ASTR 421
Galaxies

Prof. Stacy McGaugh
Spring 2011
Tuesday & Thursday
11:00 AM - 12:15 PM
CSS 0201

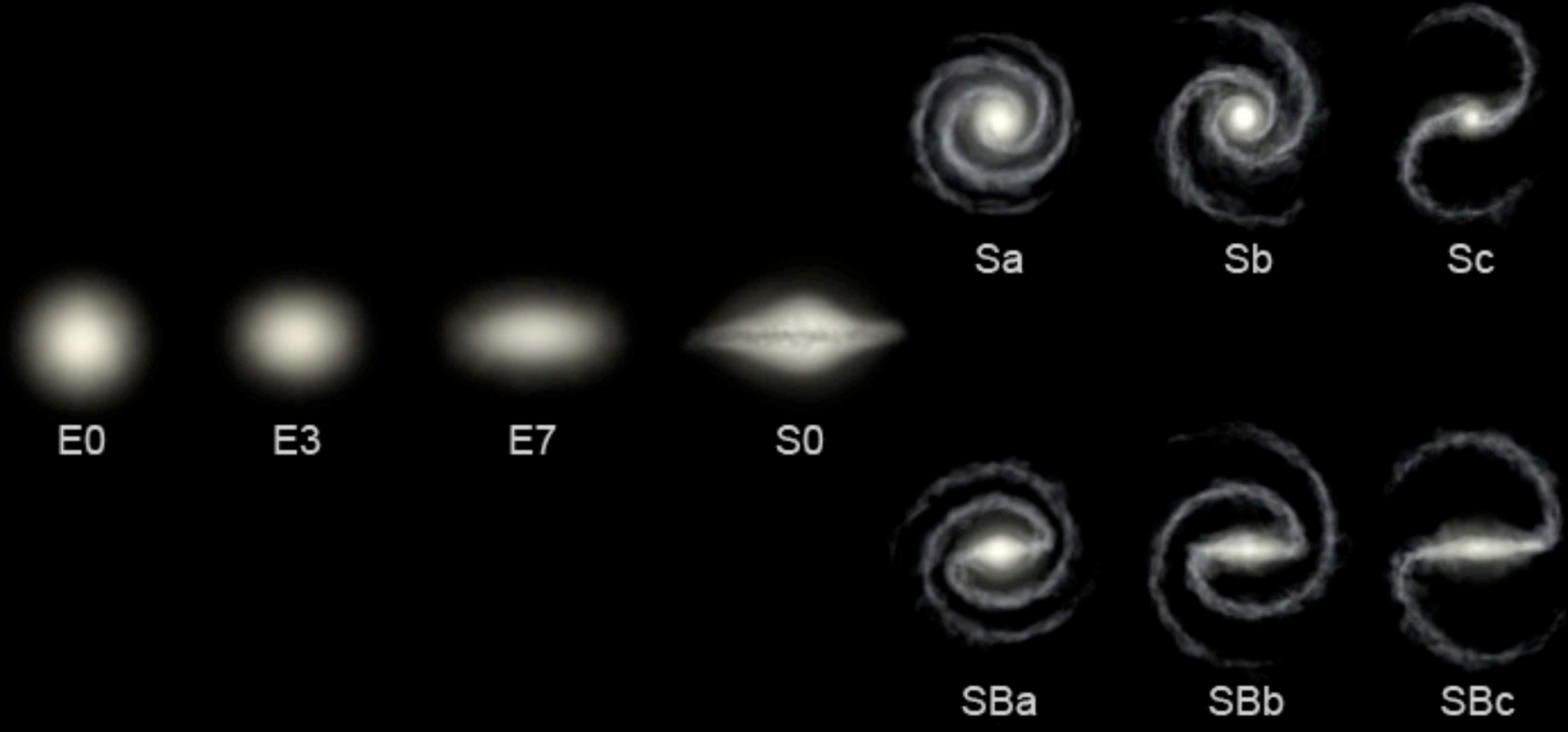
NGC 6946: a spiral galaxy

NGC 628: a spiral galaxy with many star forming regions

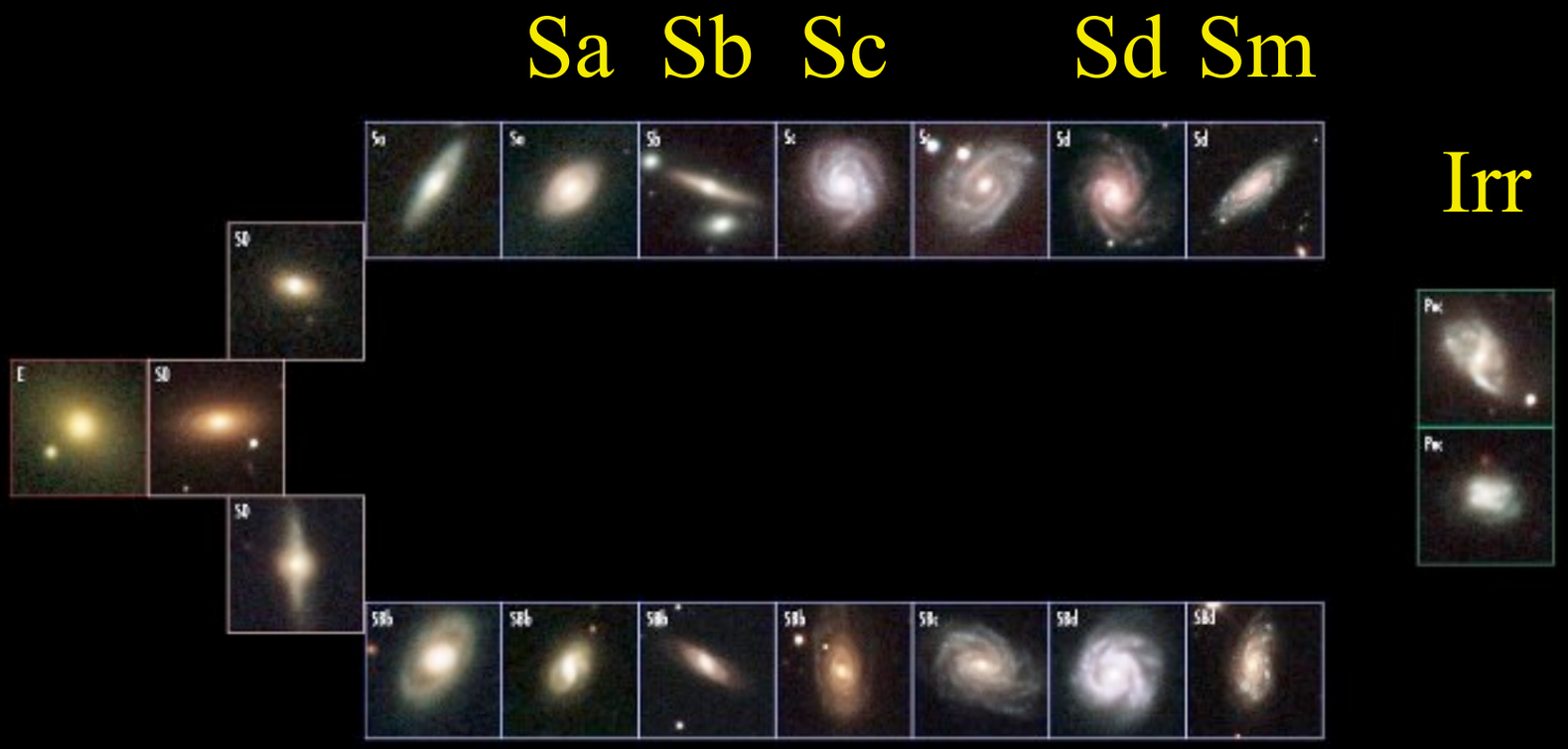
M87: a giant Elliptical galaxy

M87 © Anglo-Australian Observatory
Photo by David Malin

Galaxy Classification
The Hubble Tuning-fork sequence



More recent observations require extension to later types



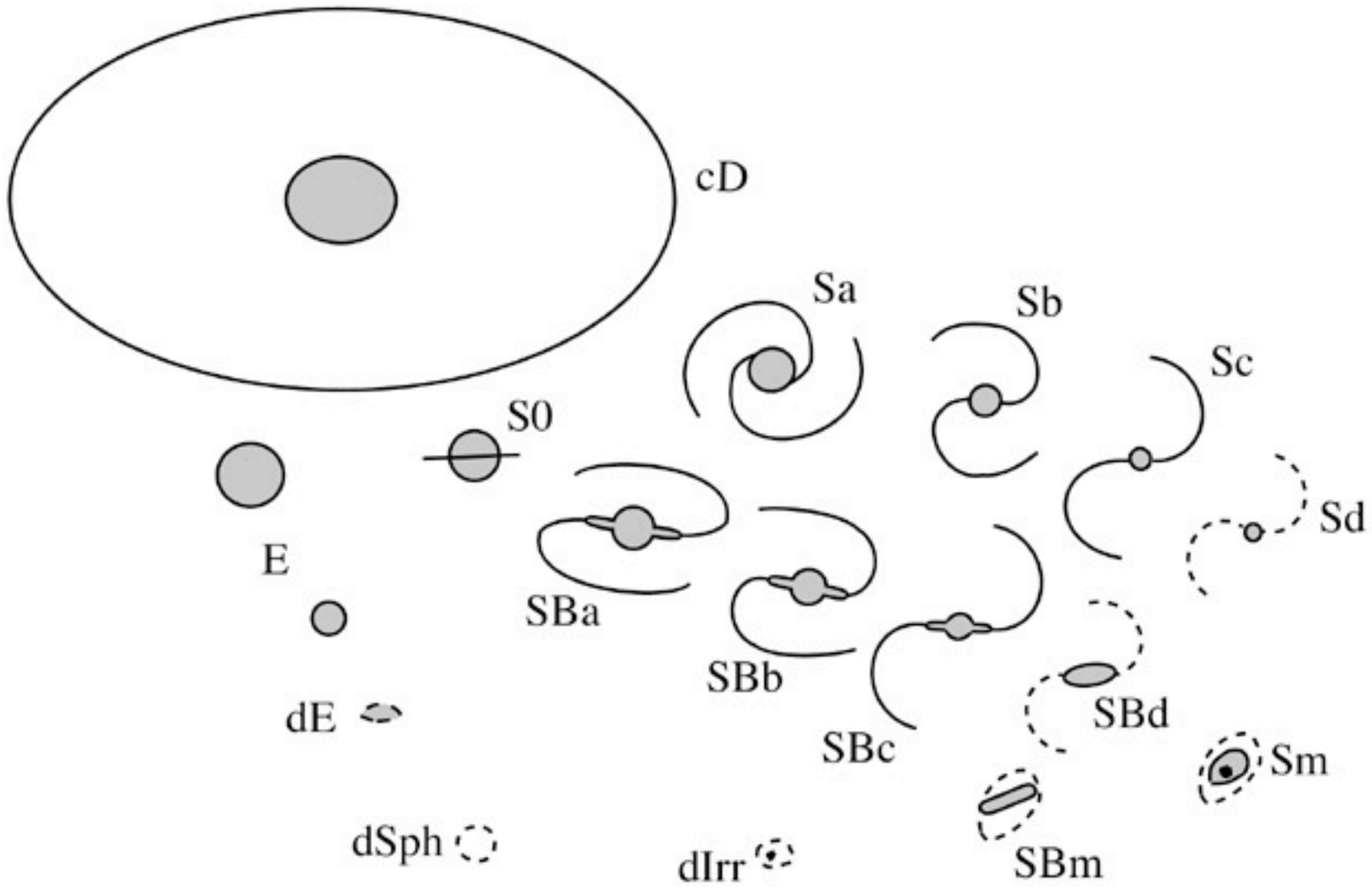


Fig 1.11 'Galaxies in the Universe' Sparke/Gallagher CUP 2007

The Spitzer Space Telescope observed 75 galaxies as part of its SINGS (Spitzer Infrared Nearby Galaxies Survey) Legacy Program. The galaxies are presented here in a Hubble Tuning-Fork diagram, which groups galaxies according to the morphology of their nuclei and spiral arms. The designation of these galaxies and their placement in the diagram is based on their visible-light appearance. The main goal of the SINGS program is to characterize the infrared properties of a wide range of galaxy types. The images of the galaxies are composites created from data taken by IRAC (the Infrared Array Camera) at 3.6 and 8.0 μm, and MIPS (the Multiband Imaging Photometer for Spitzer) at 24 μm.

The infrared range probed by these and other observations taken for the SINGS project allows for the detailed study of star formation, dust emission, and the distribution of stars in each galaxy. Light from old stars appears as blue in the images, while the lumpy knots of green and red light are produced by dust clouds surrounding newly born stars. The elliptical galaxies on the left are almost entirely made of old stars, while spiral galaxies like our own Milky Way are rich in young stars and the raw materials for future star formation.

