# Do Ultraluminous X-ray Sources Exist in Dwarf Galaxies?

**Douglas Swartz**
**Universities Space Research Association**

**Roberto Soria**
**Allyn Tennant**

# Do Ultraluminous X-ray Sources Exist in Dwarf Galaxies?

Dwarf Galaxies ⟷ Giant Galaxies

**Star Formation**

External Pressure ⟷ Density Waves, Bars

**Metallicity**

Low ⟷ High

**Gas Fraction**

High ⟷ Low

The Astronomical Journal, 127:2031–2068, 2004 April


# A CATALOG OF NEIGHBORING GALAXIES

Igor D. Karachentsev
Special Astrophysical Observatory, Russian Academy of Sciences, 369167 Nizhny Arkhyz, Karachai-Circassia, Russia; ikar@luna.sao.ru

Valentina E. Karachentseva
Astronomical Observatory of Kiev University, Observatorna 3, 254053 Kiev, Ukraine; vkarach@observ.univ.kiev.ua

Walter K. Huchtmeier
Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany; p083huc@mpifr-bonn.mpg.de

and

Dmitry I. Makarov
Special Astrophysical Observatory, Russian Academy of Sciences, 369167 Nizhny Arkhyz, Karachi-Circassia, Russia; and
Isaac Newton Institute of Chile, SAO Branch, Russia; dim@sao.ru
*Received 2003 November 3; accepted 2004 January 13*

## ABSTRACT

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C N G

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Special Astrophysical Observatory, Russian Academy of Sciences, 369167 Nizhny Arkhyz, Karachai-Cherkessia, Russia; ikar@luna.sao.ru

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Astronomical Observatory, Kiev University, Observatorna 3, 04053 Kiev, Ukraine; vkarach@observ.univ.kiev.ua

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$B_t < 17.5$ mag

$D < 8$ Mpc

## ABSTRACT

TABLE 1

CATALOG OF LV GALAXIES

| Name (1) | R.A. (J2000.0) (2) | Decl. (J2000.0) (3) | $a$ (4) | $b/a$ (5) | $B_t$ (6) | $A_g$ (7) | $T$ (8) | $T_R$ (9) | $V_h$ (10) | $V_{LG}$ (11) | $W_{50}$ (12) | log $P$ (13) | $D$ (14) | Method (15) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WLM, DDO 221 | 00 01 58.1 | −15 27 40 | 11.5 | 0.35 | 11.03 | 0.16 | 9 | A | −116 | −10 | 57 | 2.30 | 0.92 | rgb |
| E349−031, SDIG | 00 08 13.3 | −34 34 42 | 1.1 | 0.82 | 15.48 | 0.05 | 10 | A | 207 | 216 | 20 | 0.36 | 4.1 | tf |
| N55 | 00 15 08.5 | −39 13 13 | 32.4 | 0.17 | 8.84 | 0.06 | 8 | A | 129 | 111 | 172 | 3.43 | 1.8 | tf |
| N59, KK 2 | 00 15 25.1 | −21 26 38 | 2.7 | 0.48 | 12.97 | 0.09 | −3 | KB | 361 | 431 | 50 | 0.43 | 5.30 | sbf |
| E410−005, KK 3 | 00 15 31.4 | −32 10 48 | 1.3 | 0.77 | 14.90 | 0.06 | −1 | A | ... | ... | ... | ... | 1.92 | rgb |
| I10 | 00 20 24.5 | +59 17 30 | 6.8 | 0.87 | 12.20 | 3.65 | 10 | A | −344 | −60 | 63 | 2.98 | 0.66 | cep |
| Sc 22 | 00 23 51.7 | −24 42 18 | 0.9 | 0.78 | 17.73 | 0.06 | −3 | A | ... | ... | ... | ... | 4.21 | rgb |
| Cetus, KKSG 1 | 00 26 11.0 | −11 02 40 | 5.0 | 0.86 | 14.4 | 0.12 | −2 | A | ... | ... | ... | ... | 0.78 | rgb |
| E294−010 | 00 26 33.3 | −41 51 20 | 1.1 | 0.64 | 15.53 | 0.02 | −3 | A | 117 | 81 | ... | ... | 1.92 | rgb |
| U288 | 00 29 04.0 | +43 25 54 | 1.3 | 0.62 | 15.64 | 0.33 | 10 | A | 187 | 464 | 36 | 0.71 | 6.7 | bs |
| N147 | 00 33 11.6 | +48 30 28 | 13.5 | 0.61 | 10.36 | 0.75 | −3 | A | −193 | 85 | ... | ... | 0.76 | rgb |
| And III, KK 5 | 00 35 33.8 | +36 29 52 | 3.0 | 0.60 | 15.20 | 0.10 | −3 | A | −355 | −92 | ... | ... | 0.76 | rgb |
| N185 | 00 38 58.0 | +48 20 10 | 12.2 | 0.85 | 9.99 | 0.79 | −3 | A | −202 | 73 | ... | 0.23 | 0.62 | rgb |
| N205 | 00 40 22.5 | +41 41 11 | 19.4 | 0.61 | 8.72 | 0.27 | −5 | K | −244 | 24 | 13 | 0.34 | 0.83 | rgb |
| And IV | 00 42 30.1 | +40 34 33 | 1.3 | 0.77 | 16.60 | 0.27 | 10 | A | 256 | 521 | ... | ... | 6.11 | rgb |
| N221 | 00 42 42.1 | +40 51 59 | 9.0 | 0.71 | 8.73 | 0.26 | −5 | B | −145 | 121 | ... | ... | 0.77 | rgb |
| M31 | 00 42 44.5 | +41 16 09 | 189.0 | 0.33 | 4.17 | 0.27 | 3 | B | −301 | −35 | 510 | 4.53 | 0.77 | cep |
| DDO 226 | 00 43 03.8 | −22 15 01 | 2.2 | 0.36 | 14.36 | 0.07 | 10 | A | 357 | 408 | 48 | 1.01 | 4.92 | rgb |
| And I, KK 8 | 00 45 40.0 | +38 02 14 | 4.0 | 0.95 | 13.90 | 0.23 | −3 | A | −380 | −120 | ... | ... | 0.81 | rgb |
| N247 | 00 47 08.3 | −20 45 36 | 21.4 | 0.32 | 9.86 | 0.08 | 7 | K | 160 | 215 | 210 | 2.83 | 4.1 | tf |
| N253 | 00 47 34.3 | −25 17 32 | 26.7 | 0.22 | 7.92 | 0.08 | 5 | B | 241 | 274 | 410 | 2.90 | 3.94 | rgb |
| KDG 2, E540−030 | 00 49 21.1 | −18 04 28 | 1.2 | 0.92 | 16.37 | 0.10 | −1 | A | ... | ... | ... | ... | 3.40 | rgb |
| DDO 6 | 00 49 49.3 | −21 00 58 | 1.7 | 0.41 | 15.19 | 0.07 | 10 | A | 295 | 348 | 22 | 0.53 | 3.34 | rgb |
| E540−032, FG 24 | 00 50 24.6 | −19 54 25 | 1.3 | 0.92 | 16.44 | 0.09 | −3 | A | ... | ... | ... | ... | 3.42 | rgb |
| SMC | 00 52 38.0 | −72 48 01 | 319 | 0.64 | 2.75 | 0.17 | 9 | A | 158 | −22 | 90 | 4.95 | 0.06 | cep |
| N300 | 00 54 53.5 | −37 40 57 | 21.9 | 0.71 | 8.95 | 0.06 | 7 | K | 144 | 114 | 149 | 3.31 | 2.15 | cep |
| Sculptor | 01 00 09.4 | −33 42 33 | 35.2 | 0.79 | 10.05 | 0.05 | −3 | A | 110 | 96 | ... | 0.11 | 0.09 | rgb |
| LGS−3 | 01 03 56.6 | +21 53 41 | 1.2 | 0.58 | 16.18 | 0.18 | −1 | A | −286 | −74 | 18 | 0.23 | 0.62 | rgb |
| I1613 | 01 04 54.1 | +02 07 60 | 16.4 | 0.90 | 9.92 | 0.11 | 10 | A | −232 | −89 | 25 | 2.67 | 0.73 | cep |

