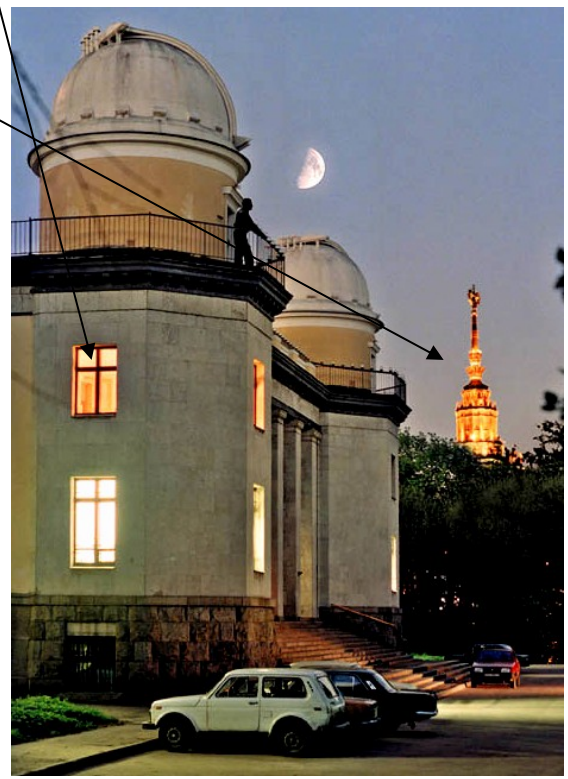
Yury N.Efremov

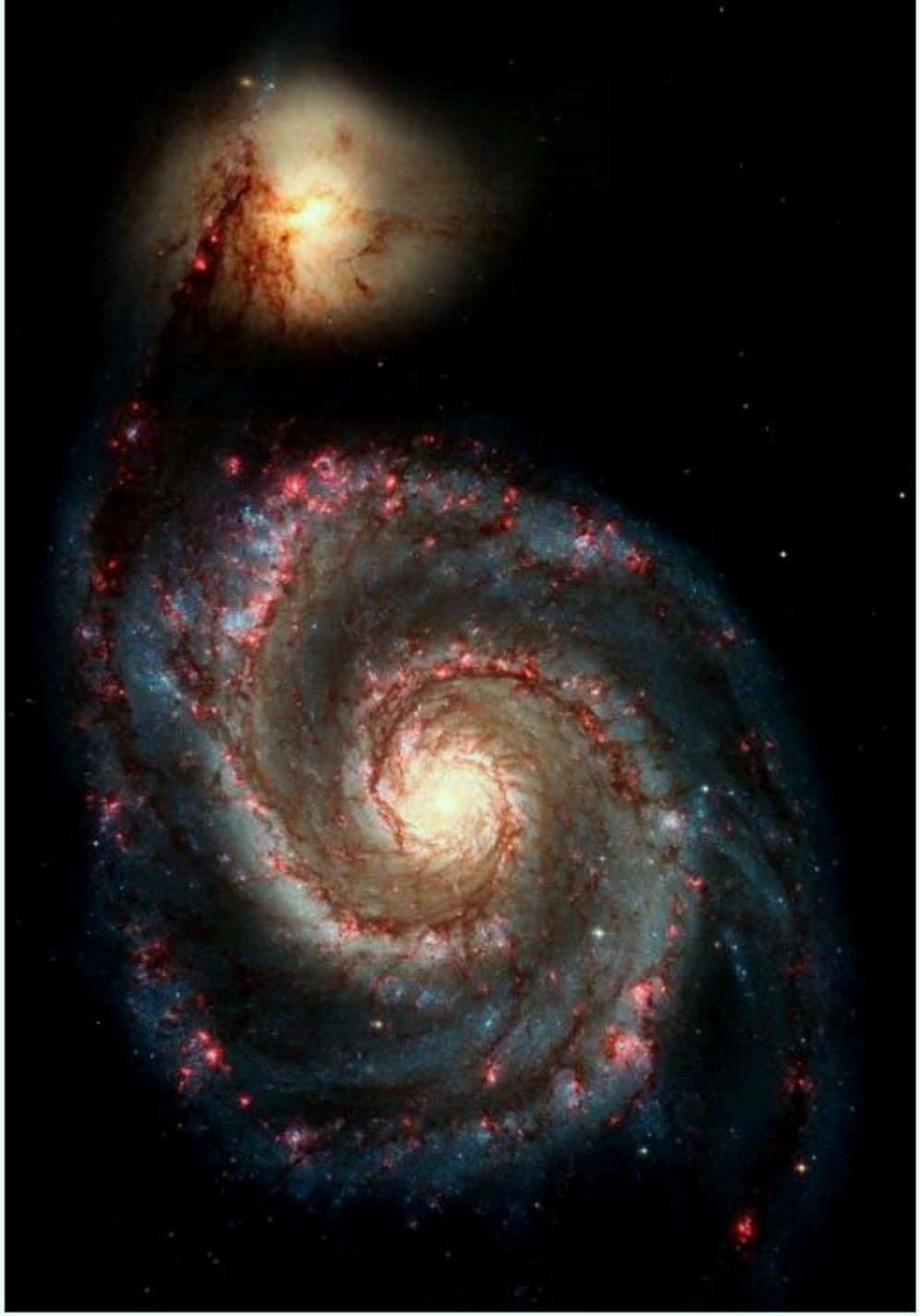
Sternberg Astronomical Institute,

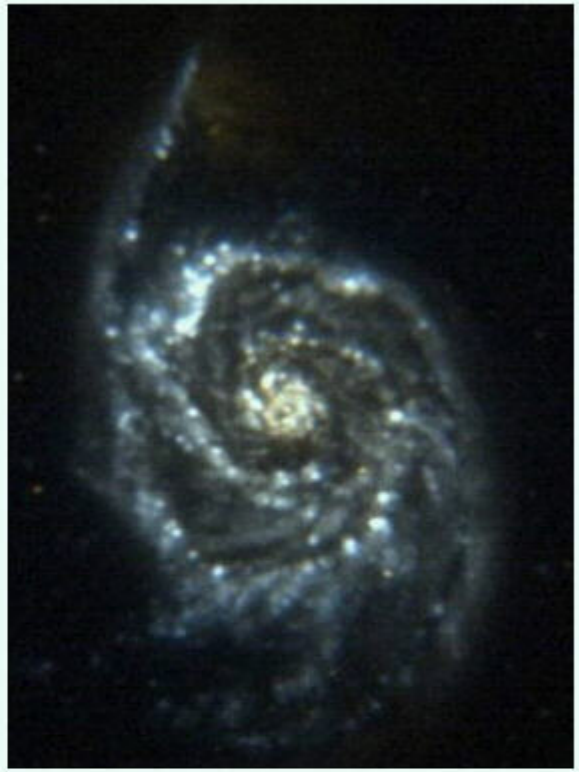
MSU

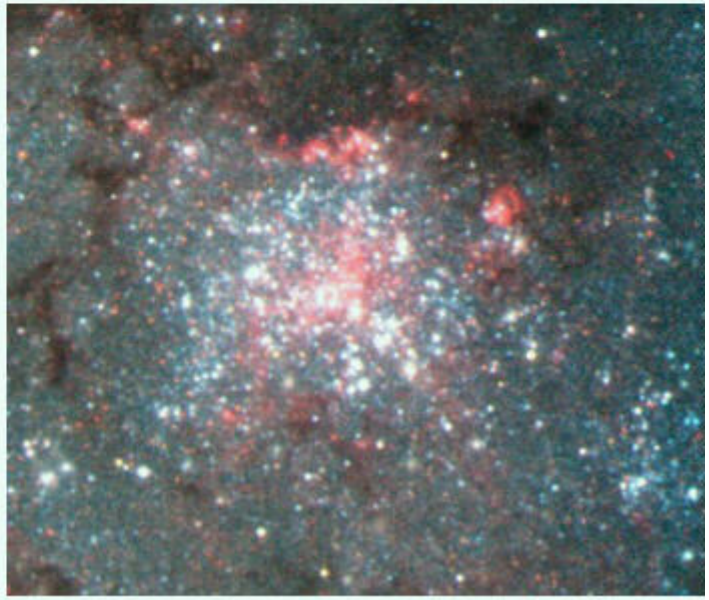


Morphology and distribution of star/cluster/gas complexes in grand design spiral galaxies

