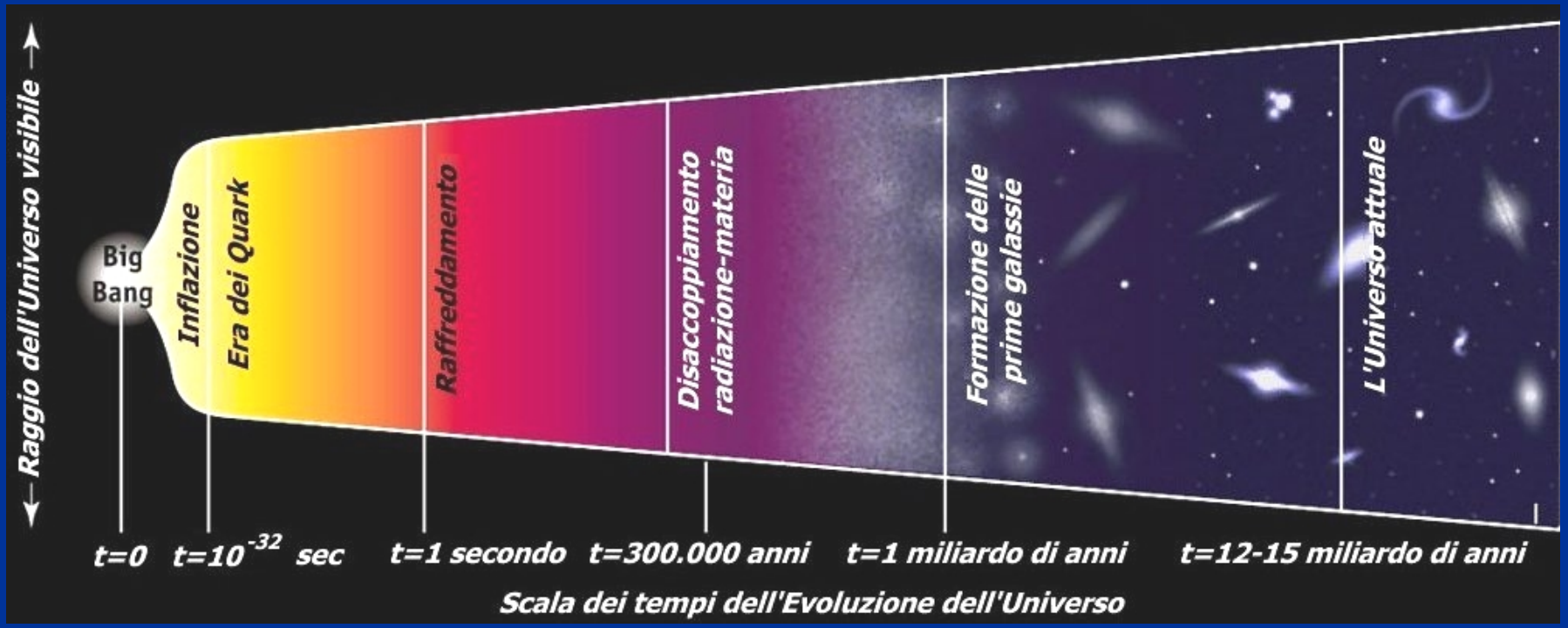
LE GALASSIE

Renzo Sancisi

INAF-Osservatorio Astronomico di Bologna

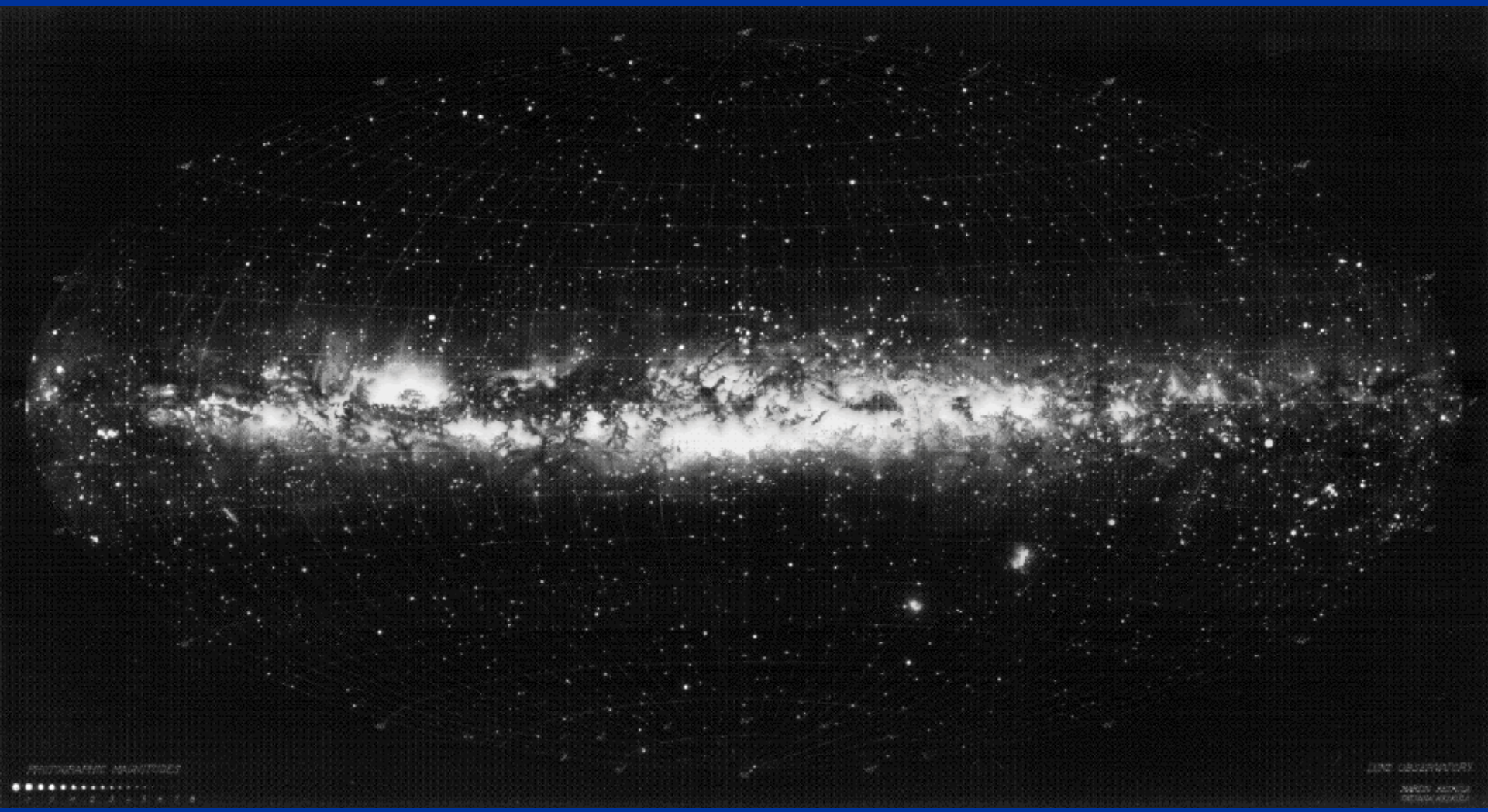
Kapteyn Institute, Groningen (Olanda)

Storia dell'Universo

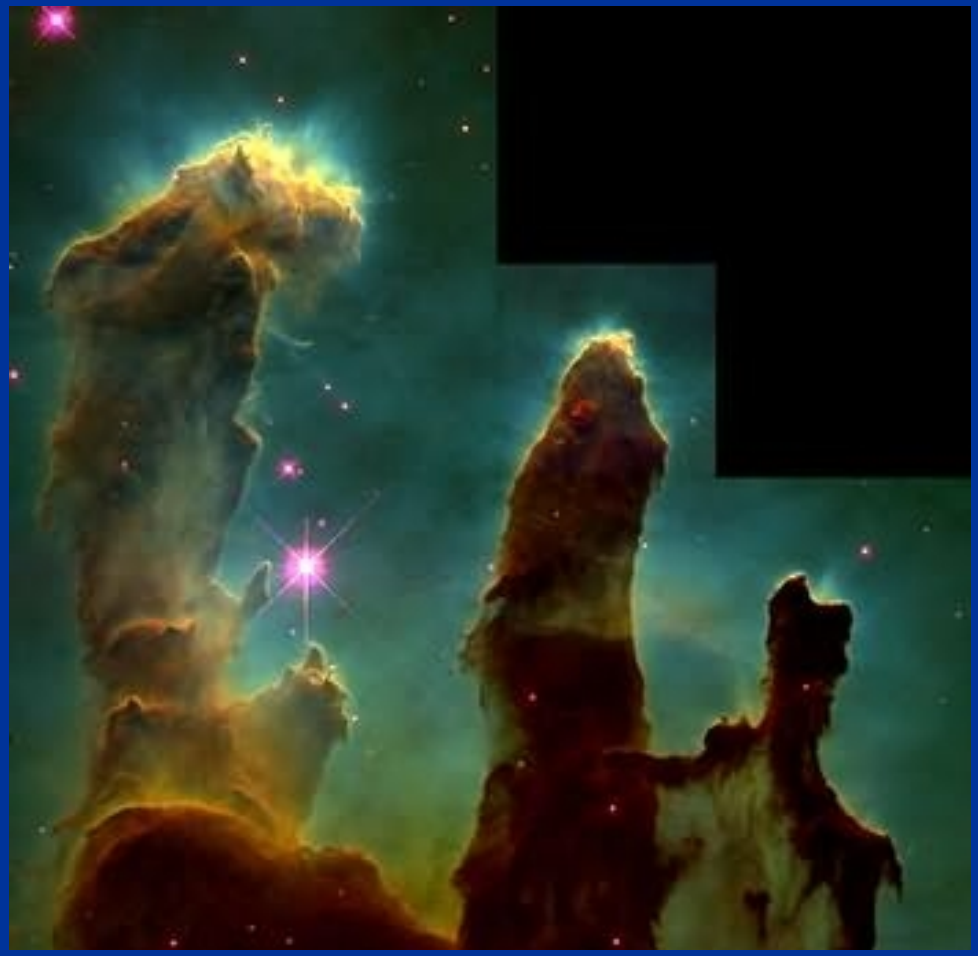


Il cielo di notte *La Via Lattea*

Via Lattea



Nascita di nuove stelle



Morte delle stelle

crab nebula

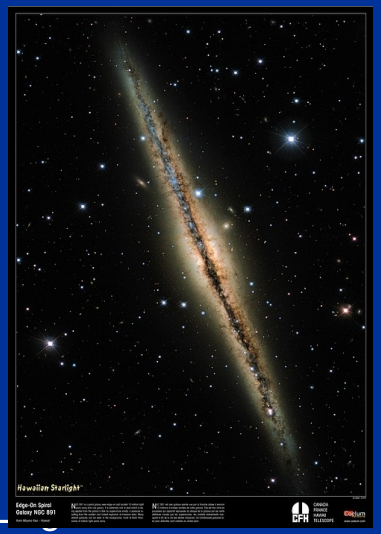
M 31 Andromeda

distante 2 milioni di anni luce

E. Hubble

Sterrewacht Leiden 1967

si passa dalla VIA LATTEA alle altre galassie


Hawaiian Starlight
Edge-On Spiral
Galaxy NGC 891
CANADA
FRANCE
HAWAII
TELESCOPE

ESO 510-13

galassia con warp

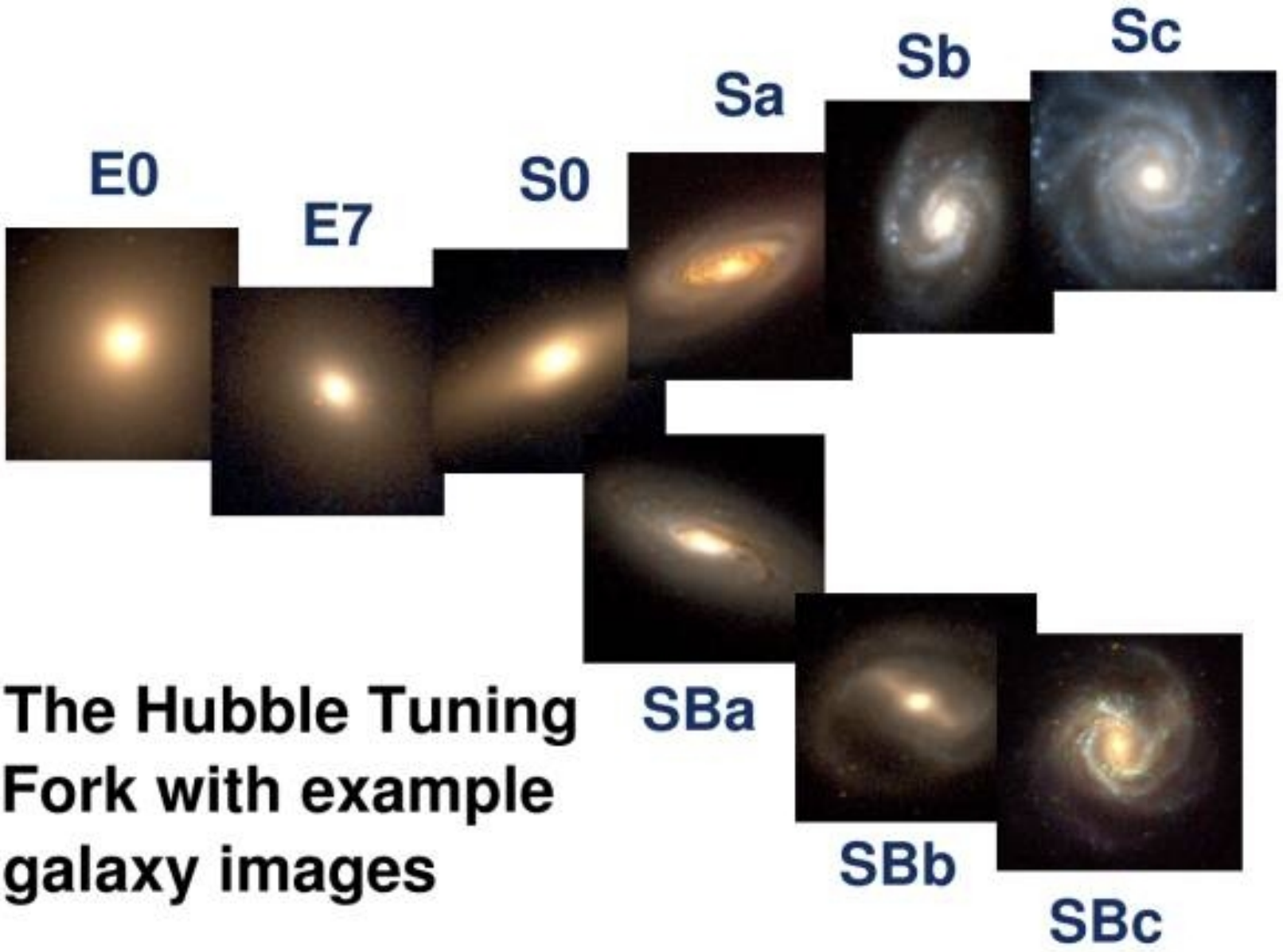
M 87

galassia ellittica

Cen A

ellittica pec.