More information can be found at:
http://sings.stsci.edu/

Ellipticals

Irregulars

Strong Bulge

Strong Bulge

Unbarred Spirals

Weak Bulge

Intermediate Spirals

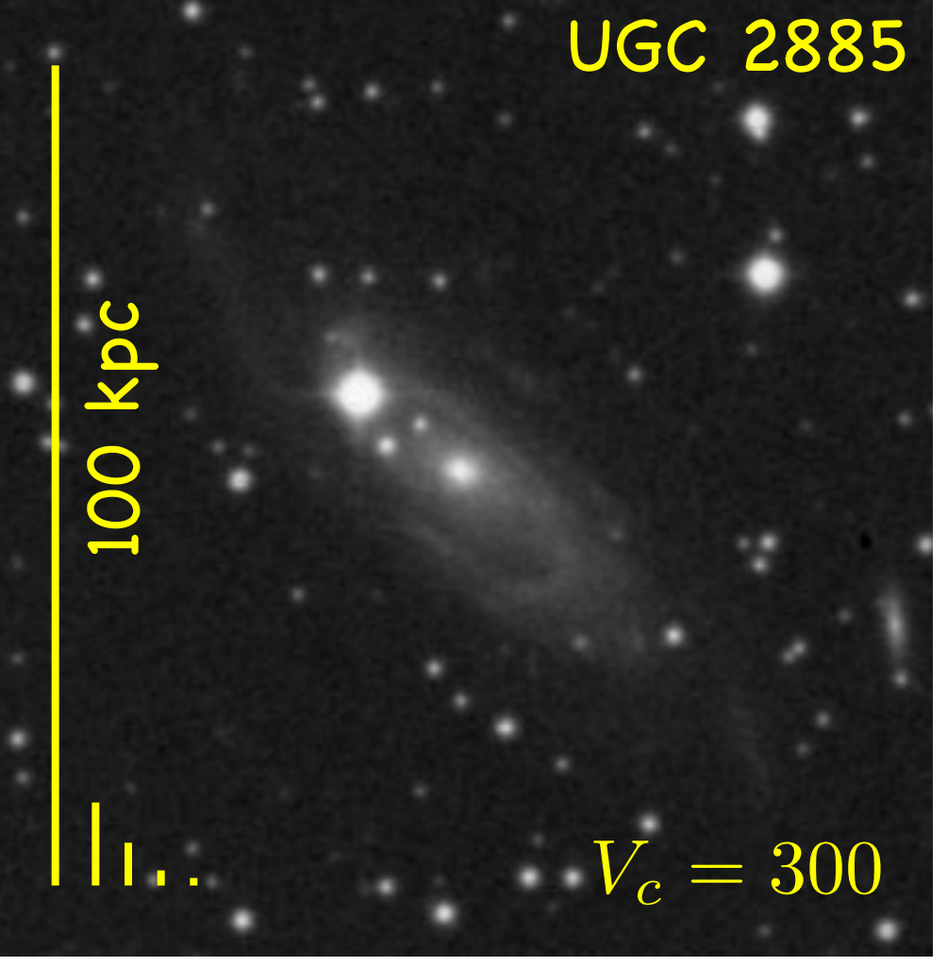
Weak Bulge

