Photometric Selection of quasar candidates at z～4-5 based on the optical and near-IR data

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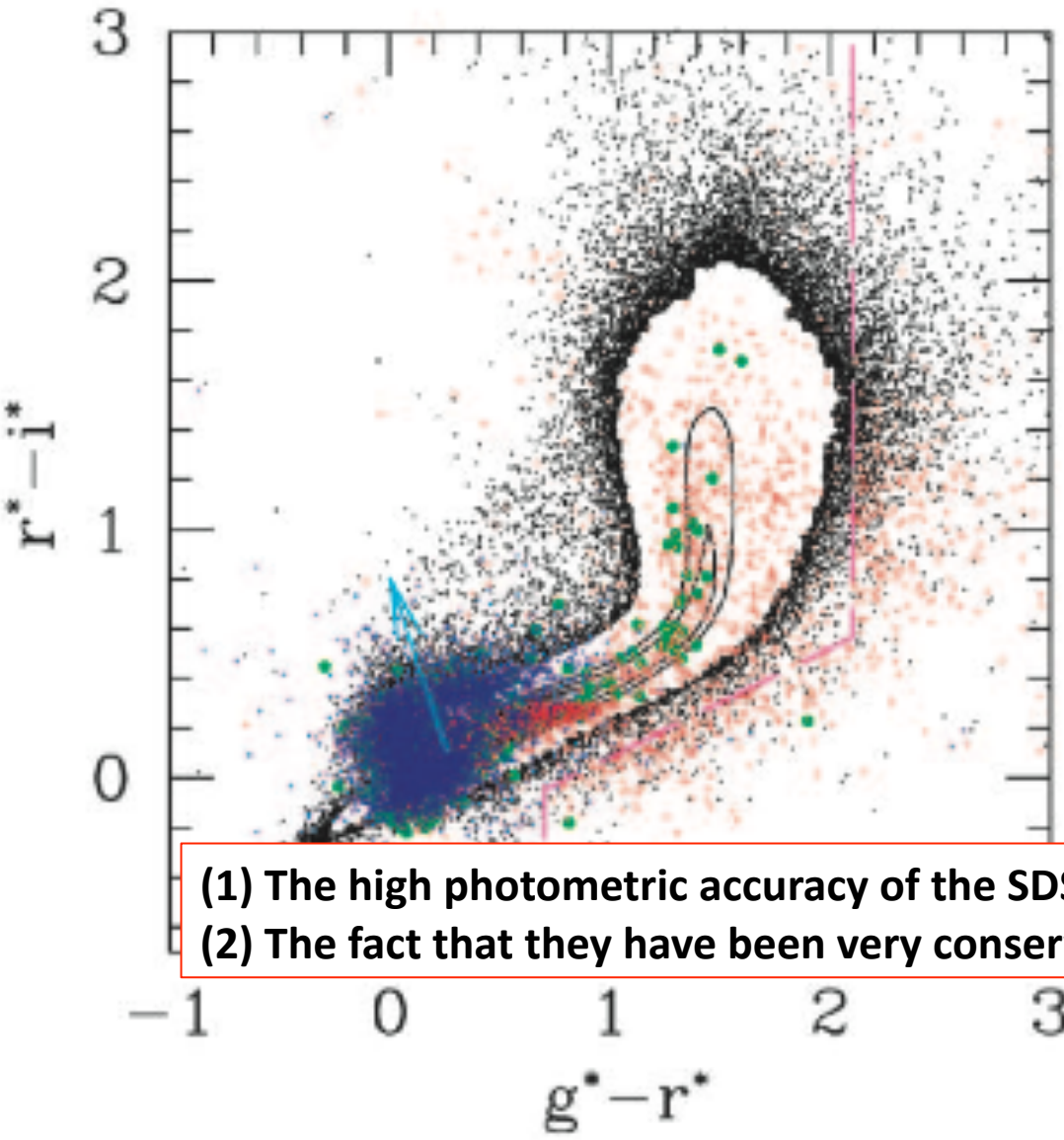
Previous High-Luminosity Quasar Survey at z～4-5 (SDSS)

Selection of quasar candidates at z～4



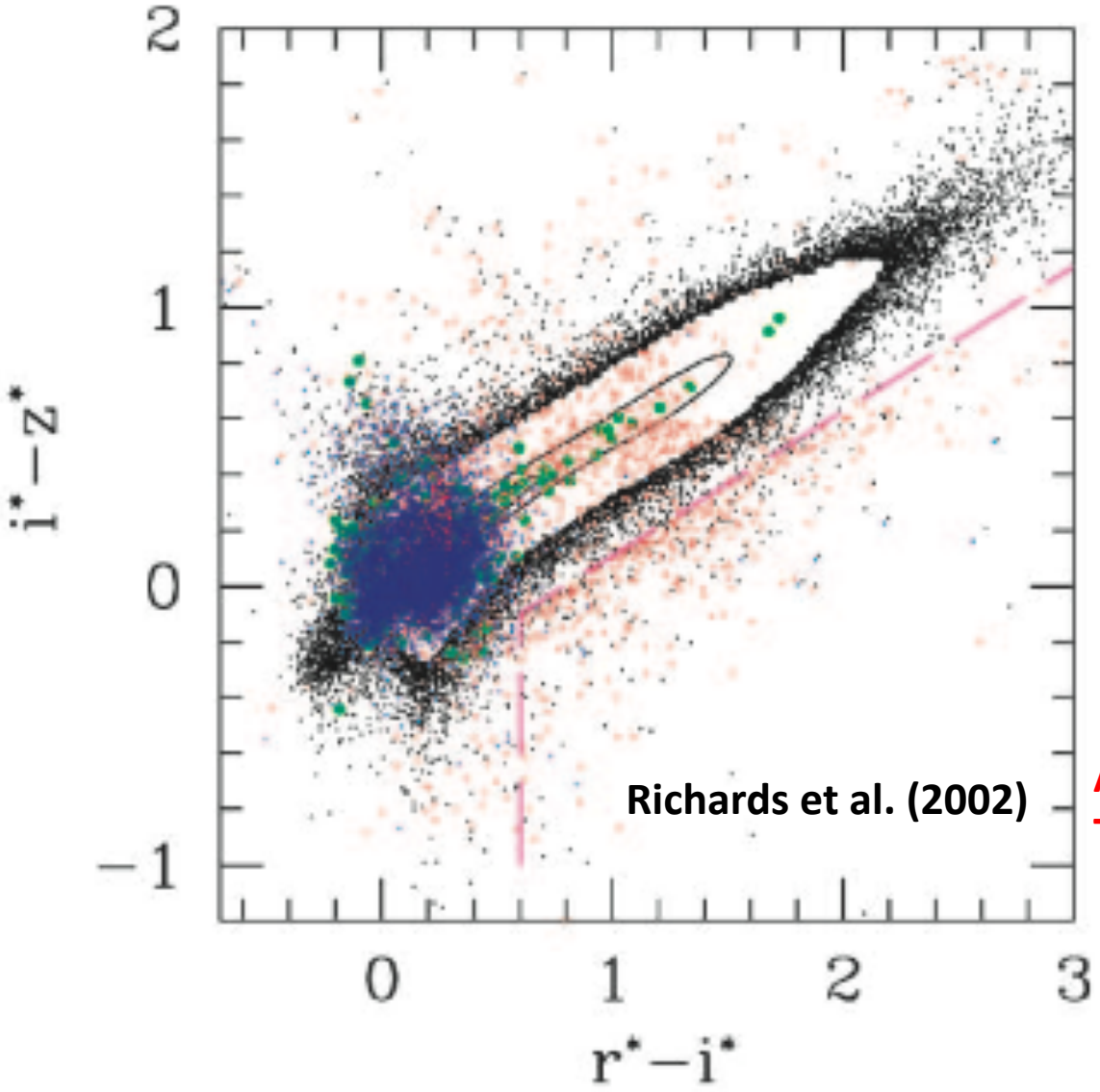
＜Selection criteria＞

- σ_i<0.2
- u-g>1.5 or u>20.6
- g-r>0.7
- g-r>2.1 or r-i<0.44(g-r)-0.358
- i-z<0.25
- i-z>-1.0
- Point Source

According to Fan, Strauss et al. (1999), the success rate is 70% (12/17)!!