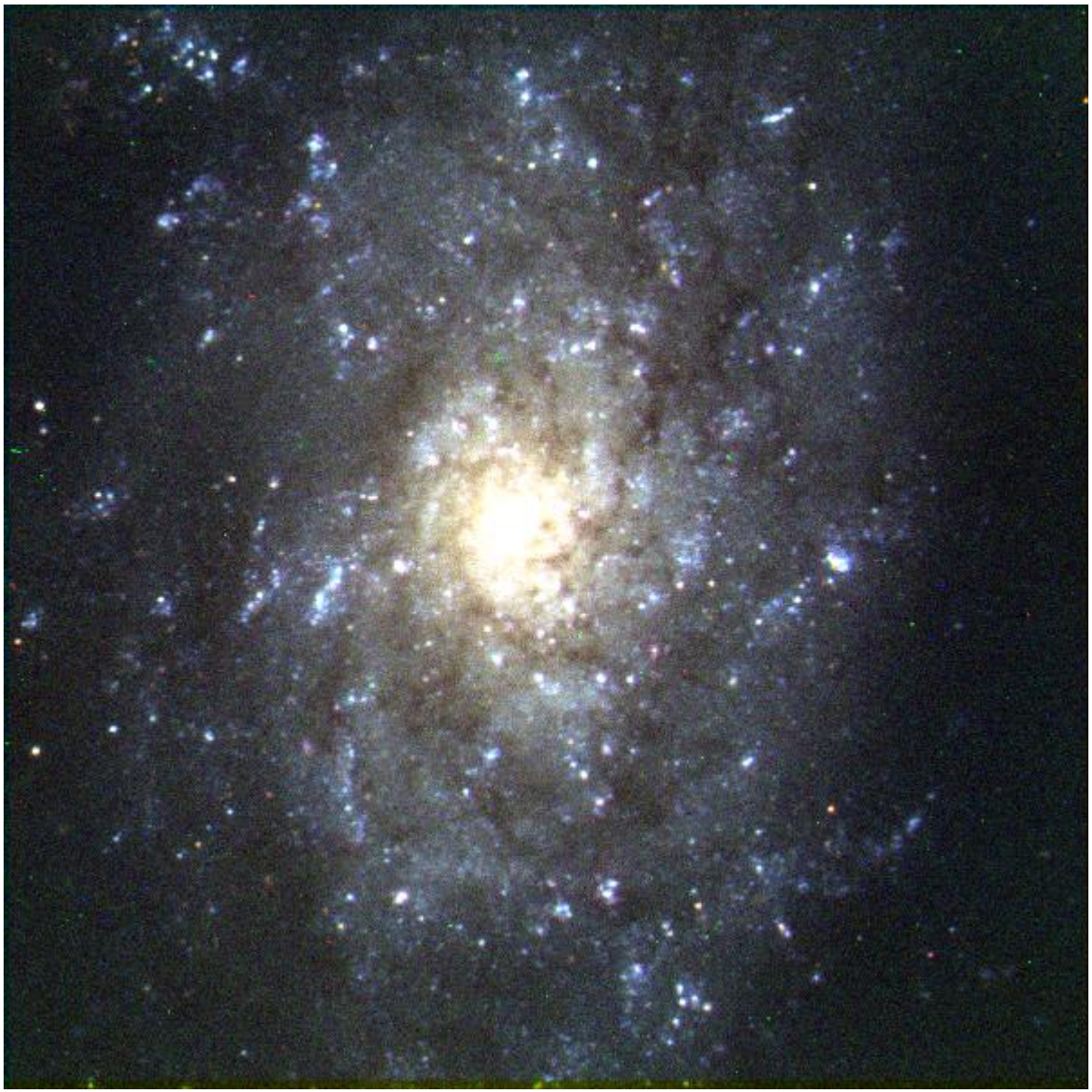






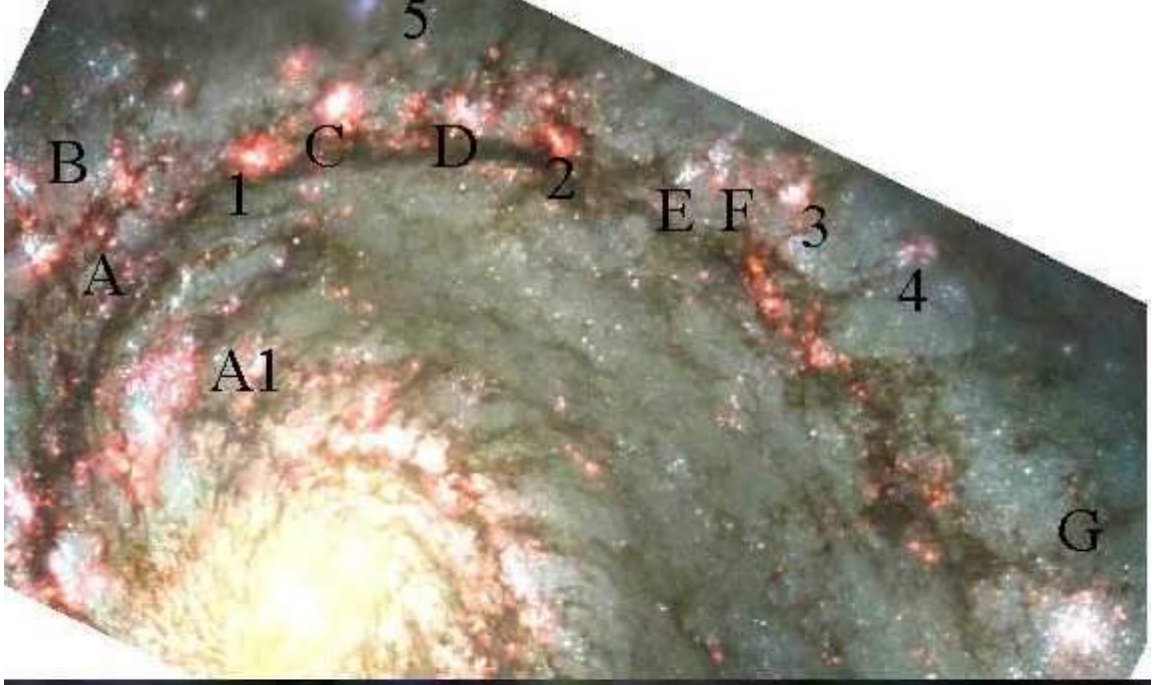


**Younger clusters form within
the larger and older ones.
Complexes - the largest and oldest,
the final step in the hierachical sequence
of embedded young star groups.
Their size is determined by the thickness
of the galactic disks. The flocculent spiral
arms and some spurs from the grand design
spirals are plausibly the sheared older
complexes.**