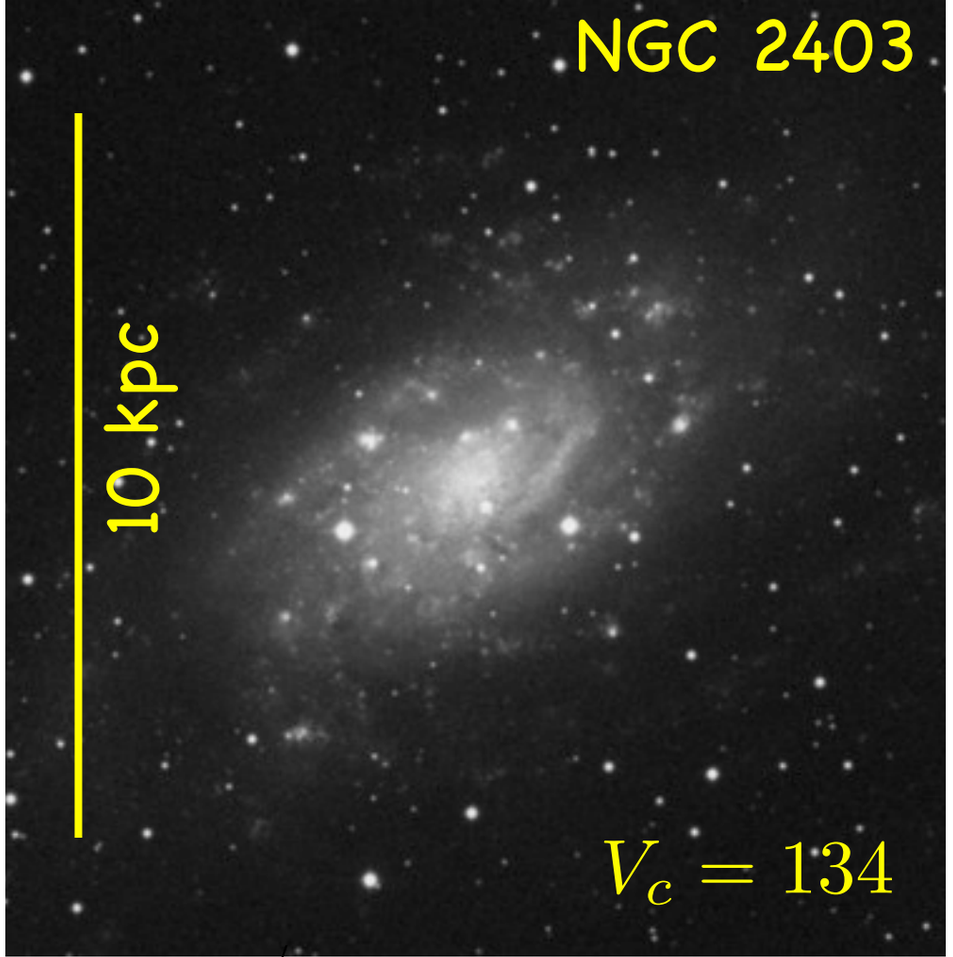
Barred Spirals

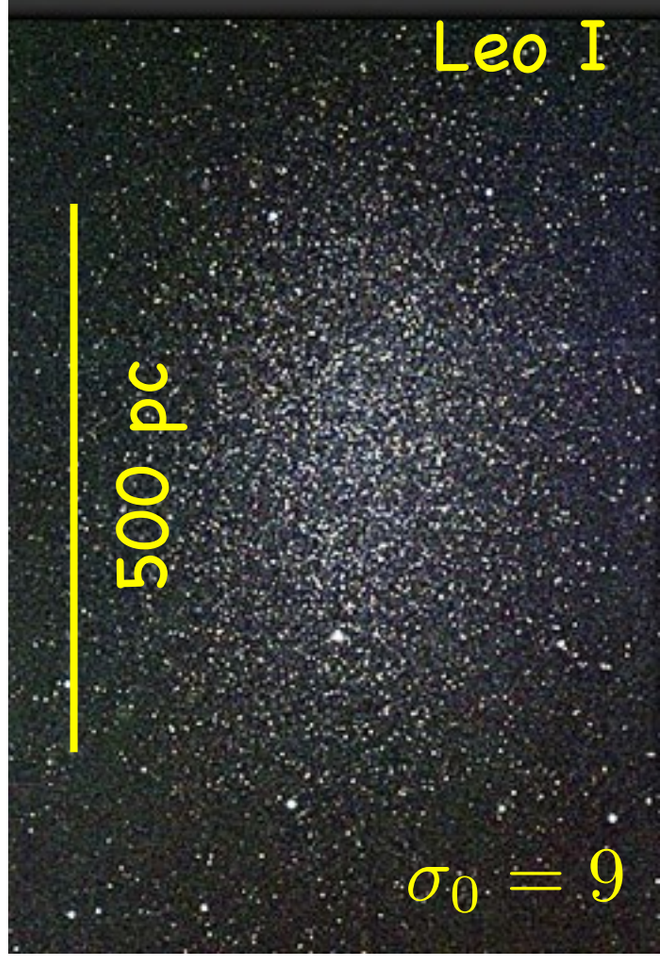
Poster and composite images created from SINGS observations by Karl D. Gordon (Oct 2007)
Blue=IRAC 3.6μm (stars)