(1) The high photometric accuracy of the SDSS data
(2) The fact that they have been very conservative in their candidate selection

Selection of Quasar Candidates at z～5

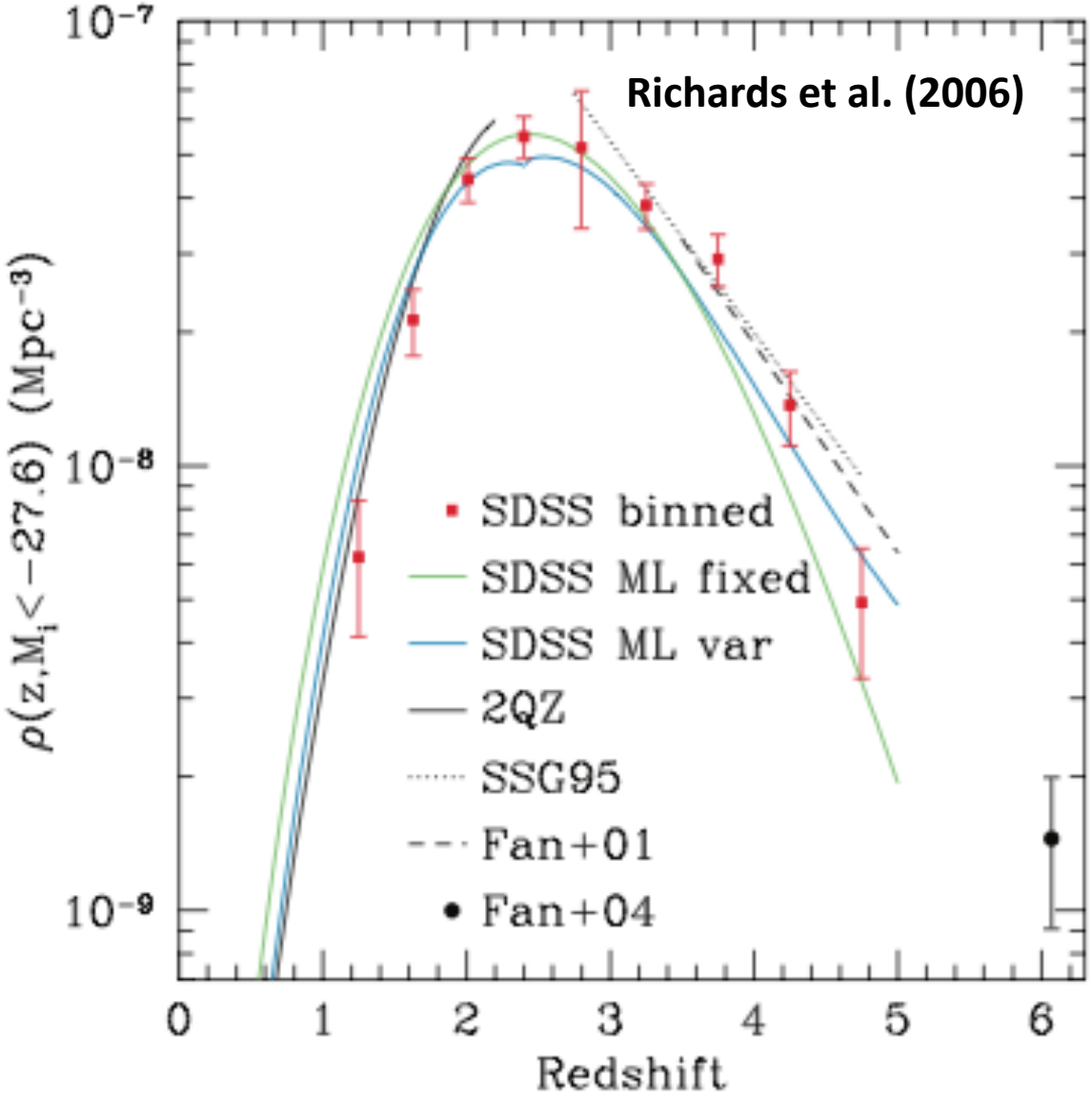


＜Selection criteria＞

- σ_i<0.2
- u>21.5
- g>21.0
- r-i>0.6
- i-z<0.52(r-i)-0.412
- i-z>-1.0
- Point Source

According to Fan, Strauss et al. (1999),
The success rate is 38% (3/8).

Integrated i-band Quasar Luminosity Function



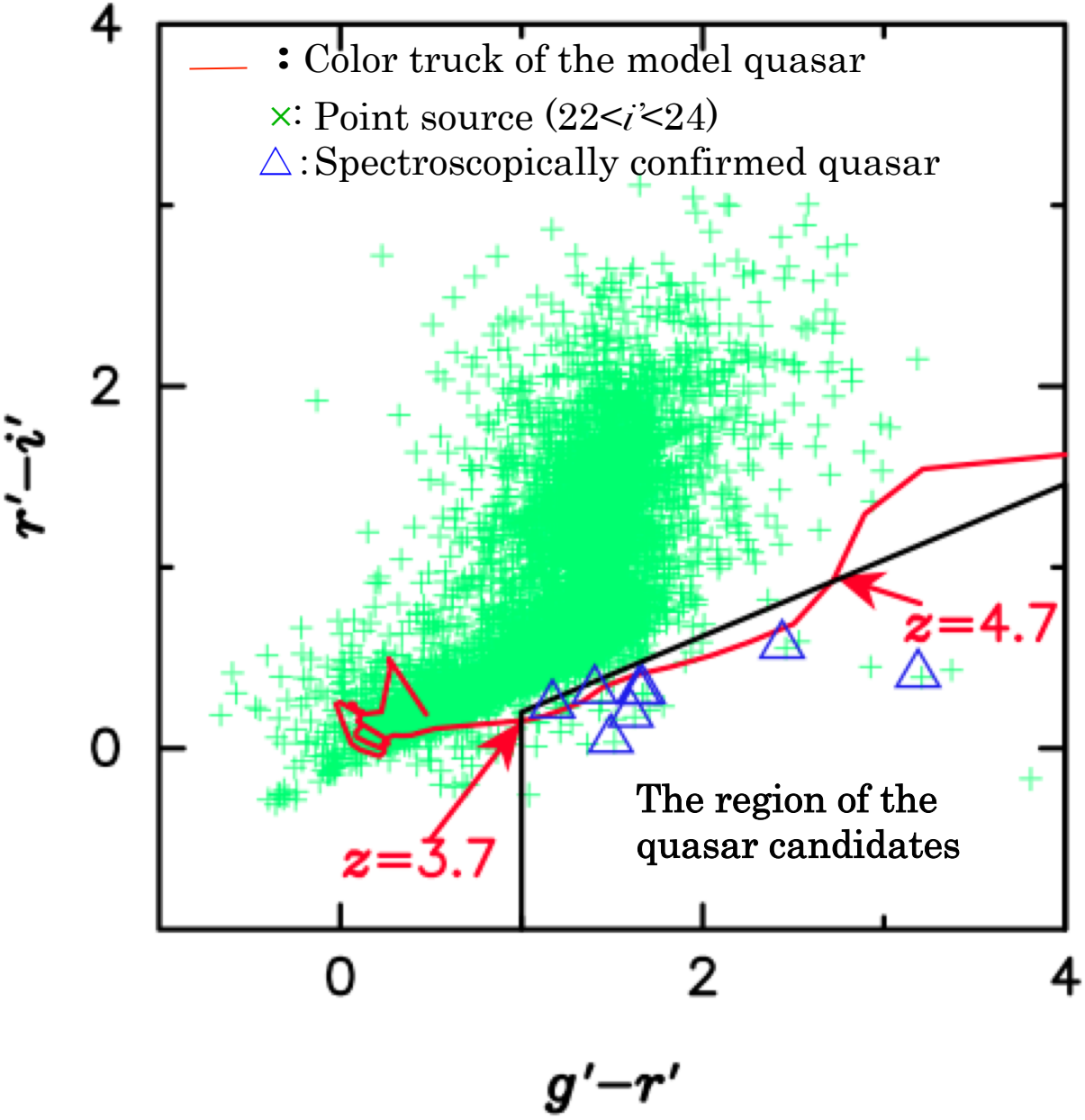
The i-band quasar luminosity function peaks at z~2-3.

But only high-luminosity quasars have been discovered at z>3.

