

**The all-sky catalog of
isolated galaxies selected
from 2MASS**

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2 MASS survey

The 2MASS All-Sky Data Release contains Image and Catalog data covering 99.998% of the sky, derived from all Northern and Southern Survey observations.

- The All-Sky Release products include a Point Source Catalog (PSC), containing positions and photometry for **470 992 970** objects,
- **Extended Source Catalog (XSC)**, containing positions, photometry and basic shape information for **1 647 599** resolved sources, most of which are galaxies $K_s < 14.5^m$ and angular diameter $> 10''$ (Jarrett et al. 2000) ,
- the Image Atlas, containing over **4 121 439** J, H and Ks FITS images covering the sky.

Goal

Based on modified criterion of isolation
(Karachentseva, CIG, 1973)

**to compile a numerous reference
sample of isolated galaxies**

extracted from the all-sky, homogeneous
2MASS XSC survey.

Selection criteria

Karachentseva (1973)

$$x_{1i} \geq 20 a_i \quad (1)$$

$$\frac{1}{4} a_1 \leq a_i \leq 4a_1, \quad (2)$$

where indexes “1” and “i” correspond to fixed and neighbouring galaxies. Primary galaxies with angular diameter a_1 are considered as isolated if any galaxy with diameters a_i has the apparent angular separation x_{1i} from the primary galaxy greater than $20 a_i$

We found that the median ratio of optical-to-infrared diameters for the CIG galaxies is $a_{25}/2r_{20fe} = 1.5$ with a large spread from one object to other. So, we use the value

$$s = x_{1i}/a_i = x_{1i}/2r_{20fe} = 30$$

To have a reserve of background/foreground objects we limited the parameters of the 2MASS XSC galaxies - candidates:

$$4.0 < K_s \leq 12.0 \quad (3)$$

$$a_K \geq 30'' \quad (4)$$

$K_s=12^m$ corresponds to a limit magnitude of the CIG galaxies with a typical $(B-K) = 3.5-4.0^m$.

Note that total number of the 2MASS XSC objects satisfying the solutions (3), (4) is $N=51572$.

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Selection of Isolated Galaxies:

The automated selection was carried out with the Pleinpot package environment designed for astronomical data reduction and analysis of the PostgreSQL Global Development Group.

Using the modified criteria (1)-(4) we found a total of 4045 candidates (or $4045/51572=7.8\%$).

After a visual inspection on DSS-1,2 and using the NED, LEDA radial velocity data for the primary and neighbouring galaxies:

- We excluded 51 non-galaxy objects - PN, Star Cluster, Part of Galaxy, etc;
- To avoid cases when a galaxy isolation may be destroyed by blue galaxies unseen in 2MASS, we examined implementation of conditions (1) and (2)



Selection of Isolated Galaxies:

- candidates WITHOUT significant neighbours:
N=2493, or $2493/51572 = 4.8\%$.
- candidates WITH significant neighbours:
 - if $|dV| > 500$ km/s, a galaxy was included in 2493 sample;
 - if $|dV| < 500$ km/s, a galaxy to be removed as a member of pair or group, N=567;
 - without V_h - we believe them as potentially isolated, N=734.
- with UNSIGNIFICANT neighbours and small $|dV|$, N=141.

Formally they are included in the 2493 sample. Such systems, consist of one dominated galaxy surrounded by dwarf galaxies, are important for study of different problems.