TABLE 1

CATALOG OF LV GALAXIES

| Name (1) | R.A. (J2000.0) (2) | Decl. (J2000.0) (3) | $a$ (4) | $b/a$ (5) | $B_t$ (6) | $A_g$ (7) | $T$ (8) | $T_a$ (9) | $V_h$ (10) | $V_{LG}$ (11) | $W_{50}$ (12) | log $F$ (13) | $D$ (14) | Method (15) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WLM, DDO 221 | 00 01 58.1 | −15 27 40 | 11.5 | 0.35 | 11.03 | 0.16 | 9 | A | −116 | −10 | 57 | 2.30 | 0.92 | rgb |
| E349−031, SDIG | 00 08 13.3 | −34 34 42 | 1.1 | 0.82 | 15.48 | 0.05 | 10 | A | 207 | 216 | 20 | 0.36 | 4.1 | tf |
| N55 | 00 15 08.5 | −39 13 13 | 32.4 | 0.17 | 8.84 | 0.06 | 8 | A | 129 | 111 | 172 | 3.43 | 1.8 | tf |
| N59, KK 2 | 00 15 25.1 | −21 26 38 | 2.7 | 0.48 | 12.97 | 0.09 | −3 | KB | 361 | 431 | 50 | 0.43 | 5.30 | sbf |
| E410−005, KK 3 | 00 15 31.4 | −32 10 48 | 1.3 | 0.77 | 14.90 | 0.06 | −1 | A | ... | ... | ... | ... | 1.92 | rgb |
| I10 | 00 20 24.5 | +59 17 30 | 6.8 | 0.87 | 12.20 | 3.65 | 10 | A | −344 | −60 | 63 | 2.98 | 0.66 | cep |
| Sc 22 | 00 23 51.7 | −24 42 18 | 0.9 | 0.78 | 17.73 | 0.06 | −3 | A | ... | ... | ... | ... | 4.21 | rgb |
| Cetus, KKSG 1 | 00 26 11.0 | −11 02 40 | 5.0 | 0.86 | 14.4 | 0.12 | −2 | A | ... | ... | ... | ... | 0.78 | rgb |
| E294−010 | 00 26 33.3 | −41 51 20 | 1.1 | 0.64 | 15.53 | 0.02 | −3 | A | 117 | 81 | ... | ... | 1.92 | rgb |
| U288 | 00 29 04.0 | +43 25 54 | 1.3 | 0.62 | 15.64 | 0.33 | 10 | A | 187 | 464 | 36 | 0.71 | 6.7 | bs |
| N147 | 00 33 11.6 | +48 30 28 | 13.5 | 0.61 | 10.36 | 0.75 | −3 | A | −193 | 85 | ... | ... | 0.76 | rgb |
| And III, KK 5 | 00 35 33.8 | +36 29 52 | 3.0 | 0.60 | 15.20 | 0.10 | −3 | A | −355 | −92 | ... | ... | 0.76 | rgb |
| N185 | 00 38 58.0 | +48 20 10 | 12.2 | 0.85 | 9.99 | 0.79 | −3 | A | −202 | 73 | ... | 0.23 | 0.62 | rgb |
| N205 | 00 40 22.5 | +41 41 11 | 19.4 | 0.61 | 8.72 | 0.27 | −5 | K | −244 | 24 | 13 | 0.34 | 0.83 | rgb |
| And IV | 00 42 30.1 | +40 34 33 | 1.3 | 0.77 | 16.60 | 0.27 | 10 | A | 256 | 521 | ... | ... | 6.11 | rgb |
| N221 | 00 42 42.1 | +40 51 59 | 9.0 | 0.71 | 8.73 | 0.26 | −5 | B | −145 | 121 | ... | ... | 0.77 | rgb |
| M31 | 00 42 44.5 | +41 16 09 | 189.0 | 0.33 | 4.17 | 0.27 | 3 | B | −301 | −35 | 510 | 4.53 | 0.77 | cep |
| DDO 226 | 00 43 03.8 | −22 15 01 | 2.2 | 0.36 | 14.36 | 0.07 | 10 | A | 357 | 408 | 48 | 1.01 | 4.92 | rgb |
| And I, KK 8 | 00 45 40.0 | +38 02 14 | 4.0 | 0.95 | 13.90 | 0.23 | −3 | A | −380 | −120 | ... | ... | 0.81 | rgb |
| N247 | 00 47 08.3 | −20 45 36 | 21.4 | 0.32 | 9.86 | 0.08 | 7 | K | 160 | 215 | 210 | 2.83 | 4.1 | tf |
| N253 | 00 47 34.3 | −25 17 32 | 26.7 | 0.22 | 7.92 | 0.08 | 5 | B | 241 | 274 | 410 | 2.90 | 3.94 | rgb |
| KDG 2, E540−030 | 00 49 21.1 | −18 04 28 | 1.2 | 0.92 | 16.37 | 0.10 | −1 | A | ... | ... | ... | ... | 3.40 | rgb |
| DDO 6 | 00 49 49.3 | −21 00 58 | 1.7 | 0.41 | 15.19 | 0.07 | 10 | A | 295 | 348 | 22 | 0.53 | 3.34 | rgb |
| E540−032, FG 24 | 00 50 24.6 | −19 54 25 | 1.3 | 0.92 | 16.44 | 0.09 | −3 | A | ... | ... | ... | ... | 3.42 | rgb |
| SMC | 00 52 38.0 | −72 48 01 | 319 | 0.64 | 2.75 | 0.17 | 9 | A | 158 | −22 | 90 | 4.95 | 0.06 | cep |
| N300 | 00 54 53.5 | −37 40 57 | 21.9 | 0.71 | 8.95 | 0.06 | 7 | K | 144 | 114 | 149 | 3.31 | 2.15 | cep |
| Sculptor | 01 00 09.4 | −33 42 33 | 35.2 | 0.79 | 10.05 | 0.05 | −3 | A | 110 | 96 | ... | 0.11 | 0.09 | rgb |
| LGS−3 | 01 03 56.6 | +21 53 41 | 1.2 | 0.58 | 16.18 | 0.18 | −1 | A | −286 | −74 | 18 | 0.23 | 0.62 | rgb |
| I1613 | 01 04 54.1 | +02 07 60 | 16.4 | 0.90 | 9.92 | 0.11 | 10 | A | −232 | −89 | 25 | 2.67 | 0.73 | cep |