Therefore the redshift evolution of the quasar luminosity function for lower-luminosity have not been studied…

Previous Low-Luminosity Quasar Survey at z～4-5 (COSMOS)

Selection of Quasar Candidates at z～4



<Selection Criteria>

(1)g'-r'>1.0

(2)r'-i'<0.42(g'-r')-0.22

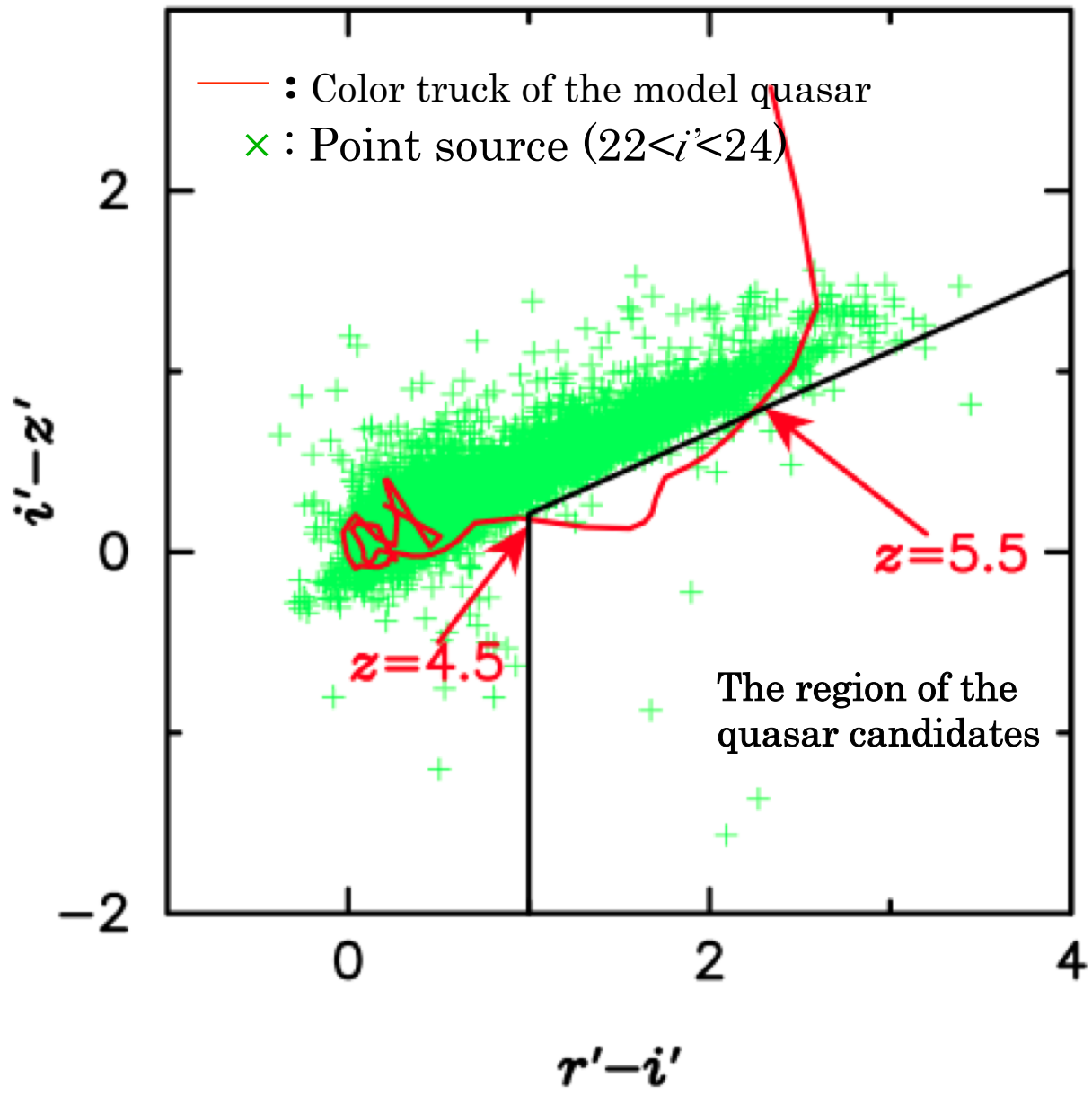
(3)u-g'>2.0

(4)Point Source on the HST

31 Quasar Candidates at z~4

The success rate is ~35%. (8/23)

Selection of Quasar Candidates at z～5



<Selection Criteria>

(1)r'-i'>1.0

(2)i'-z'<0.45(r'-i')-0.24

(3)g'-r'>2.0

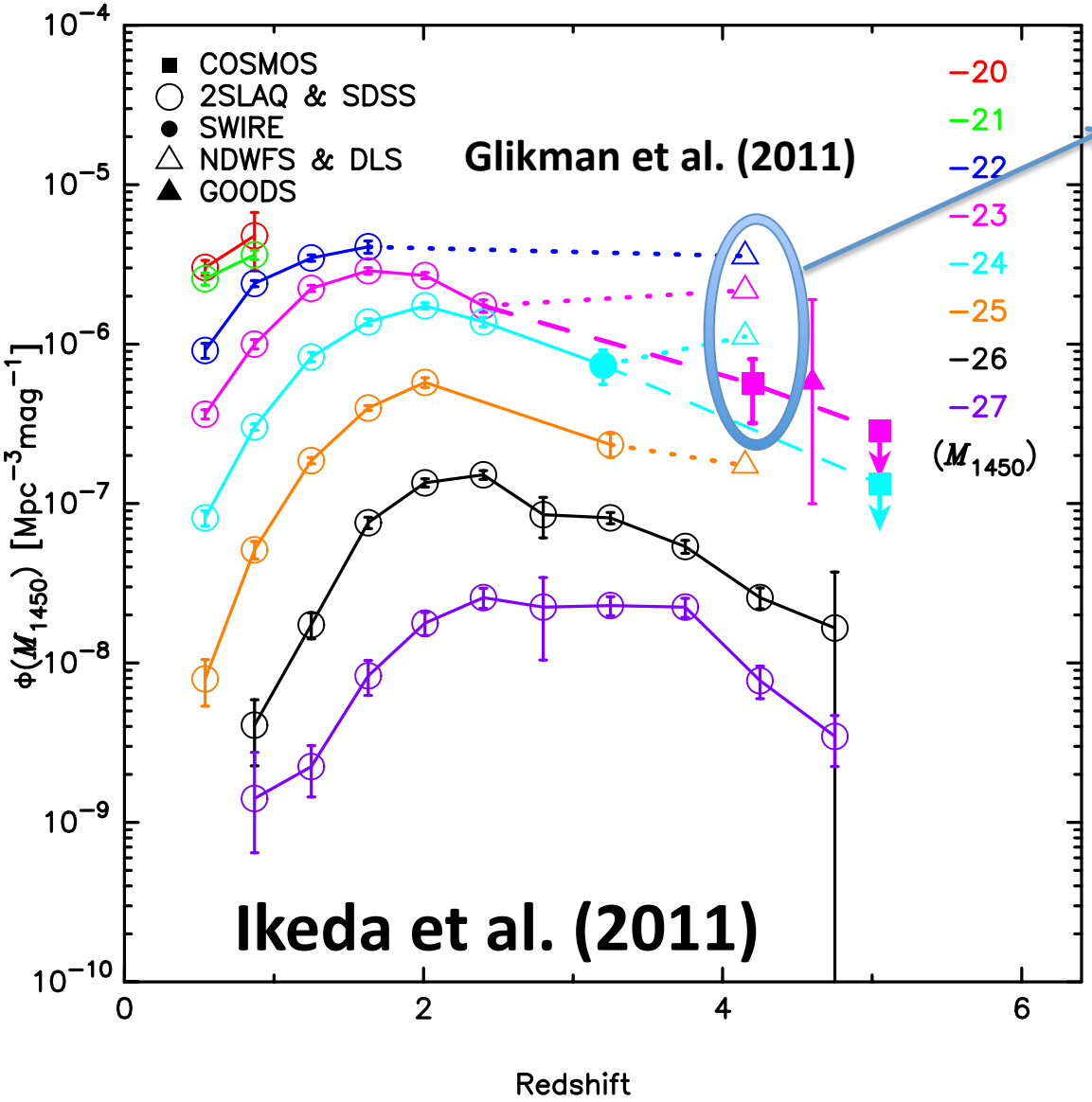
(4)Point Source on the HST

15 Quasar Candidates at z~5

Results of the spectroscopic follow-up observation

Redshift	Number of the QSO candidates	Number of the spectroscopic confirmed objects	Number of the quasars	Number of the contaminants
4	31	23	8	15
5	15	14	0	14