Sequenza di Hubble



galassie in interazione gravitazionale

cannibalismo

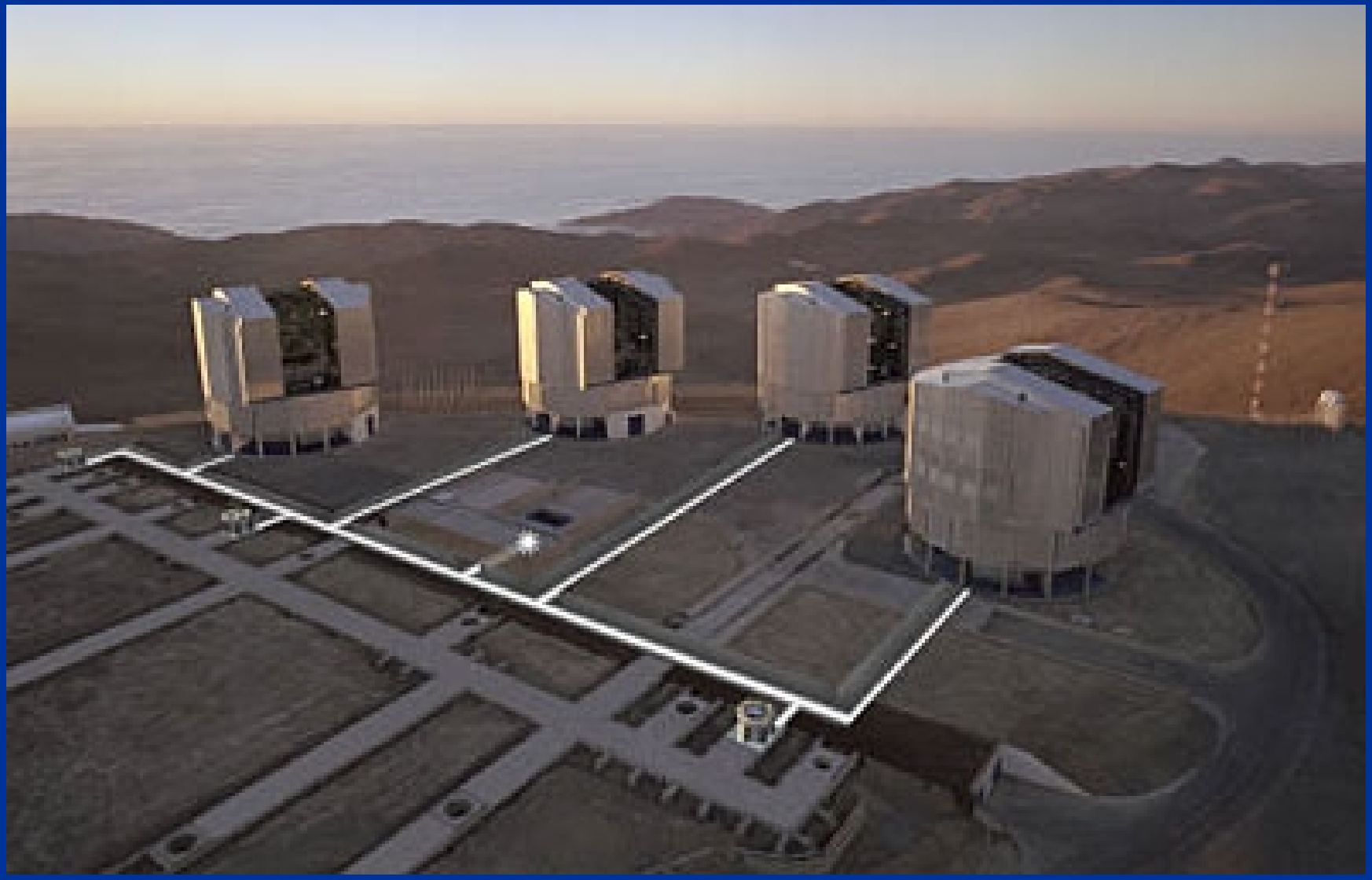
mergers

Coma

Ammasso *di galassie*

Abell 1689 ***ammasso*** *di galassie*

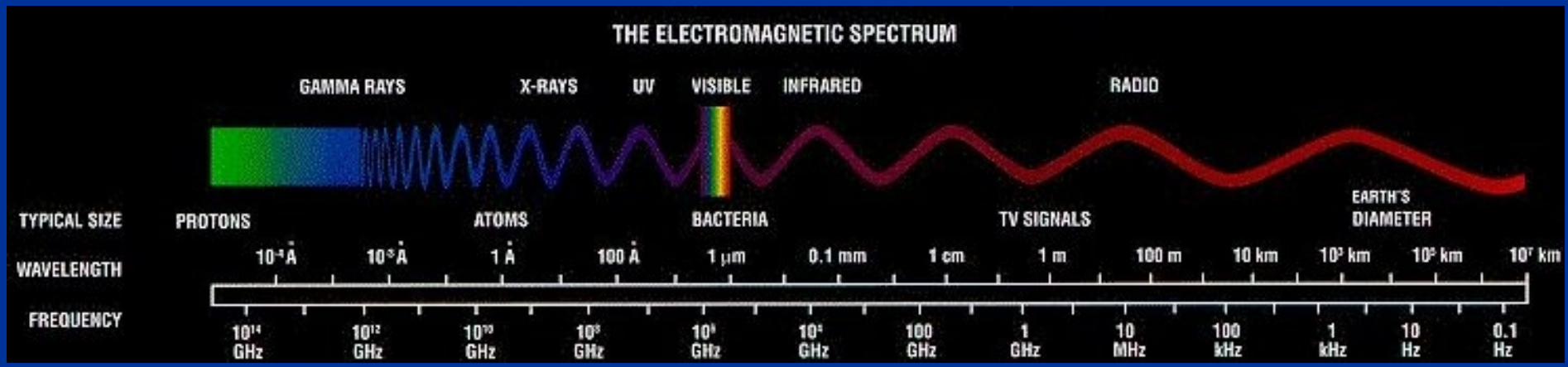
VLT *Paranal* Cile



Hubble Space Telescope

Hubble Ultra Deep Field

Allargamento
a tutto lo spettro elettromagnetico



nuove tecnologie ***- radiotelescopi***

- satelliti X, IR, UV

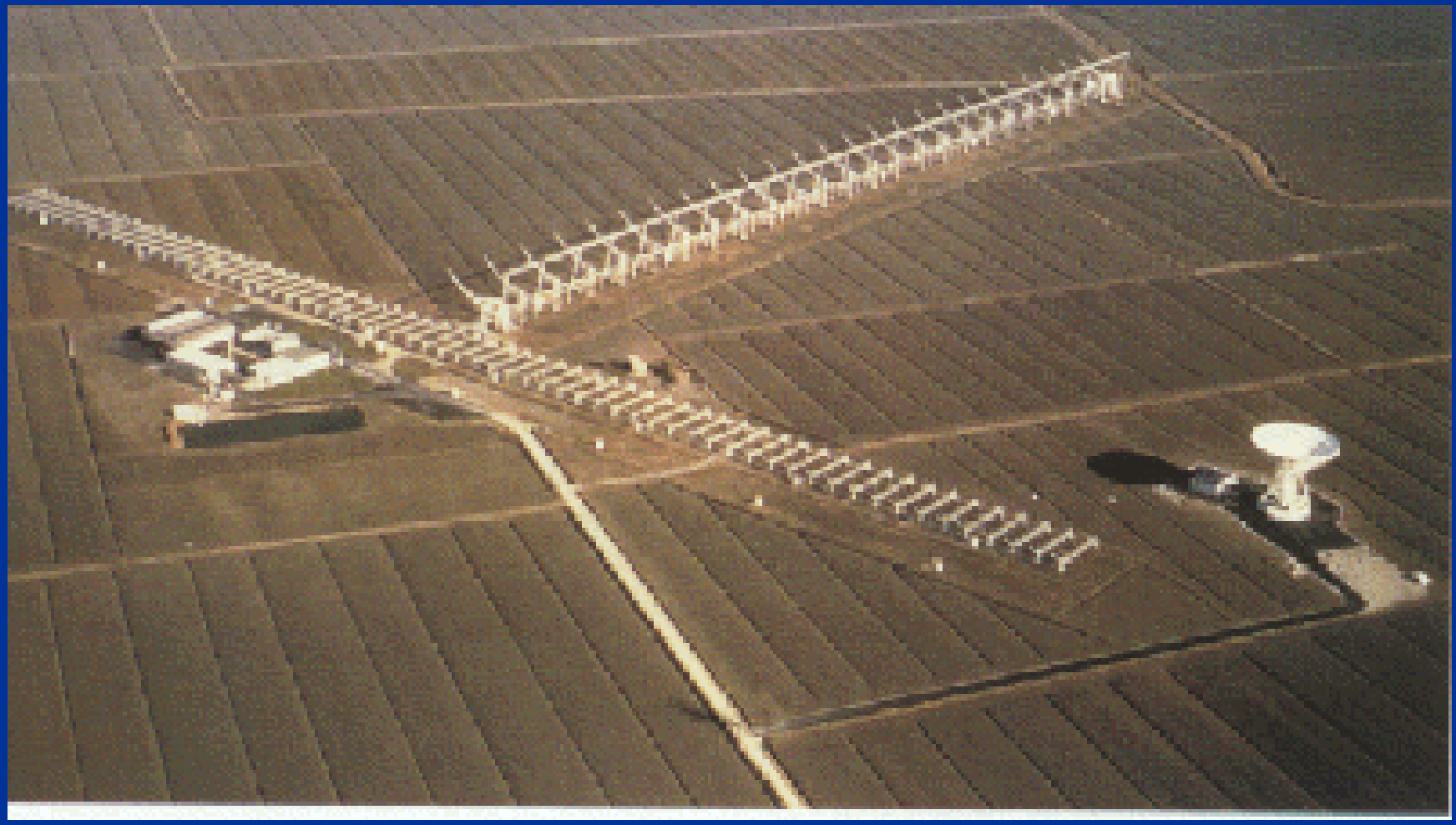
RADIO telescopio

VLA

New Mexico

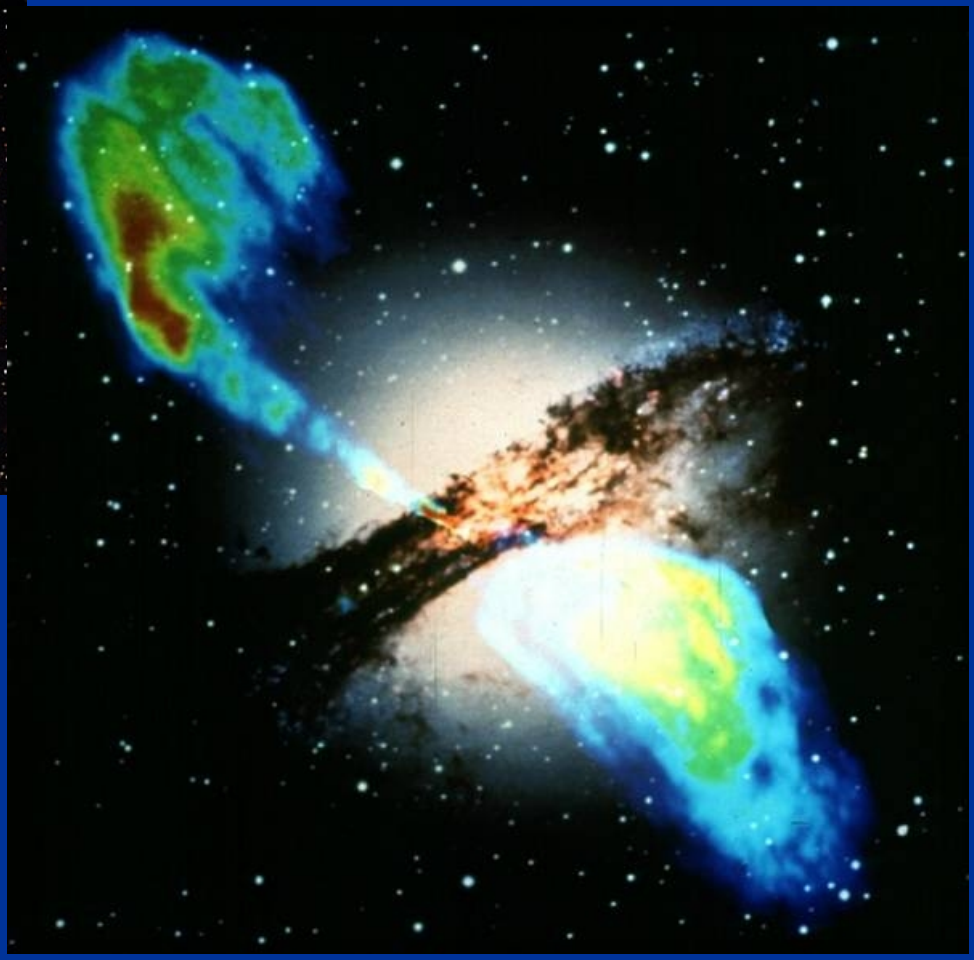
Radio telescopio di Westerbork (Olanda)