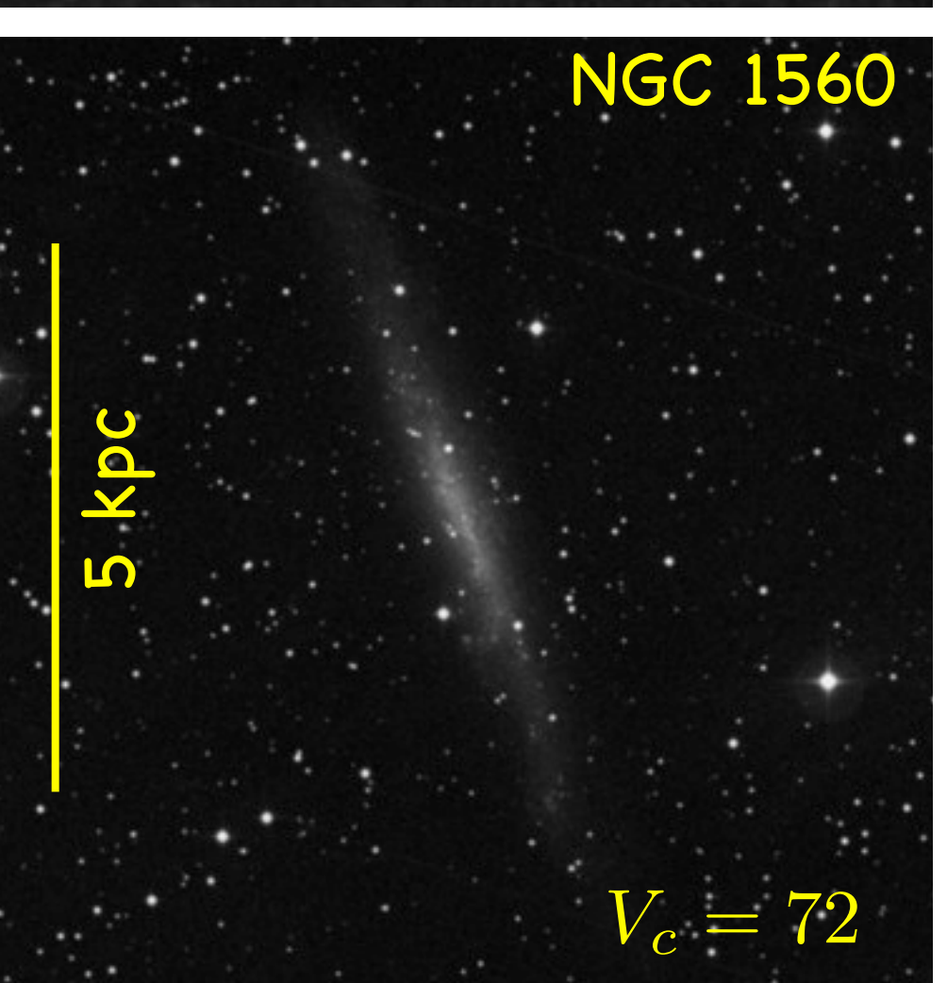
SINGS Team

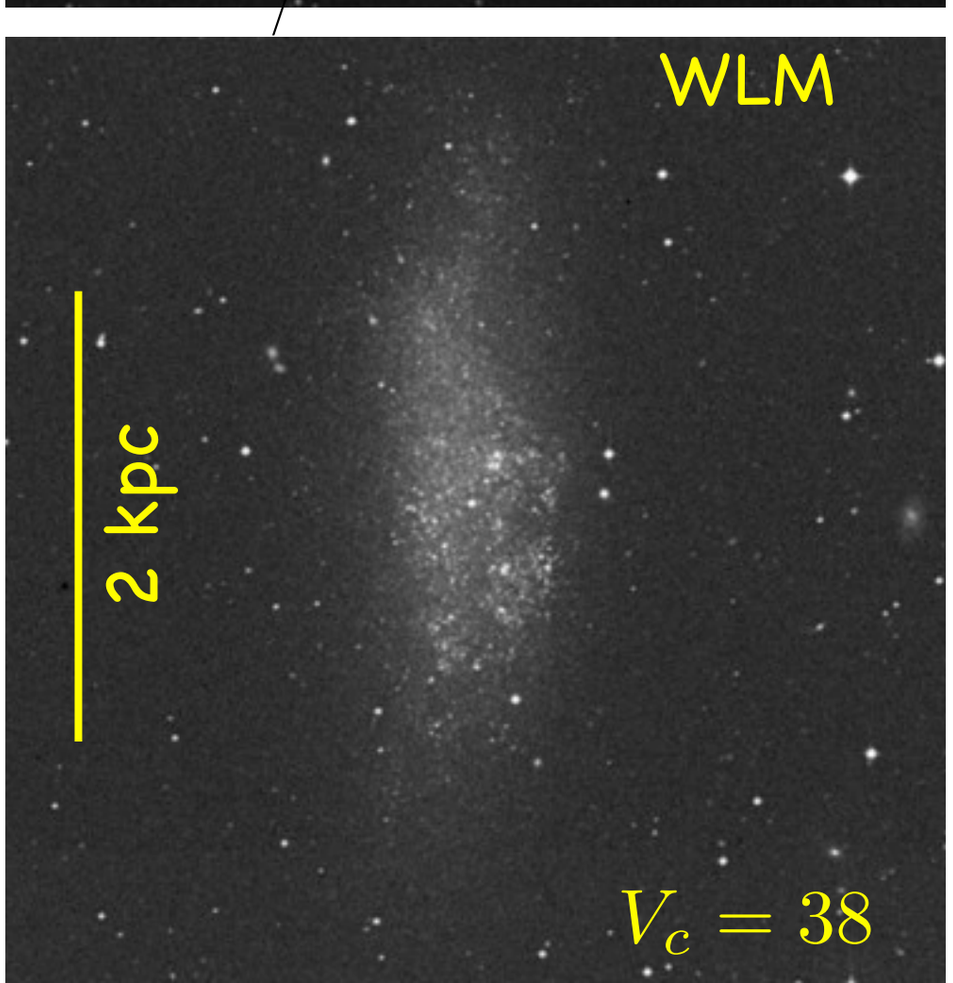
Robert Kennicutt, Jr. (Principle Investigator), Daniela Calzetti (Deputy Principle Investigator), Charles Engelbracht (Technical Contact), Lee Armus, George Bendo, Caroline Bot, Brent Buckalew, John Cannon, Daniel Dale, Bruce Draine, Karl Gordon, Albert Grauer, David Hollenbach, Tom Jarrett, Lisa


