Do dwarf galaxies magnetize the Universe?

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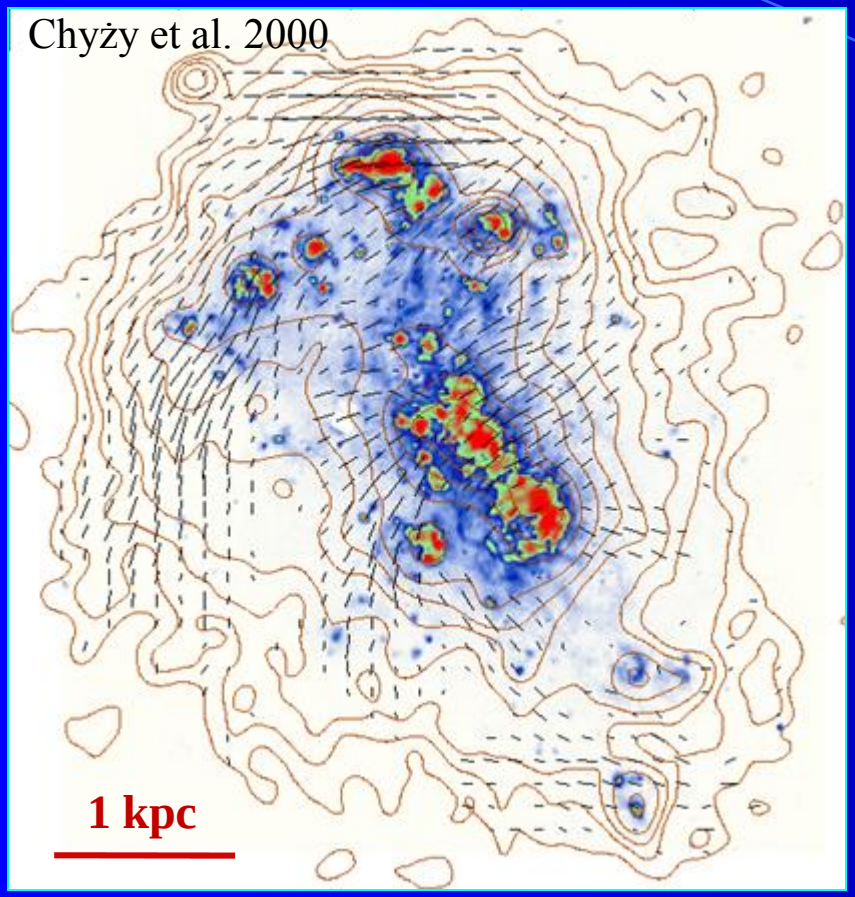