NGC 7793

flocculent

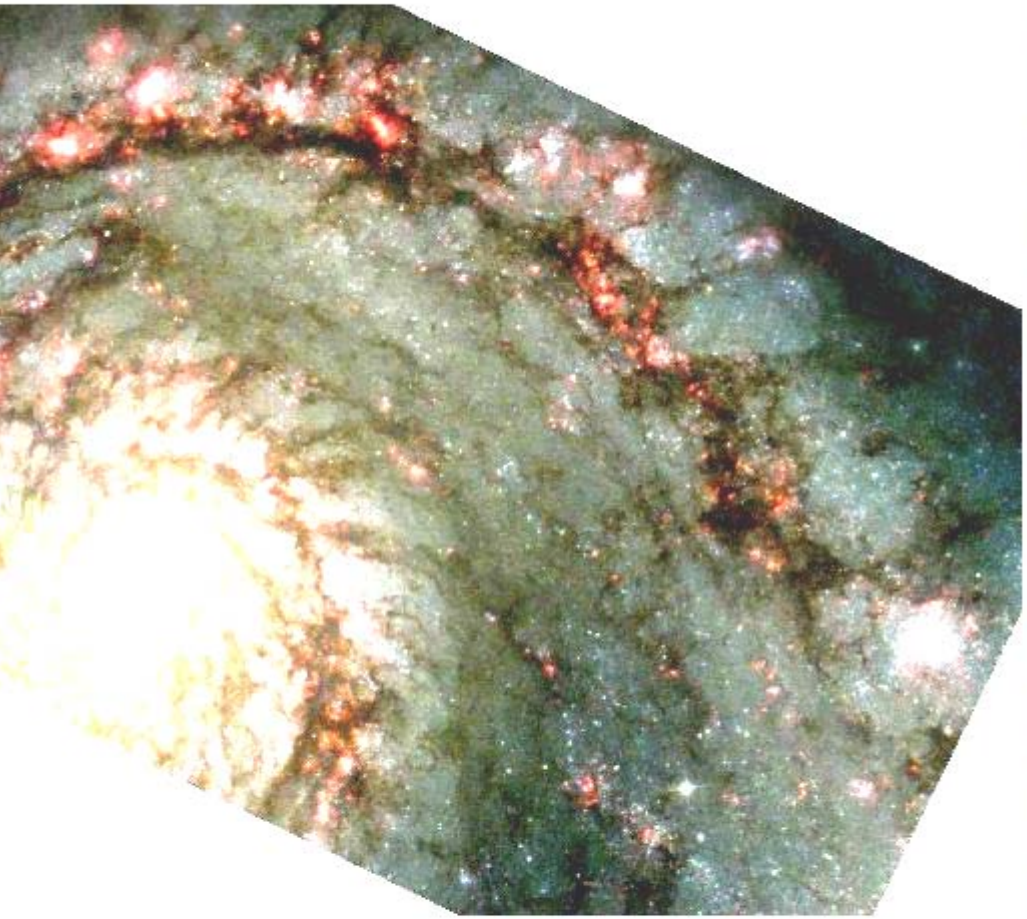


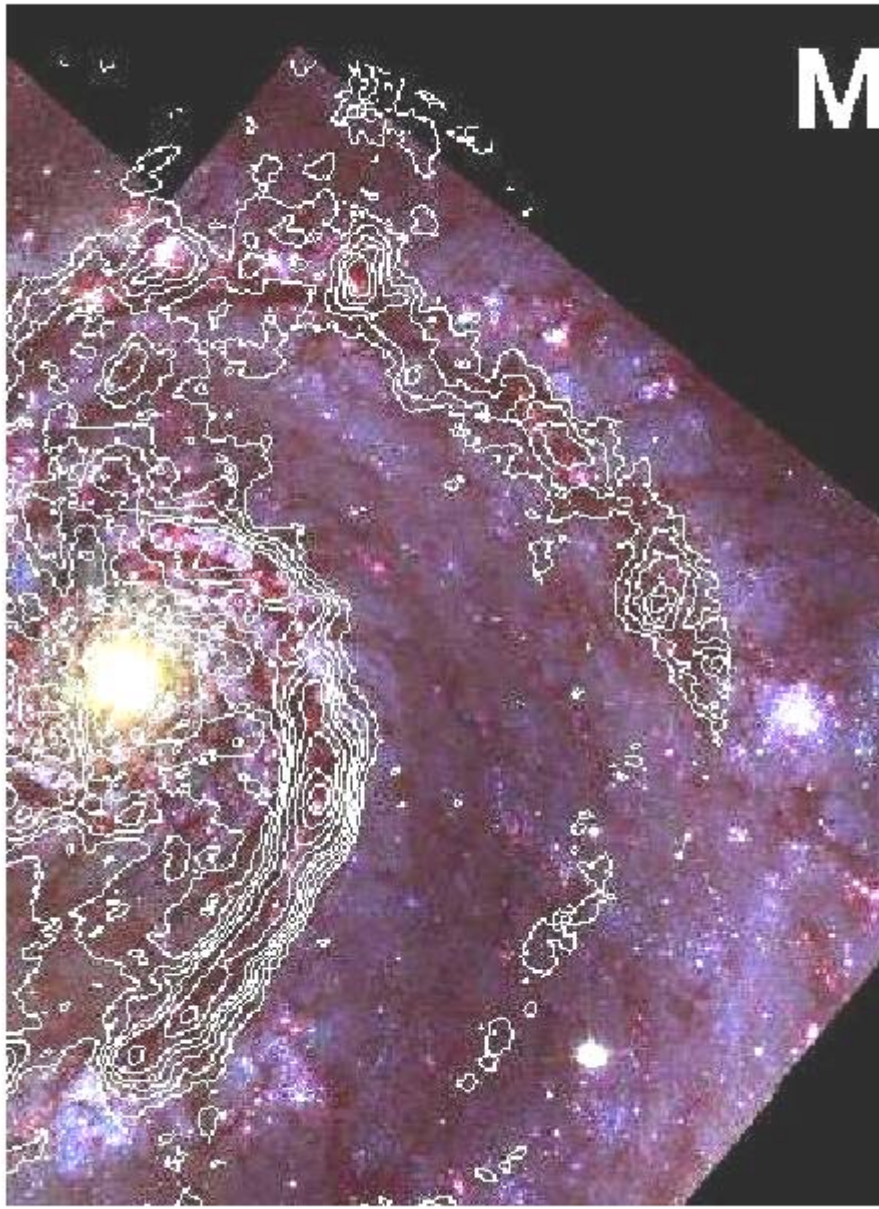
M51

HST



GALEX





HST

+CO E.Schinnerer & A.Weiss

More warm and more turbulent gas downstream - after SDW passage

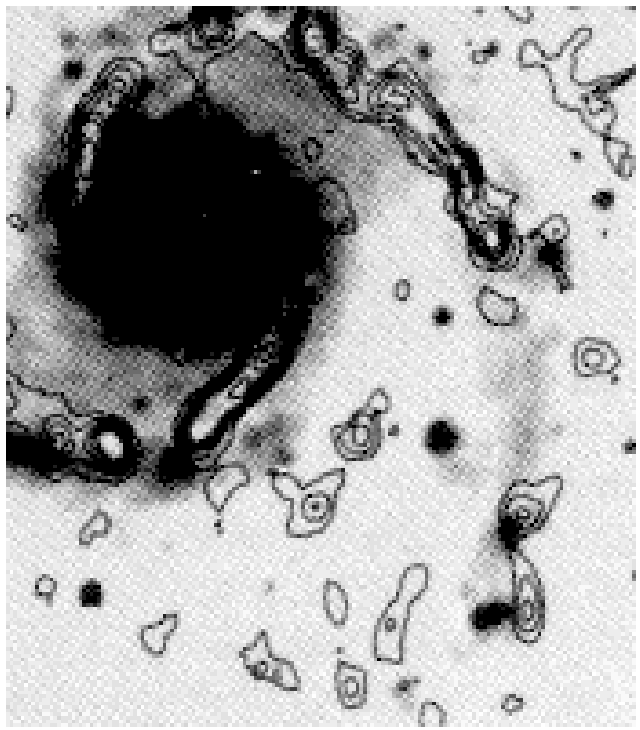
M51

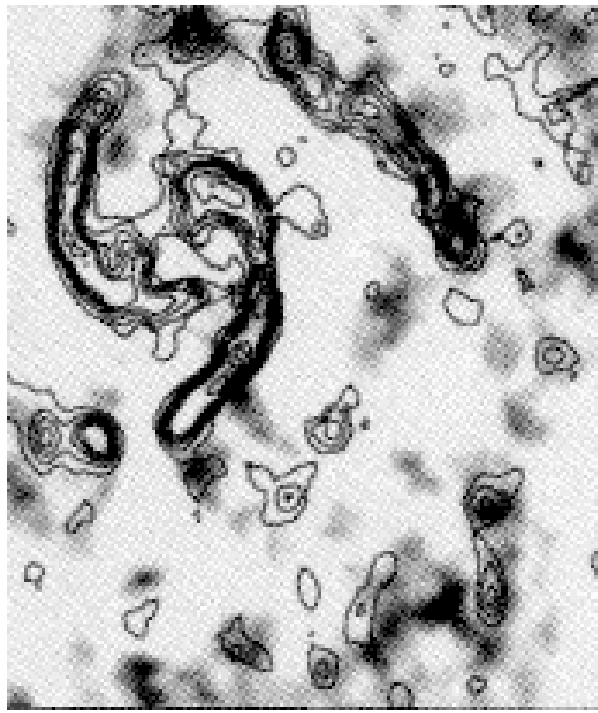
Sloan DSS

CO on red

CO on HI







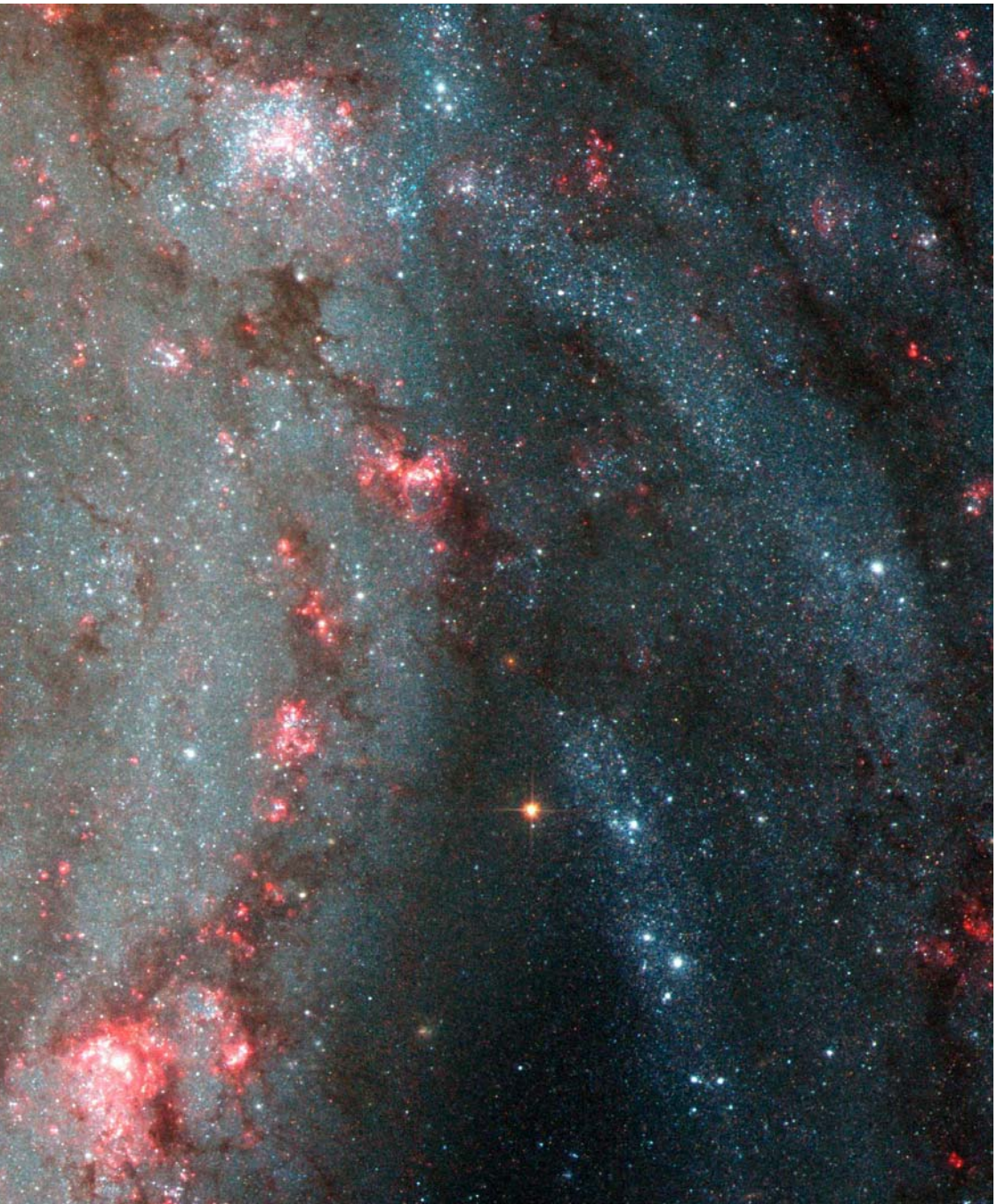
M51

optics



Far IR





M51 West

ACS HST

Spurs
populated
with clusters

Complex G2 400 pc in diameter





YMC
in
young
complex

M51 SW



Complex A1

bright YMC
and arcs
of dust

Two complexes
with YMCs,

young and older one







M51

no SAs

Some complexes are young and have the very high SFR - they are the localized starbursts (superassociations)
- mostly 0-1 per a galaxy.
None in M51.
Transitions (in SFR, size, gas content, age) from superassociations to common complexes and from the latters to OB-associations are to be studied.