Radiotelescopi di Medicina

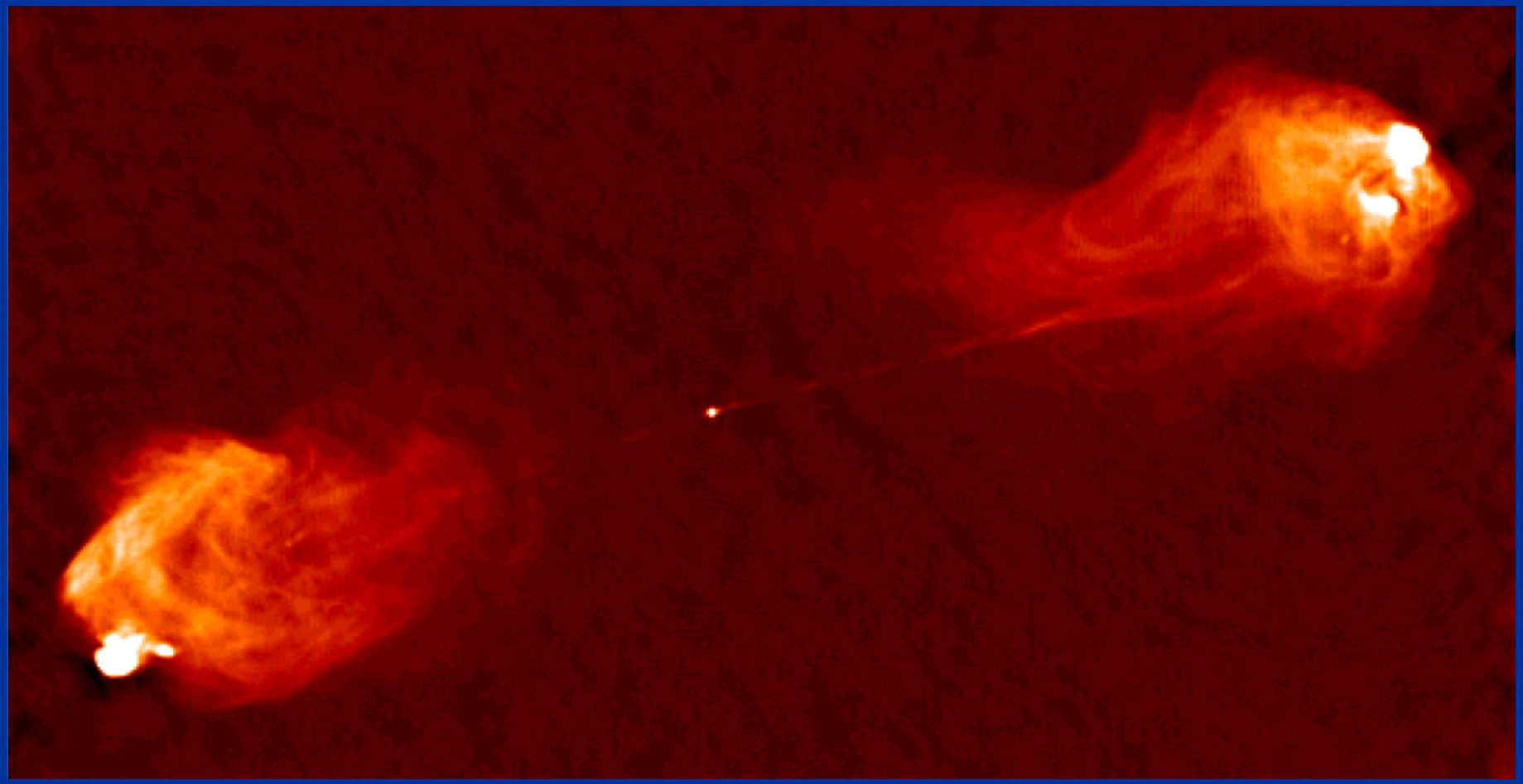


CenA *galassia ellittica*

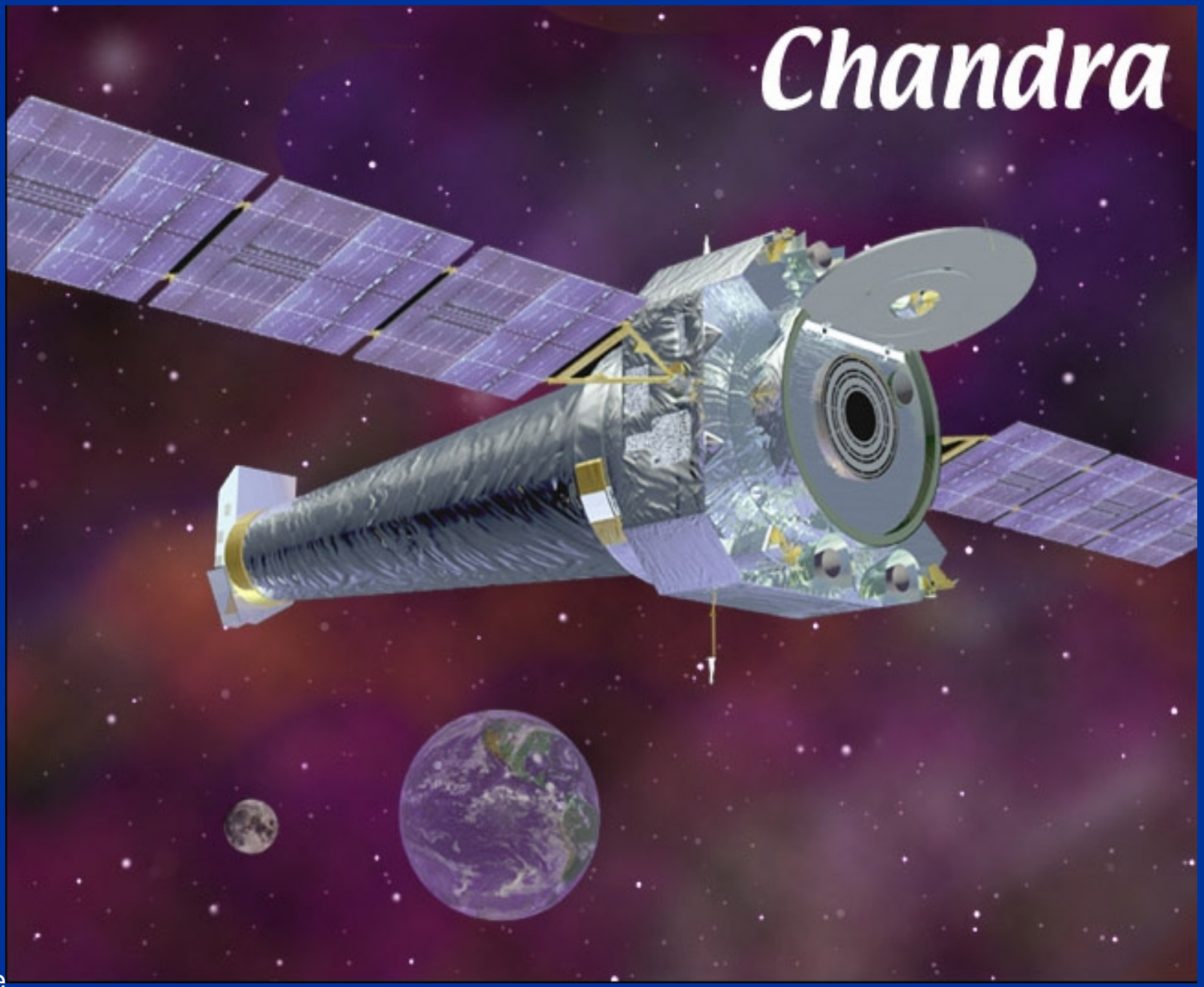
radio



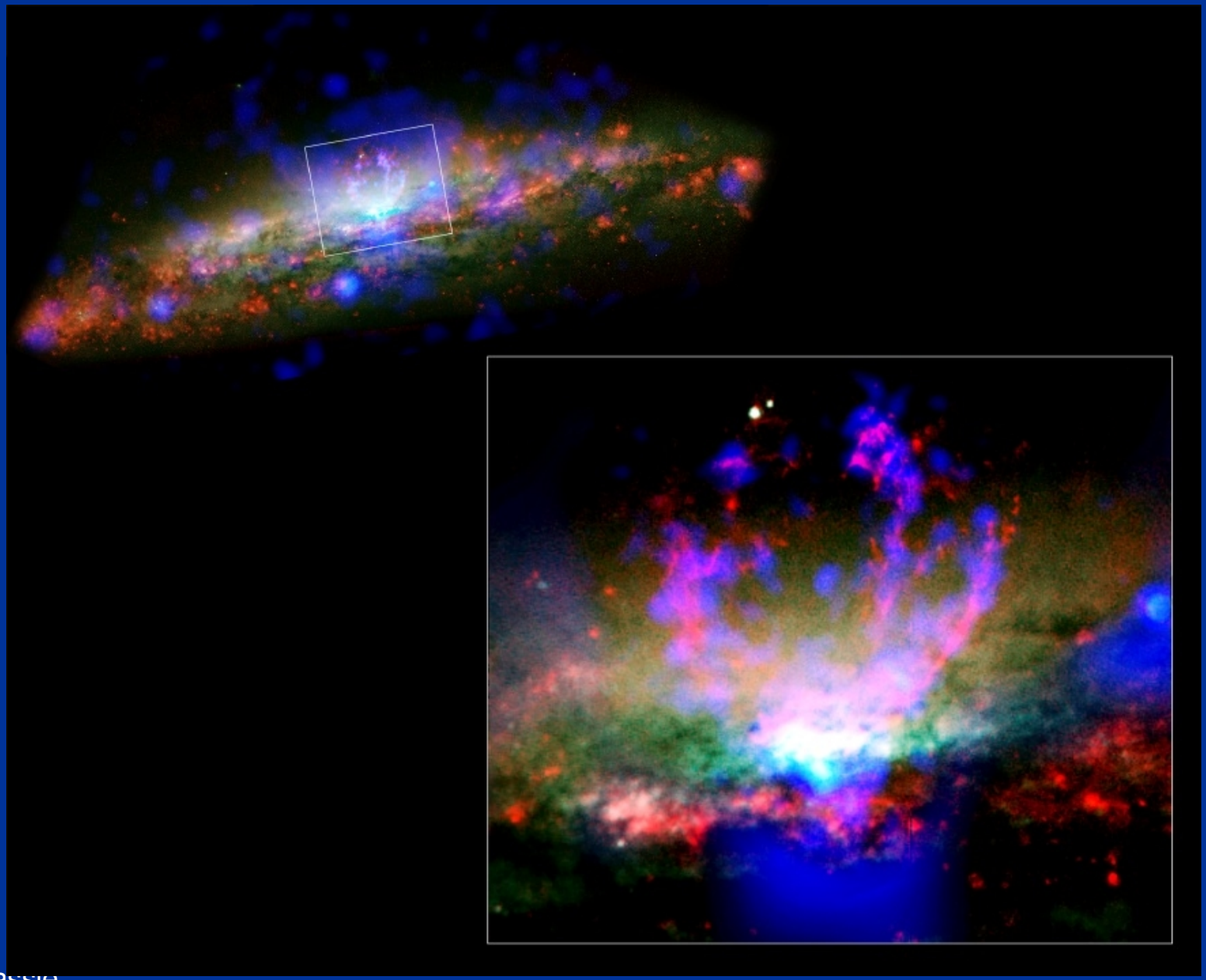
Cyg A *radiogalassia*



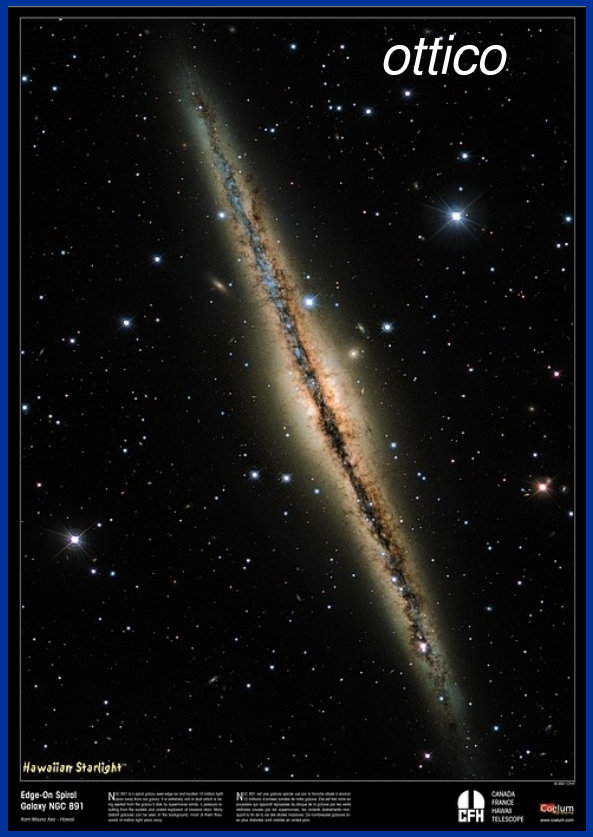
Telescopio X



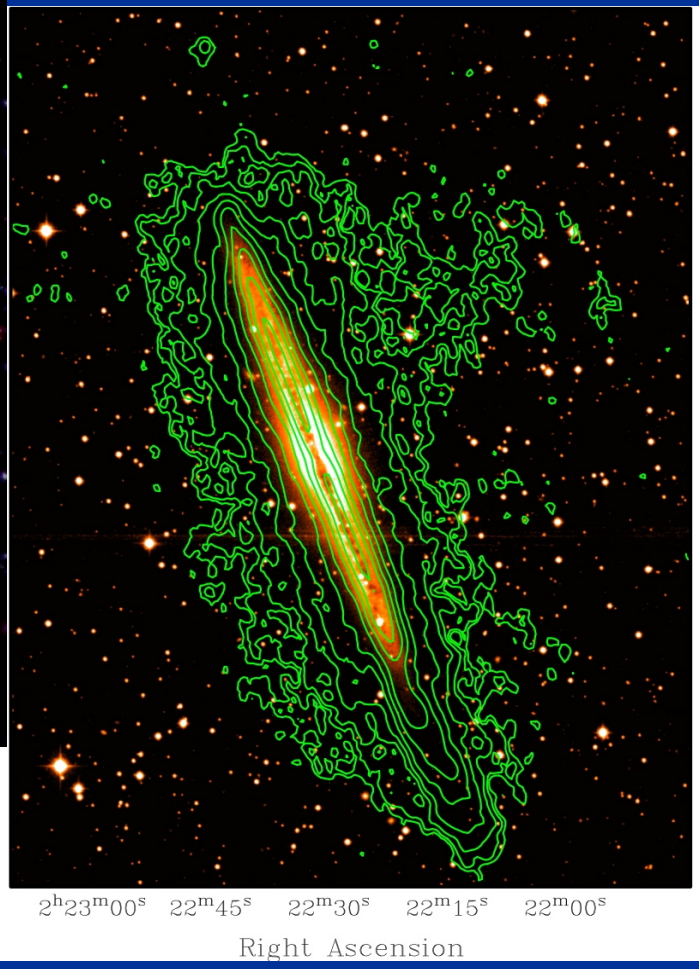
NGC 3079 *immagine x e ottica*



NGC 891 *galassia edge-on*



