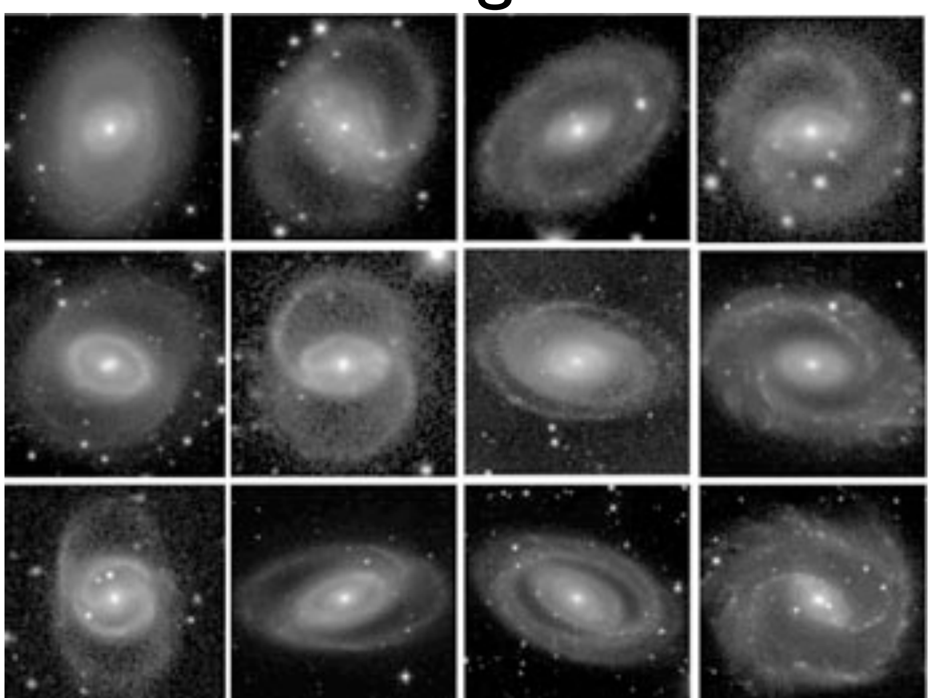
Milky Way model illustrating Freeman type II profile



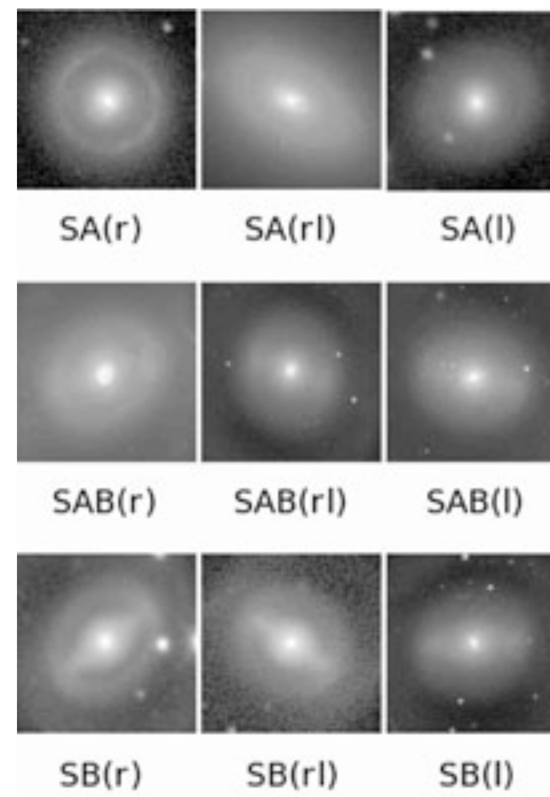


spiral arm
type & multiplicity

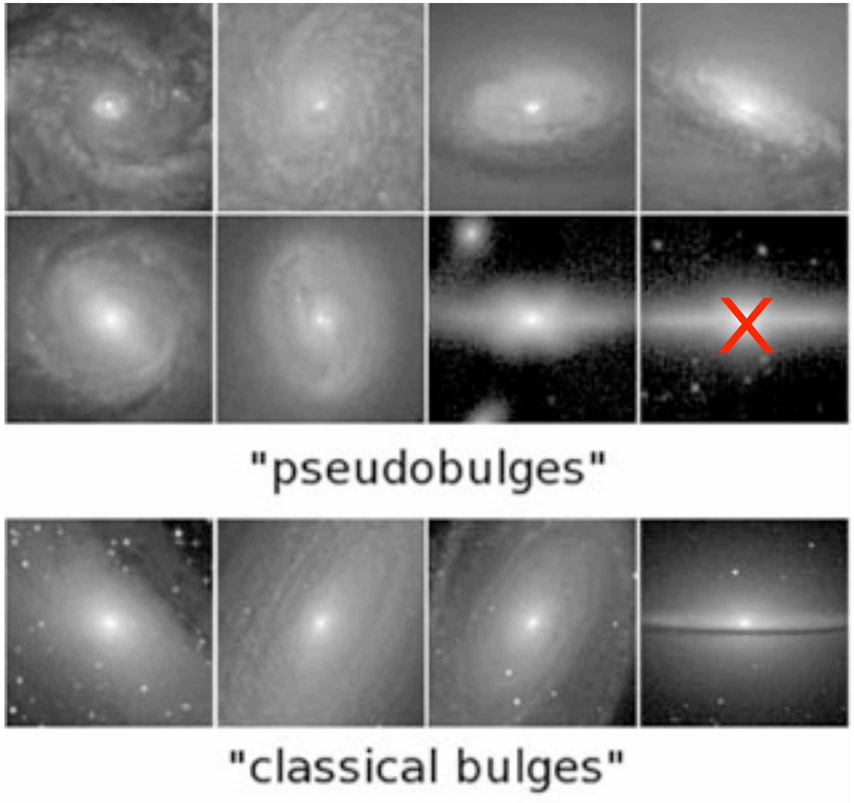
rings



lenses



Pseudo-bulges have various Sersic indices, often closer to n=1 (exponential) than to n=4 (de Voucoulers profile)



X/peanut shape characteristic of bars seen edge-on

Classical bulges tend to have Sersic indices closer to n=4 (de Voucoulers profile)