SA

NGC 3631

Shachbazian, 1968;
Wray & de Vaucouleur, 1980

Regular spacing of complexes, too

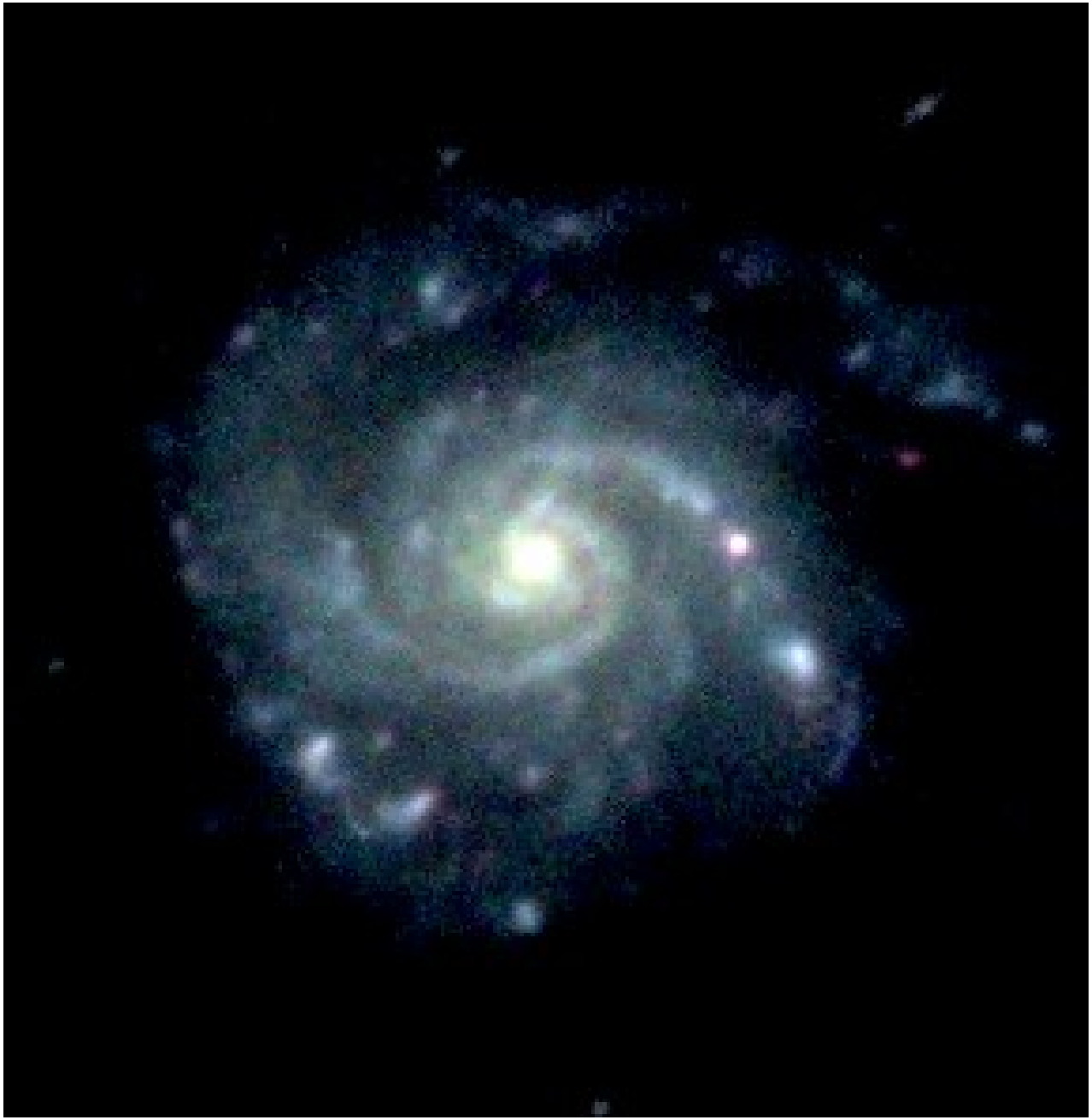


SA

NGC 2276

Sh, W & de V

Bow shock



SA

NGC 5660

SA at the arm tip

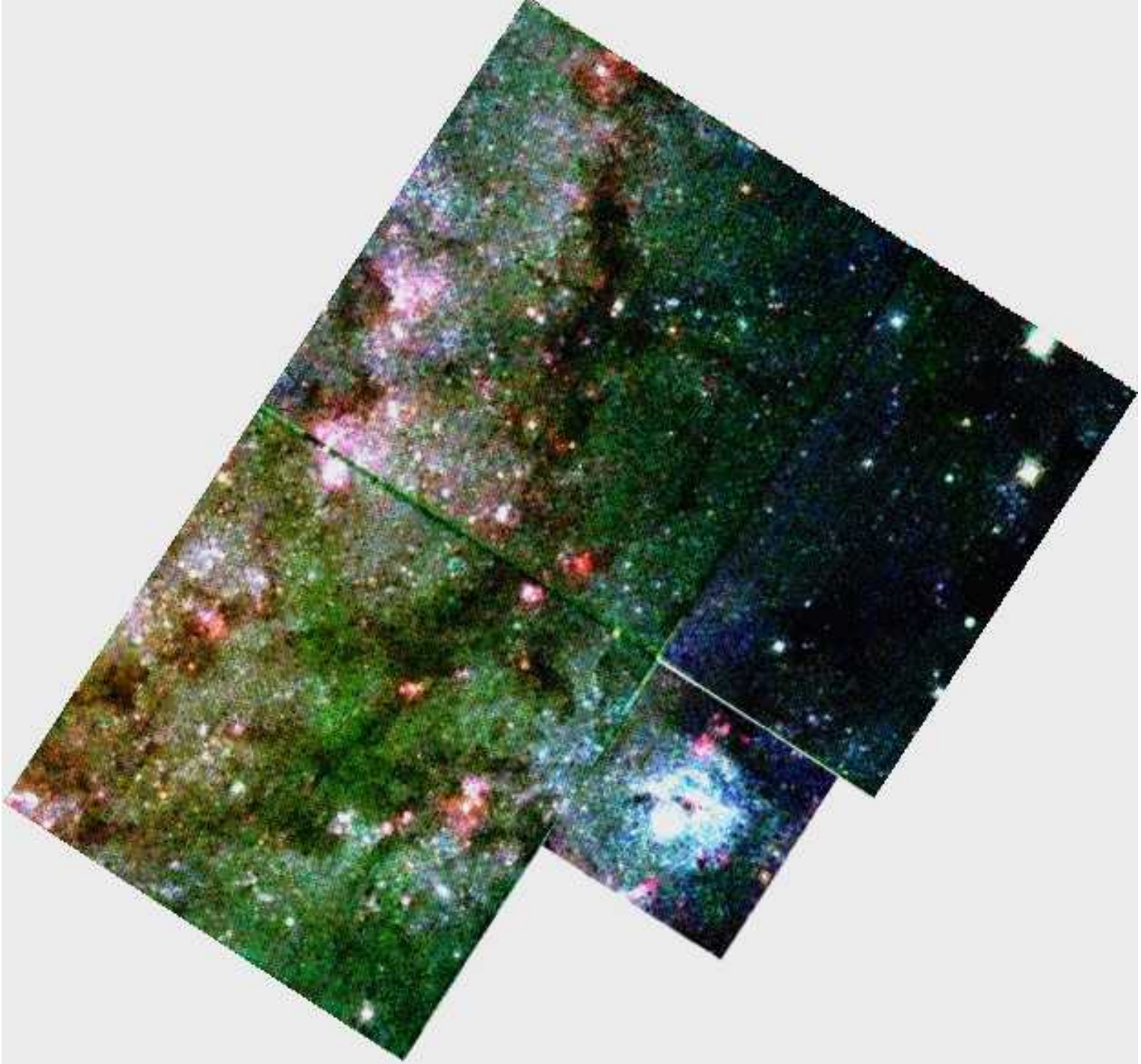


NGC 6946

Gemini N

Highest (local) SFR - 8 observed SNe

no regular spacing of complexes

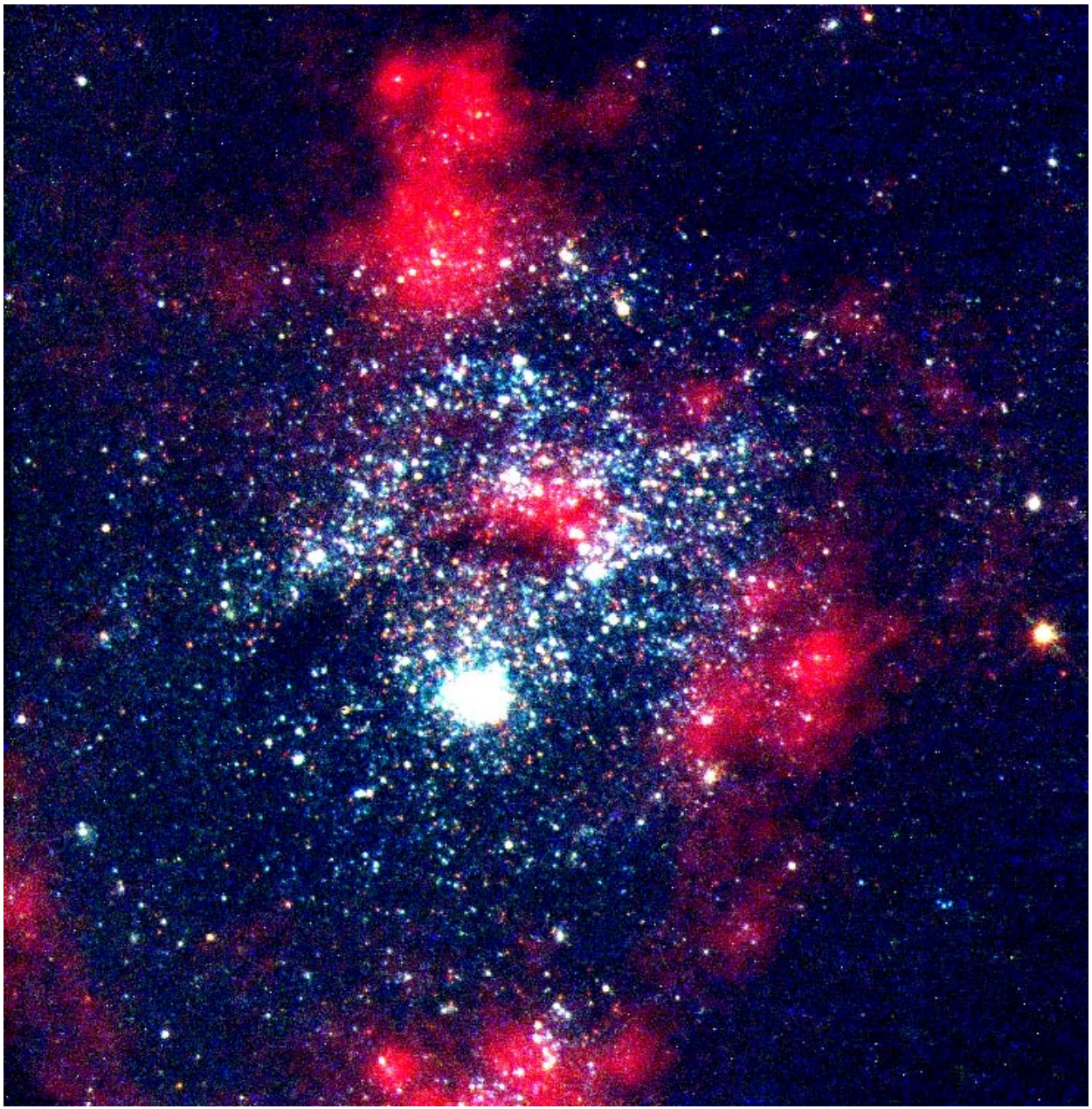


NGC 6946

HST

complexes of stars, HII, dust/CO

Hodge complex

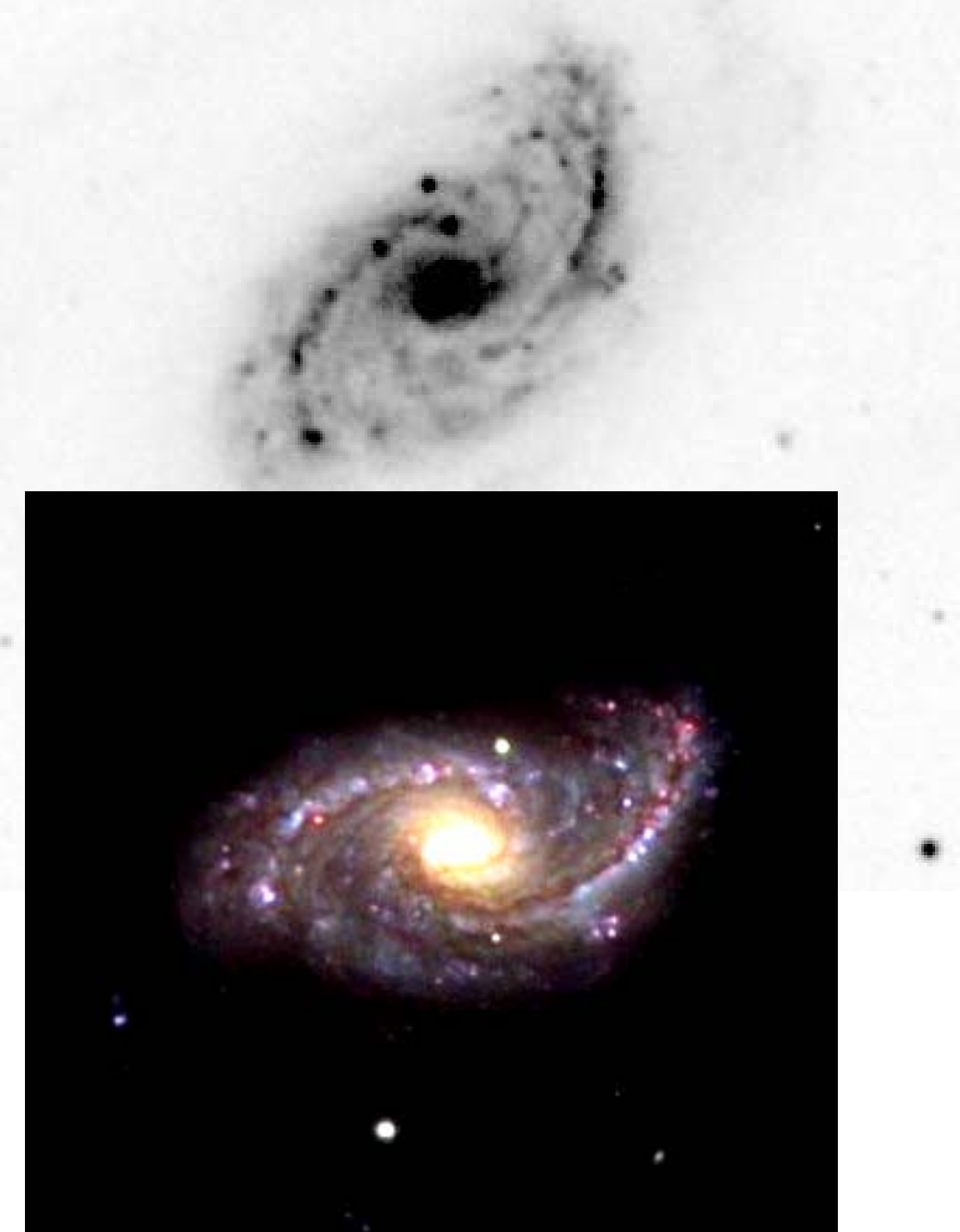


Hodge complex in NGC 6946