The Redshift Evolution of the QLF

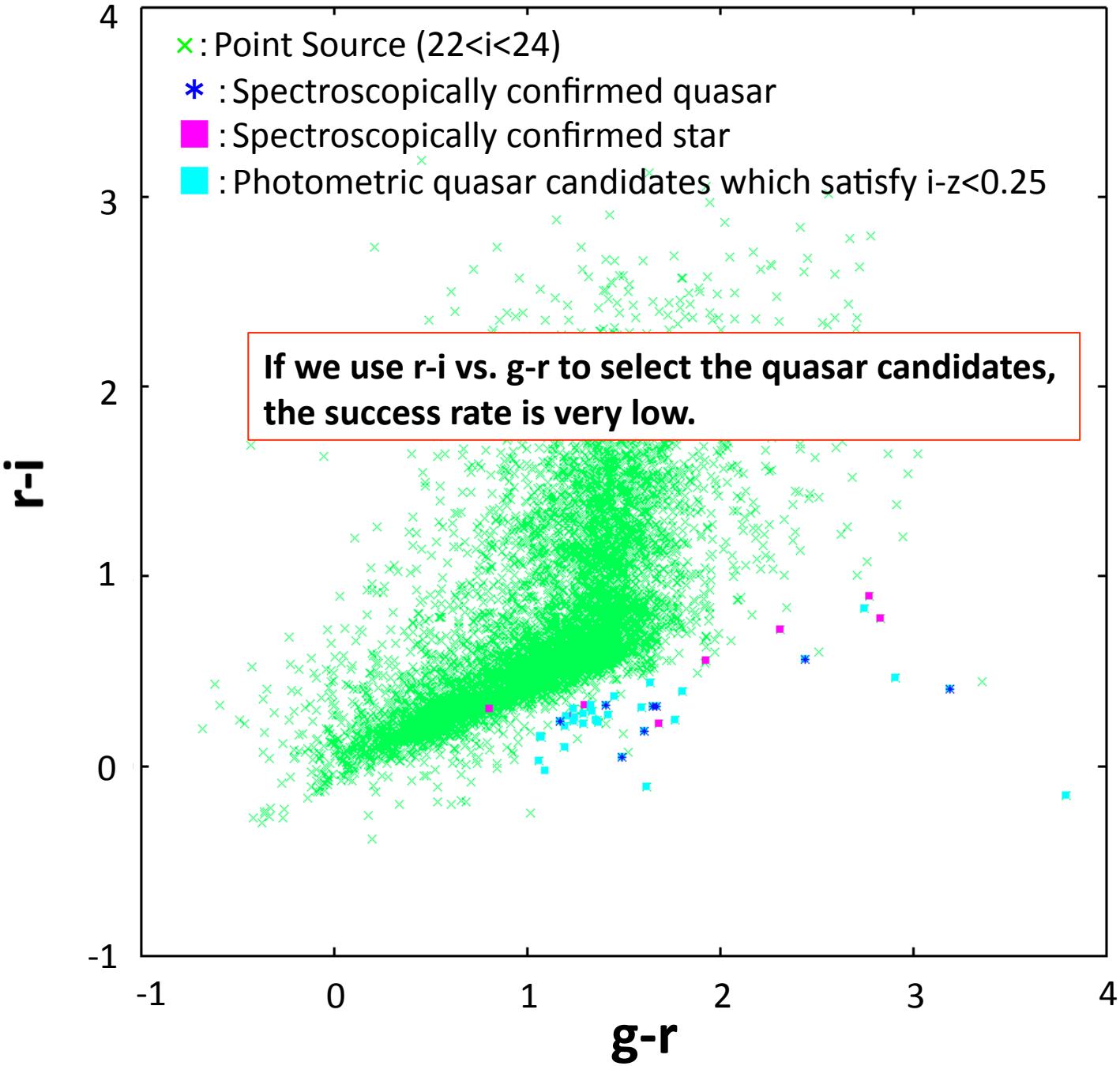


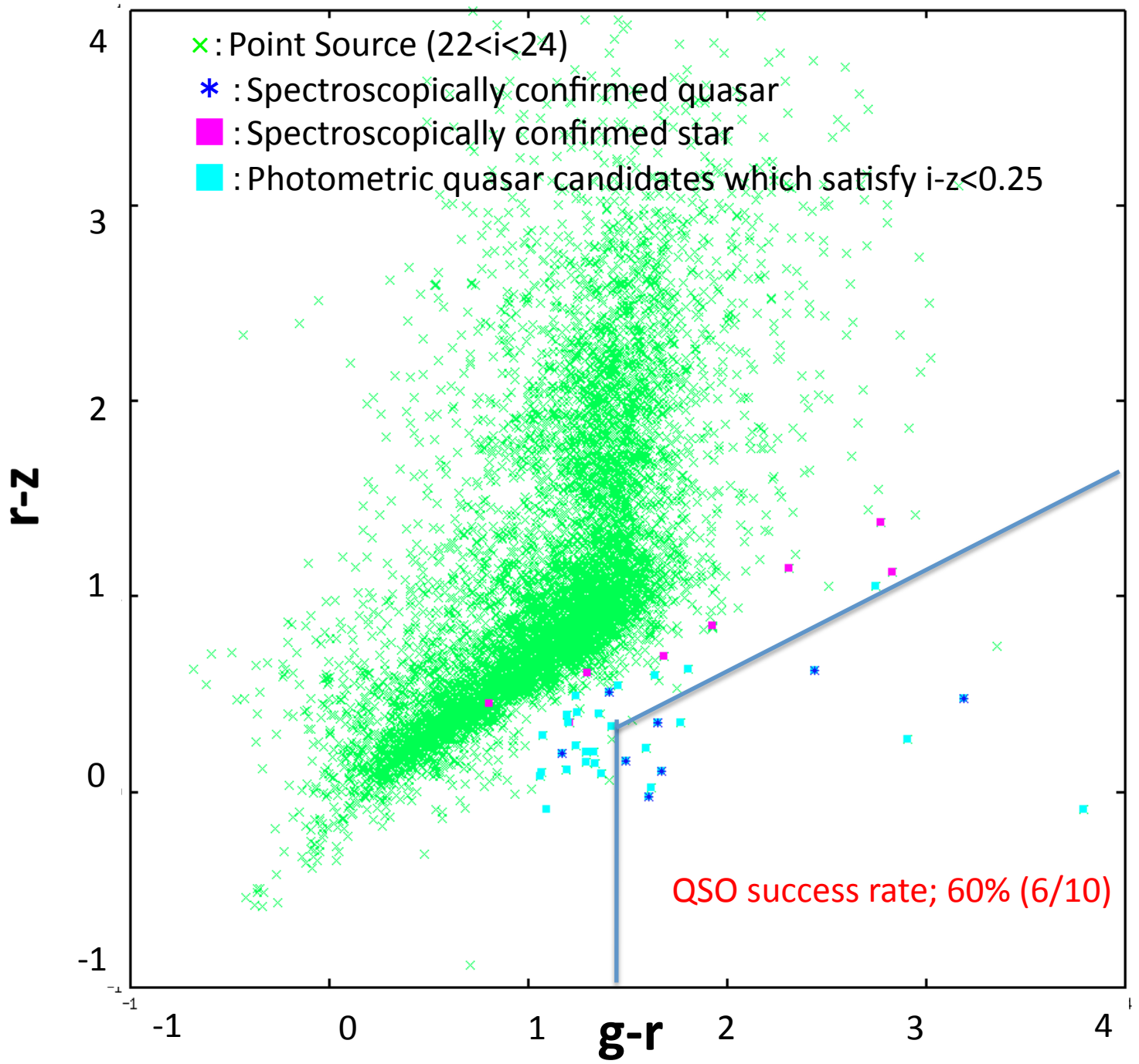
Ikeda et al. (2011) is consistent with the downsizing AGN evolution. (Ueda et al. 2003; Croom et al. 2009)

However the result of Glikman et al. (2011) is inconsistent with the downsizing AGN evolution.

It is not obvious why this discrepancy is caused.

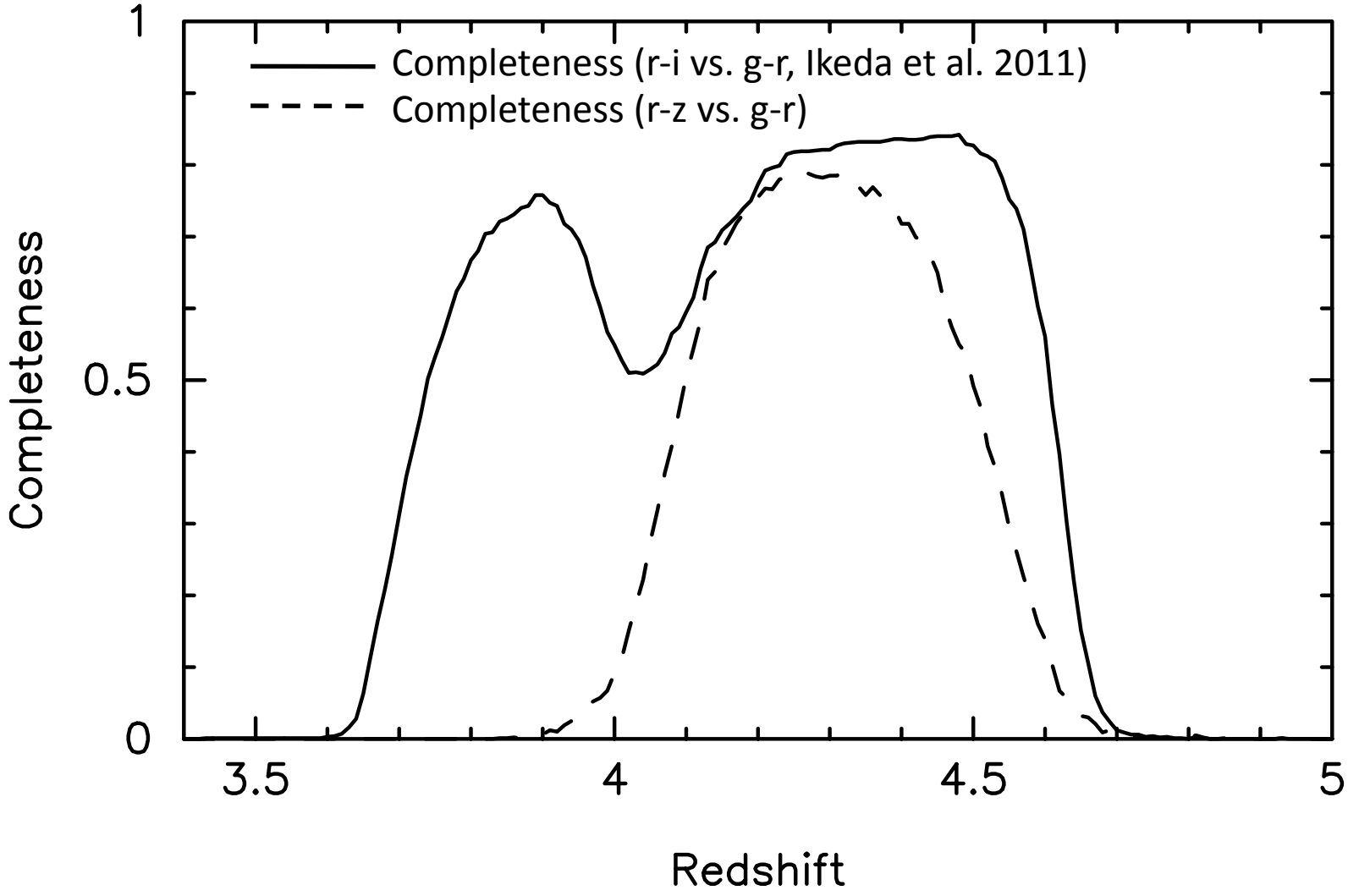
Therefore it should be very important that we search for low-luminosity quasars at z～4-5 by using HSC.