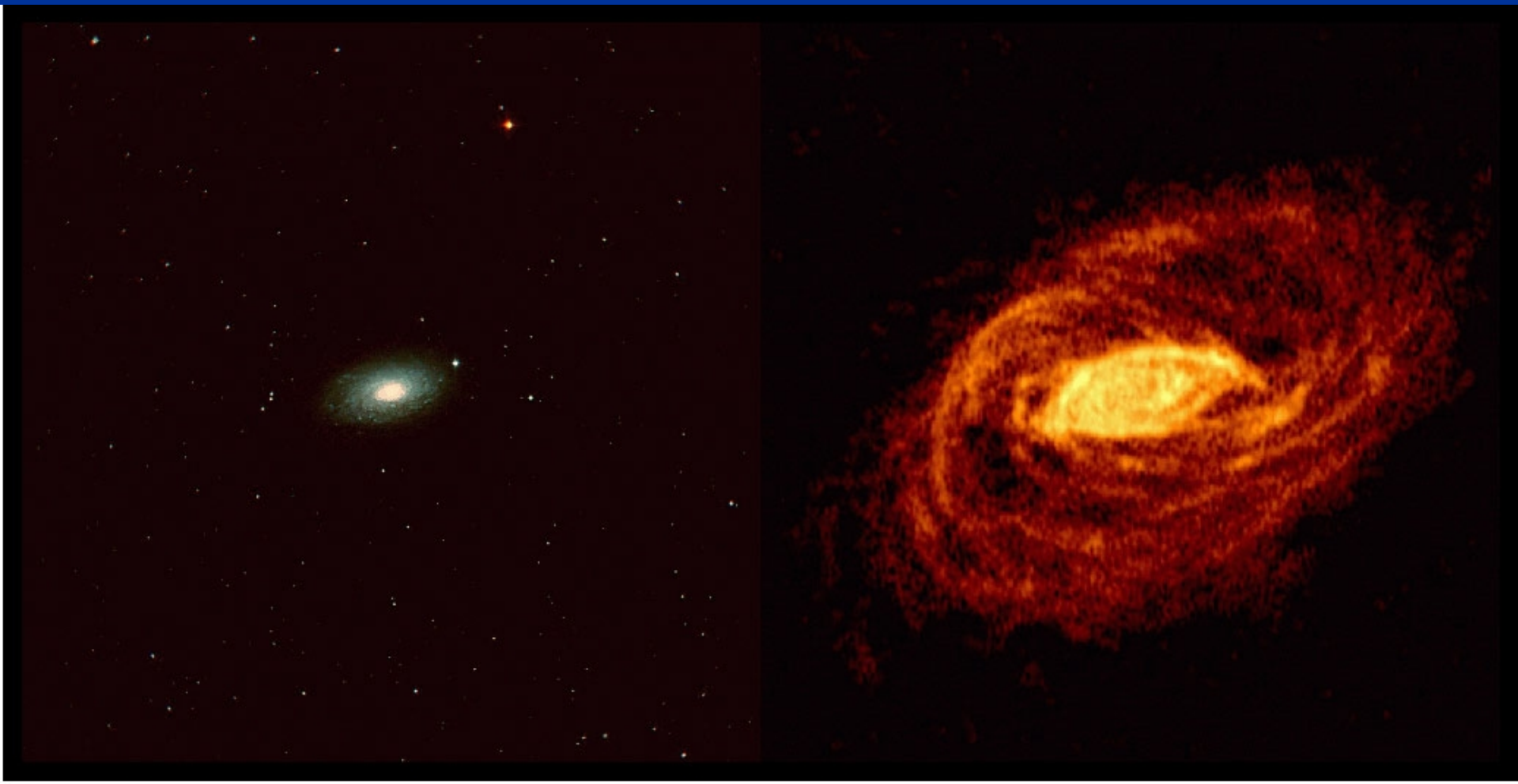
idrogeno neutro (riga 21 cm)



NGC 5055

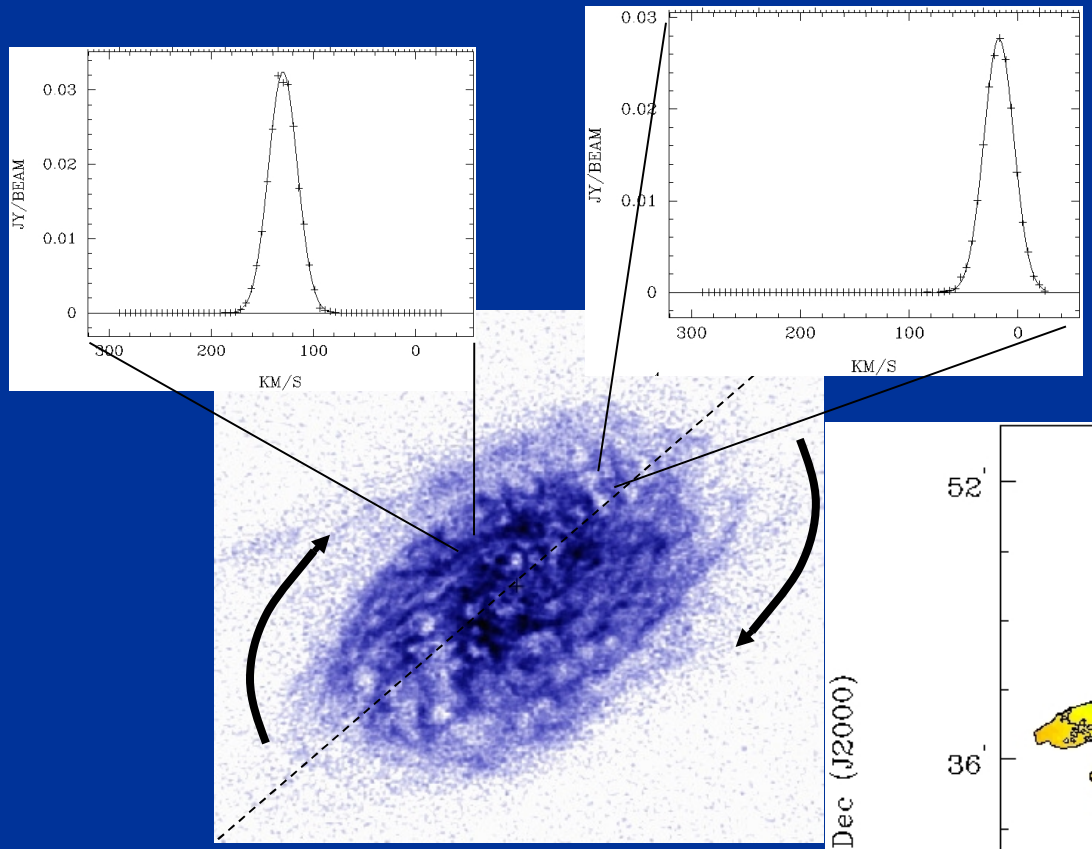
Immagine ottica

idrogeno neutro



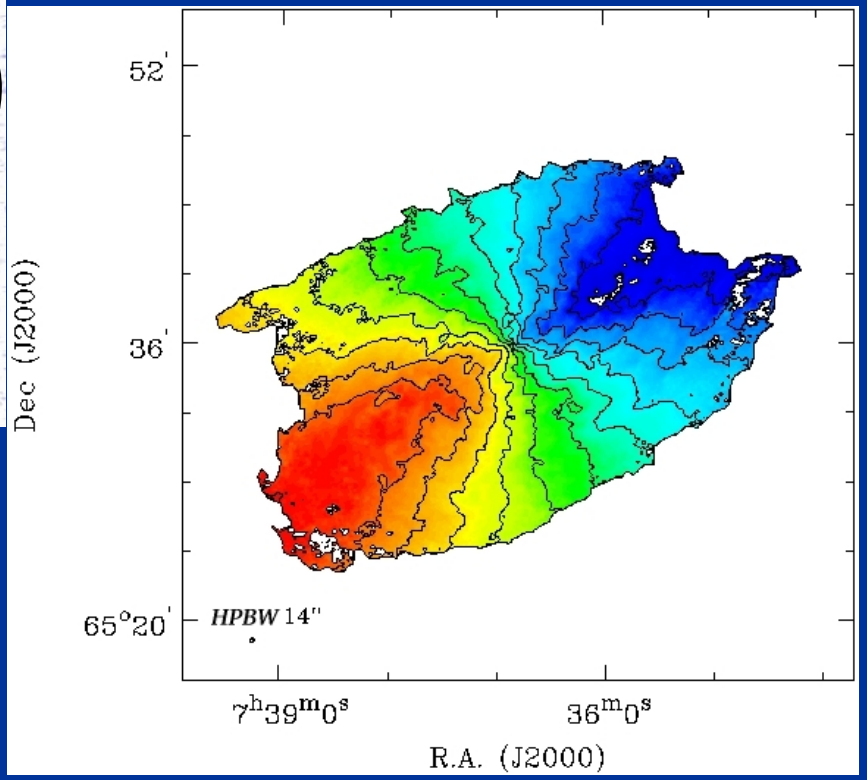
stessa scala

IDROGENO NEUTRO (riga 21 cm)



Informazione sulla dinamica

campo di velocita'

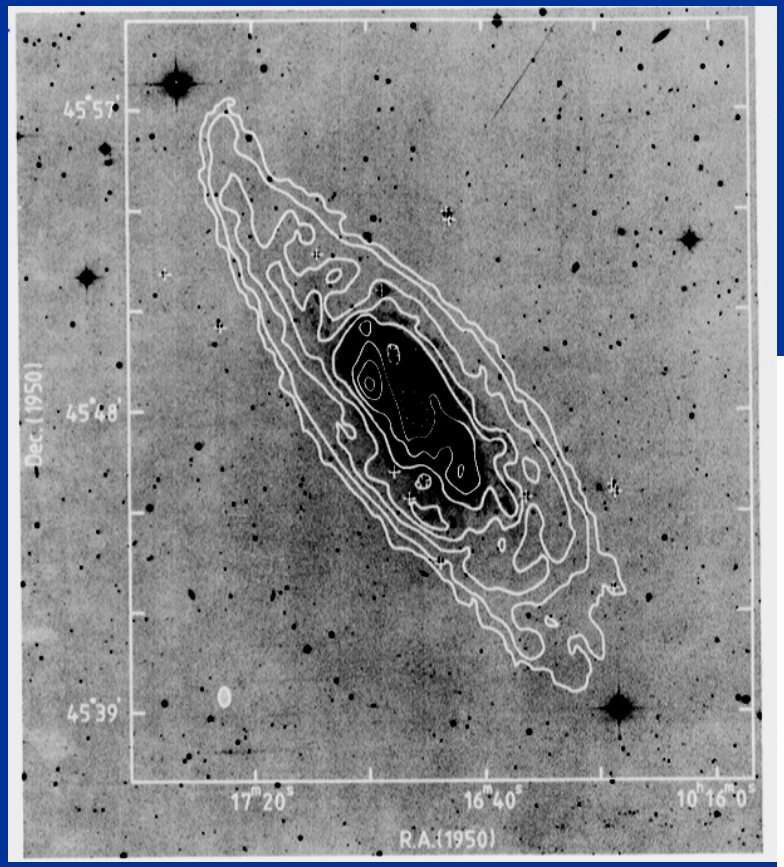


rotazione:

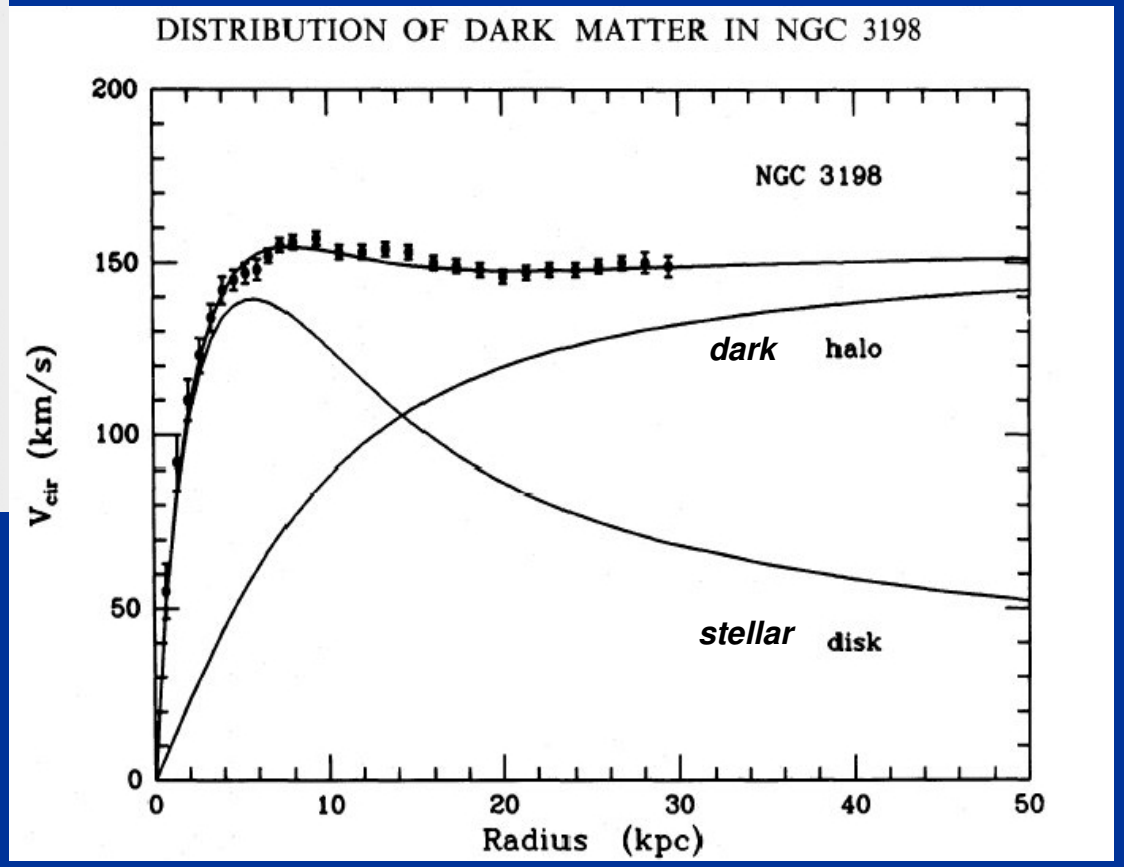
rosso - si allontana

blue - si avvicina

NGC 3198 *idrogeno neutro (riga 21 cm)*



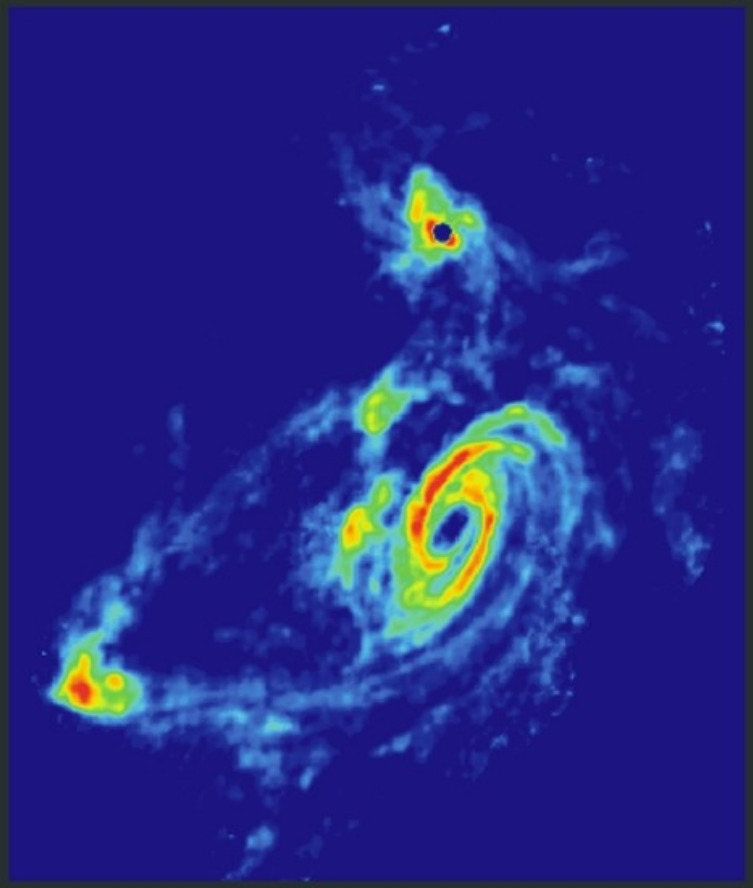
CURVA di rotazione



TIDAL INTERACTIONS IN M81 GROUP

Stellar Light Distribution

21 cm HI Distribution



Le galassie

MISTERI:

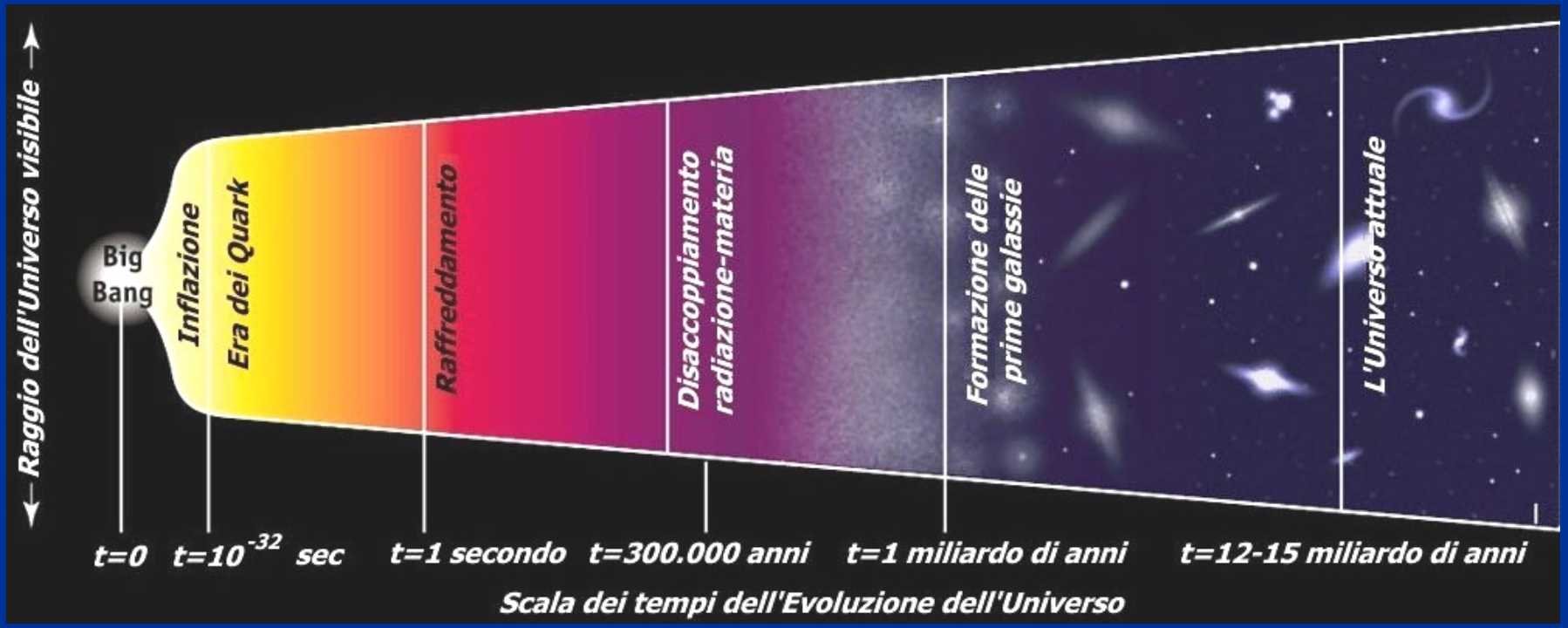
1. *COME SI FORMANO*
2. *COME SI NUTRONO*
3. *LA MATERIA OSCURA*

1. Come si formano

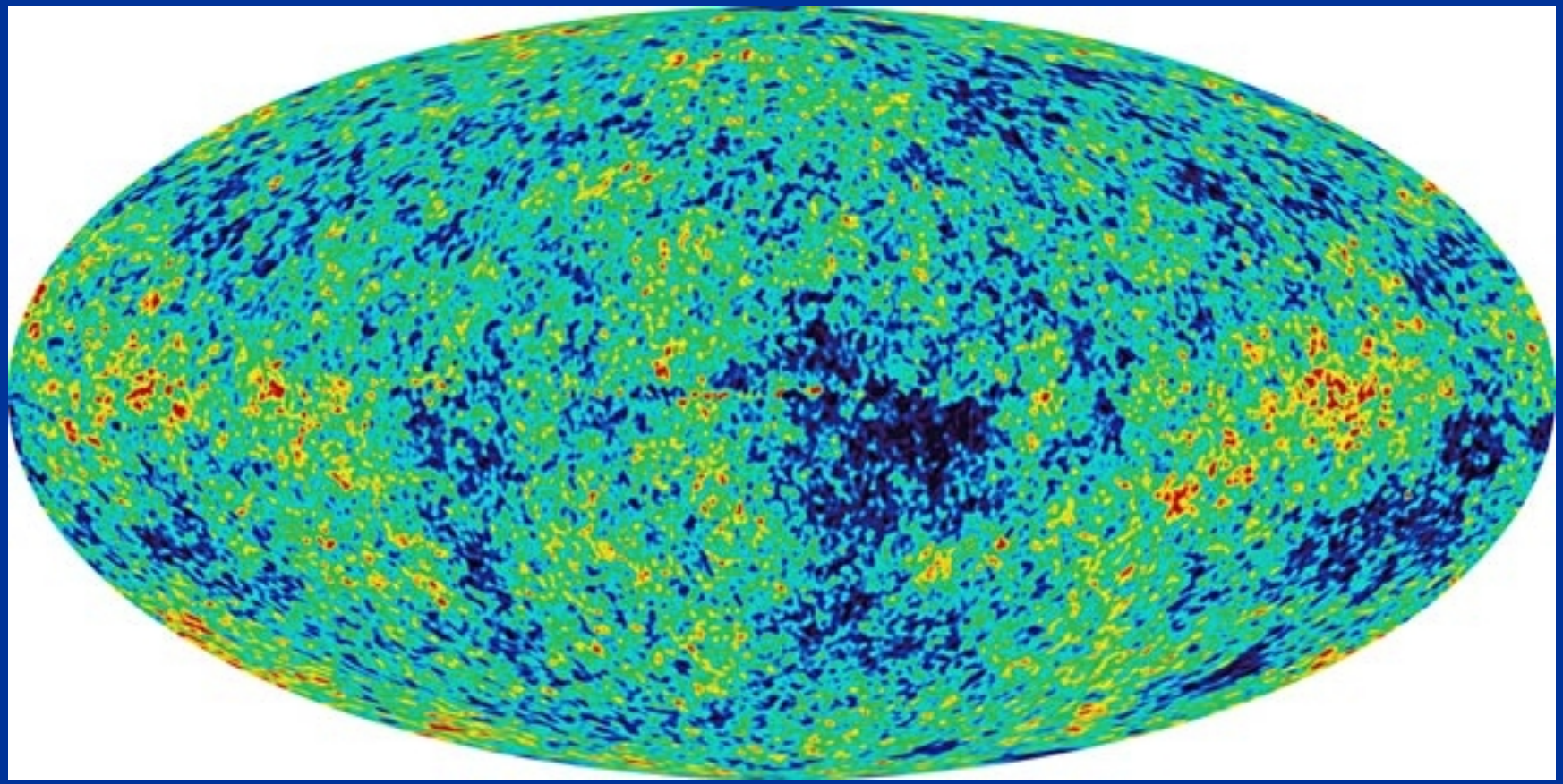
ipotesi monolitica

ipotesi gerarchica

Storia dell'Universo

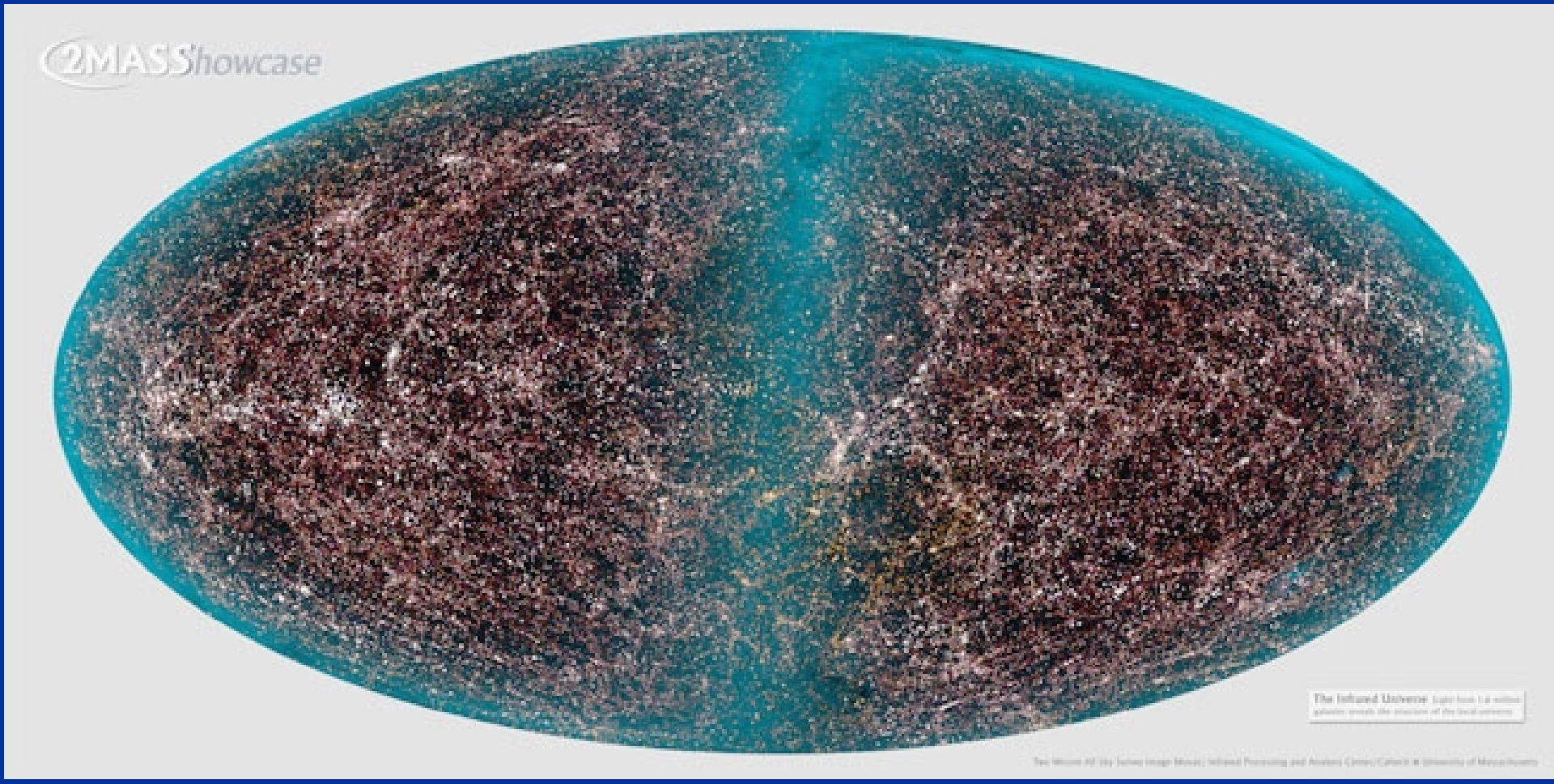


WMAP ***CMB*** *radiazione di fondo (2.73 gradi kelvin)*



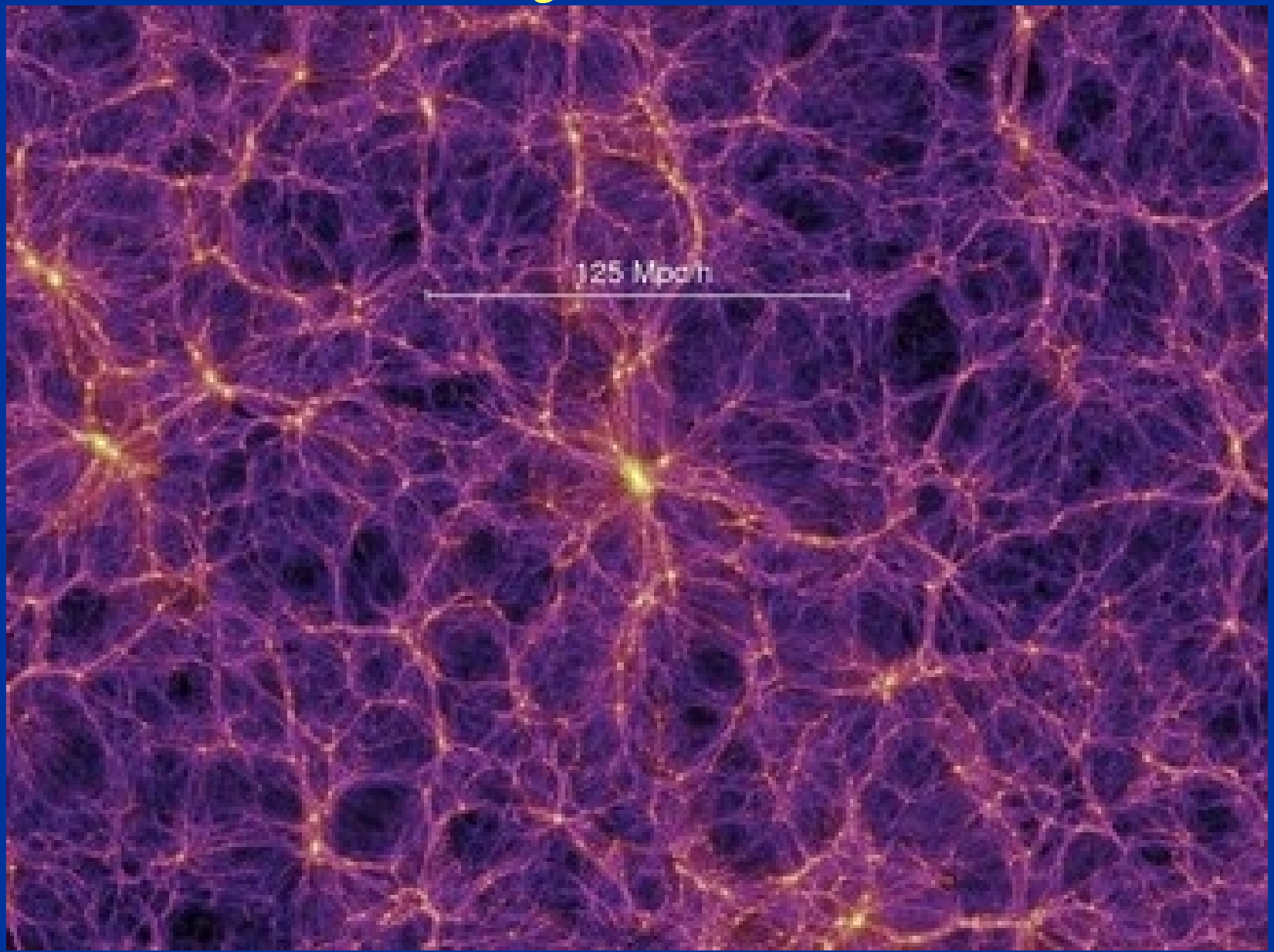
Un milione di galassie

Survey del cielo a 2 micron



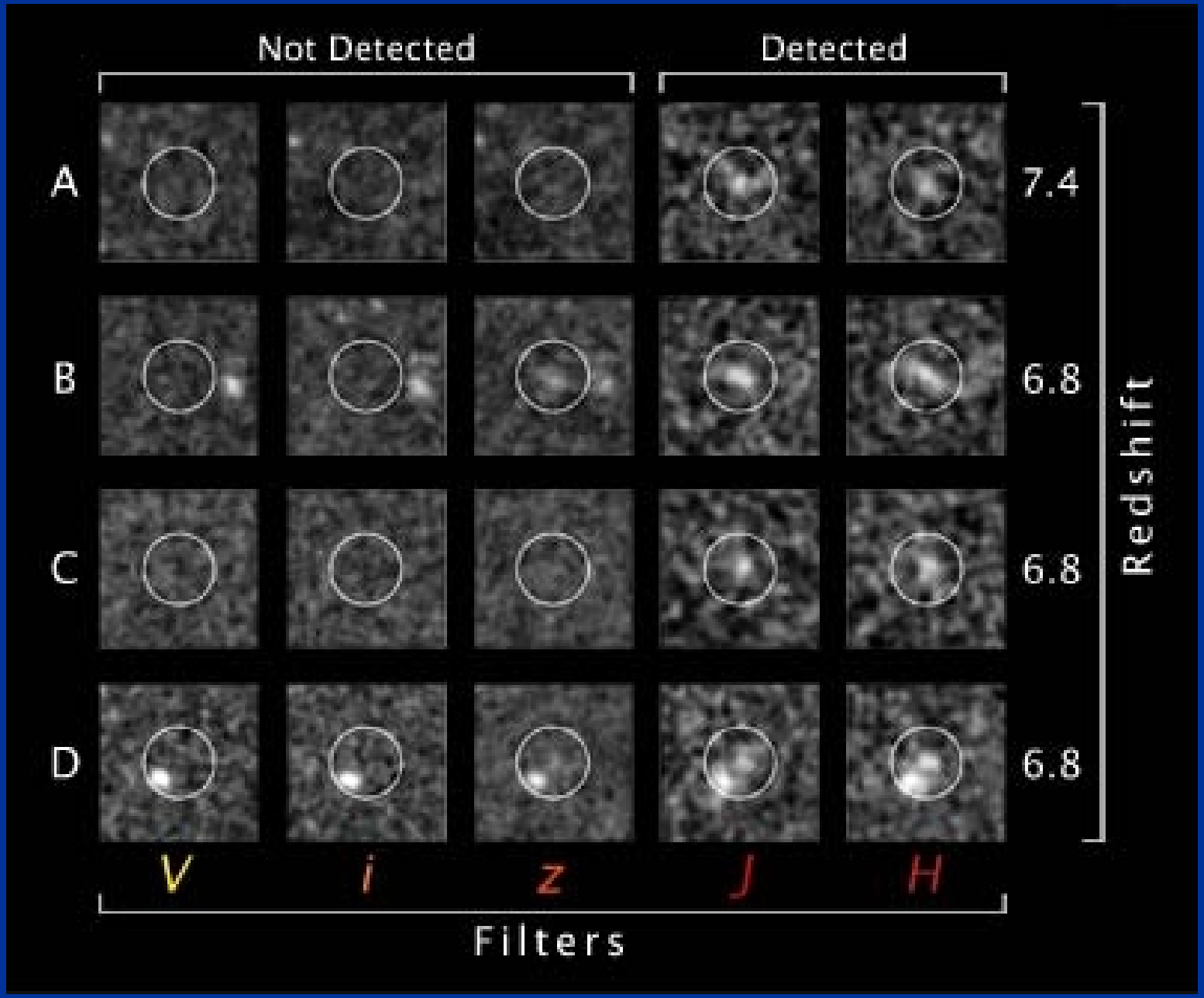
Formazione di strutture su larga scala

simulazione cosmologica "Millennium"



Le prime galassie

alto redshift



MISTERO:

- quando si sono formate?

- come?

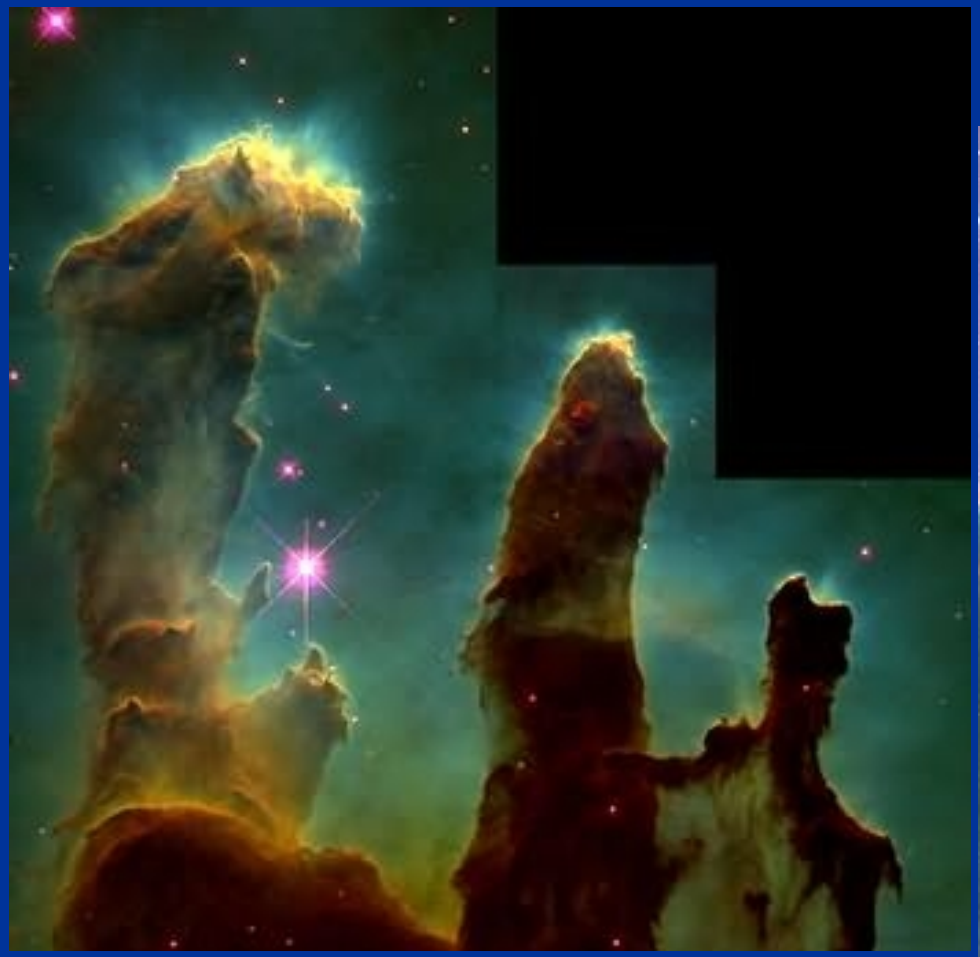
per aggregazione e merger?

processo monolitico?

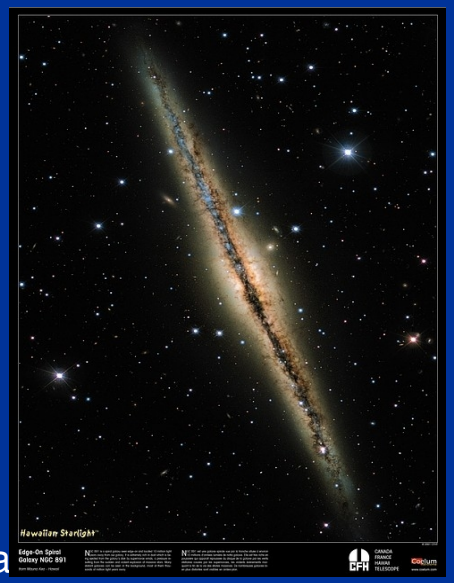
2. Come si nutrono

Nascita di nuove stelle

nella nostra galassia



Formazione di stelle nelle galassie



Formazione di stelle

~1 massa solare/anno

richiede *continuo* ***rifornimento*** *di gas*

Gas accretion?