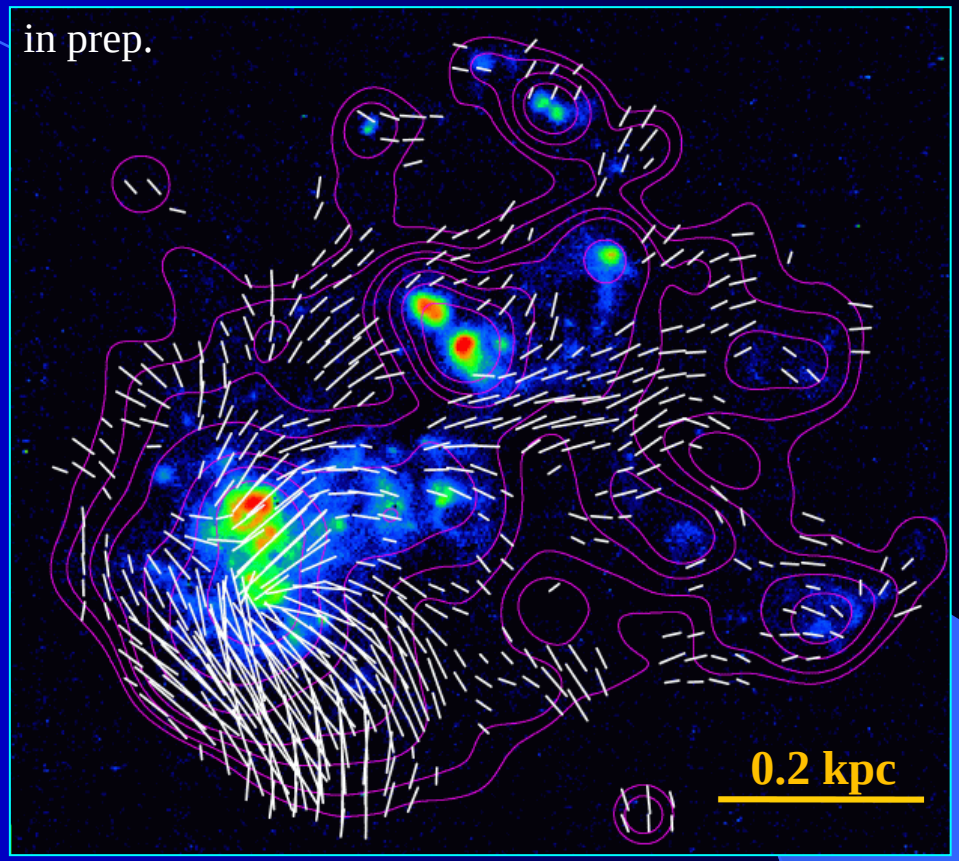
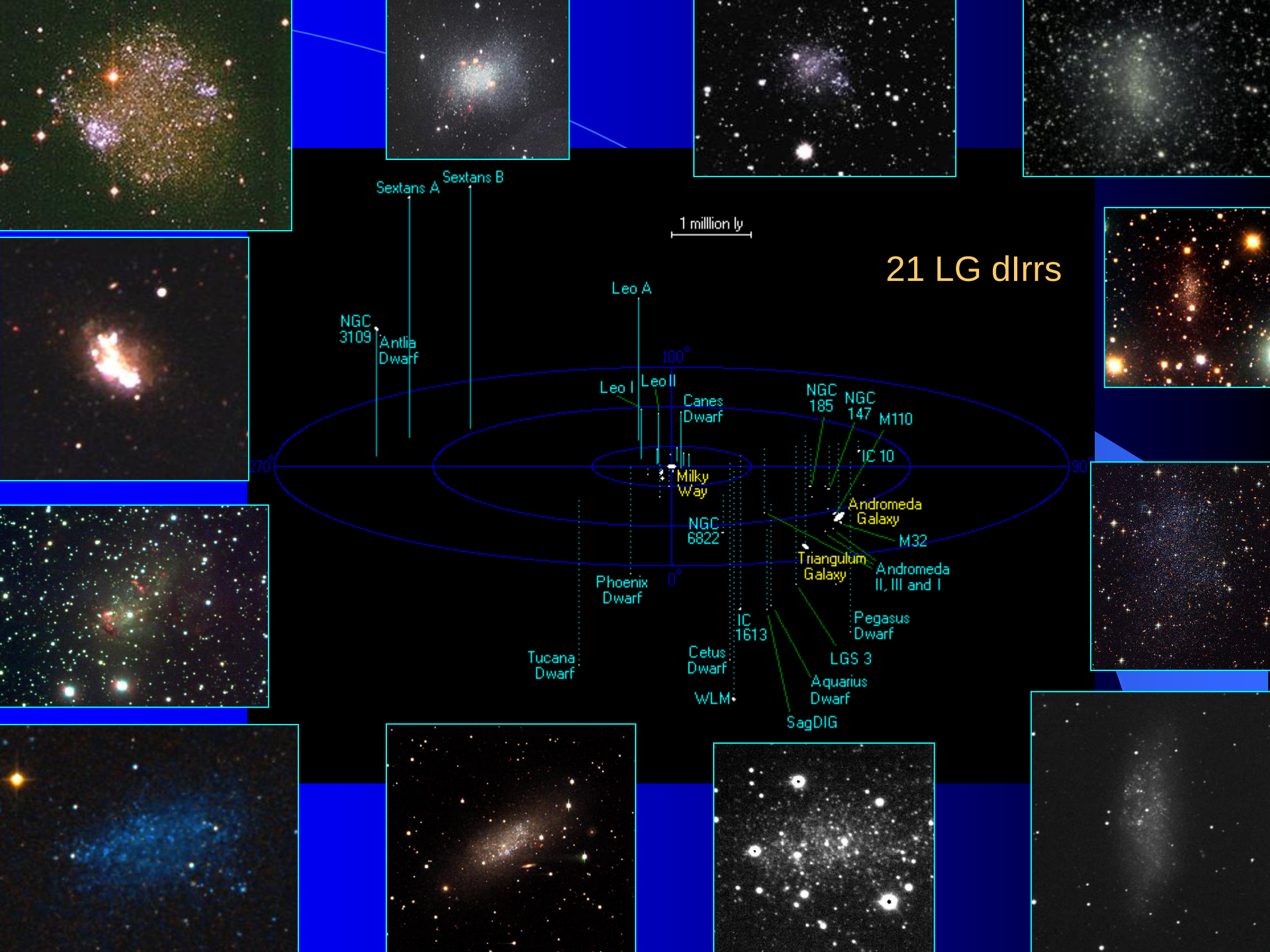
NGC 4449 and IC 10