×: Point Source (22<i<24)
*: Spectroscopically confirmed quasar
: Spectroscopically confirmed star
: Photometric quasar candidates which satisfy i-z<0.25
If we use r-i vs. g-r to select the quasar candidates, the success rate is very low.
r-i
g-r
4
3
2
1
0
-1
-1
0
1
2
3
4


×: Point Source (22<i<24)
*: Spectroscopically confirmed quasar
: Spectroscopically confirmed star
: Photometric quasar candidates which satisfy i-z<0.25
QSO success rate; 60% (6/10)
r-z
g-r
4
3
2
1
0
-1
-1
0
1
2
3
4

Completeness

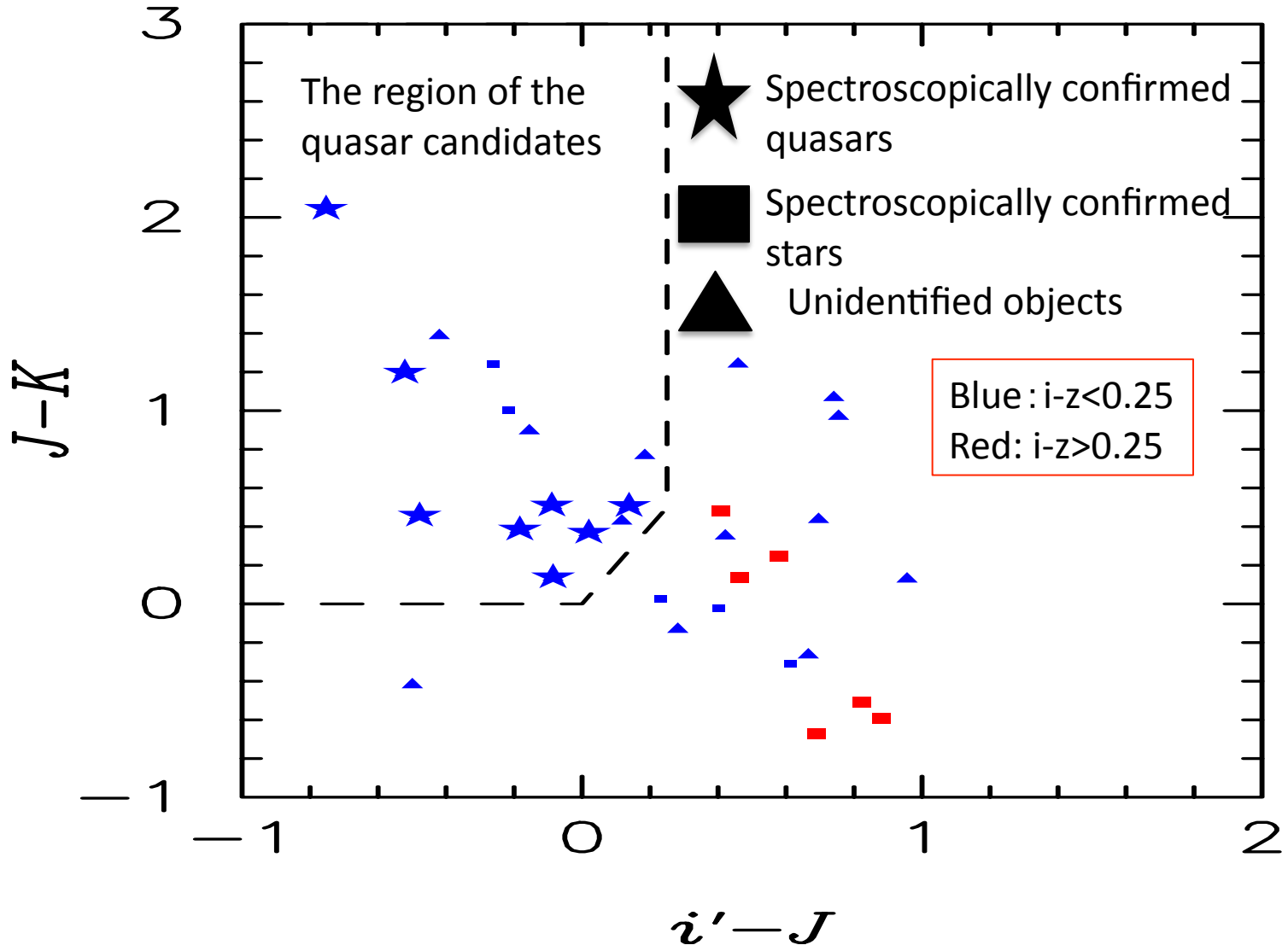
Estimated photometric completeness at z～4-4.5 is not so different while the redshift range is smaller than previous study.



Additional Criterion of Quasar Candidates

Success rate: 8/14～57% (i-J vs. J-K only)

Success rate:6/8～75% (optical+near-IR)



Summary of previous quasar survey at z～4-5

＜High-luminosity quasars＞

- The success rate;
  70% at z～4
  (Fan, Strauss et al. 2001)
  38% at z～5
  (Fan, Strauss et al. 2001)