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| Name (1) | R.A. (J2000.0) (2) | Decl. (J2000.0) (3) | $a$ (4) | $b/a$ (5) | $B_t$ (6) | $A_g$ (7) | $T$ (8) | $T_s$ (9) | $V_h$ (10) | $V_{LG}$ (11) | $W_{50}$ (12) | log $F$ (13) | $D$ (14) | Method (15) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WLM, DDO 221 | 00 01 58.1 | −15 27 40 | 11.5 | 0.35 | 11.03 | 0.16 | 9 | A | −116 | −10 | 57 | 2.30 | 0.92 | rgb |
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| N59, KK 2 | 00 15 25.1 | −21 26 38 | 2.7 | 0.48 | 12.97 | 0.09 | −3 | KB | 361 | 431 | 50 | 0.43 | 5.30 | sbf |
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| I10 | 00 20 24.5 | +59 17 30 | 6.8 | 0.87 | 12.20 | 3.65 | 10 | A | −344 | −60 | 63 | 2.98 | 0.66 | cep |
| Sc 22 | 00 23 51.7 | −24 42 18 | 0.9 | 0.78 | 17.73 | 0.06 | −3 | A | ... | ... | ... | ... | 4.21 | rgb |
| Cetus, KKSG 1 | 00 26 11.0 | −11 02 40 | 5.0 | 0.86 | 14.4 | 0.12 | −2 | A | ... | ... | ... | ... | 0.78 | rgb |
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| U288 | 00 29 04.0 | +43 25 54 | 1.3 | 0.62 | 15.64 | 0.33 | 10 | A | 187 | 464 | 36 | 0.71 | 6.7 | bs |
| N147 | 00 33 11.6 | +48 30 28 | 13.5 | 0.61 | 10.36 | 0.75 | −3 | A | −193 | 85 | ... | ... | 0.76 | rgb |
| And III, KK 5 | 00 35 [illegible] | [illegible] | 3.0 | 0.60 | [illegible] | [illegible] | [illegible] | A | −355 | −92 | ... | ... | 0.76 | rgb |