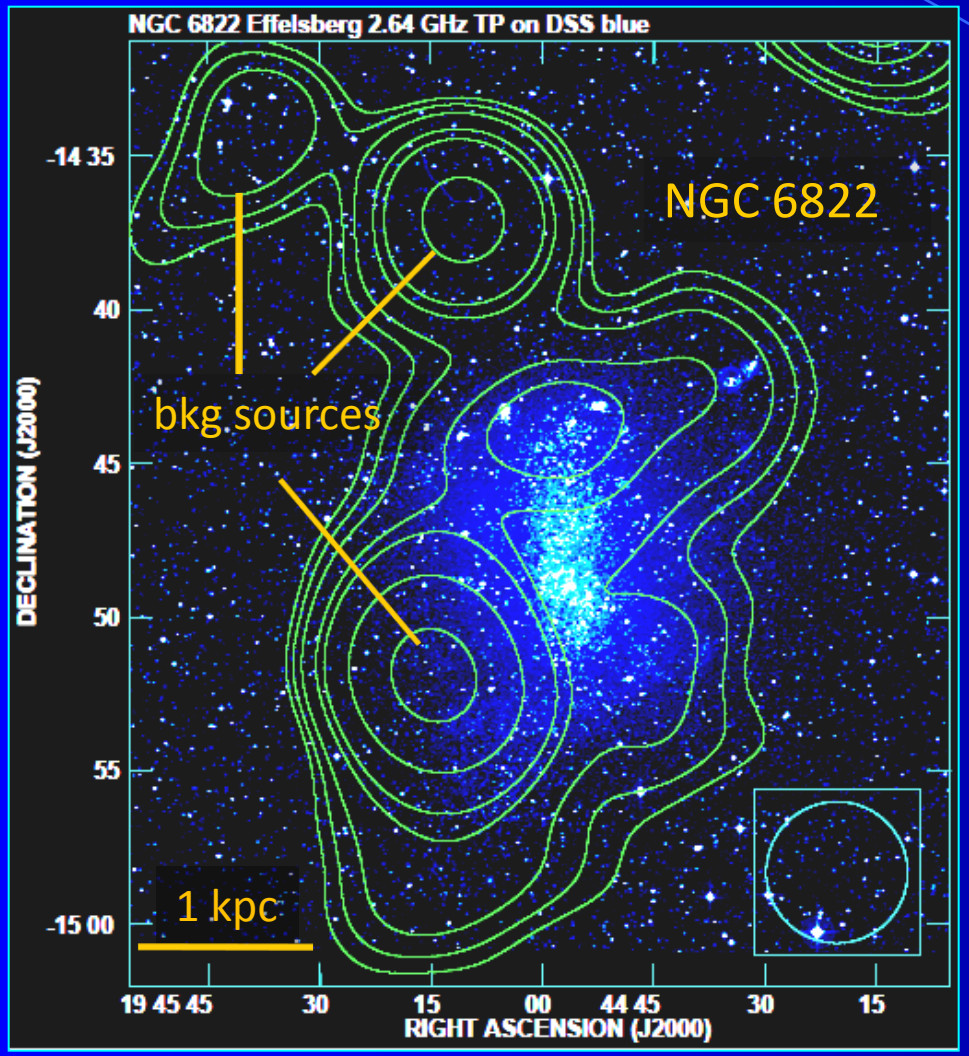


- 5x smaller, 8x less massive than the Milky Way, no spiral arms, slow rotation (30-50 km/s)
- But B=12μG (regular 8μG)! Efficient large-scale dynamo?

- 10x less massive than NGC 4449, local BCG
- B=10μG, small-scale dynamo?


21 LG dIrrs
1 milllion ly
Sextans A
Sextans B
Leo A
NGC 3109
Antlia Dwarf