- **The i-band quasar luminosity function peaks at z～2-3.**

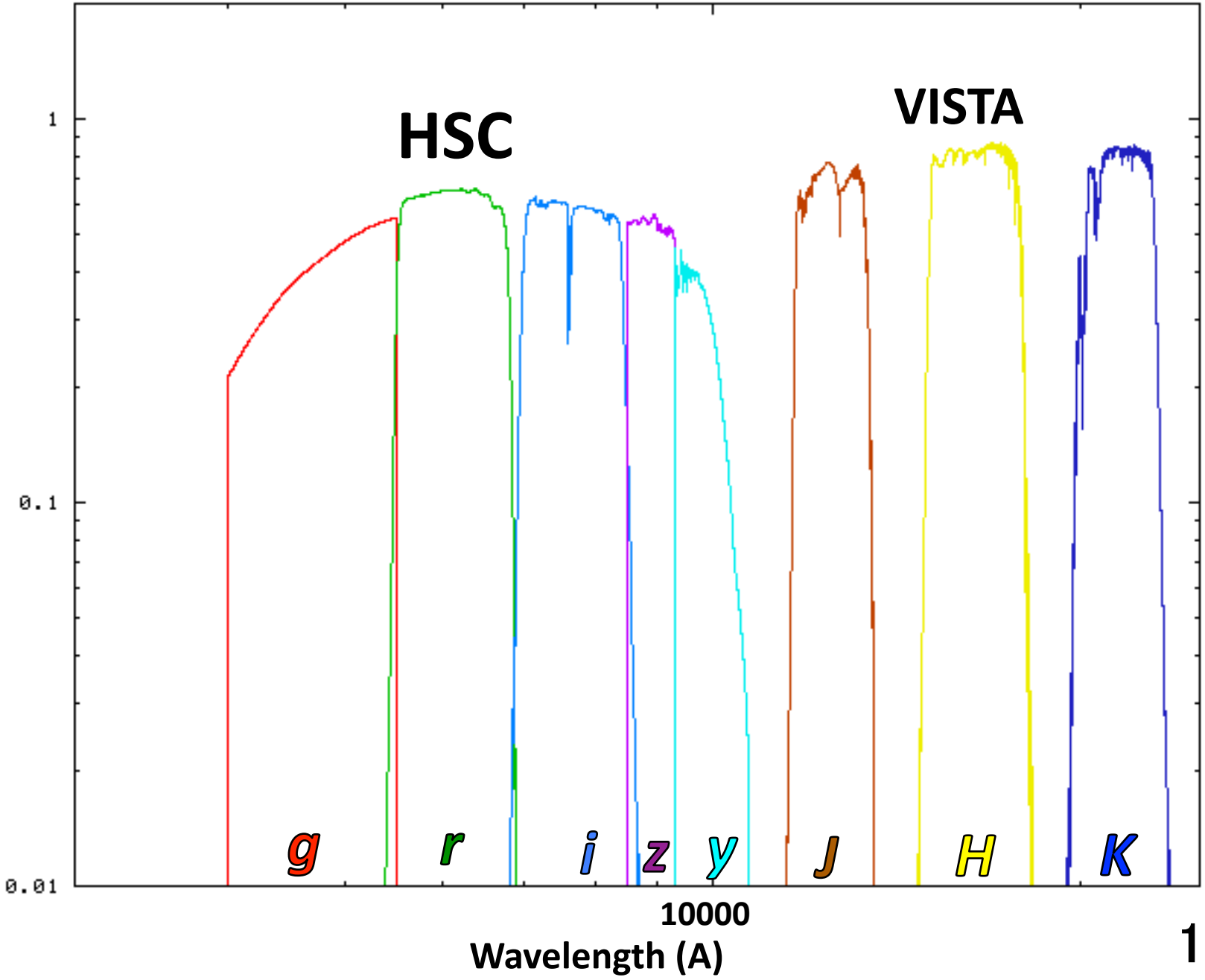
＜Low-luminosity quasars＞

- The success rate;
  35% at z～4
  (Ikeda et al. 2011)
  75% at z～4
  (If we use optica+near-IR data)

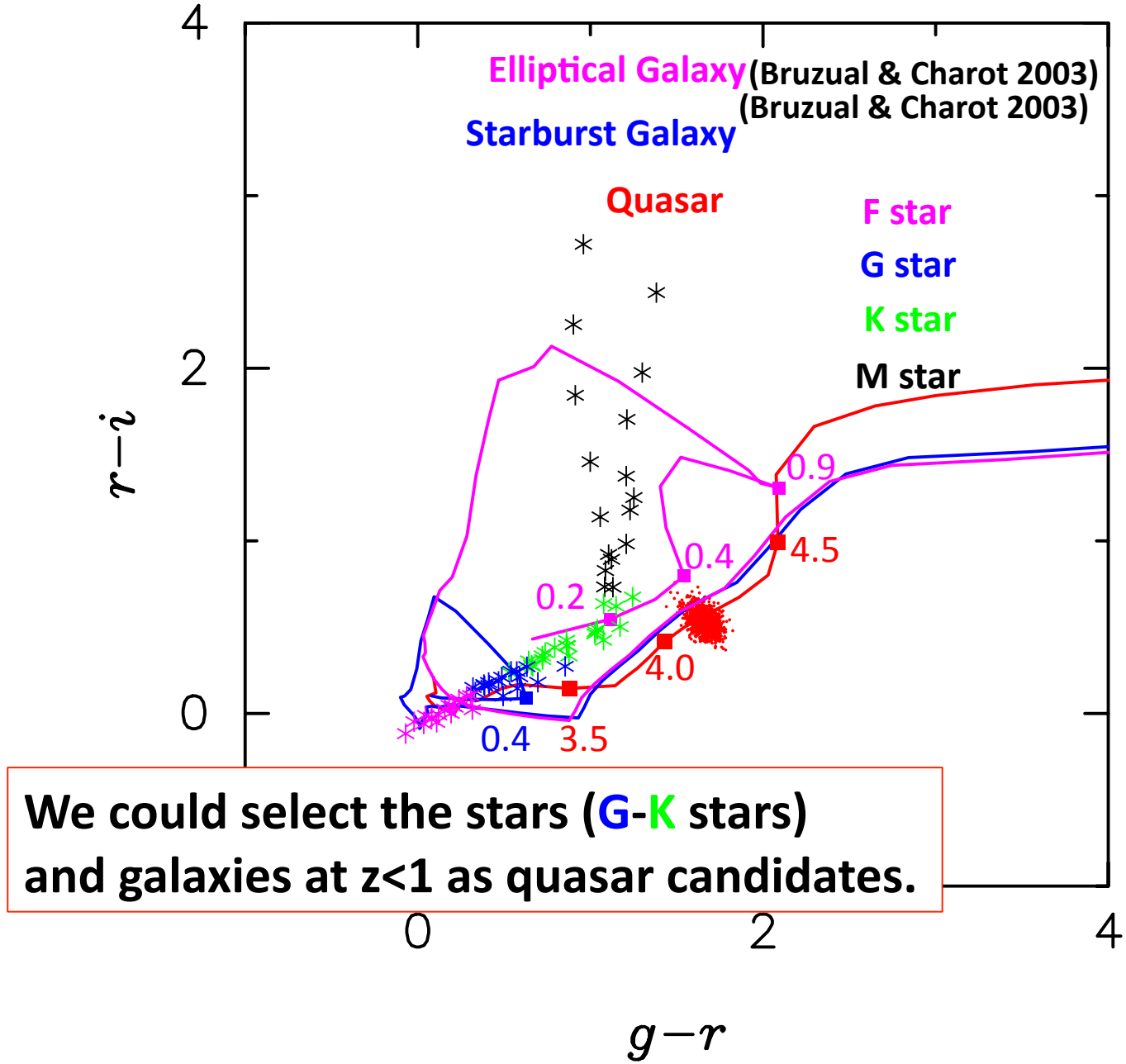
- **Ikeda et al. (2011) is consistent with the downsizing AGN evolution.**

$z\sim4$ QSO Selection with using HSC and VISTA data

Filter Response of the HSC and VISTA

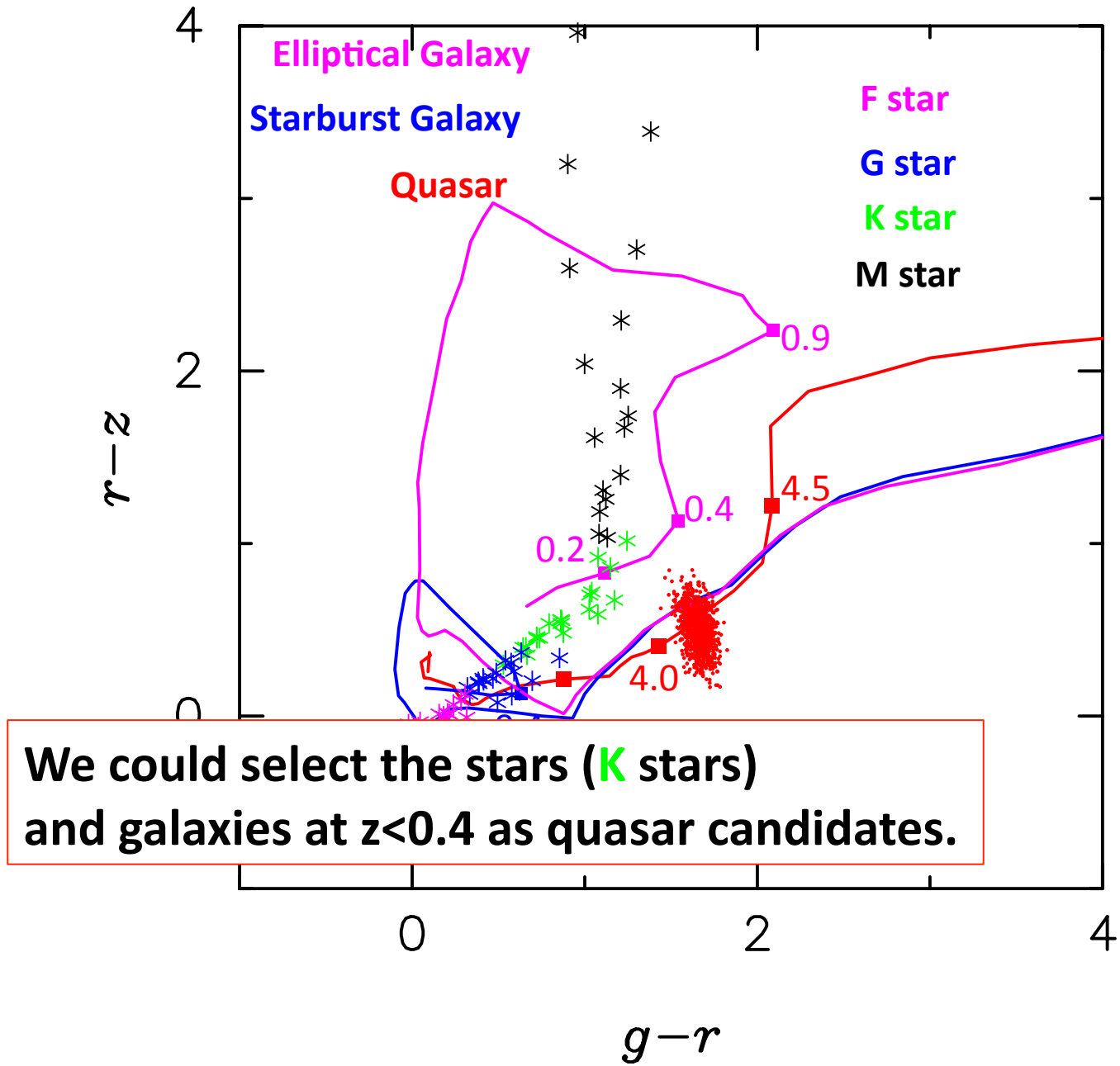


We can select the quasar candidates by using r-i vs. g-r.