| N185 | 00 3[illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | A | −202 | 73 | ... | 0.23 | 0.62 | rgb |
| N205 | 00 40 22.5 | [illegible] | 19.4 | 0.61 | [illegible] | [illegible] | [illegible] | K | −244 | 24 | 13 | 0.34 | 0.83 | rgb |
| And IV | 00 42 30.1 | +40 34 33 | 1.3 | 0.77 | 16.60 | 0.27 | 10 | A | 256 | 521 | ... | ... | 6.11 | rgb |
| N221 | 00 42 42.1 | +40 51 59 | 9.0 | 0.71 | 8.73 | 0.26 | −5 | B | −145 | 121 | ... | ... | 0.77 | rgb |
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| N247 | 00 47 08.3 | −20 45 36 | 21.4 | 0.32 | 9.86 | 0.08 | 7 | K | 160 | 215 | 210 | 2.83 | 4.1 | tf |
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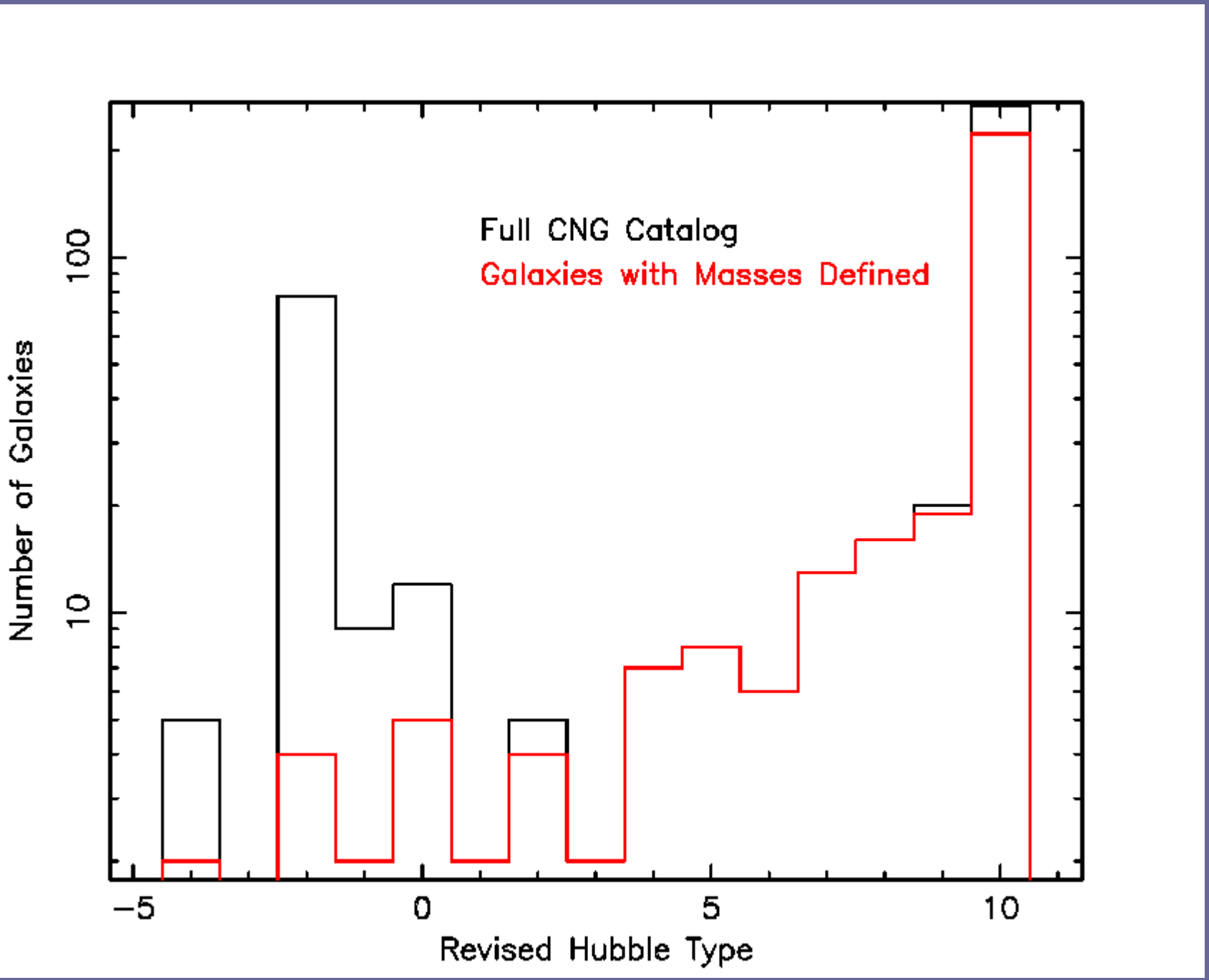
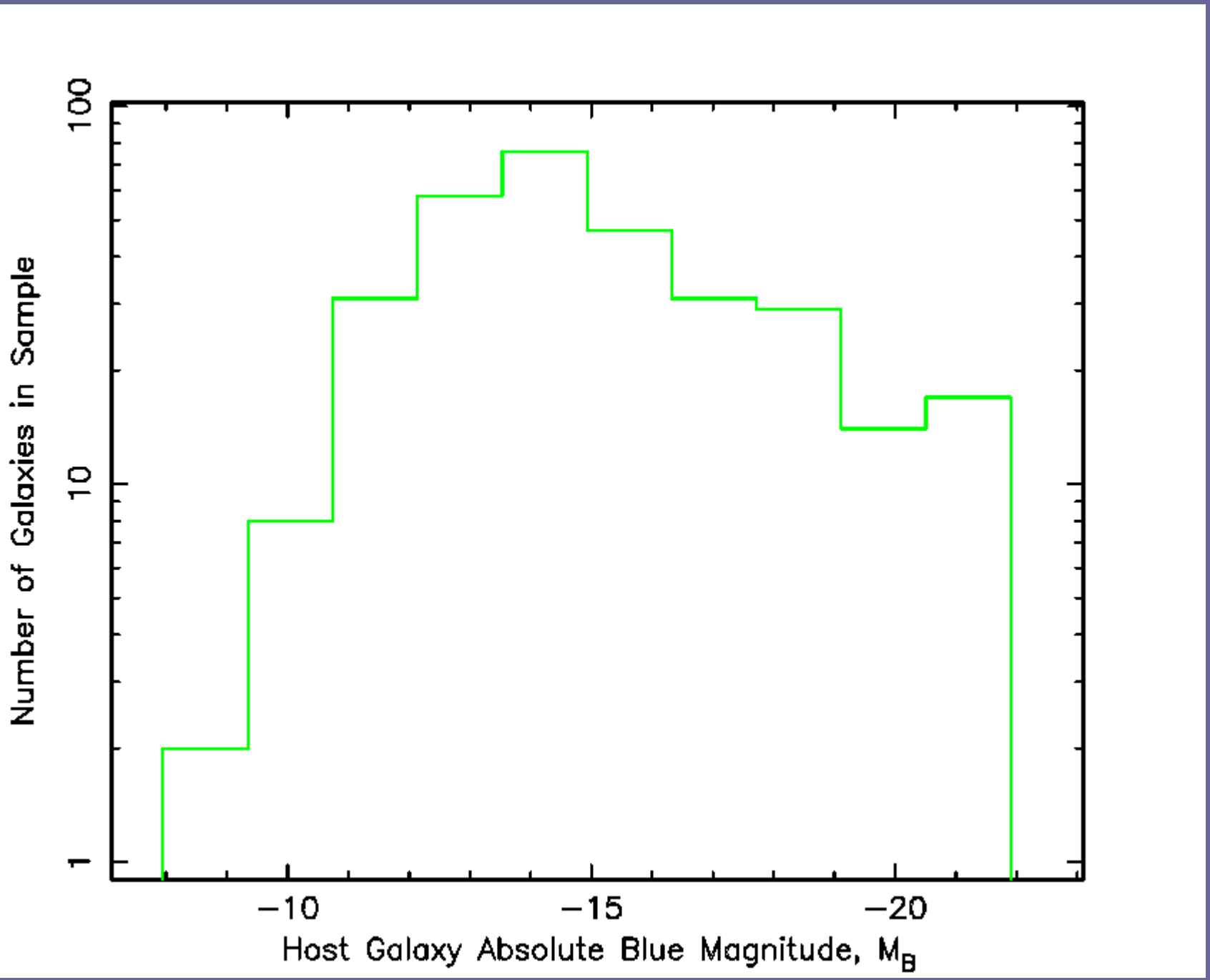
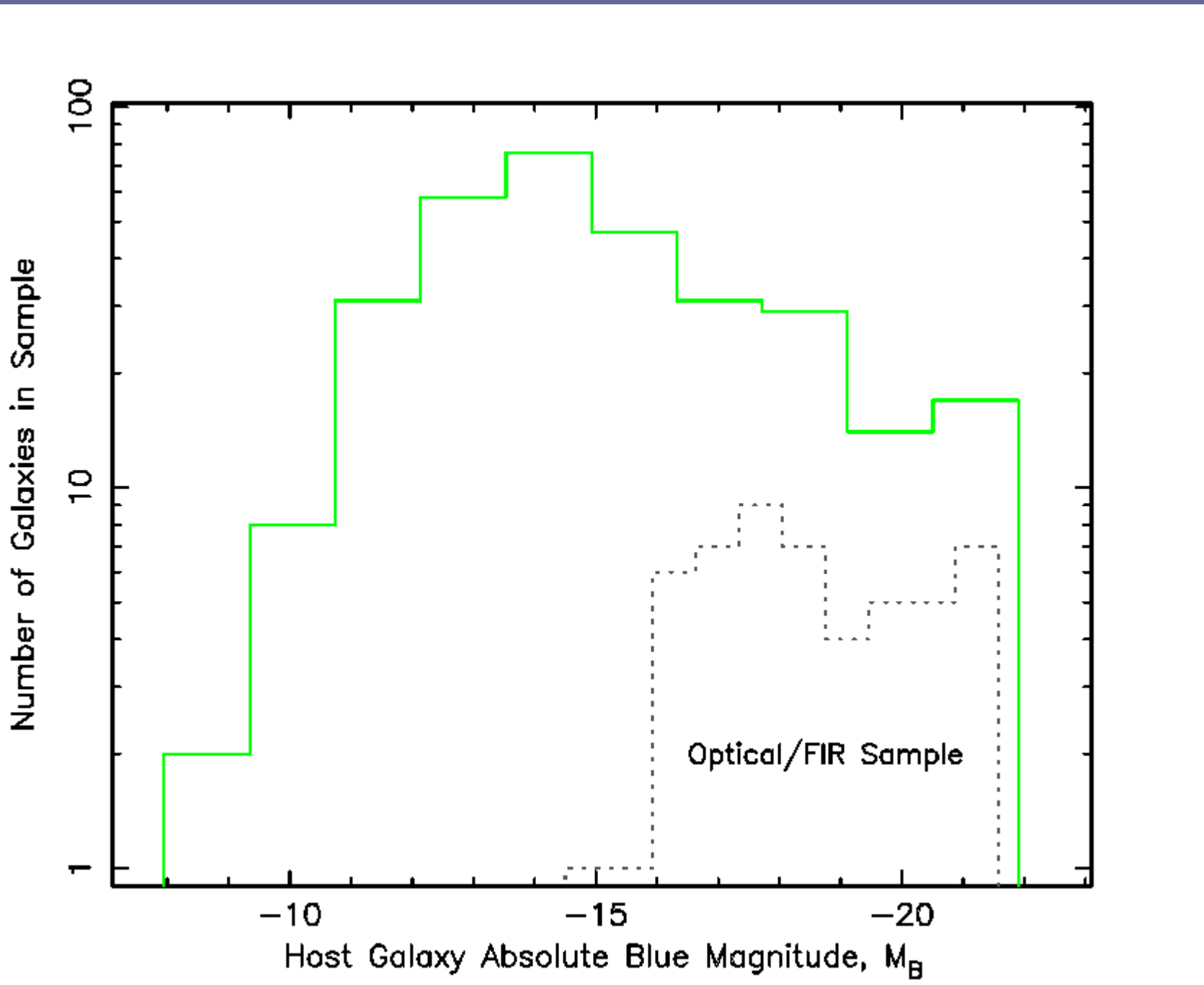
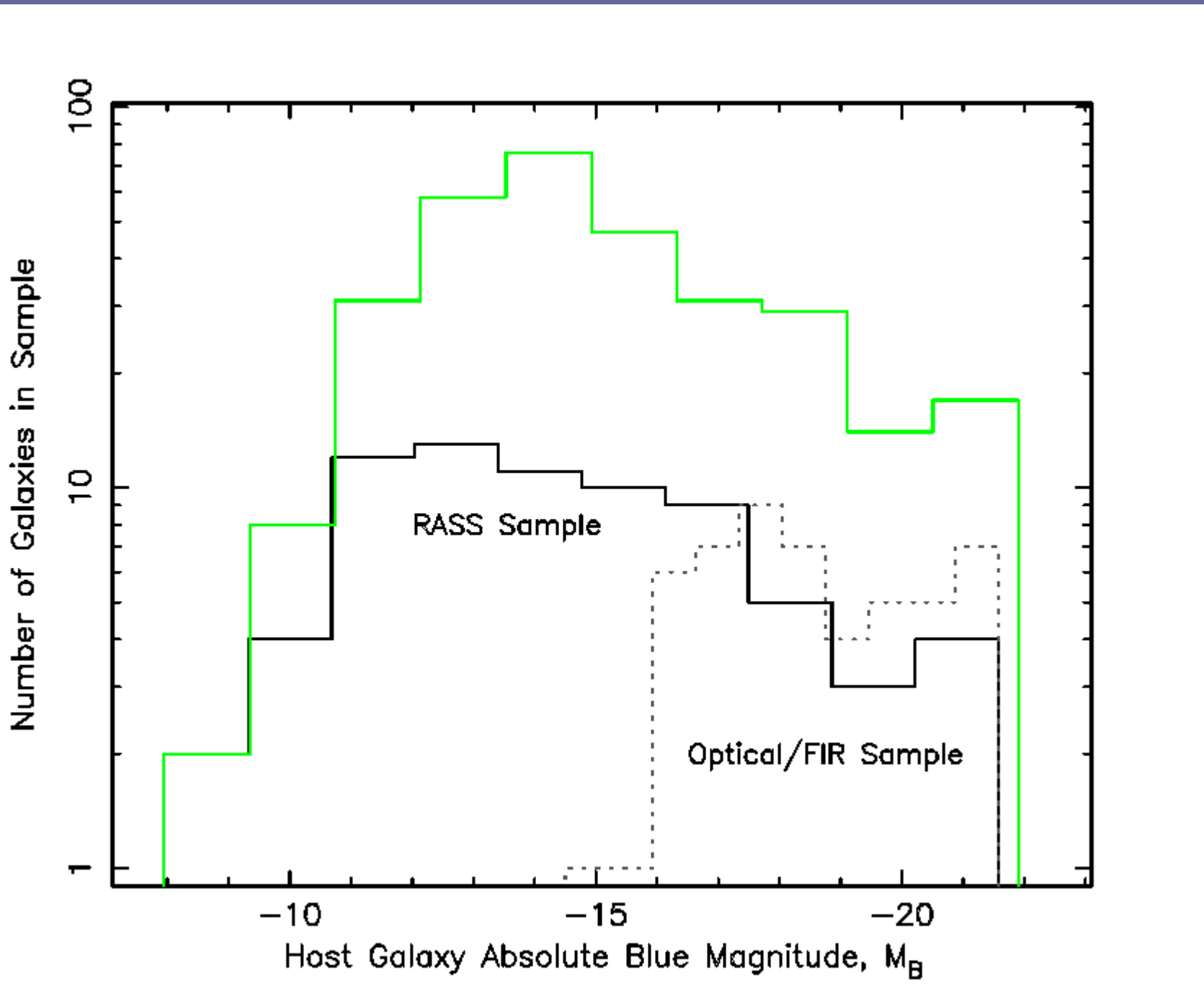
| N300 | 00 54 53.5 | −37 40 57 | 21.9 | 0.71 | 8.95 | 0.06 | 7 | K | 144 | 114 | 149 | 3.31 | 2.15 | cep |
| Sculptor | 01 00 09.4 | −33 42 33 | 35.2 | 0.79 | 10.05 | 0.05 | −3 | A | 110 | 96 | ... | 0.11 | 0.09 | rgb |
| LGS−3 | 01 03 56.6 | +21 53 41 | 1.2 | 0.58 | 16.18 | 0.18 | −1 | A | −286 | −74 | 18 | 0.23 | 0.62 | rgb |
| I1613 | 01 04 54.1 | +02 07 60 | 16.4 | 0.90 | 9.92 | 0.11 | 10 | A | −232 | −89 | 25 | 2.67 | 0.73 | cep |