UGC 2885
100 kpc
$V_c = 300$


NGC 2403
10 kpc
$V_c = 134$

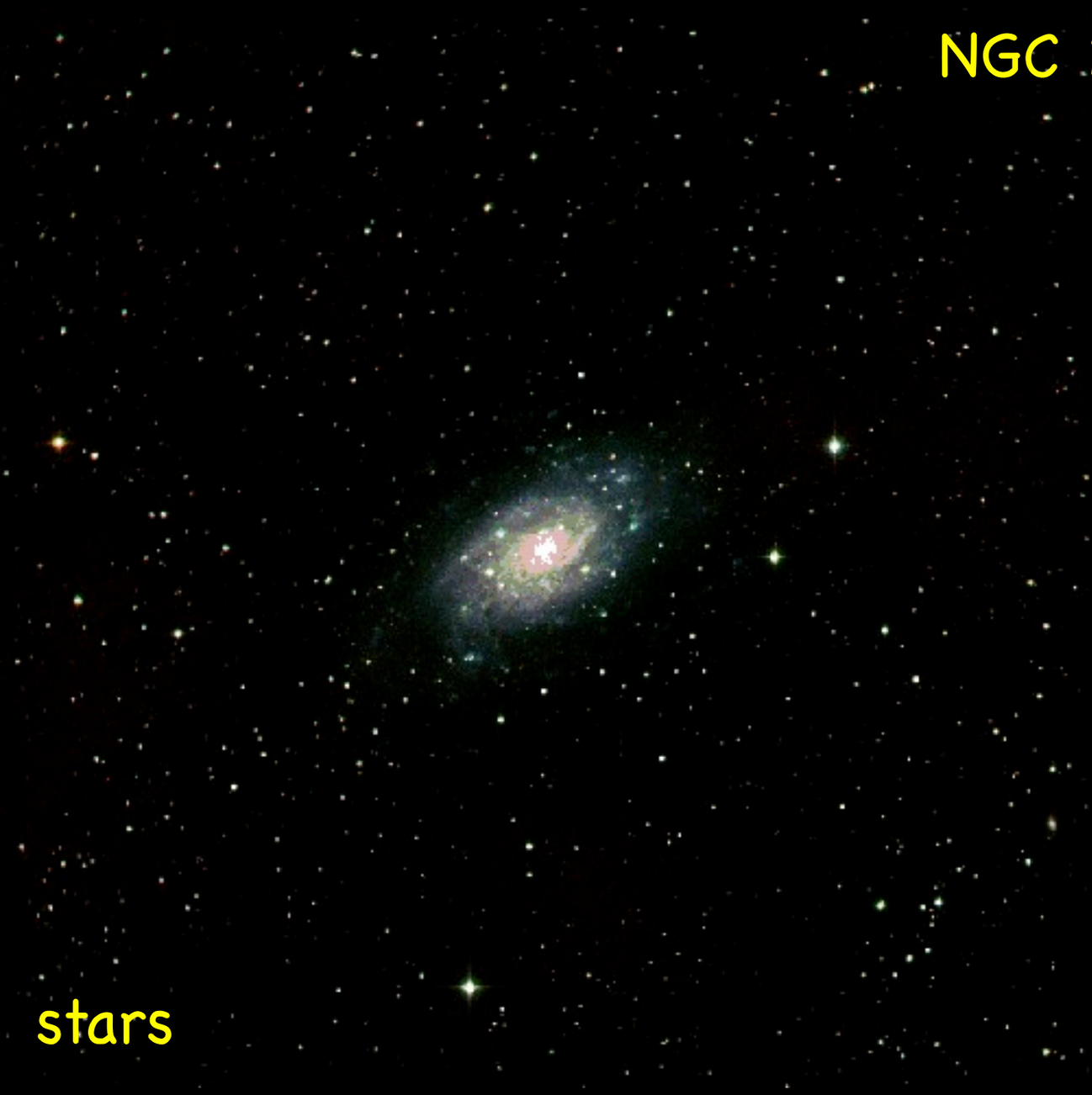

Leo I
500 pc
$\sigma_0 = 9$


NGC 1560
5 kpc
$V_c = 72$


WLM
2 kpc
$V_c = 38$


M13
20 pc
$\sigma_0 = 6$

NGC 2403

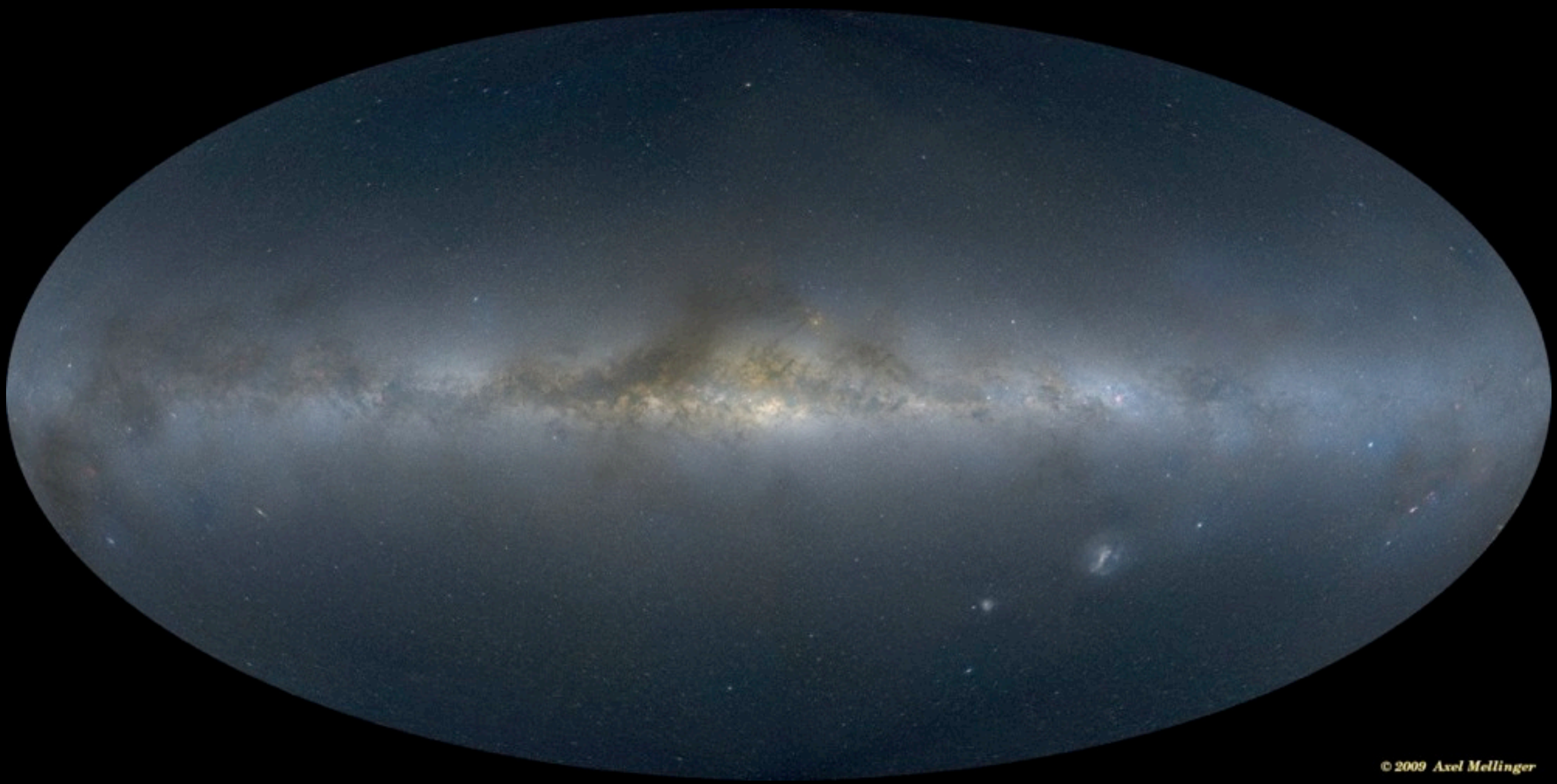


stars

atomic gas

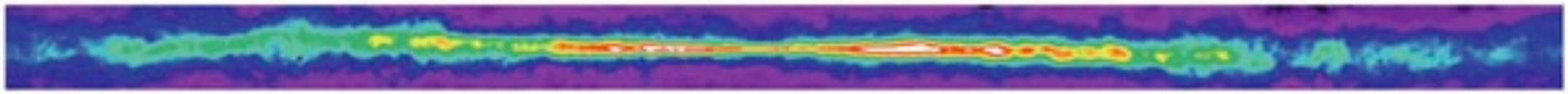
Fraternali, F., Oosterloo, T., Sancisi, R., van Moorsel, G.A. 2001, ApJ, 562, L47

The Milky Way (all sky projection)