180°
Leo I
Leo II
Canes Dwarf
NGC 185
NGC 147
M110
IC 10
270°
90°
Milky Way
Andromeda Galaxy
M32
NGC 6822
Triangulum Galaxy
Andromeda II, III and I
Phoenix Dwarf
0°
IC 1613
Pegasus Dwarf
LGS 3
Tucana Dwarf
Cetus Dwarf
Aquarius Dwarf
WLM
SagDIG

Radio Detections



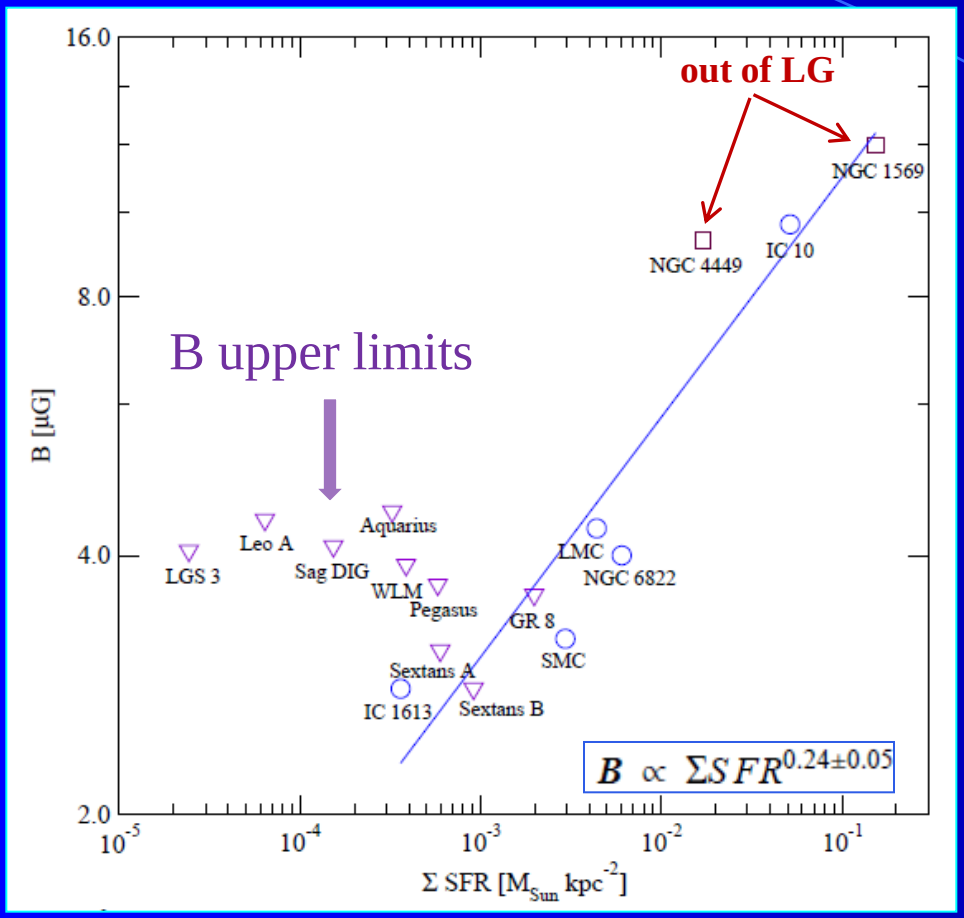
Mateo (1998), Salvadori & Ferrara (2009)