hosts YMC with mass one millions suns - progenitor of the globular cluster

HST WFPC2

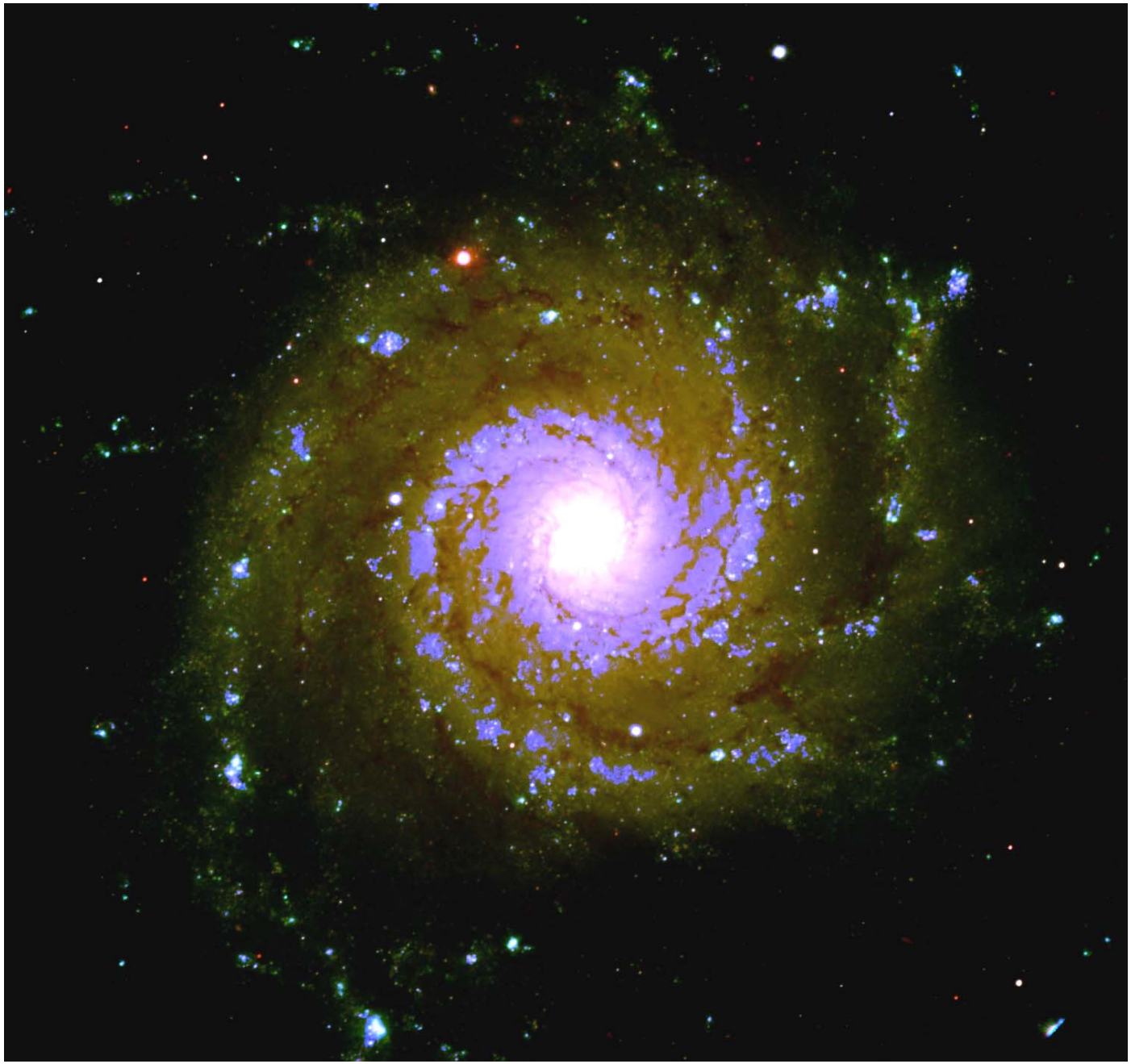
Complexes are connected with gas superclouds and often distributed in quazy-regular way along the grand design spiral arms. This may be the clue to origin of both GD arm and complexes- enhanced gas density and regular magnetic field along the arm ---> grav.-magnetic instability along the arm leads to supercloud formation



NGC 5248

the best example of regular spacing of complexes in the sample of 22 such galaxies

(the Elmegreens, 1983)