As a result, we have

2MASS Isolated Galaxy catalog, **2MIG, N=3227**

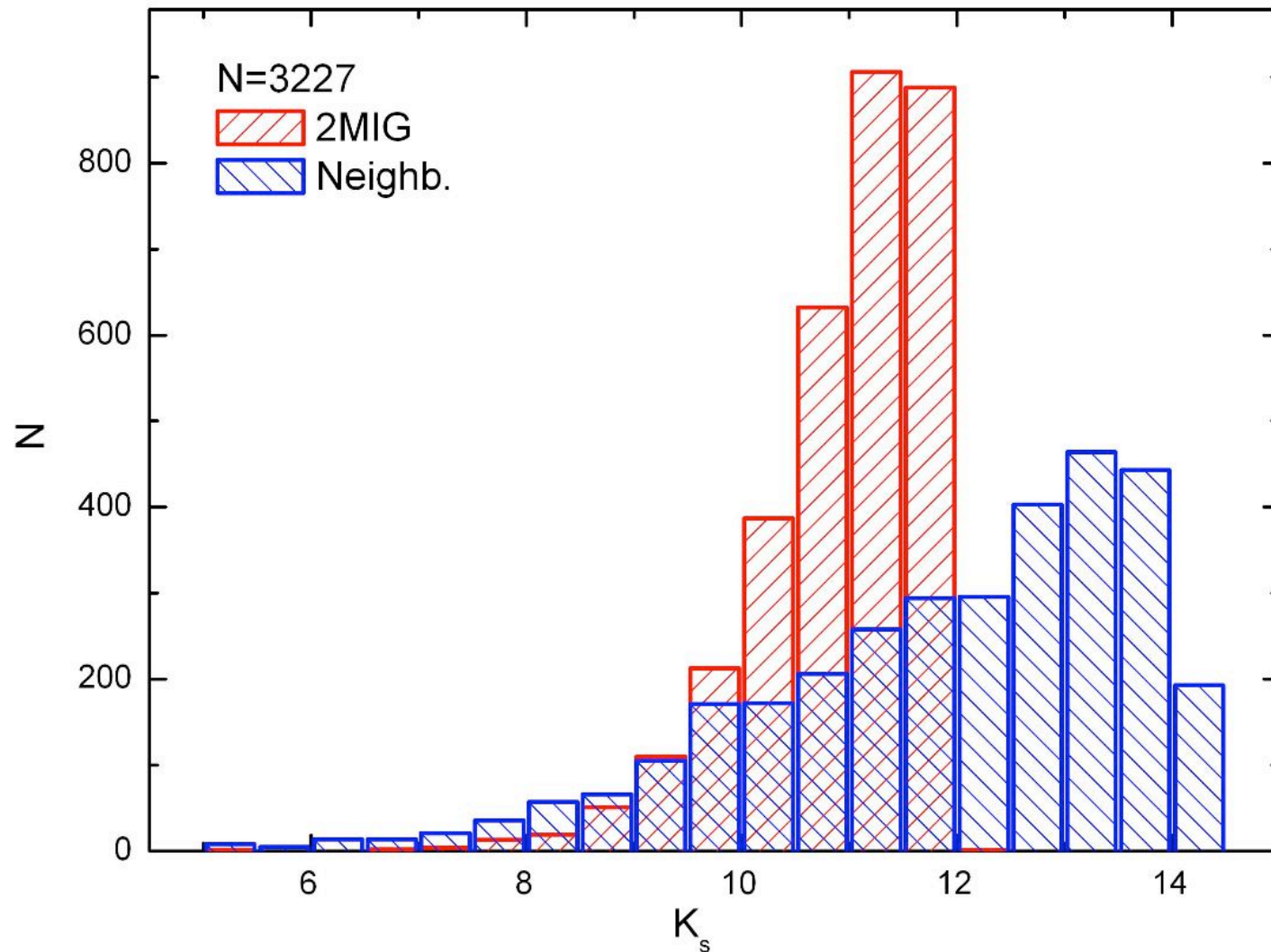
and its subsample

2MASS Very Isolated Galaxy catalog, **2MVIG, N=2493.**

COMPARISON OF THE ISOLATED GALAXY- NEIGBOUR PROPERTIES



K_s distributions for 2MIG galaxies and their significant neighbours



2MIG
N=3227
 $\langle K_s \rangle = 10.94$
SD=0.81
Neighb.
 $\langle K_s \rangle = 11.92$
SD=1.76

2MVIG
N=2493
 $\langle K_s \rangle = 10.90$
SD=0.84
Neighb.
 $\langle K_s \rangle = 11.85$
SD=1.79

Fig.1

K_s difference for neighbour and main galaxy

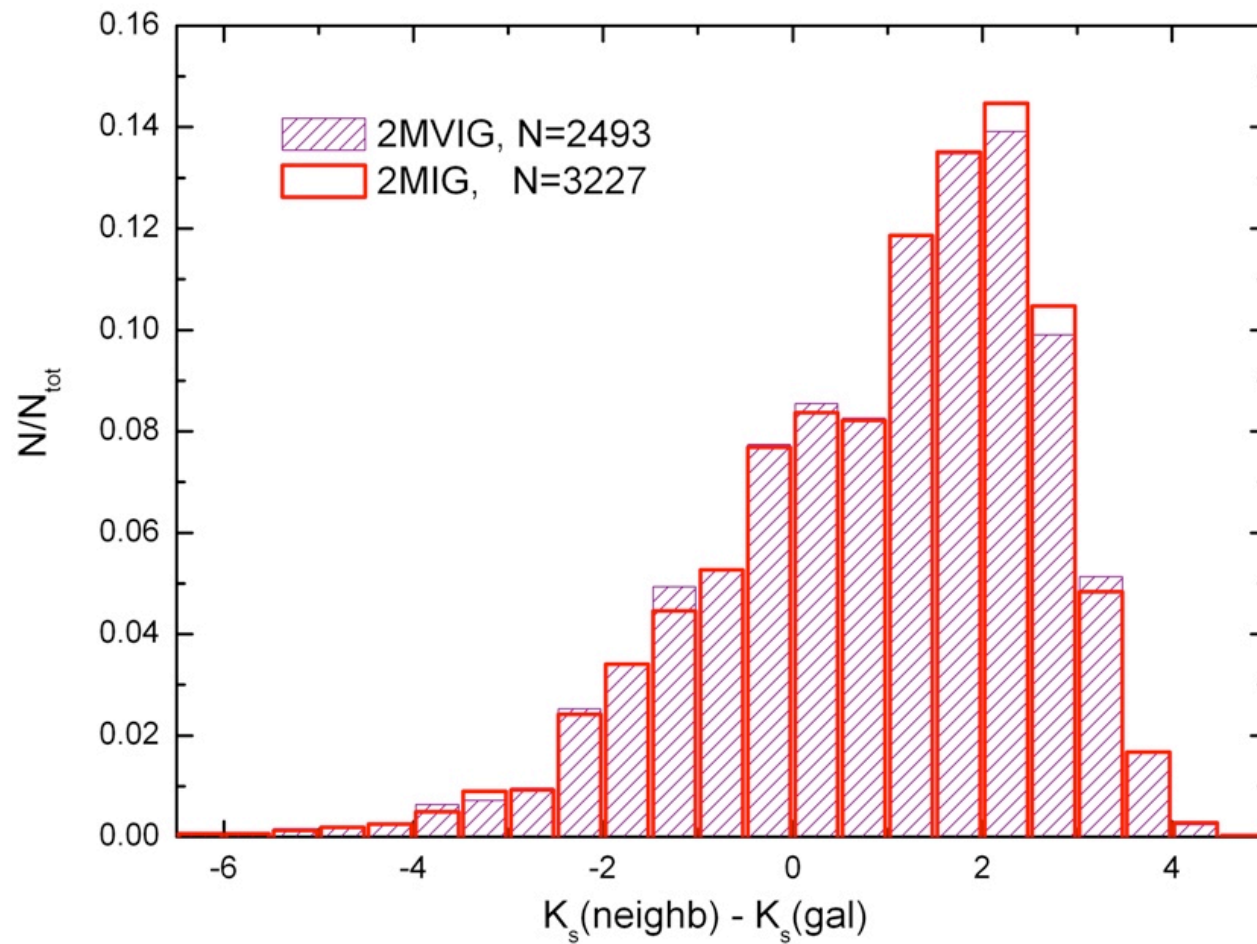
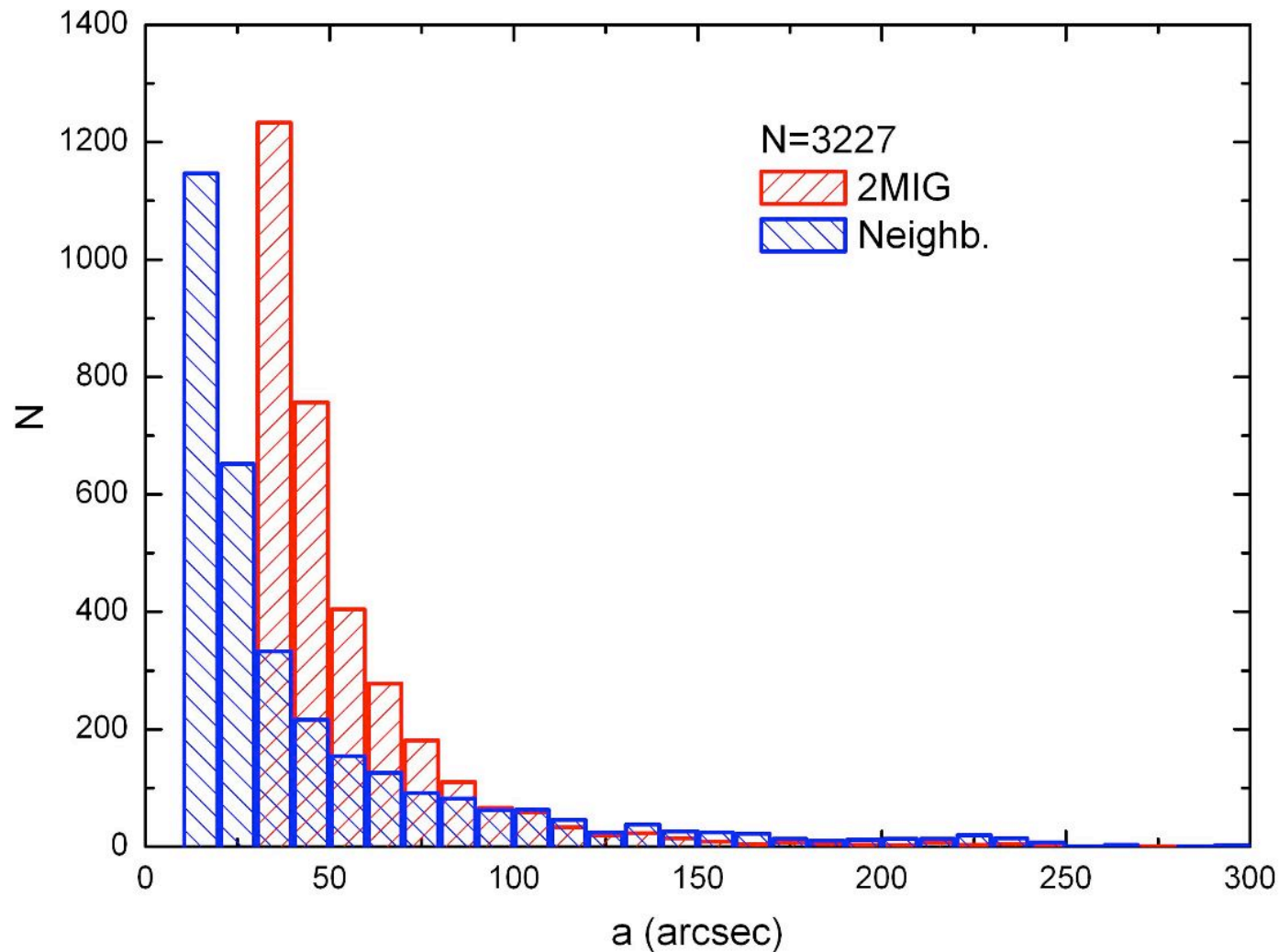