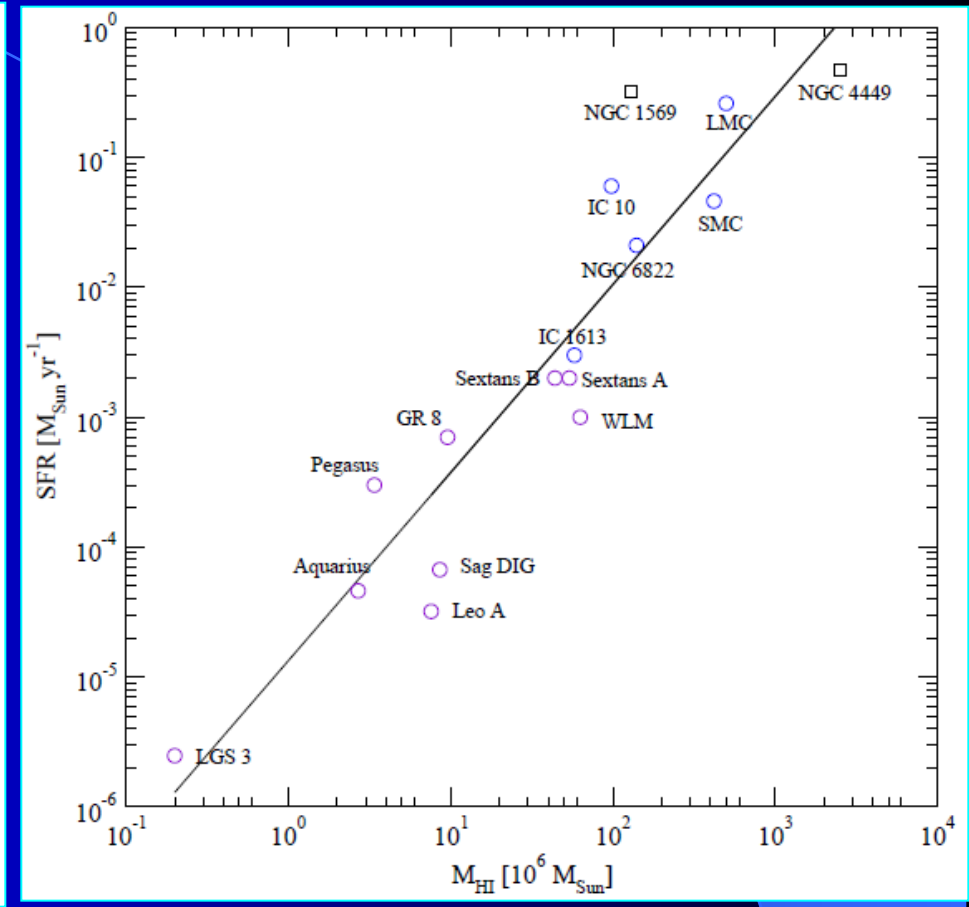
S	Irr	dwarfs			
		dIrr	dE	dSph	UF dSph
3	7	14	2	15	~20

21 dIrrs
12 attainable from Effelsberg

- 3 out of 12 dIrrs are radio detected at 2.64 GHz (IC 10, NGC 6822, IC1613)
- Undetected: their upper radio flux limits are still important