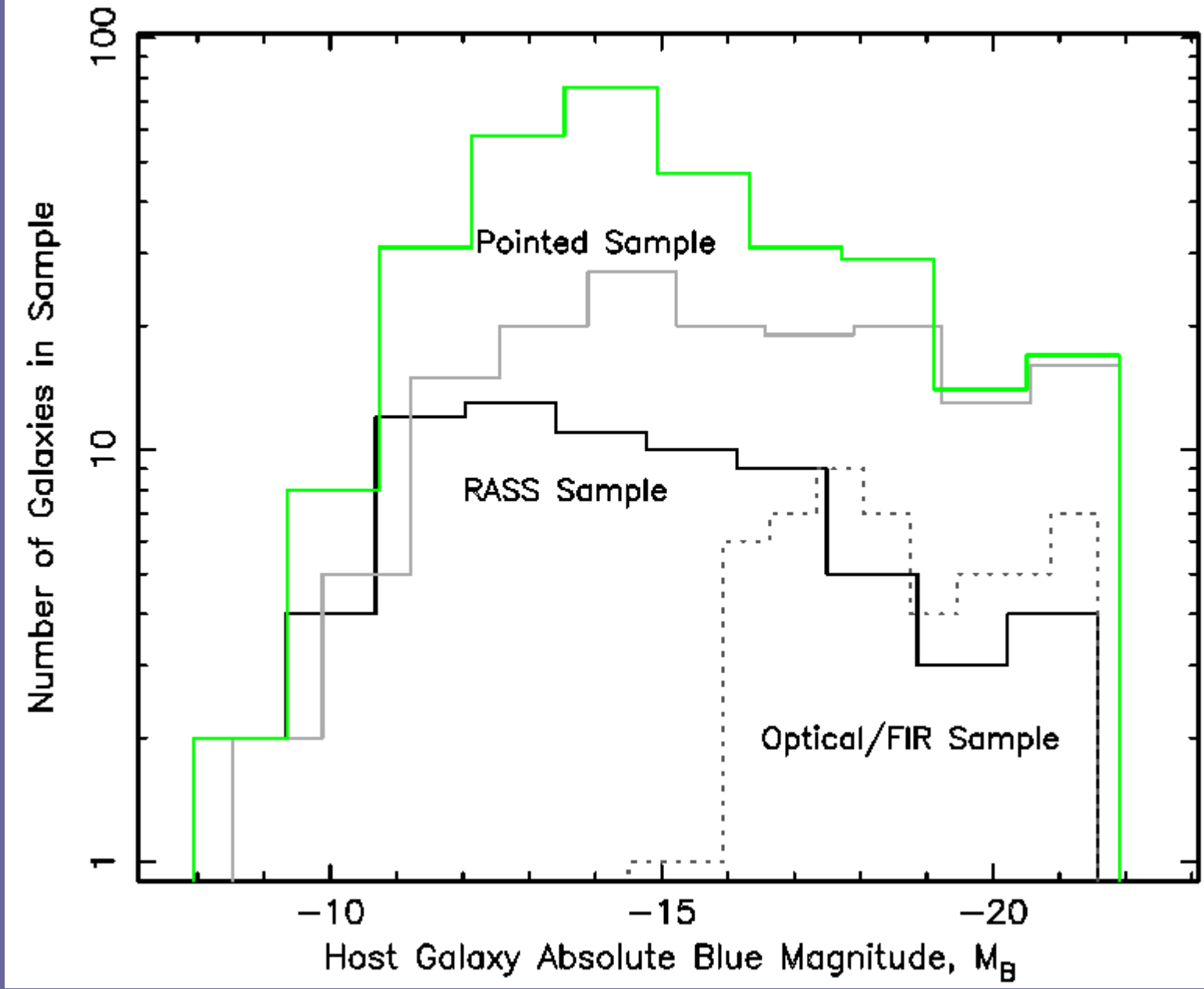
451 → 313

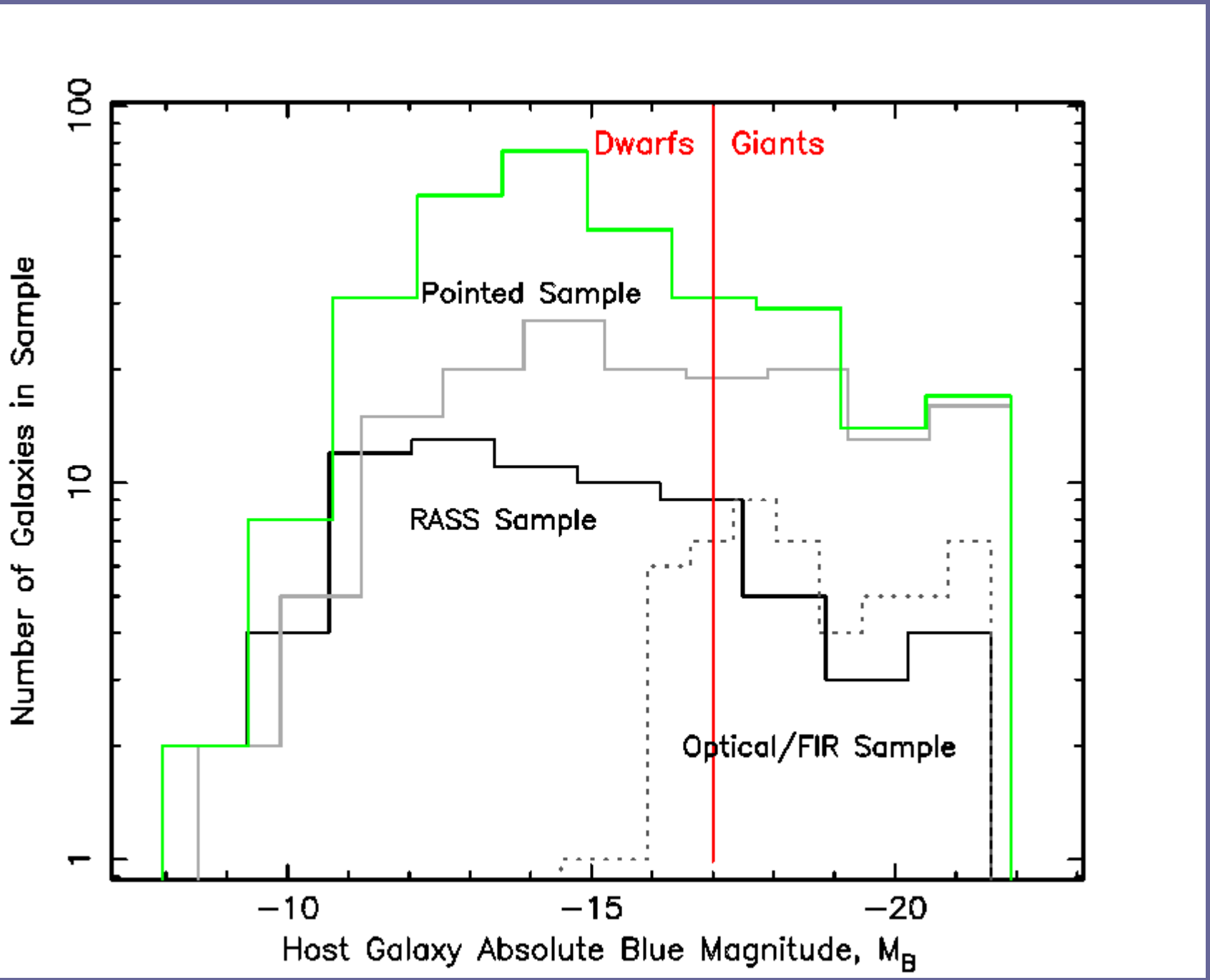

Full CNG Catalog
Galaxies with Masses Defined
Number of Galaxies
100
10
−5
0
5
10
Revised Hubble Type