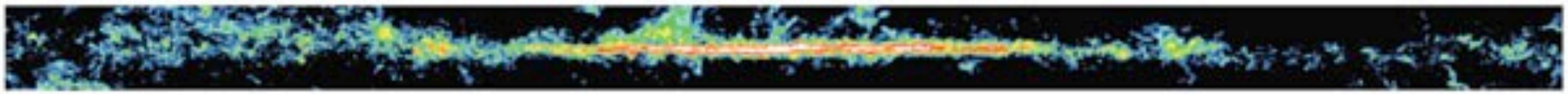
Multi-wavelength Milky Way

radio (21 cm)
HI gas



a 21-cm radio emission from atomic hydrogen gas.

radio (CO)
molecular gas



b Radio emission from carbon monoxide reveals molecular clouds.

far-IR
dust

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

near-IR
stars

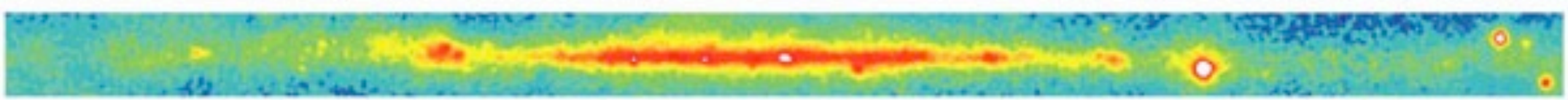
d Infrared (1–4 μm) emission from stars that penetrates most interstellar material.