Fig.2

Distributions for isolated galaxies and their neighbours by angular diameter

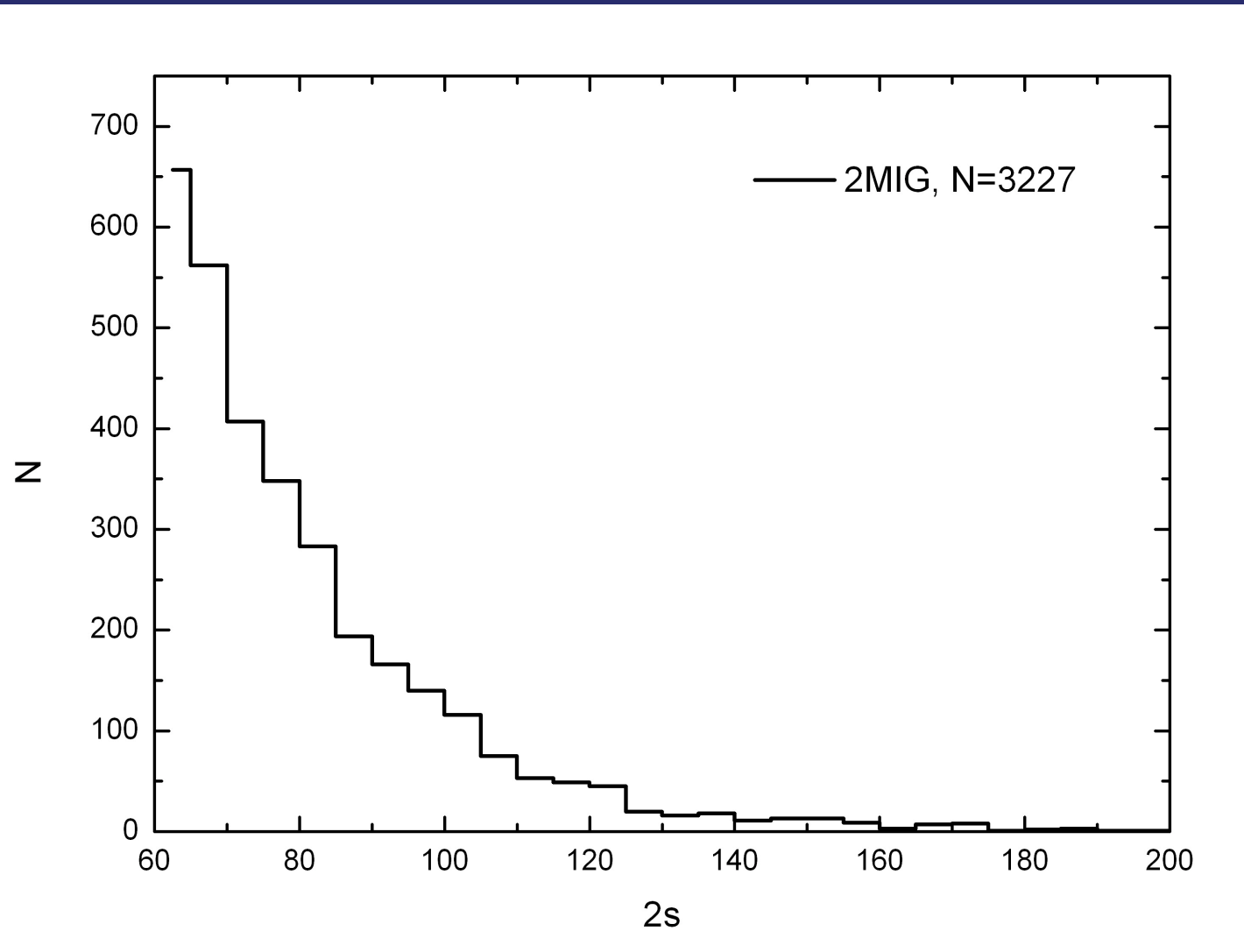


2MIG
N=3227
 $\langle a \rangle = 53.4$
SD=29.2
Neighb.
 $\langle a \rangle = 46.0$
SD=49.3

2MVIG
N=2493
 $\langle a \rangle = 55.0$
SD=31.2
Neighb.
 $\langle a \rangle = 47.5$
SD=50.4