M74 =
NGC 628

One more galaxy from the Elmegreens 1983 sample



NGC 4535

EE 1983 list



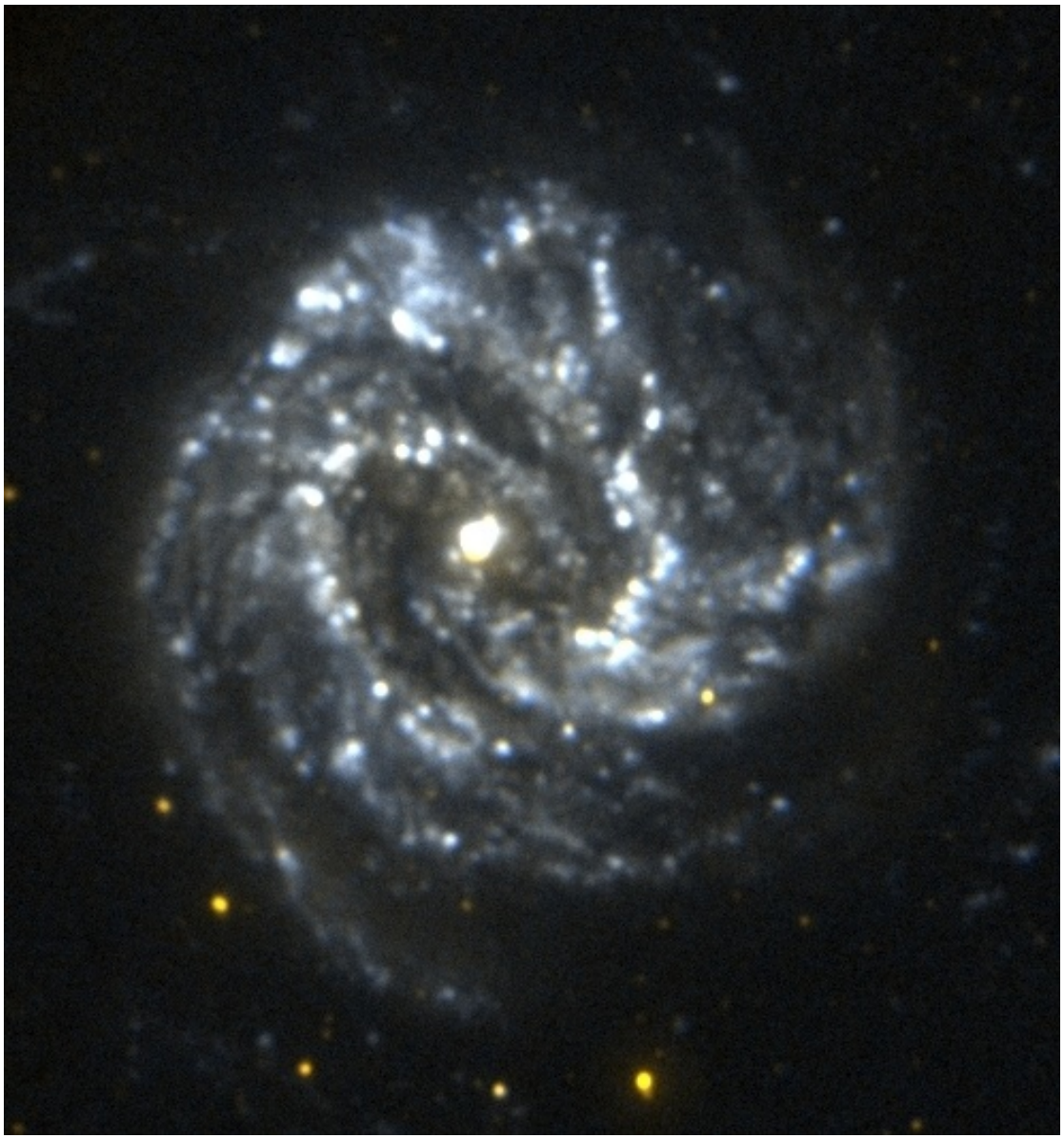
NGC 5371

Quazi-regular spacing of complexes in one arm, like it is the case in the MW



M100

One more case of different age complexes in one arm, with quazi-regular spacing



M83 GALEX

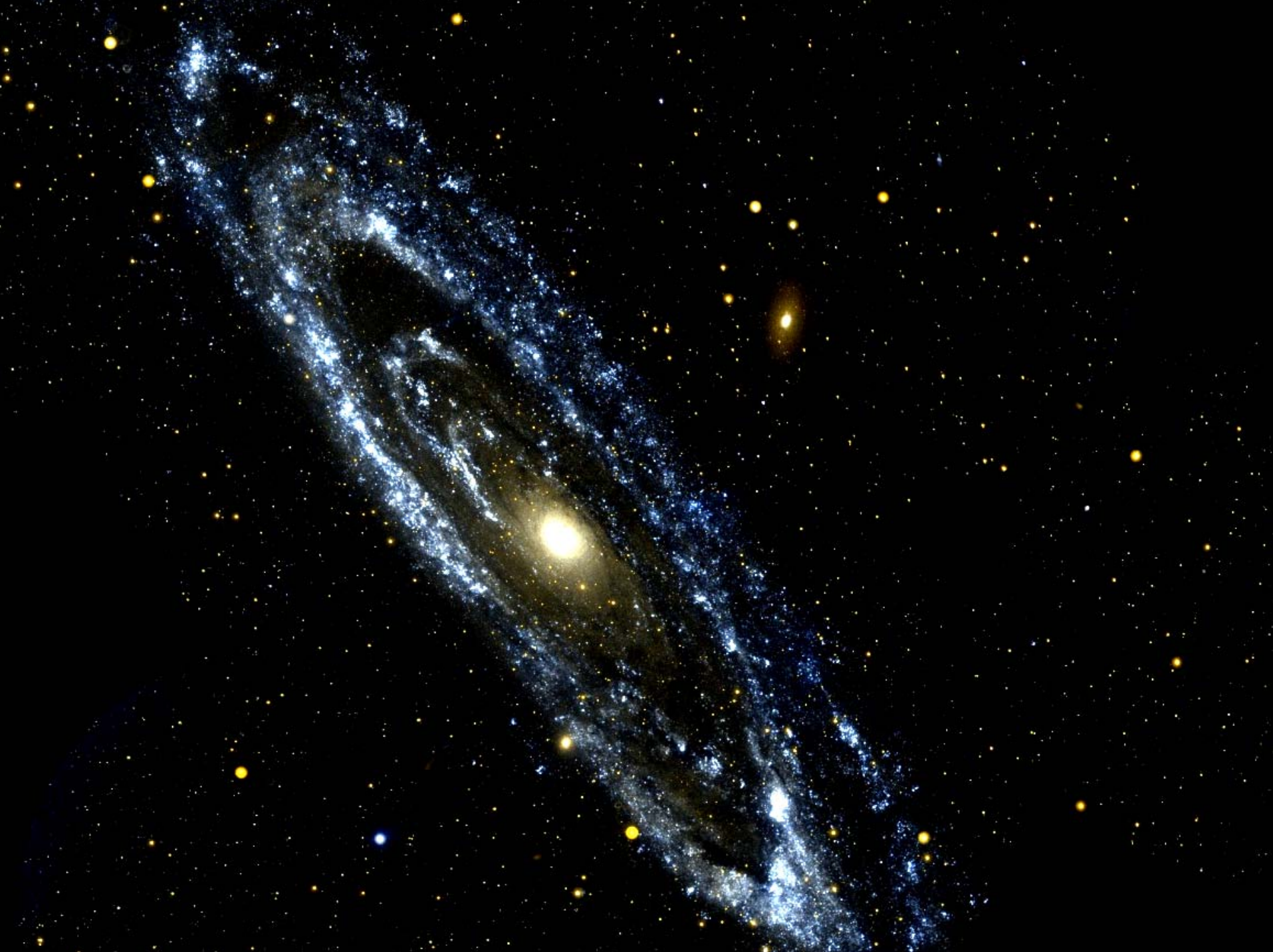
grand design arms without regular spacing of complexes - due to high SFR?

6 observed SNe

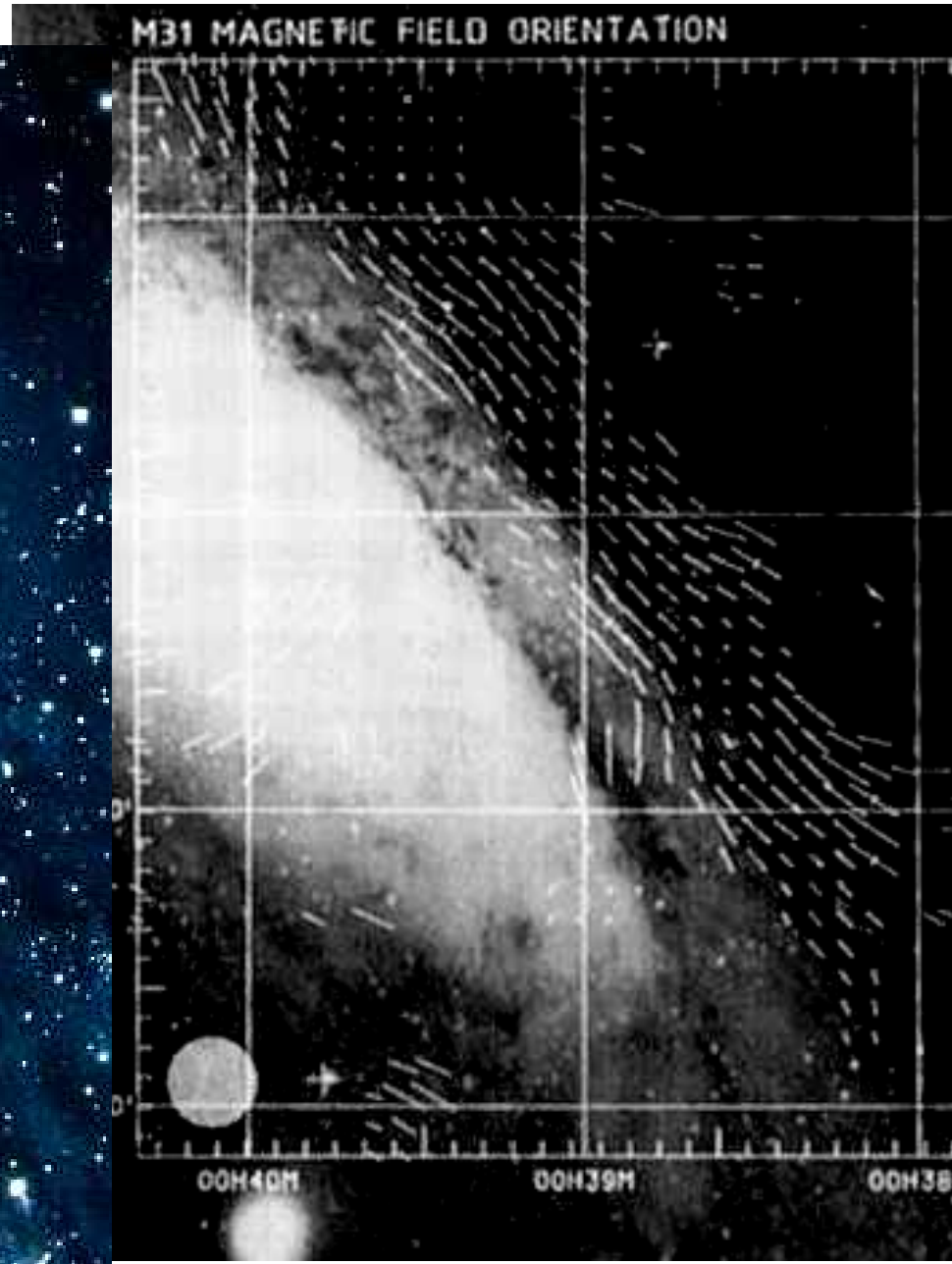
The **regular spacing suggests the origin of complexes in the density wave arms** ***under*** **large scale grav. -magnetic instability** (Elmegreen, 1994; Franco et al., 2001) along the arms

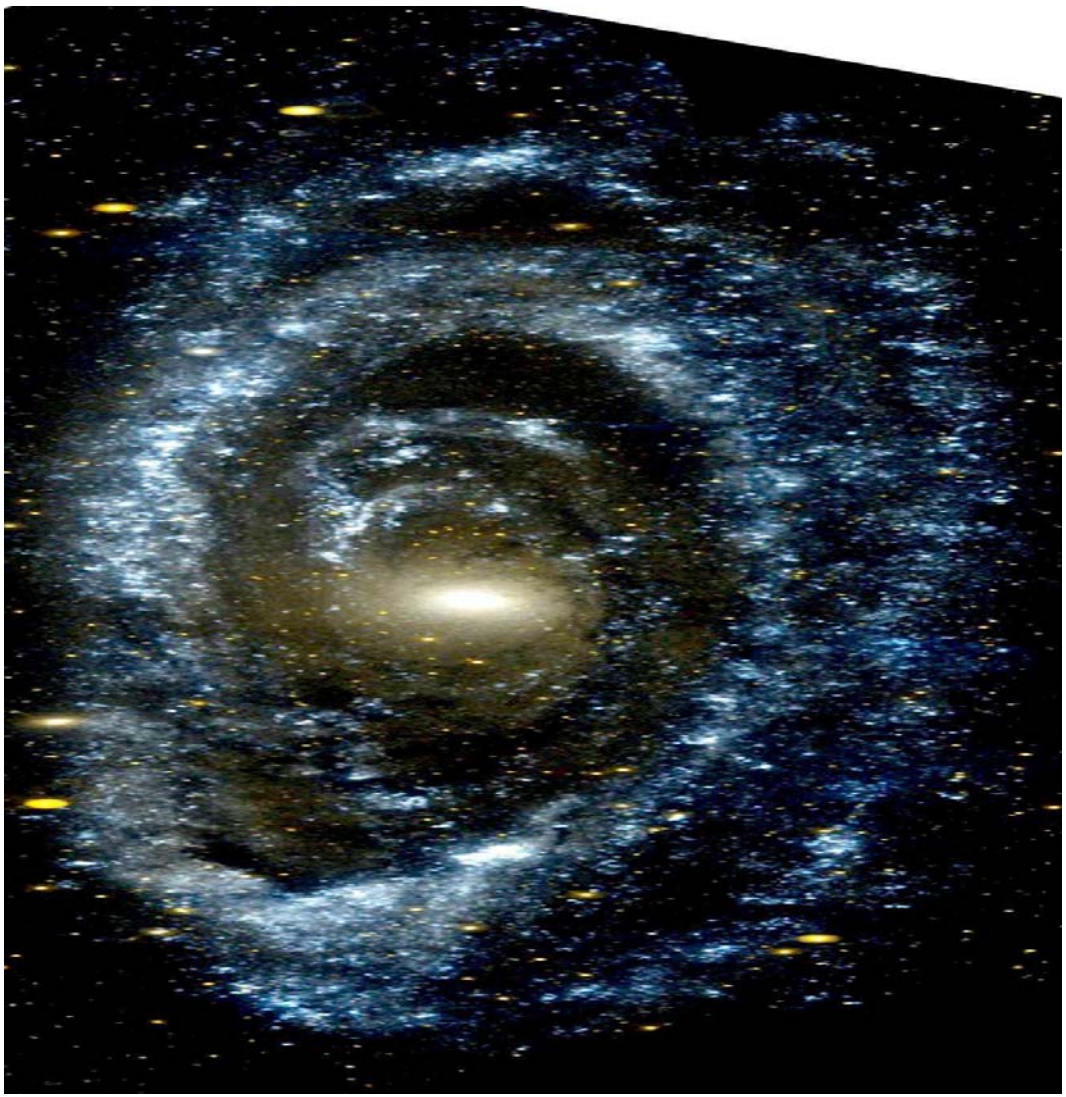
M31 and the MW galaxies have the regular magnetic field along the optical arms and the regular spacing of complexes. The wave-like in Z-coordinate appearance of the arms in MW (Alfaro et al., 1992; Berdnikov & Efremov, 1993) is in agreement with grav.-magnetic instability origin. Also, in NGC 6946 where magnetic arms are between optical ones, there is no discrete complexes in the arm. Both phenomena may be connected with the active star formation within optical arms.