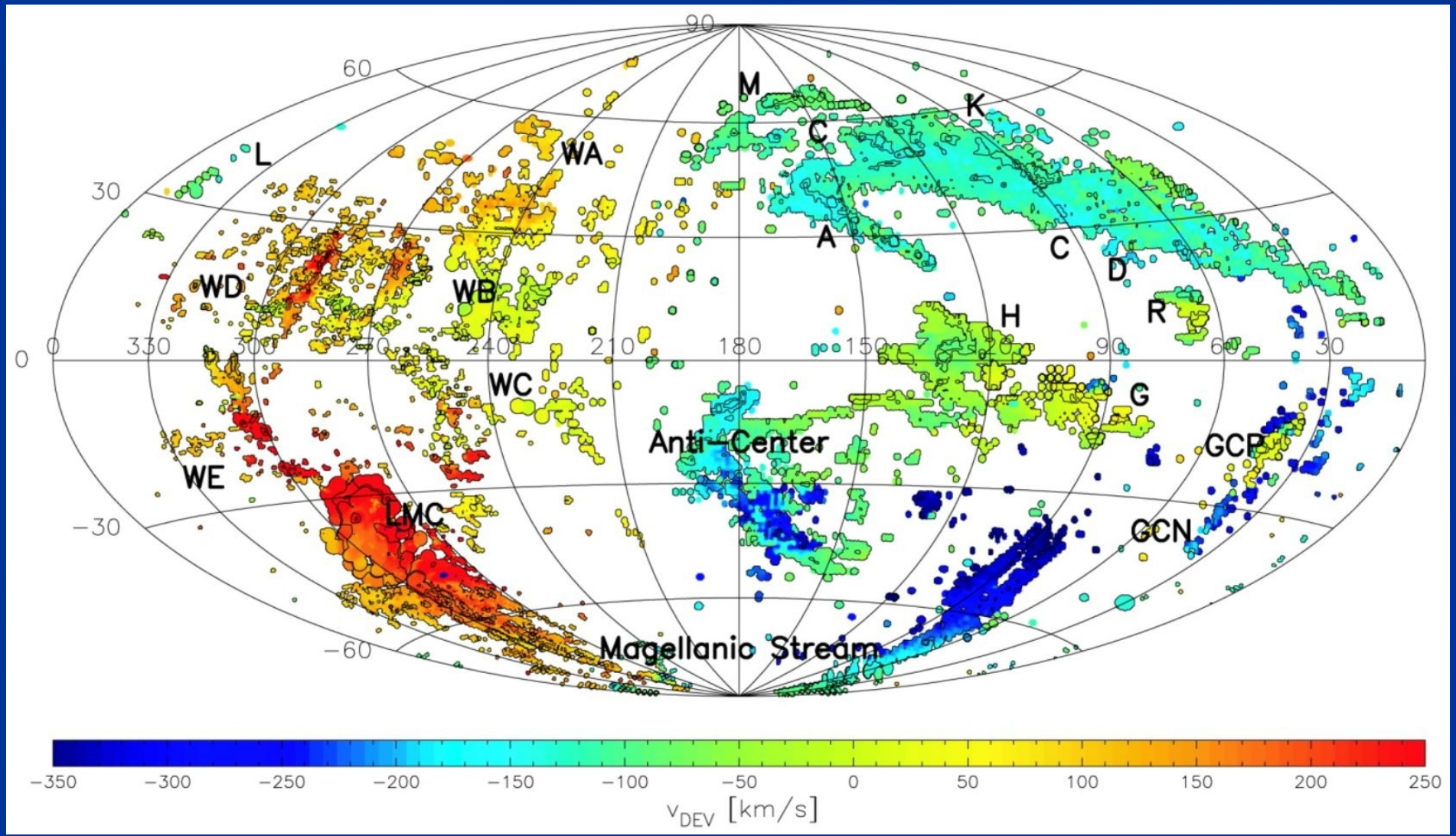
come, da dove?

quali prove?

Esempio di accretion?

VIA LATTEA

Nubi di gas (HI) ad alta velocita'

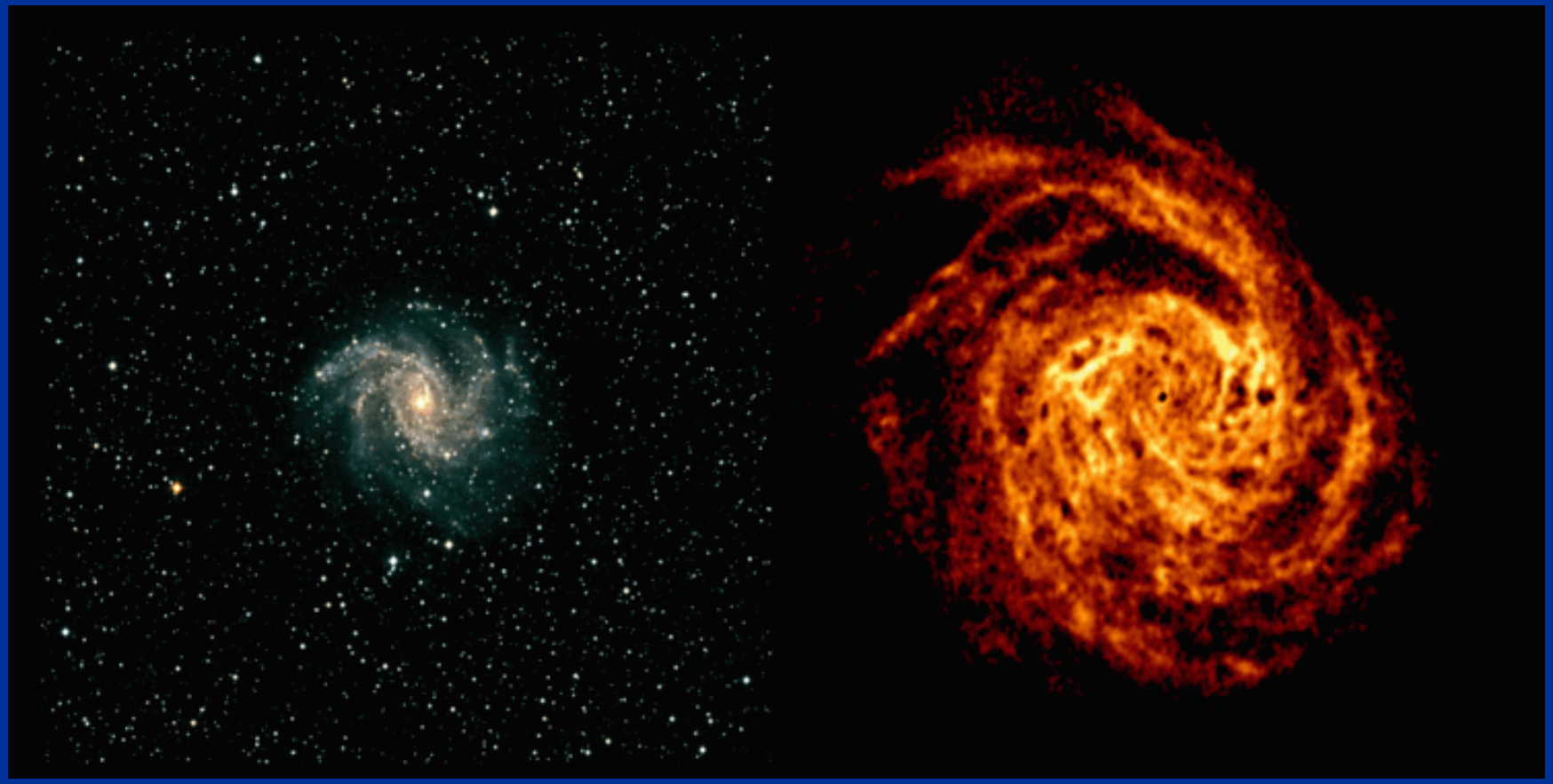


NGC 6946

riserva di gas nelle part esterne

Immagine ottica

idrogeno neutro

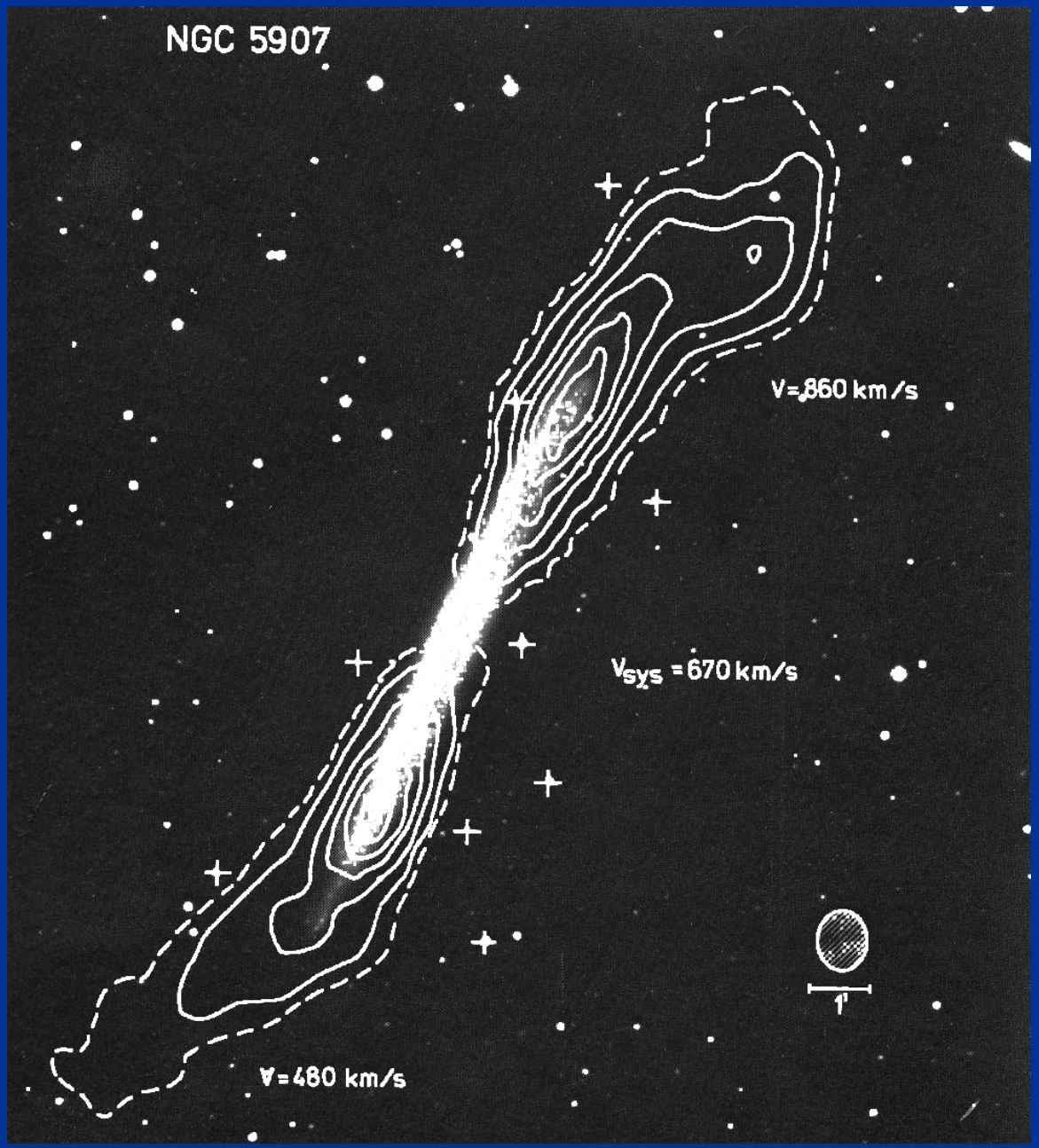


stessa scala

Galassia

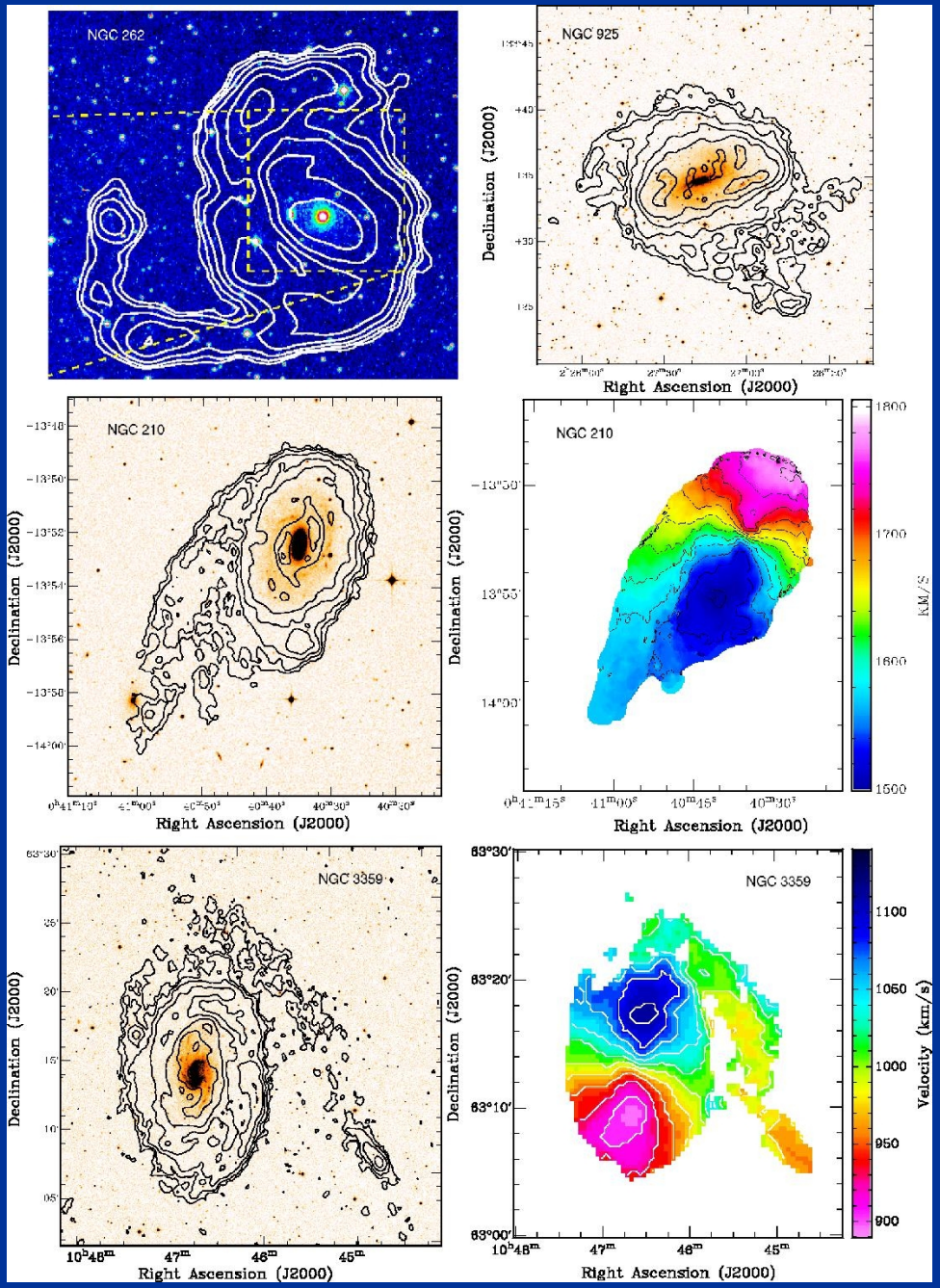
vista di taglio (edge-on)

con **warp** *gassoso (riga 21-cm)*



galassie sorprese a mangiare:

-incontro/interazione con compagne piu' piccole
-cannibalismo
-piccoli mergers



Conclusione

Al centro si pone il rapporto galassie/ambiente

PERO'
L'accretion che si vede (~ 0.2 masse solari/anno) non e' sufficiente per il tasso di formazione stellare (~1 massa solare/anno)

Mistero:

da dove e come arriva il gas?