Fig.3

2s distribution of neighbours



2MIG
N=3227
 $\langle 2s \rangle = 81.1$
SD=21.3

2MVIG
N=2493
 $\langle 2s \rangle = 81.9$
SD=21.8

Fig.4

Radial velocity comparison for 2MIG, 2MVIG galaxies and their neighbours

Sample	N	N _{vel}	$\langle V_h \rangle$, km/s	SD, km/s
2MIG	3227	1260	6573	3659
2MIG neighb.	3227	1260	11845	12444
2MVIG	2493	968	6435	3692
2MVIG neighb.	2493	968	12000	12828

So, the nearest significant neighbours of the 2MIG and 2MVIG galaxies seem mostly as background in the sky projection as well as in the depth

K_s integral distribution of different samples

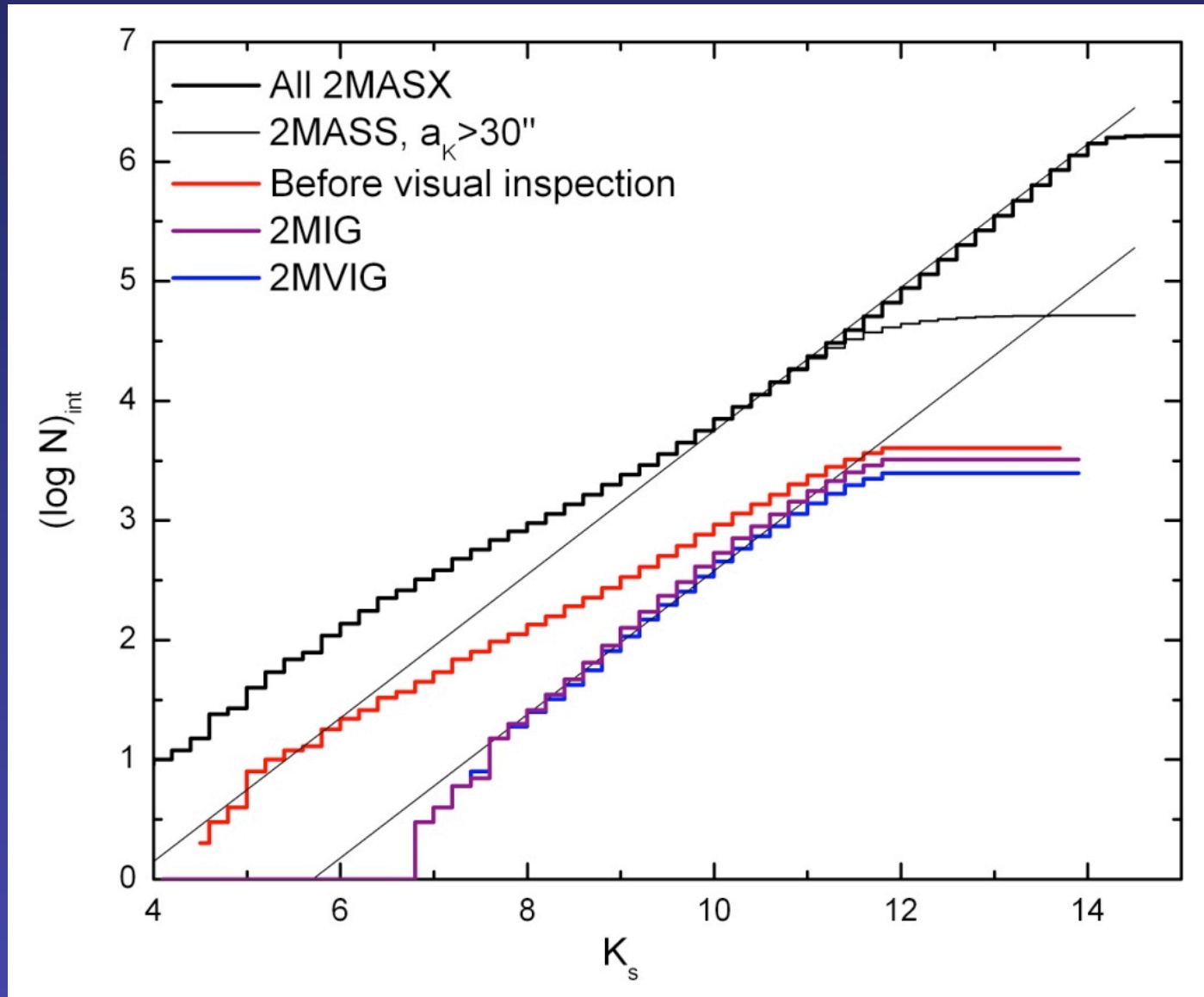


Fig.5

Isolated galaxies distribution in galactic coordinates (2MIG)