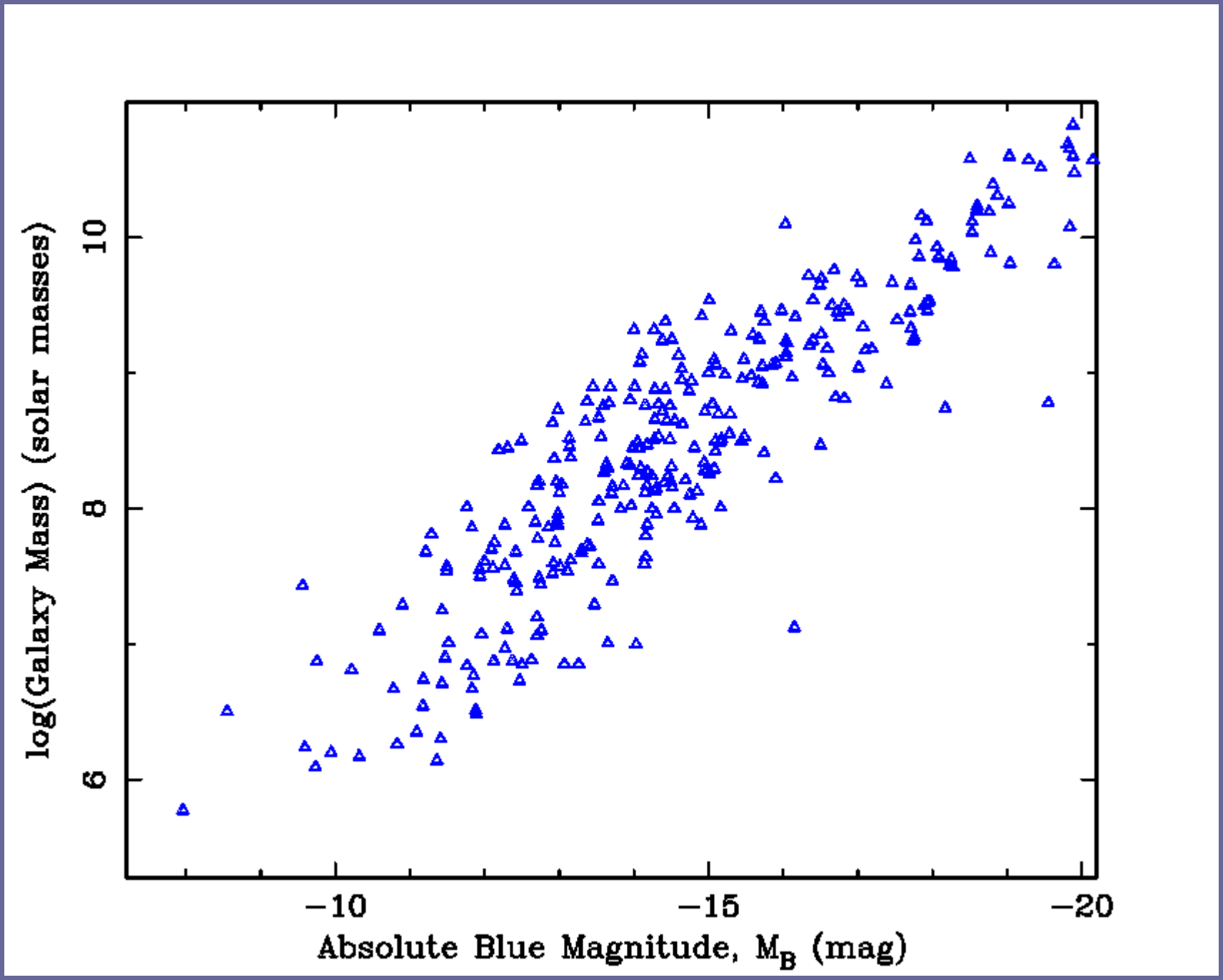

100
10
1
Number of Galaxies in Sample
−10
−15
−20
Host Galaxy Absolute Blue Magnitude, $M_B$

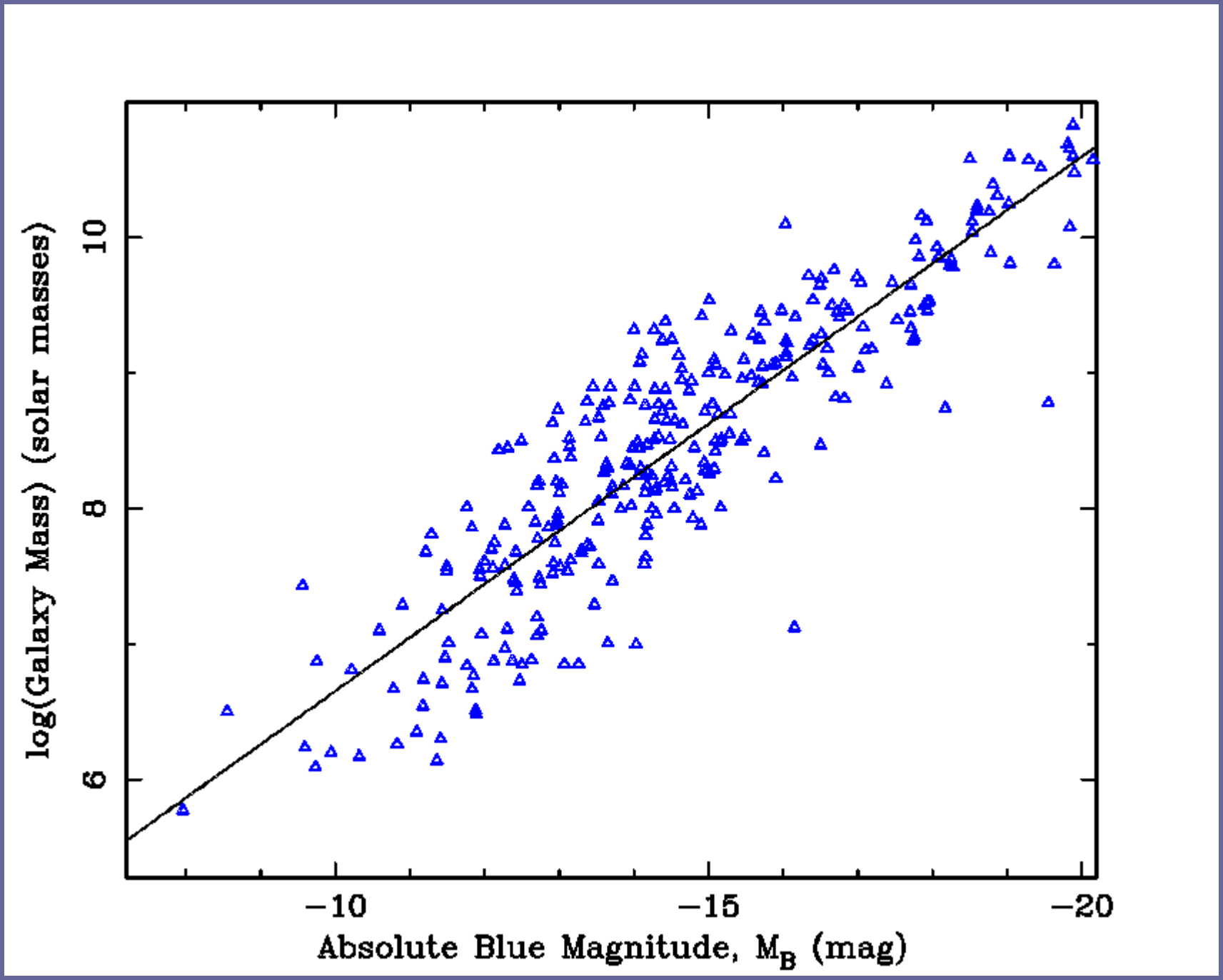

Number of Galaxies in Sample
100
10
1
−10
−15
−20
Host Galaxy Absolute Blue Magnitude, $M_B$
Optical/FIR Sample

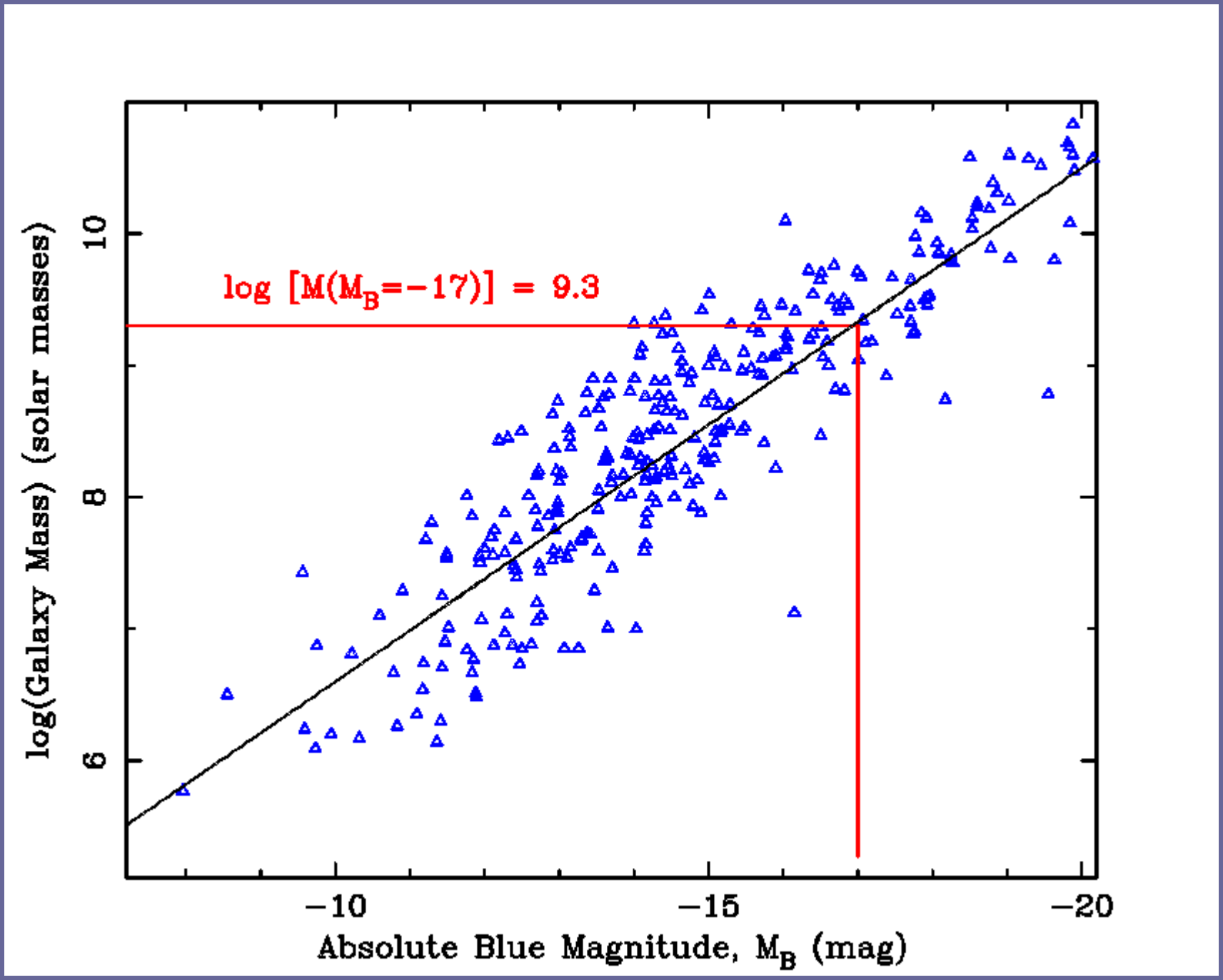

Number of Galaxies in Sample
100
10
1
RASS Sample
Optical/FIR Sample
−10
−15
−20
Host Galaxy Absolute Blue Magnitude, $M_B$