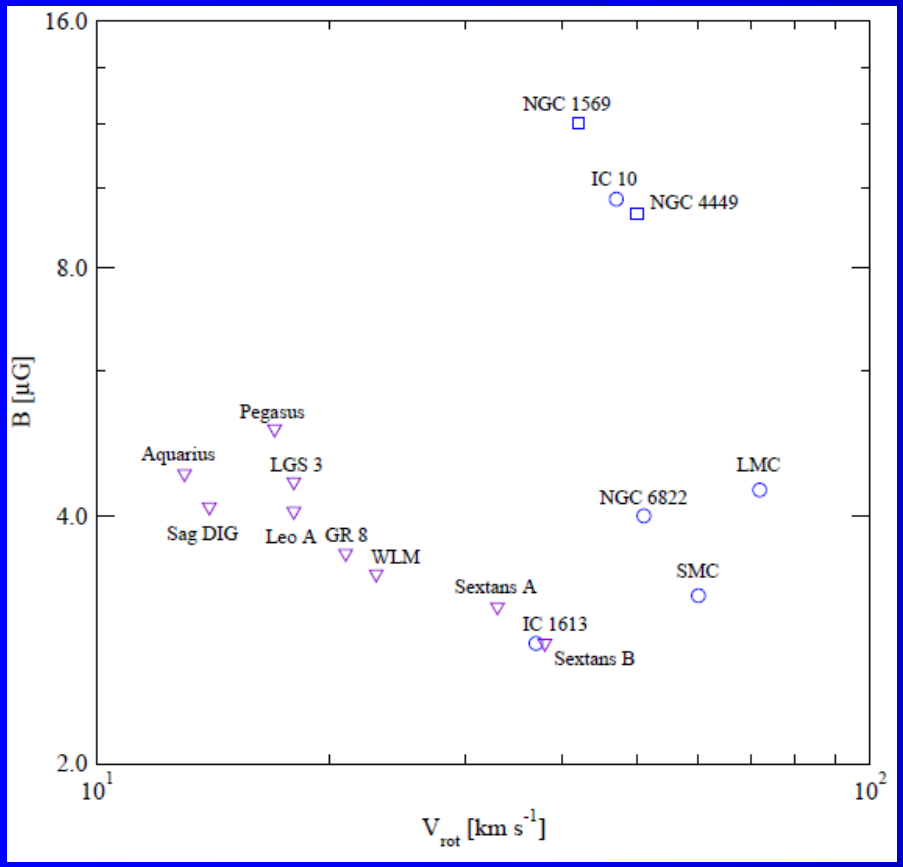
B-SFR





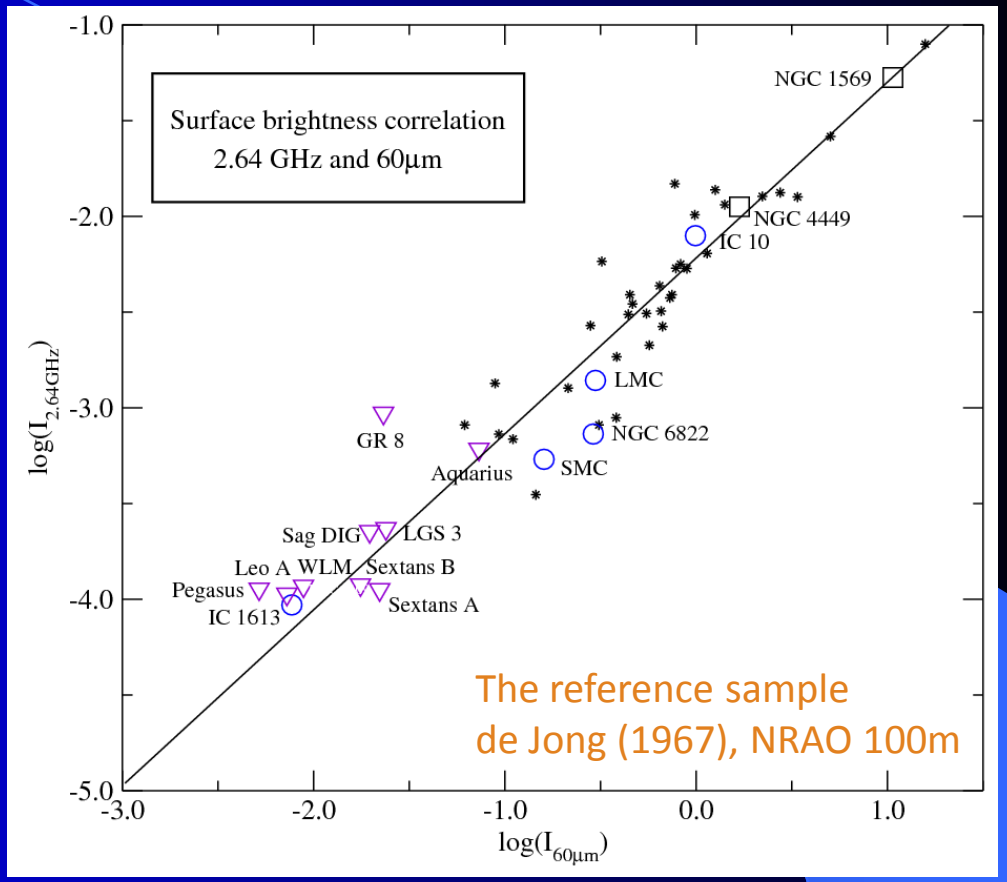
- Mean B≤4μG (10μG – IC10 – exceptionally strong)
- B depends primarly on ΣSFR or Σρ (NGC 4254 exponent 0.26±0.01)
- B correlates also with global SFR, mass, metallicity