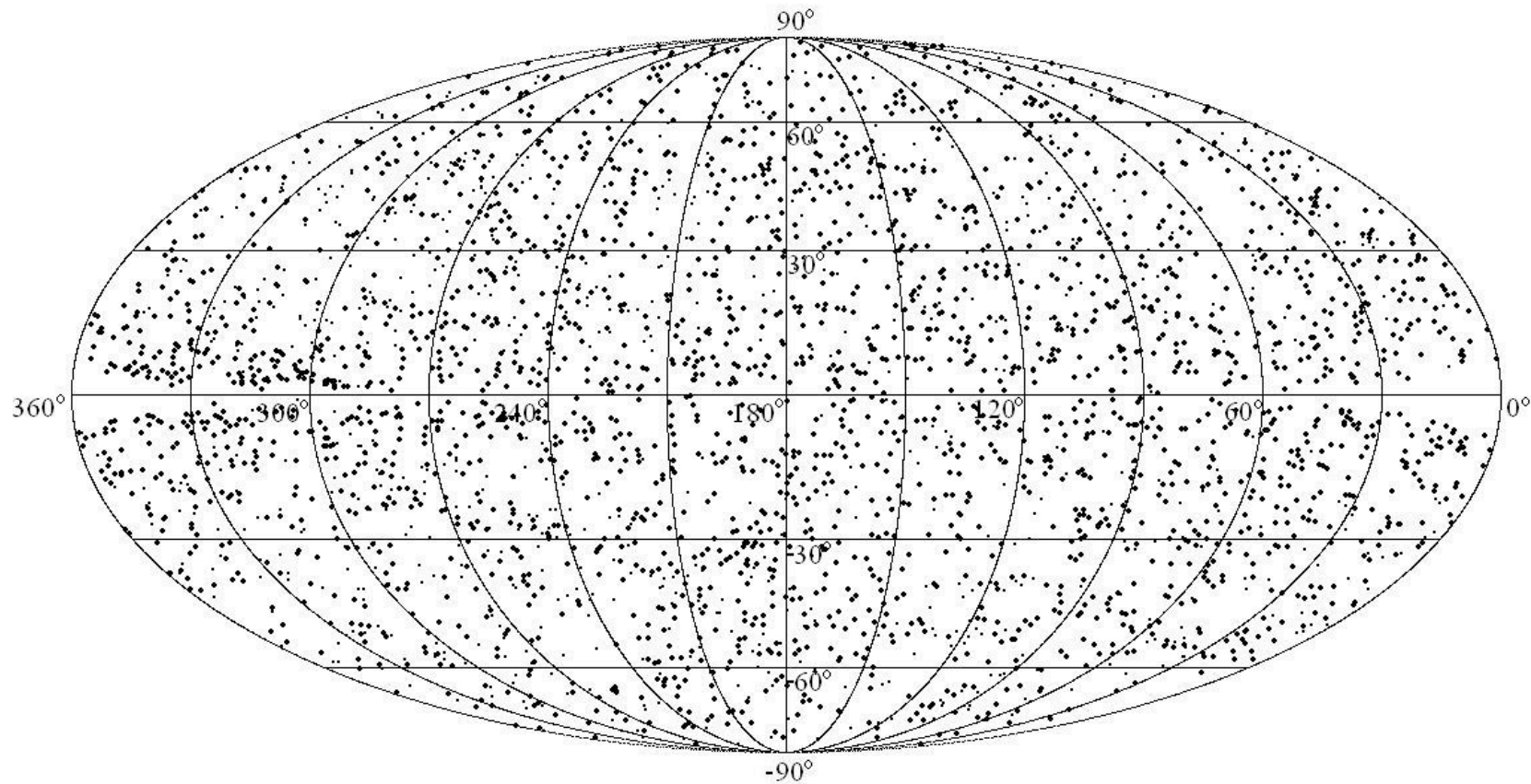


Fig.6

Isolated galaxies distribution in equatorial coordinates (2MIG)