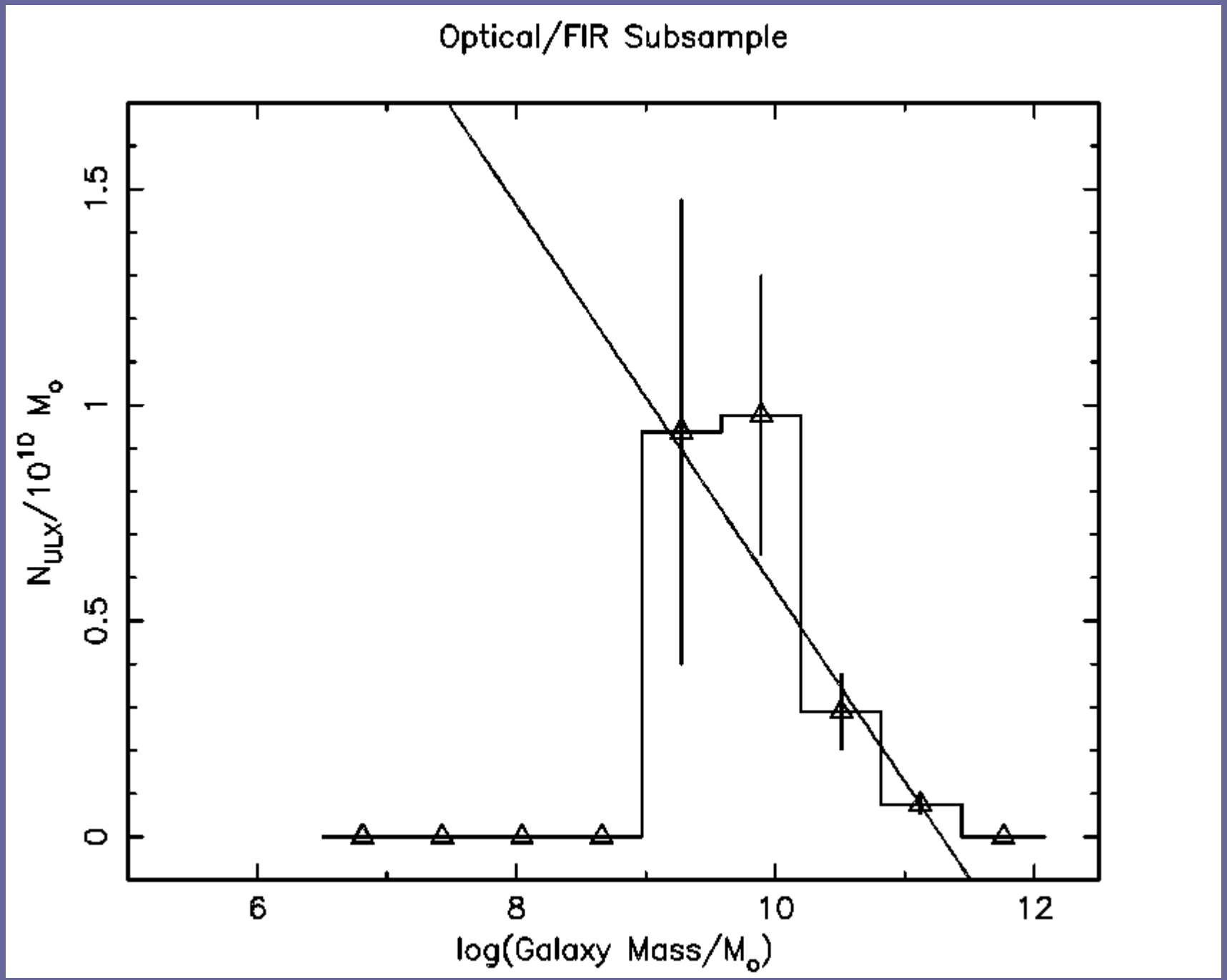

Number of Galaxies in Sample
100
10
1
Pointed Sample
RASS Sample
Optical/FIR Sample
−10
−15
−20
Host Galaxy Absolute Blue Magnitude, $M_B$

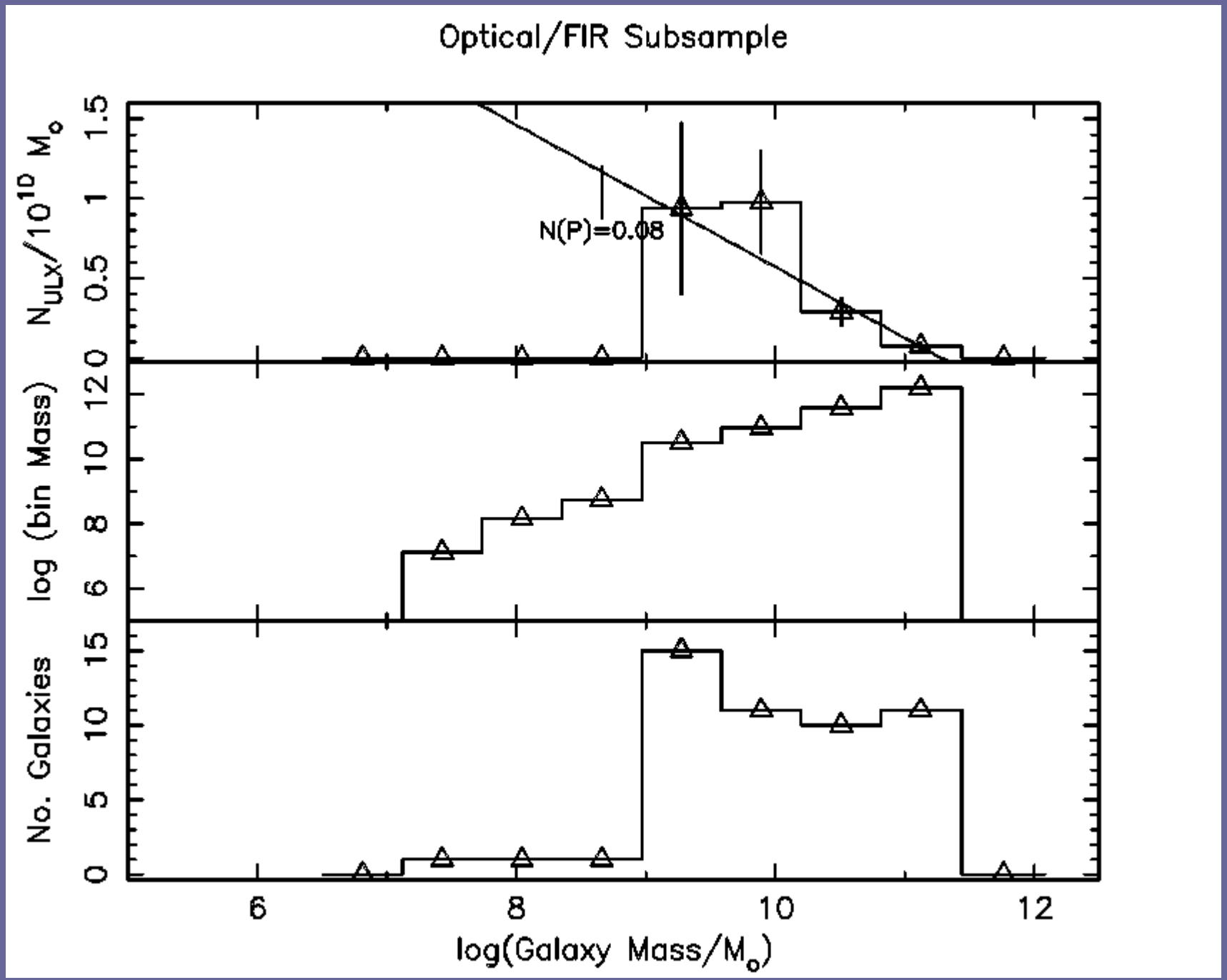

Dwarfs
Giants
Pointed Sample
RASS Sample
Optical/FIR Sample
Number of Galaxies in Sample
100
10
1
−10
−15
−20
Host Galaxy Absolute Blue Magnitude, $M_B$