B – rotation



- No correlation
- Rather small-scale dynamo?

Radio – Infrared



- Low-mass dwarf galaxies follow a trend determined for high surface brightness spirals
- Synchrotron deficiency could occur

Could dIrrs magnetize the Universe?

Type	Pri dSph	Pri dIrr	LBG	LBG
	instantaneous star formation			
SF Mass	1.0e6	1.0e7	1.0e8	1.0e9
Redshift z	8	7	5	3
Wind energy E_b [erg]	2.0e55	2.0e56	2.0e57	2.0e58
SF size R_0 [kpc]	0.5	1.0	2.0	3.0
Stall radius R_s [kpc]	15	36	103	333
B_0 [G]	1.0e-7	1.0e-6	1.0e-5	5.0e-5
B_s [G]	1.1e-10	7.8e-10	3.8e-9	4.1e-9
Type		Local Group dIrrs		
		continuous SF		
SFR	0.00001	0.0003	0.01	0.1
Redshift z	0	0	0	0
Wind energy E_b [erg]	3.0e50	1.5e52	3.0e53	3.0e54
SF size R_0 [kpc]	0.05	0.2	0.4	0.7
Stall radius R_s [kpc]	0.2	0.9	2.3	5.0
B_0 [G]	5.0e-7	1.0e-6	3.0e-6	8.0e-6
B_s [G]	2.3e-8	5.5e-8	8.8e-8	1.5e-7

- LBG – Verma et al. 2007, Samui 2008
- Pri dSph – Strigari 2008, Ricotti 2010
- If magnetization coeval with its metal enrichment then more massive (LBG) galaxies can efficiently magnetize the IGM
- Typical LG dIrrs could magnetize only the local space

$R_0/2$ => B/4 ; E_b*2 => $R_s*1.25$ B/1.6; Z=0.02 => $E_b*1.2$ $R_s*1.07$ B/1.15; $\varepsilon*10$ => R_s*2 B/4.8

LOFAR and SKA will detect the remaining LG dwarfs

Conclusions

Some dwarfs

- Show very strong (NGC 1569, IC10) and even spiral B (NGC 4449)

Unbiased sample of LG Dwarfs

- 25% are radio detected (mean B≤4μG)
- B depends primarly on ΣSFR, not on dwarf's rotation
- follow radio-infrared relation
- Strong mean magnetic fields (>5μG) are observed *only* in the most massive dwarfs, extreme in star-formation
- Not suitable objects for efficient magnetization of the IGM