Most galaxies have no even quazi-regular spacing of complexes - no regular field along arms?






M31 MAGNETIC FIELD ORIENTATION
00H40M
00H39M
00H38



M31 on pole

GALEX

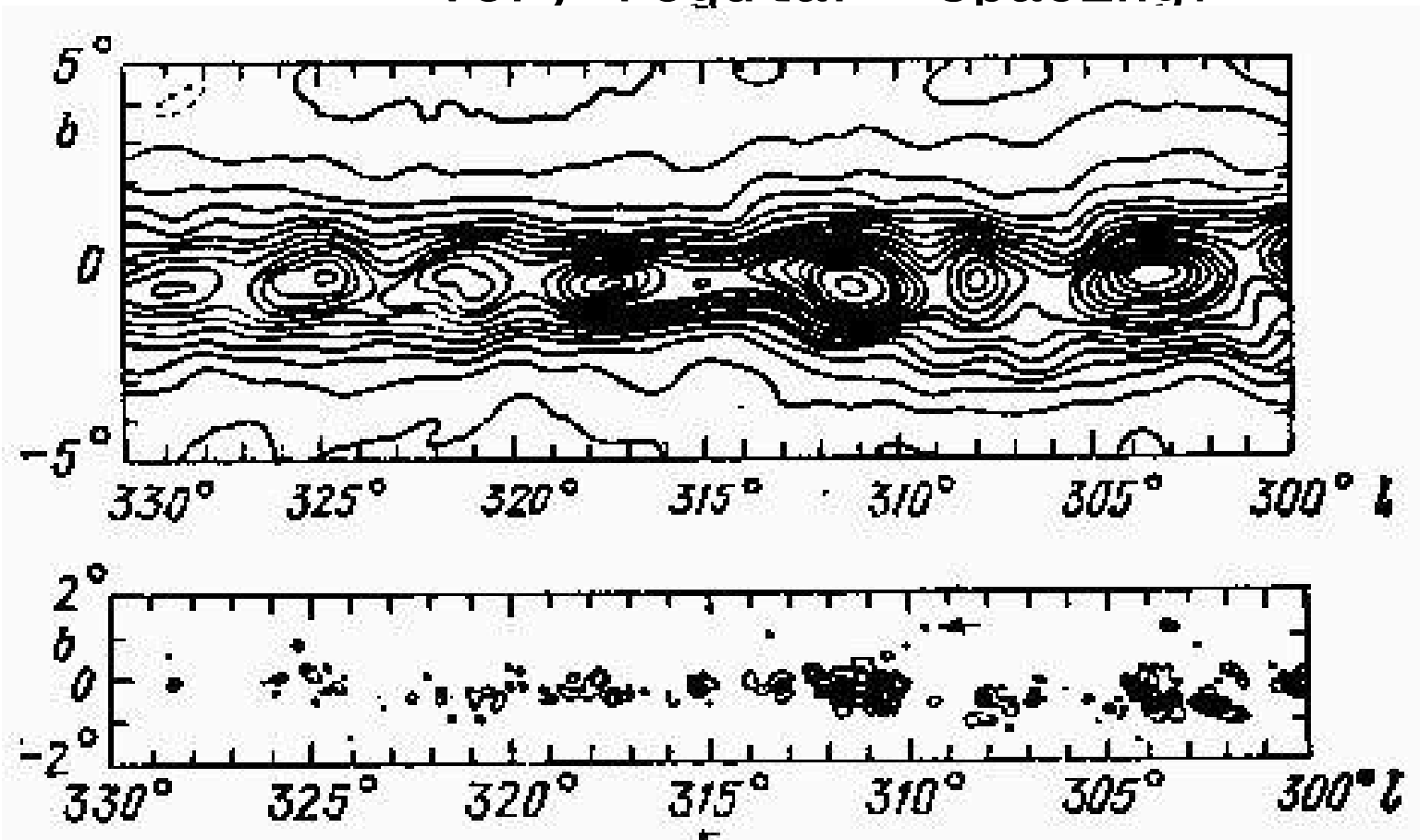
superassociation
OB78 = NGC 206

MW on sky - HI superclouds (top) and their CO cores (bottom)

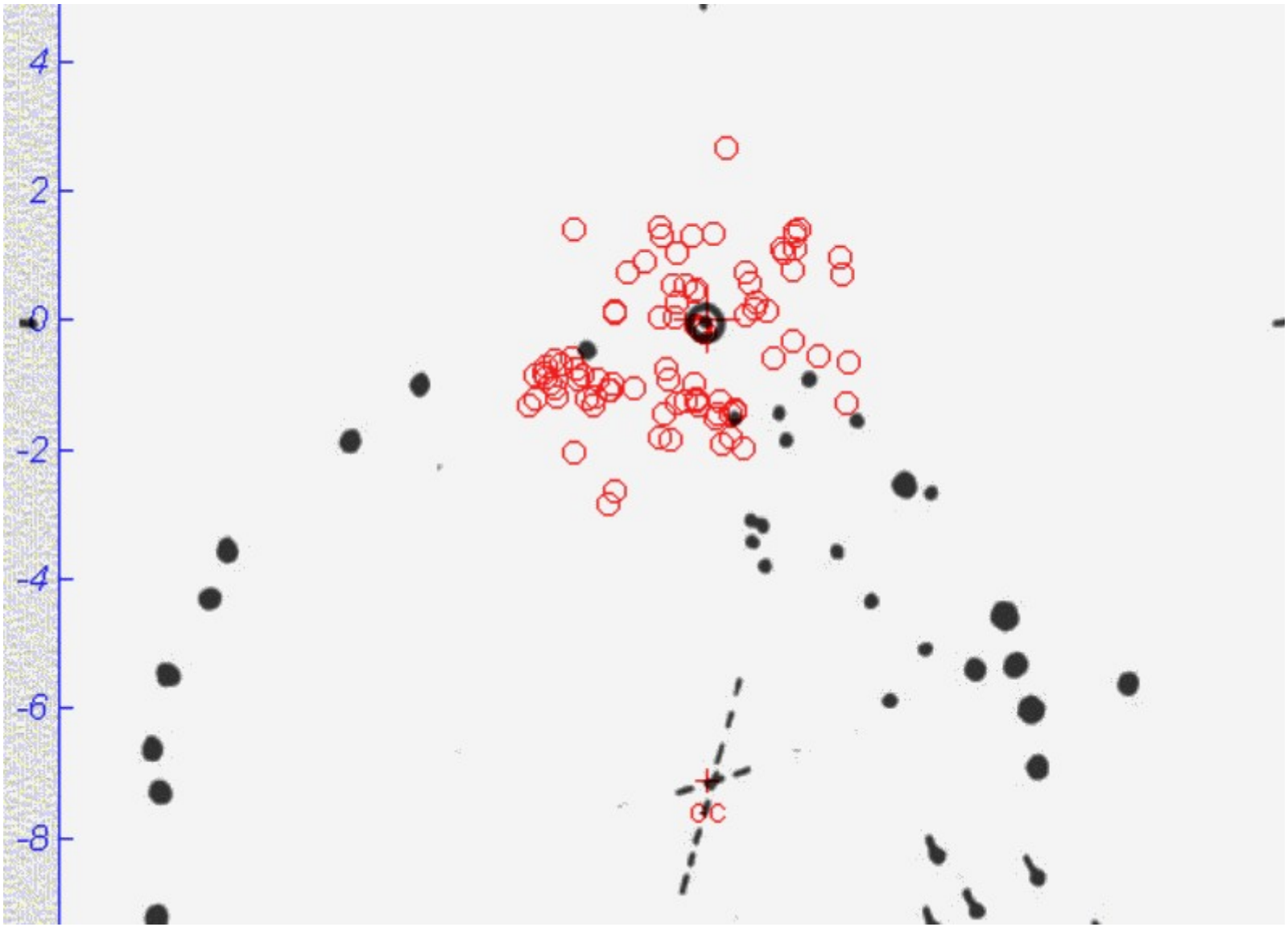
Grabelsky et al. (1988)