3. La materia oscura

Materia Oscura

e

Materia Luminosa

nelle galassie -rotazione

e

negli ammassi -moto delle galassie

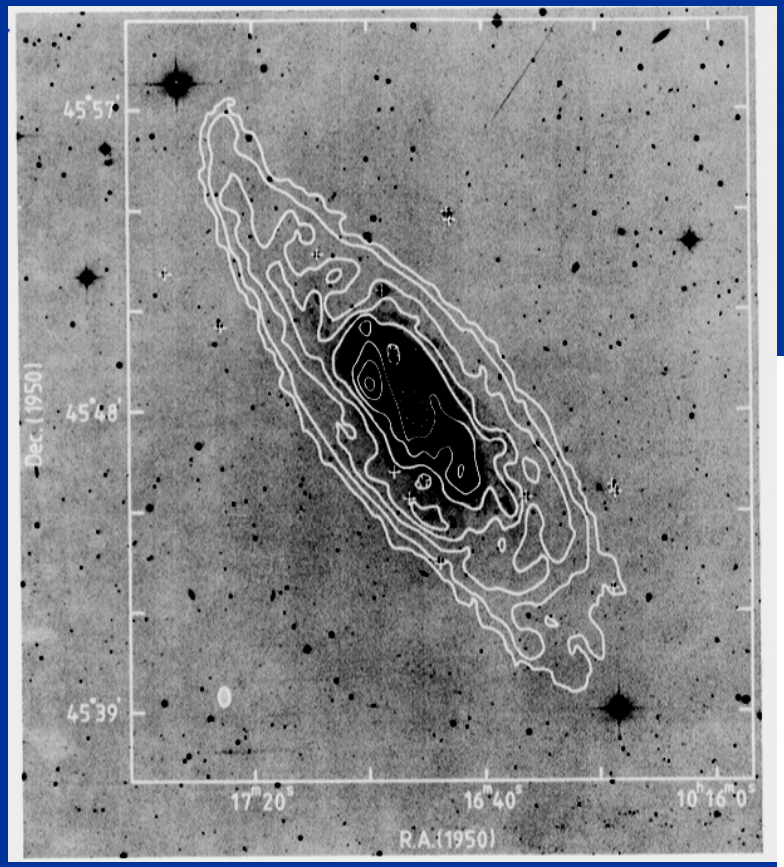
alone di gas caldo X

lenti gravitazionali

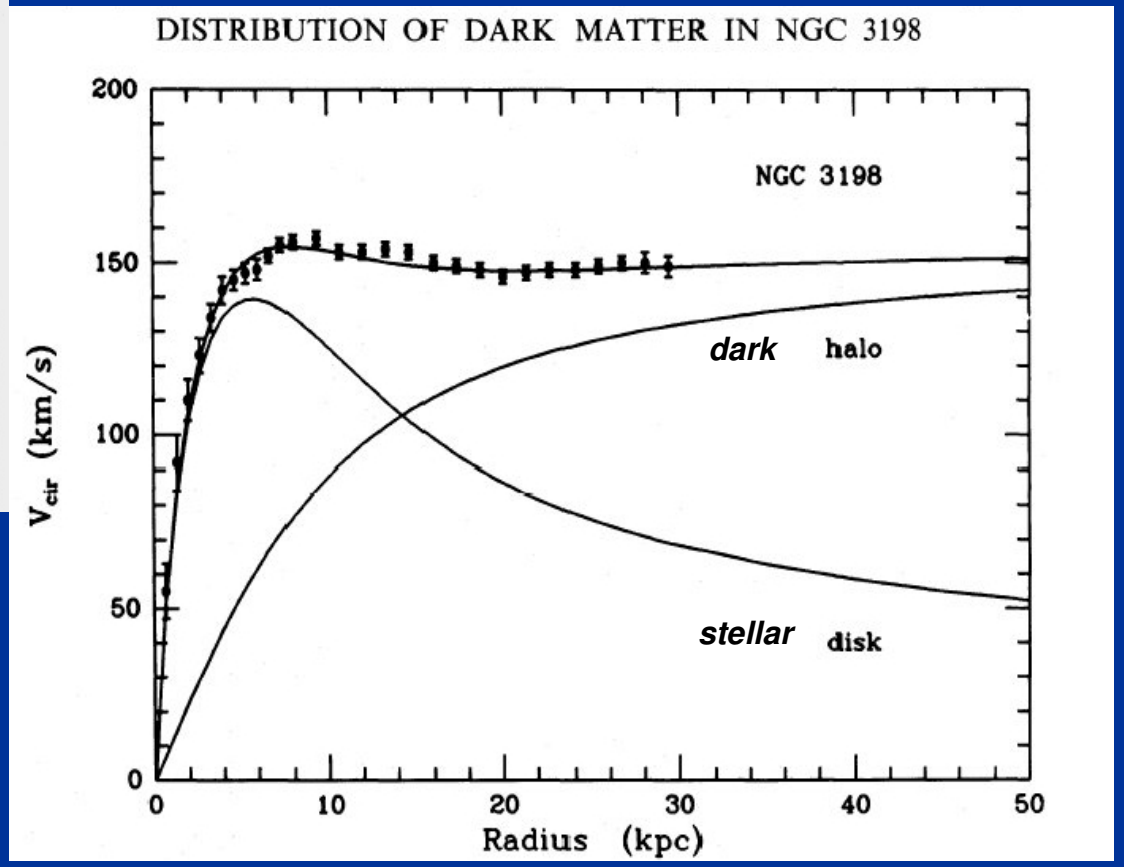
NGC 4565

edge-on

NGC 3198 *idrogeno neutro (riga 21 cm)*



CURVA di rotazione



- *dinamica delle galassie*

Materia oscura - *alone di gas caldo X*

Abell 2218 - *lenti gravitazionali*

Mistero:

La materia oscura

- *dove ?*
- *quanta?*
- ***che cosa?***

UNIVERSO

ENERGIA	*oscura*	*72 %*
MATERIA	*oscura*	*23 %*
BARIONI	*(atomi)*	*5 %*

Le "Rivoluzioni Copernicane"

1500 *Terra non piu' al centro del Sistema Solare*

1920 *Sistema Solare non piu' al centro della Via Lattea*
Via Lattea non al centro dell'Universo

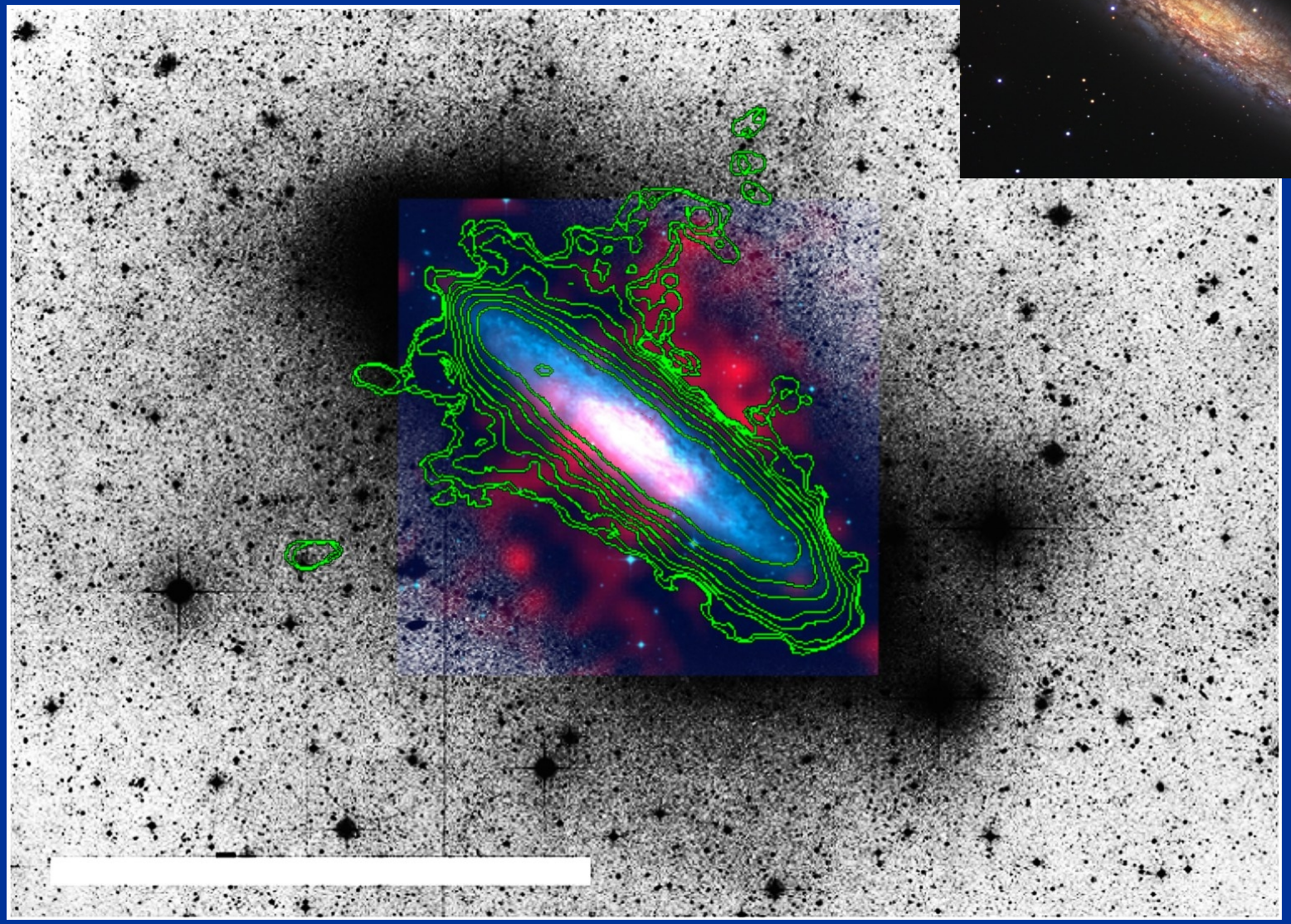
1980 *Materia Luminosa (barioni) piccola parte*
Materia Oscura dominante

2000 ***Materia (luminosa+oscura)*** *piccola parte*
Energia Oscura *dominante*

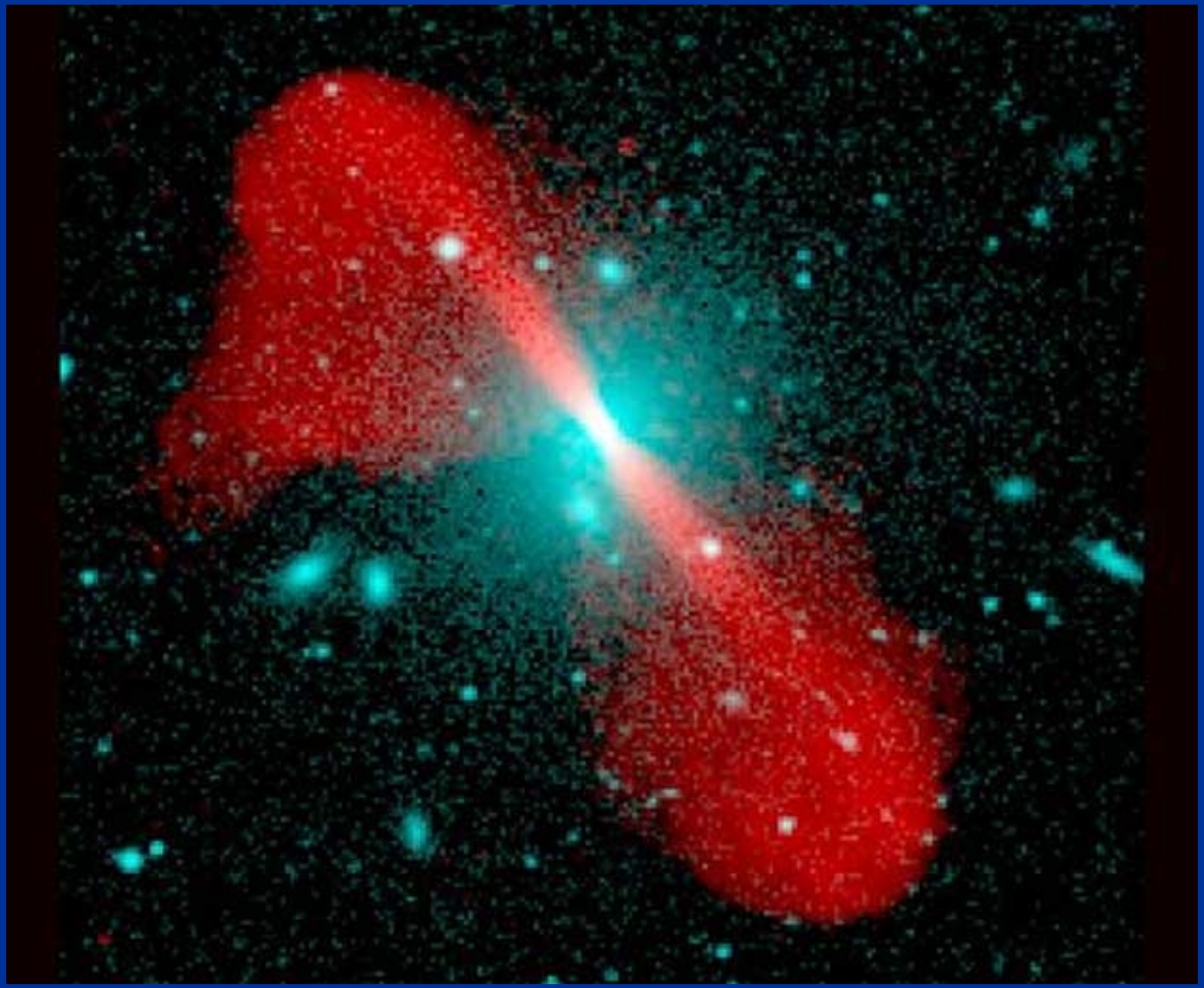
FINE

NGC 253

Immagine ottica



3C 296 *radiogalassia*



Ammasso di galassie e *materia oscura*

Formazione di strutture su larga scala

simulazione cosmologica “Millennium”