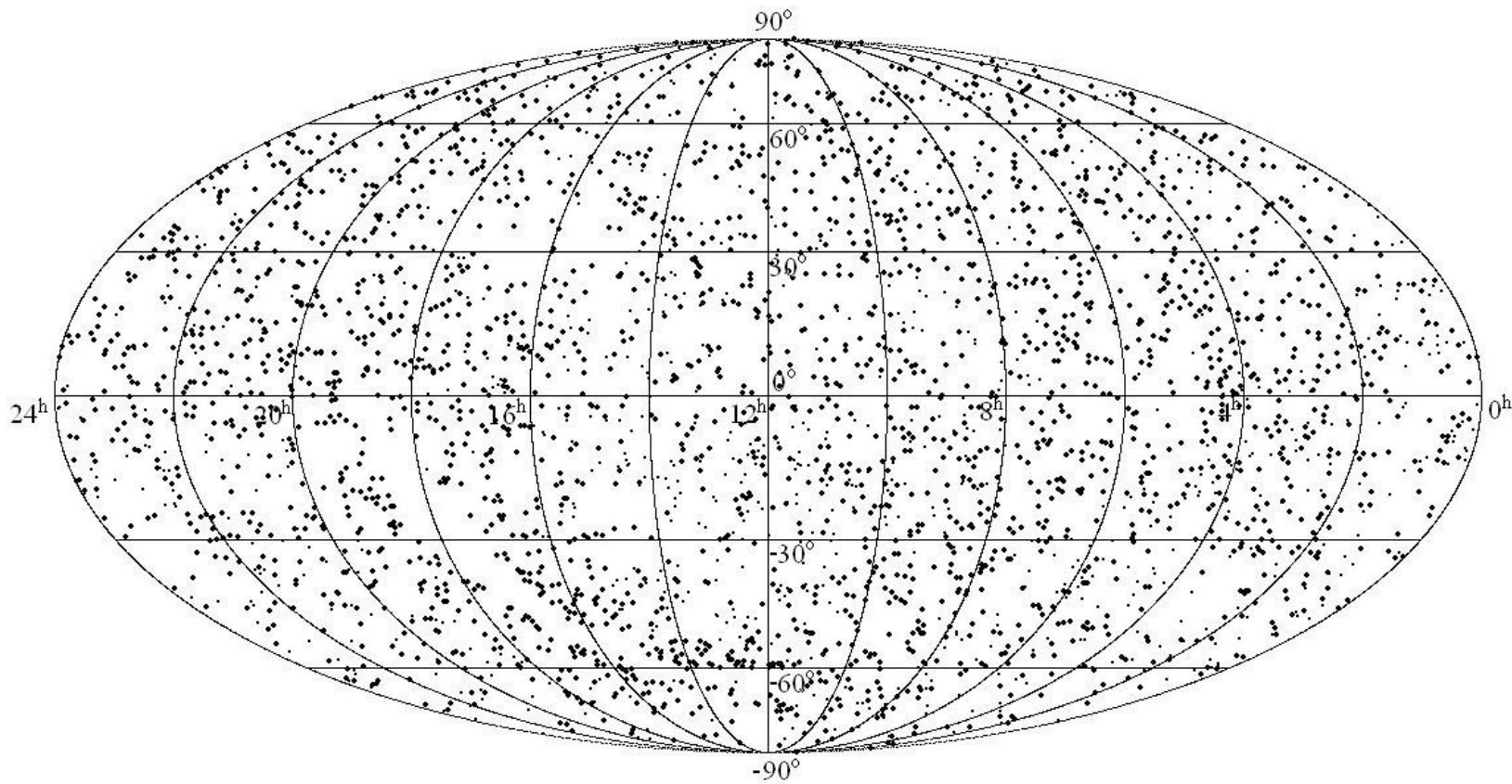


Fig.7

$K_s - \log(a'')$ relation of 2MIG galaxies

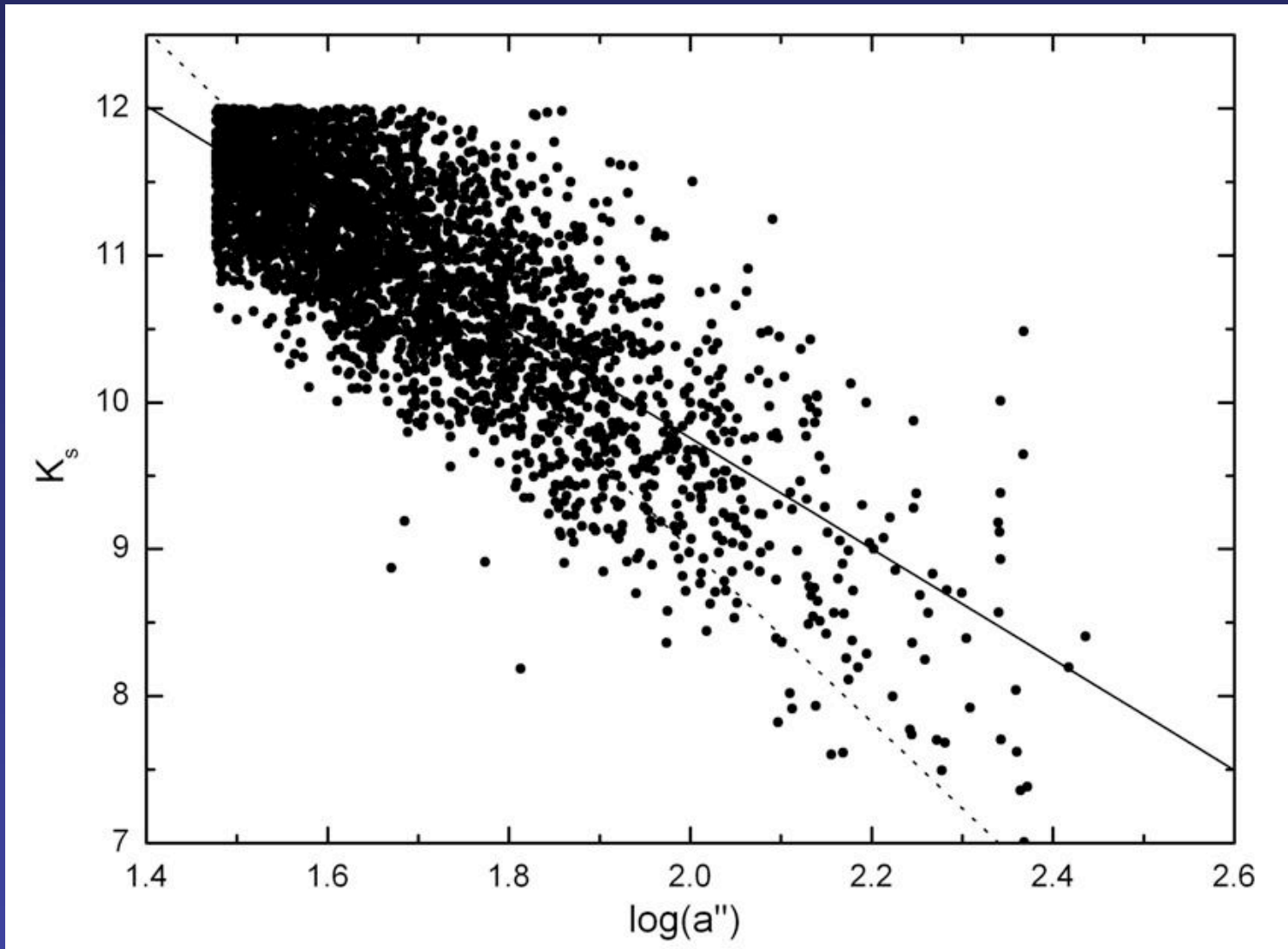
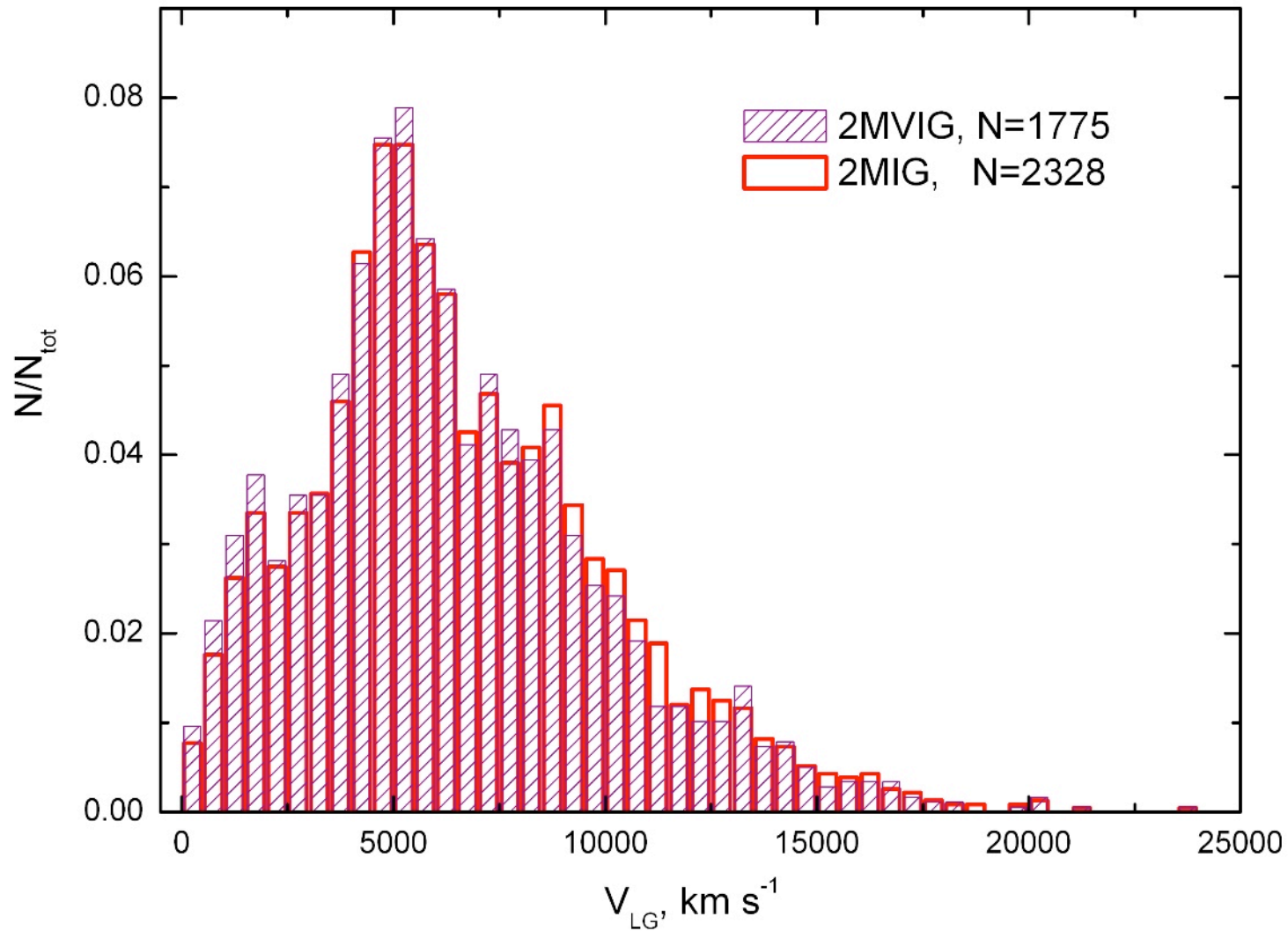