HI SC are always connected with star/cluster complexes

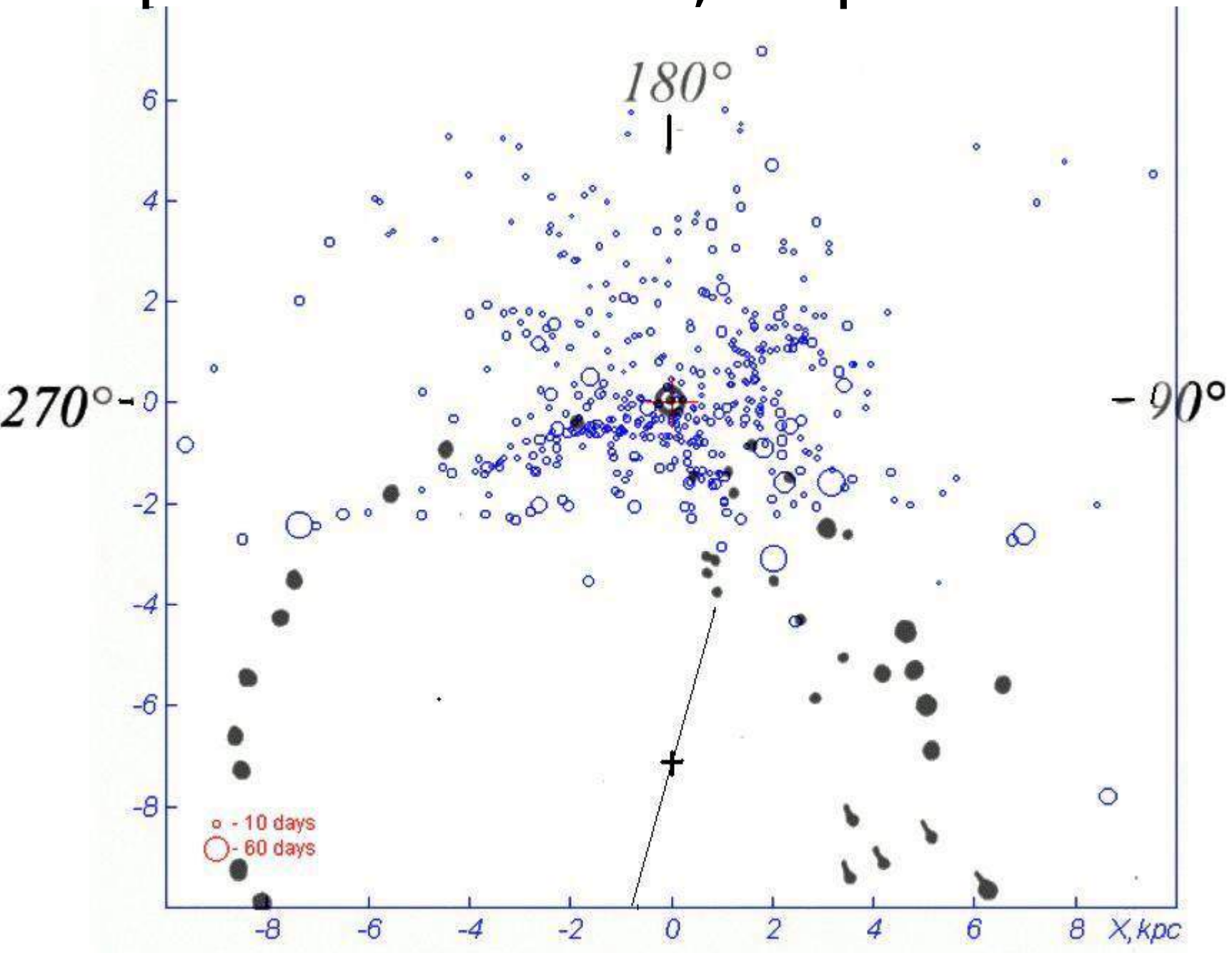
Very regular spacing!



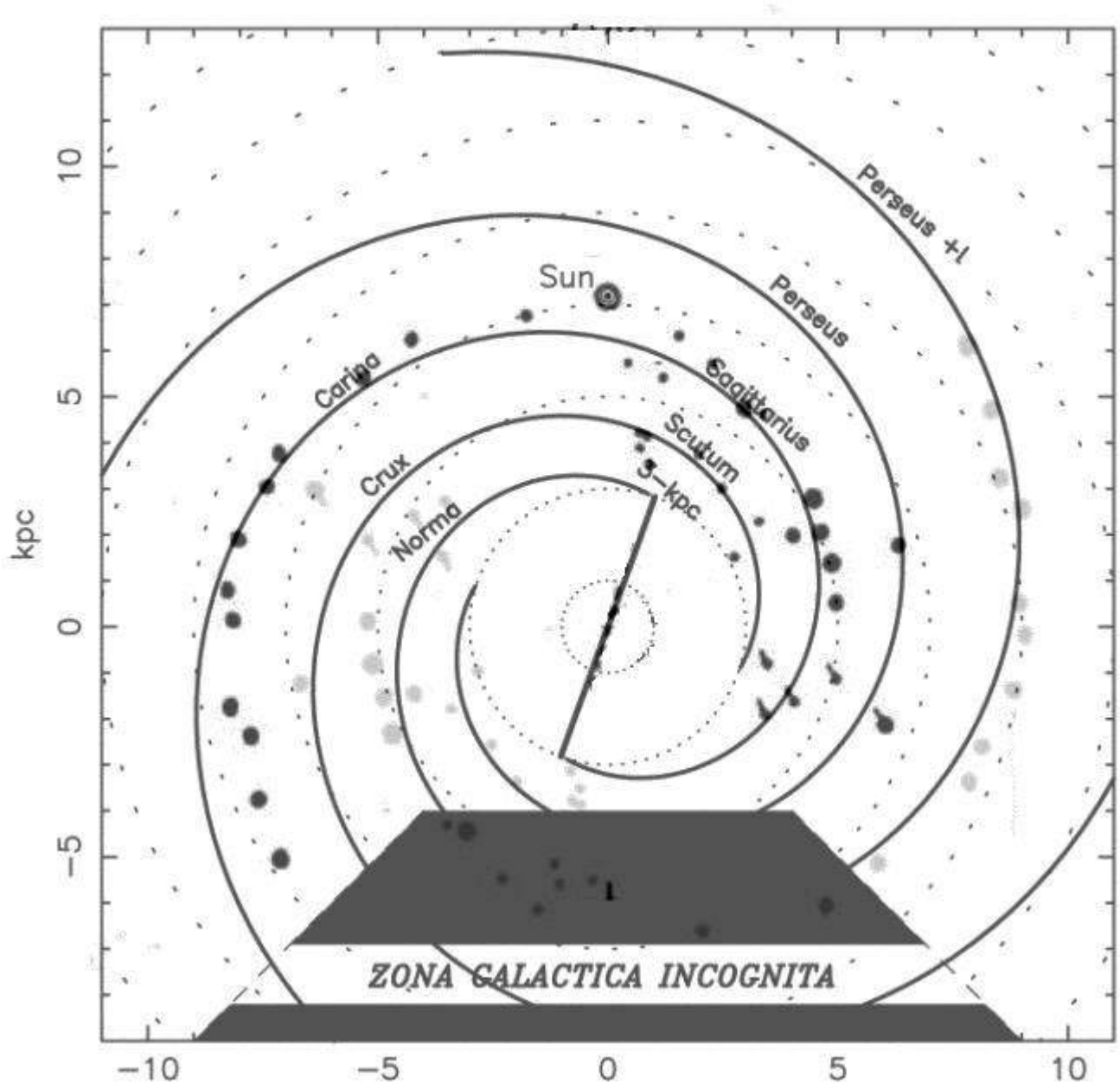
MW plane - HI superclouds (black) and OB-associations (red)



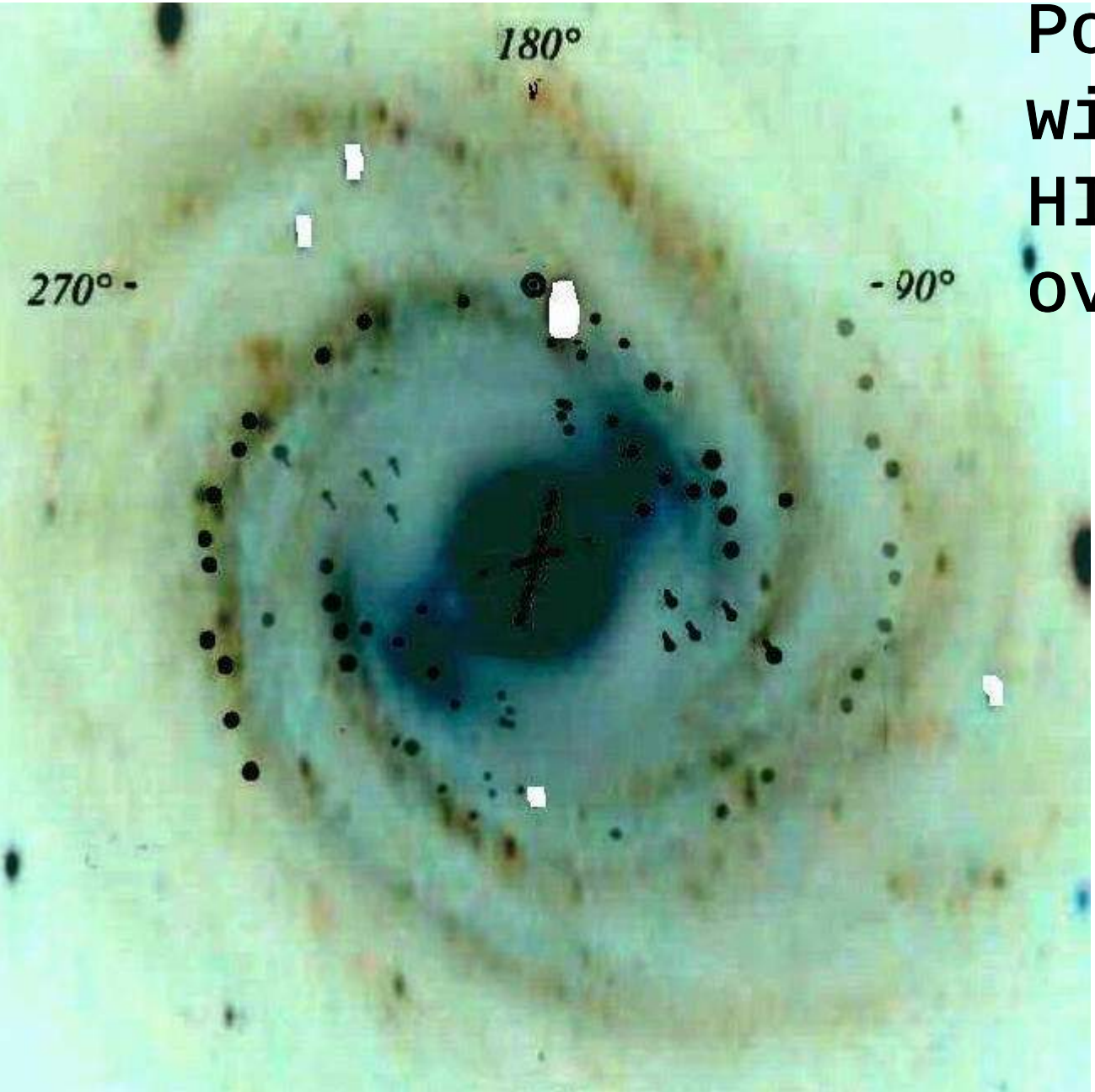
Mw plan with HI SC, Cepheids and bar



Vallee's MW plan with HI SC added



M109=NGC3992



Pole on,
with MW
HI superclouds
overlayed

M109, SB(rc)bc, and MW are twins