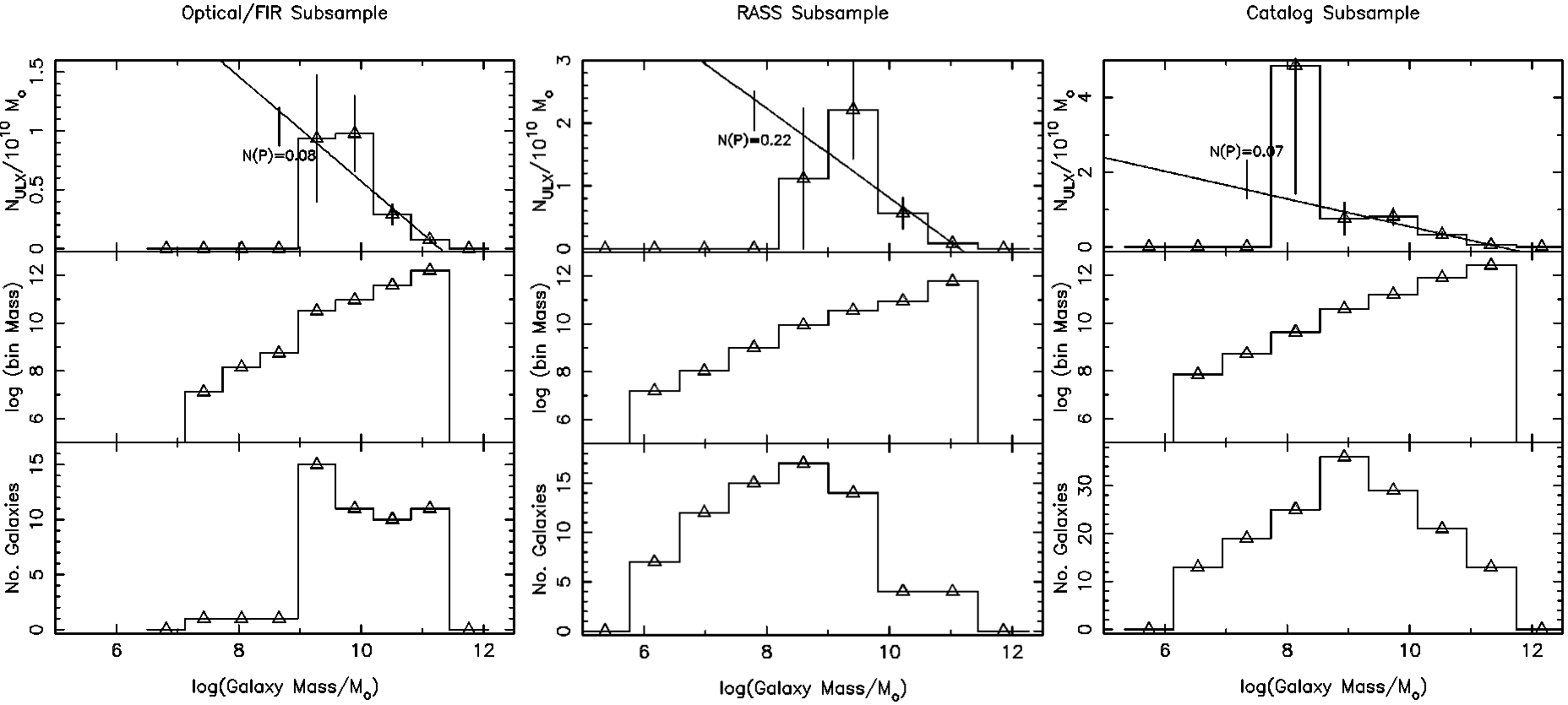

log(Galaxy Mass) (solar masses)
10
8
6
−10
−15
−20
Absolute Blue Magnitude, $M_B$ (mag)


log(Galaxy Mass) (solar masses)
6
8
10
−10
−15
−20
Absolute Blue Magnitude, $M_B$ (mag)


log [M(M_B=−17)] = 9.3
log(Galaxy Mass) (solar masses)
10
8
6
−10
−15
−20
Absolute Blue Magnitude, M_B (mag)


Optical/FIR Subsample
$N_{ULX}/10^{10}$ $M_o$
0
0.5
1
1.5
6
8
10
12
log(Galaxy Mass/$M_o$)


Optical/FIR Subsample
N(P)=0.08
$N_{ULX}/10^{10}$ $M_o$
log (bin Mass)
No. Galaxies
log(Galaxy Mass/$M_o$)
0
0.5
1
1.5
6
8
10
12
15
5


Optical/FIR Subsample
RASS Subsample
Catalog Subsample
N(P)=0.08
N(P)=0.22
N(P)=0.07
$N_{ULX}/10^{10}$ $M_o$
log (bin Mass)
No. Galaxies
log(Galaxy Mass/$M_o$)

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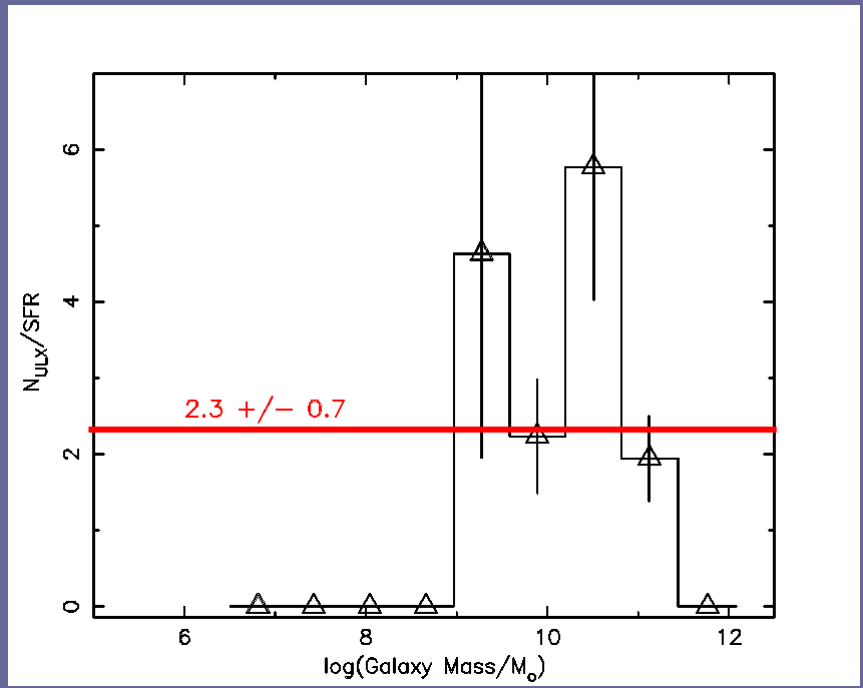

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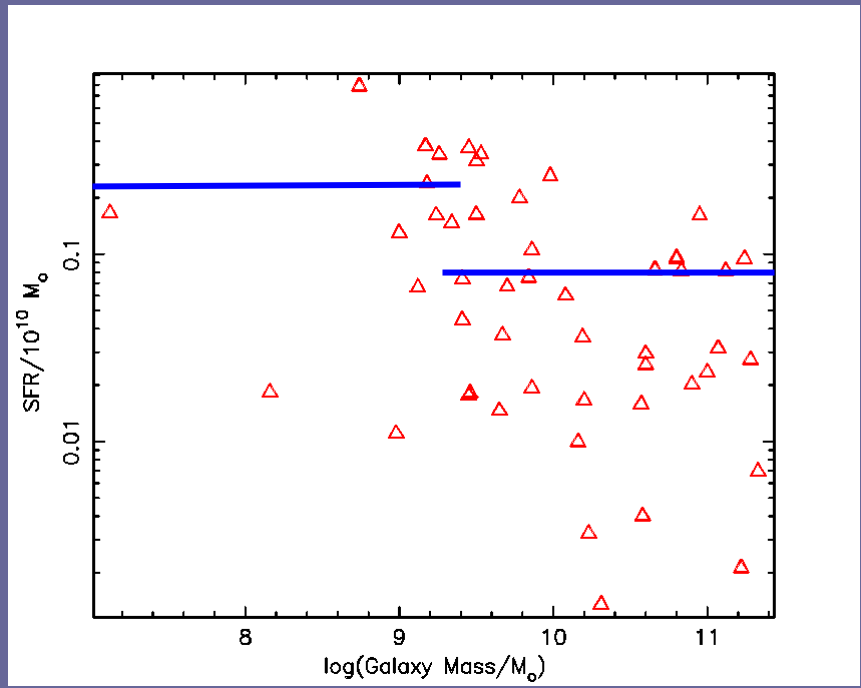

## *What may favor ULX formation in Dwarfs?*

- **Low metallicity -> high mass SNe -> BH higher $L_{Edd}$** (Heger+03)

- **Low shear -> higher mass MC -> sample high end of IMF** (Billet+02)

- **Cold, massive clusters -> protostar mergers -> top-heavy IMF** (Peretto+07)