Fig.8

$K_s = -3.77 \log a + 17.29$ ($R=-0.80.$, $SD = 0.49$) – direct regression

$\log a = -0.17 K_s + 3.53$ ($R=-0.80.$, $SD = 0.10$) – inverse regression

Velocity distribution



2MIG:

$\langle V_{LG} \rangle = 6580 \text{ km/s}$

SD=3545 km/s

2MVIG:

$\langle V_{LG} \rangle = 6359 \text{ km/s}$

SD=3521 km/s

Fig.9

Morphological type distribution

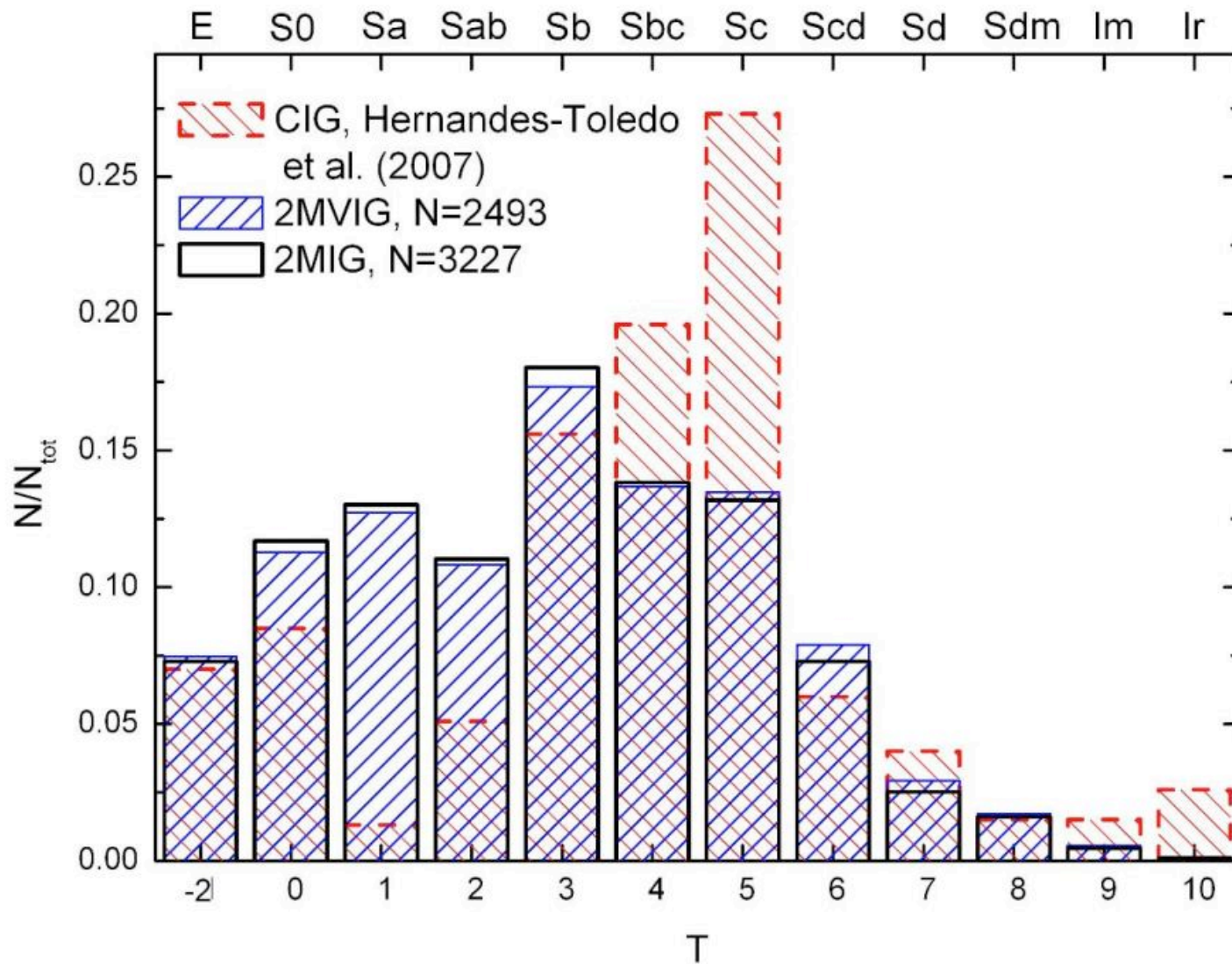


Fig.10

Difference of morphological types

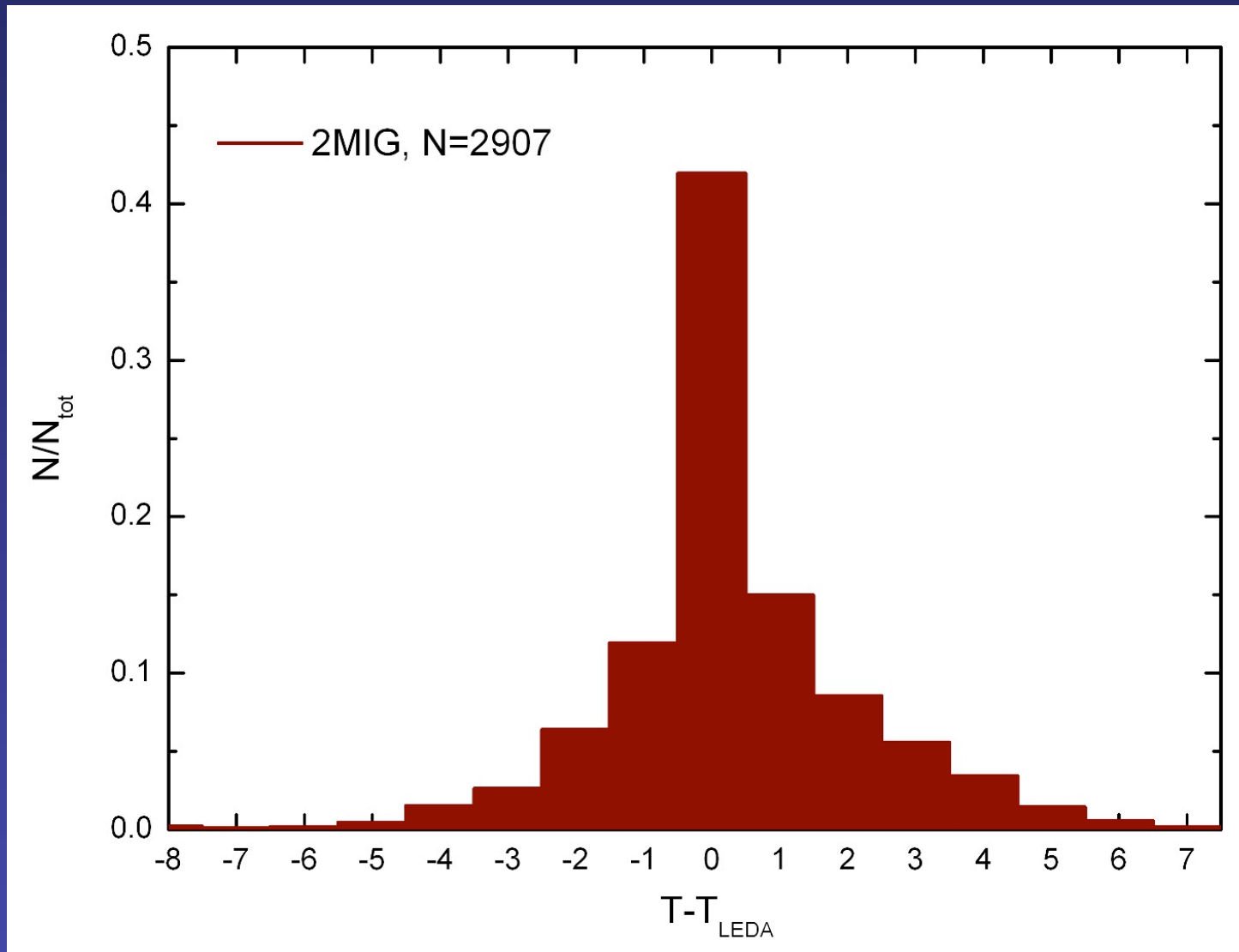


Fig.11

$\log(V_{LG})$ - T relation

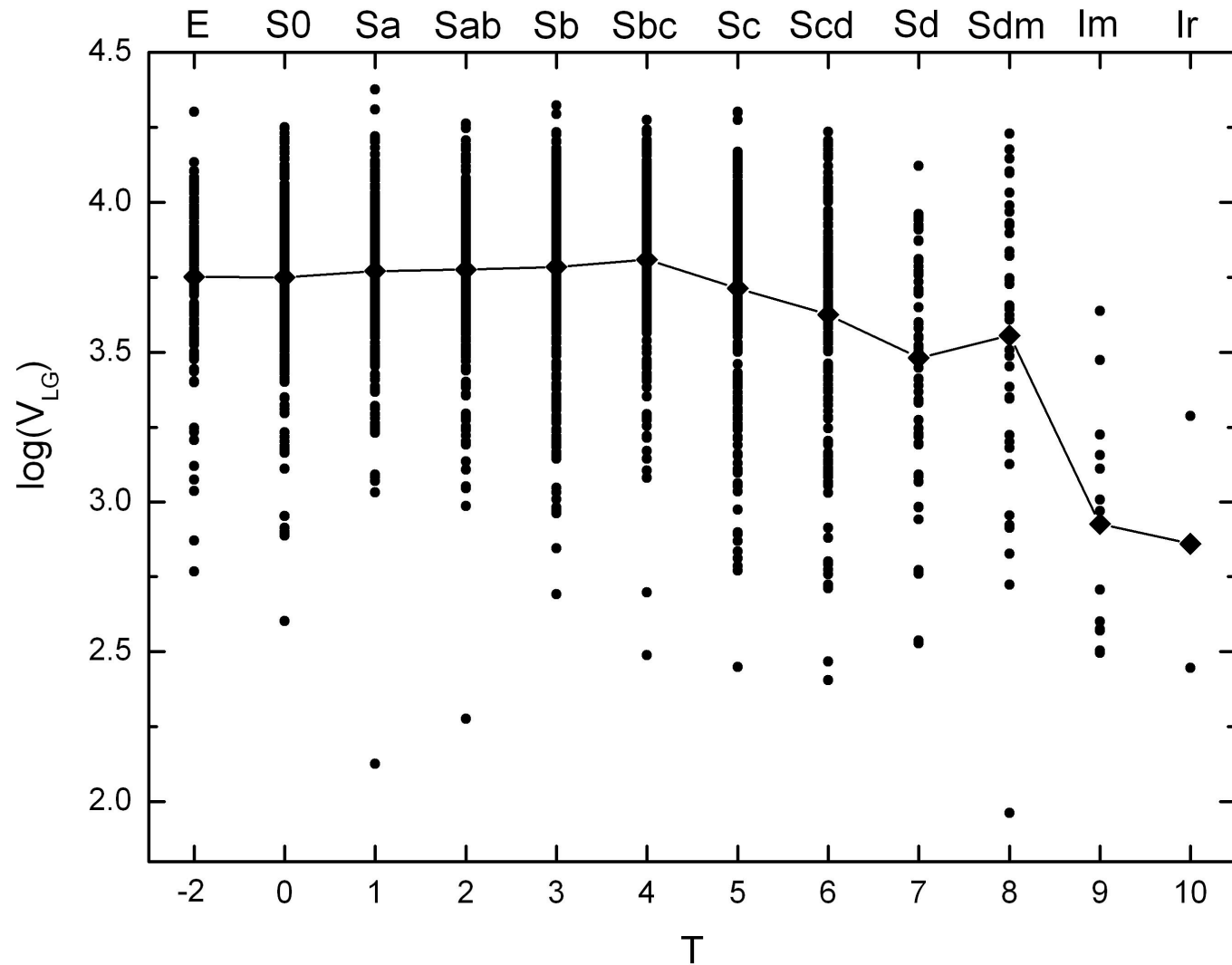


Fig.12

Conclusions

- Based on modified criterion of isolation we composed 2MASS catalog of Isolated Galaxies (N= 3227) which constitutes 6.2% of the galaxies brighter than $K=12^m$ and greater than $a=30''$ in the 2MASS XSC survey.
- The 2MIG catalog is all-sky distributed; its effective depth is about 6500 km/s.
- The rate of E and S0 galaxies is about 20%; the type distribution of spiral galaxies is shifted to the earlier subtypes; Ir galaxies are practically absent.
- The 2MIG catalog and its 2MVIG subsample may serve as a reference sample in different astronomical tasks.

**Thank you
for
attention!**