Optical
stars & dust

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

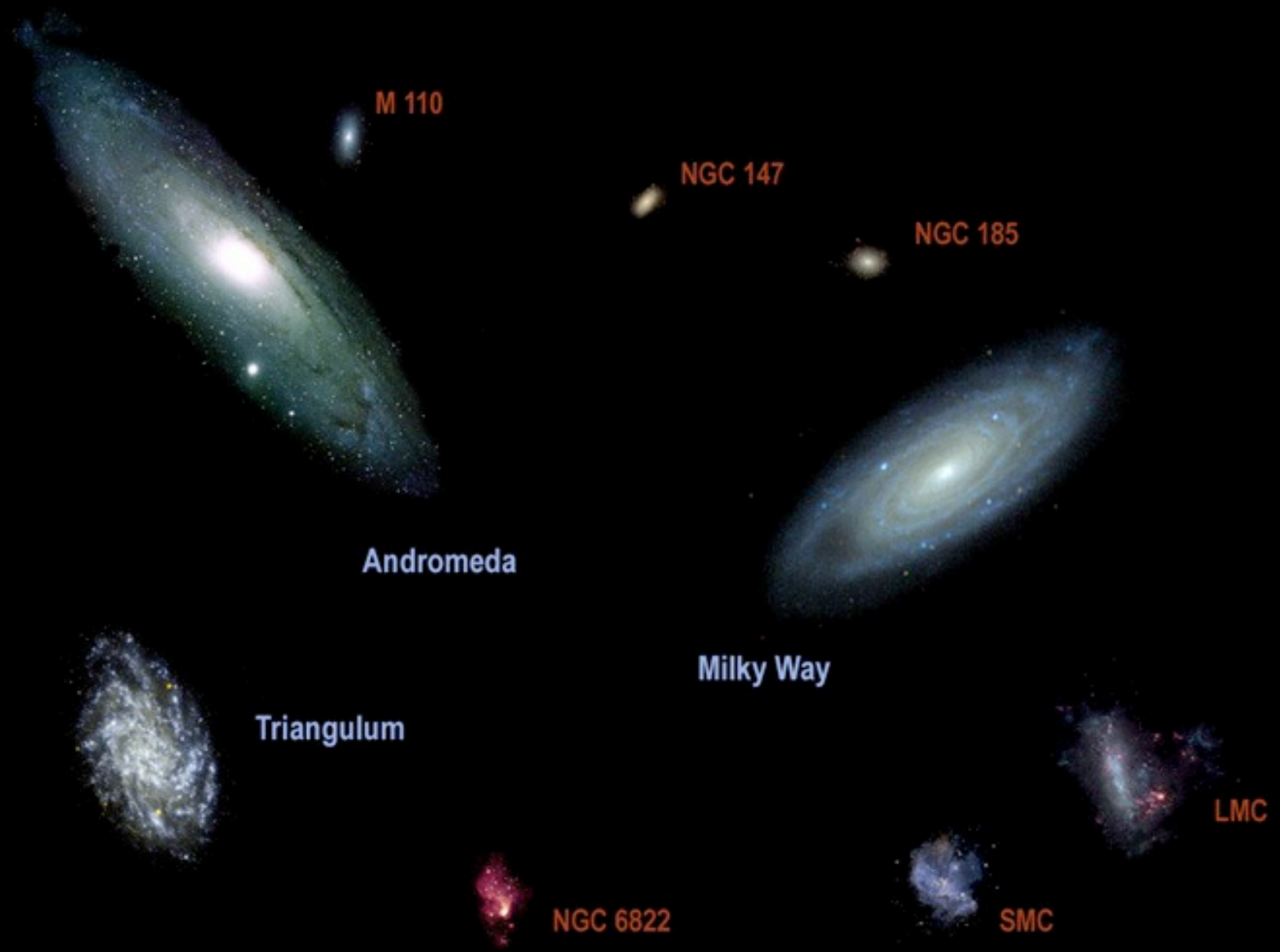
X-ray
hot gas

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.

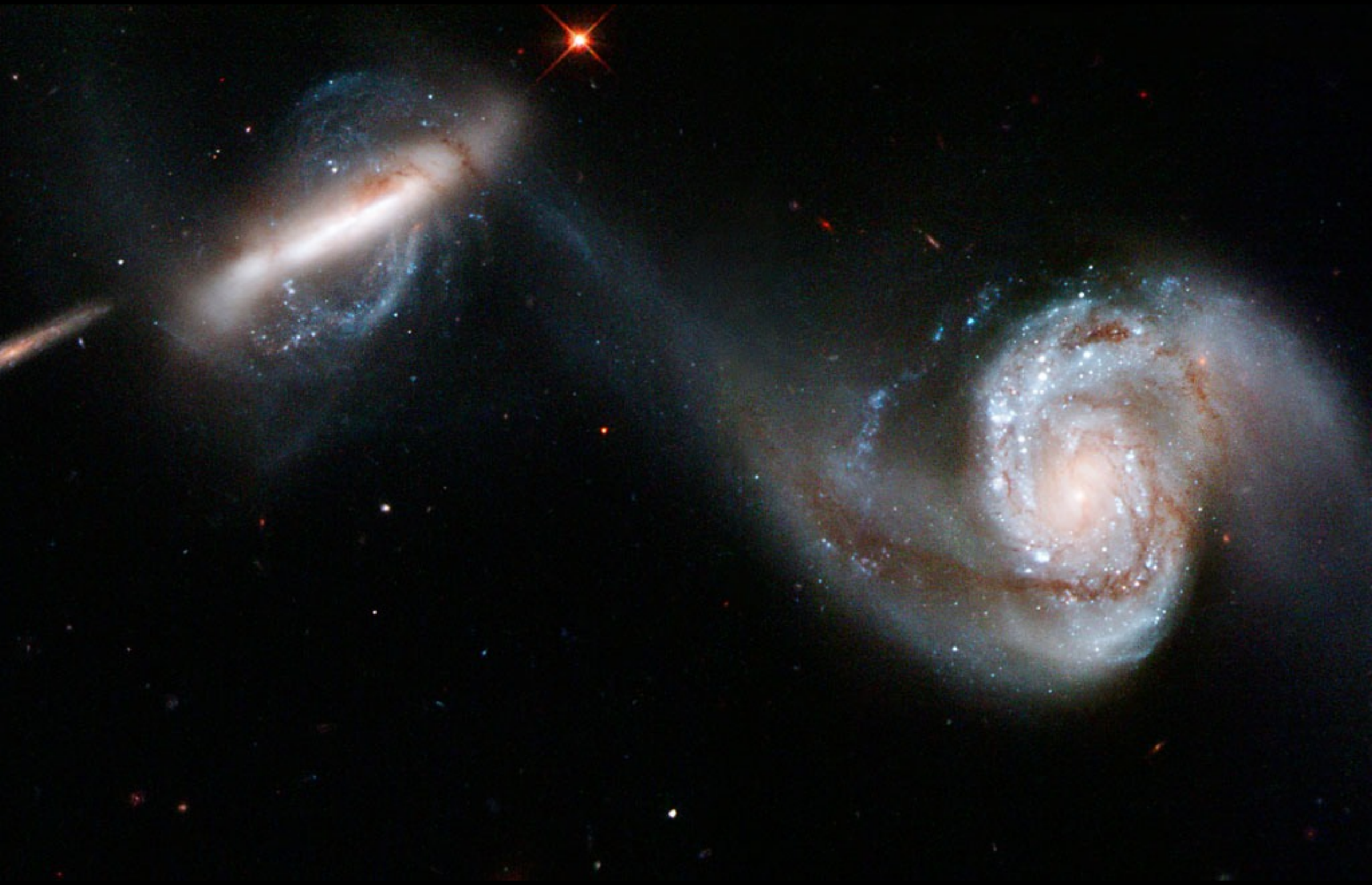
The Local Group



Hickson's Compact Group 44

Stephan's Quintet

Arp 87: interacting galaxies



Perseus Cluster