We could select the stars (G-K stars) and galaxies at z<1 as quasar candidates.

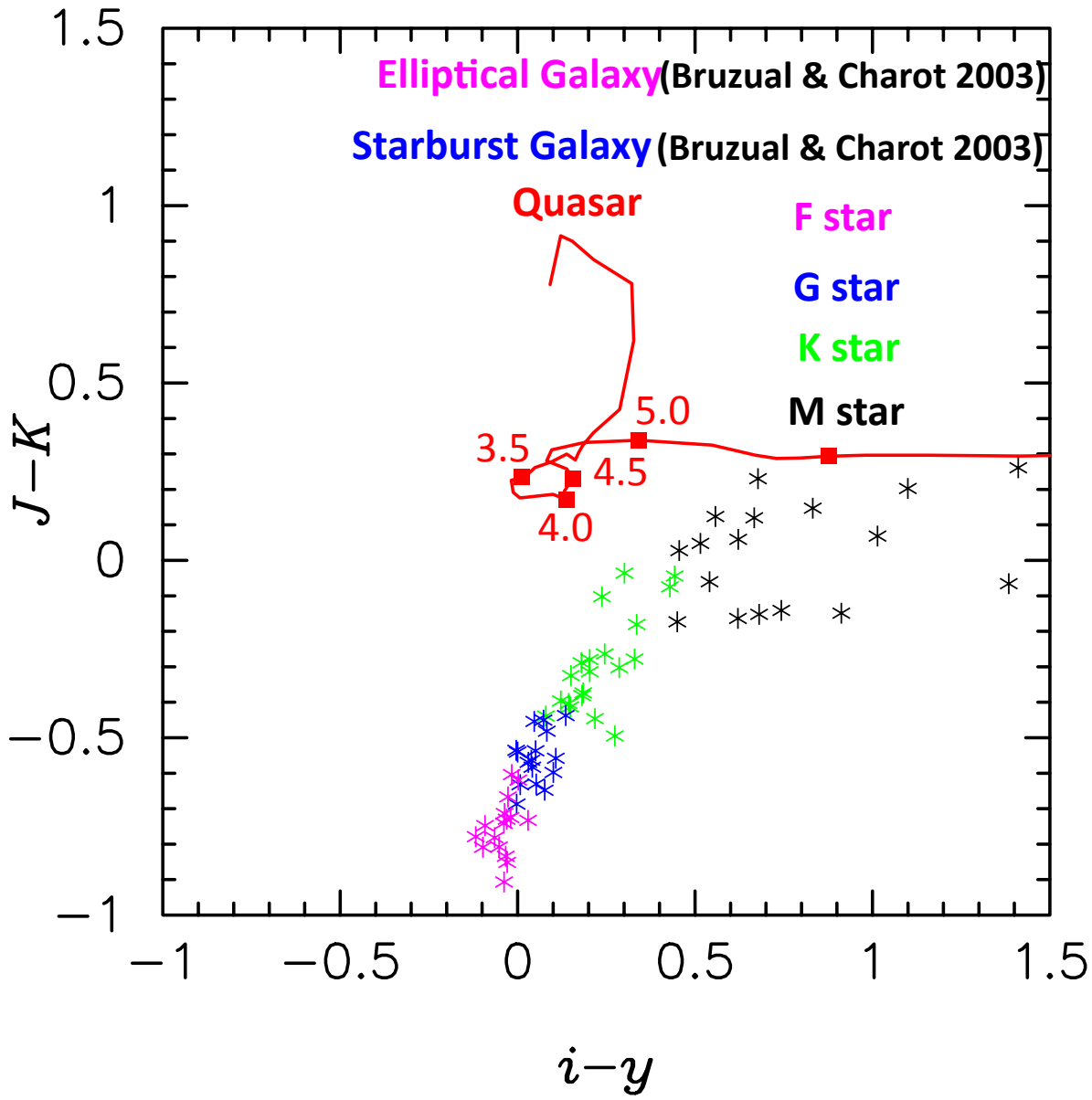
We can also select the quasar candidates by using r-z vs. g-r.



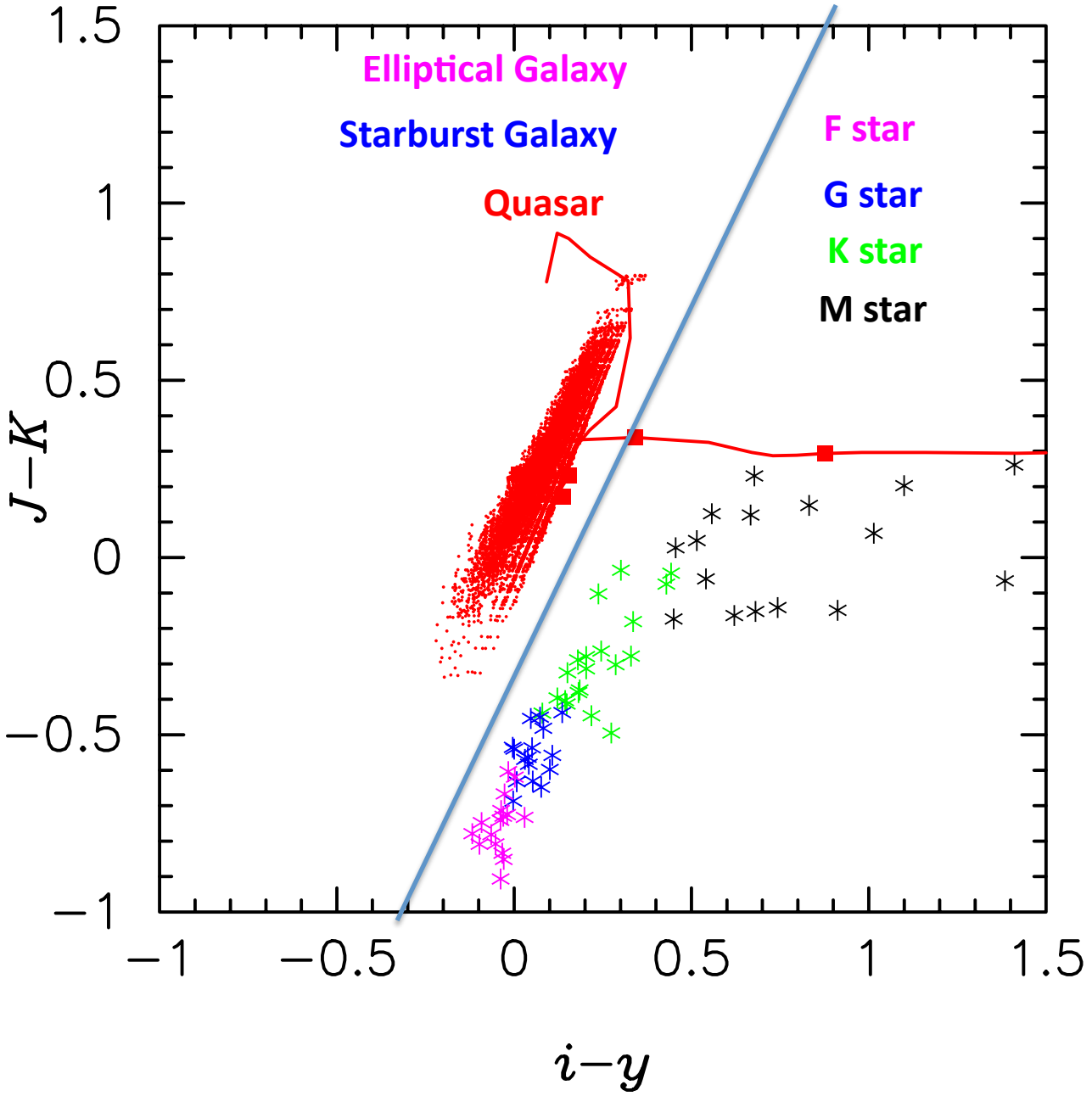
We could select the stars (K stars) and galaxies at z<0.4 as quasar candidates.

Additional criterion to remove the G-K stars

We can remove the G-K stars and select the quasars by using J-K vs. i-y.

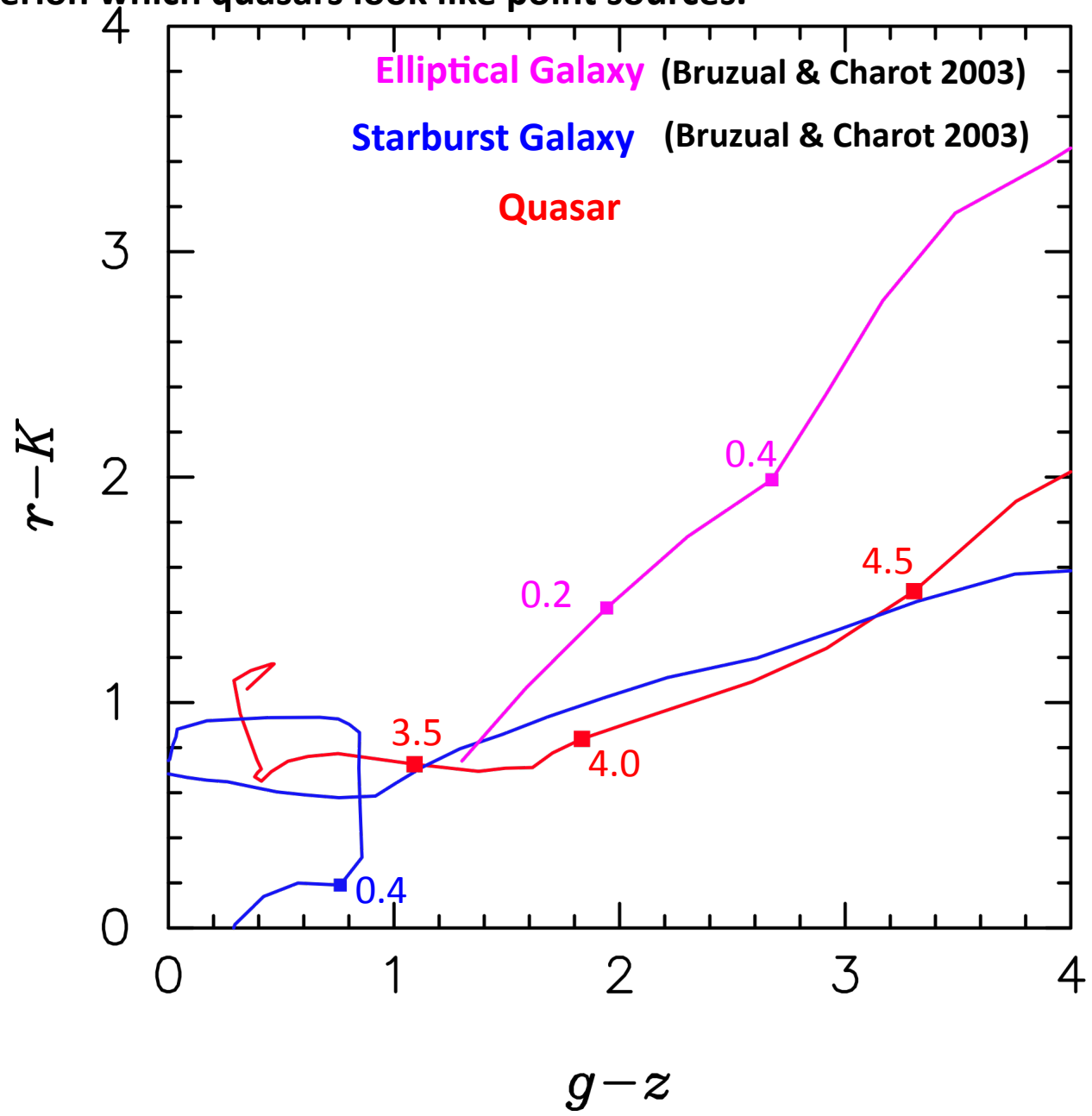


We can remove the G-K stars and select the quasars by using J-K vs. i-y.

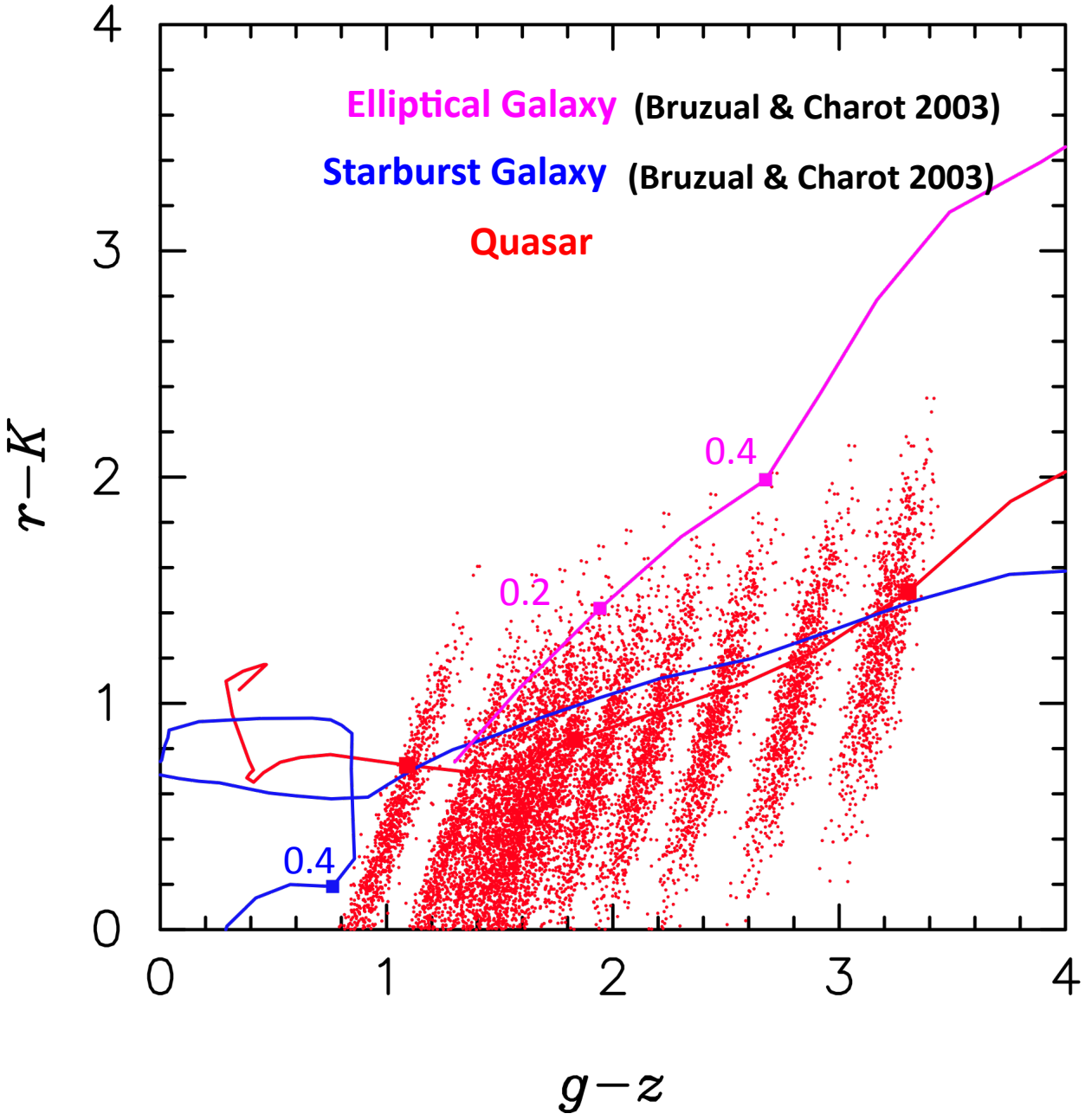


Additional criterion to remove the galaxies at $z<1$

We can remove the galaxies at z<1 and select the quasars by using r-K vs. g-z and the criterion which quasars look like point sources.



We can remove the galaxies at z<1 and select the quasars by using r-K vs. g-z and the criterion which quasars look like point sources.



Quasar candidate selection based on the optical+near-IR

z～4 Selection

- r-i vs. g-r or r-z vs. g-r

  (to remove the stars)
- J-K vs. i-y

  (to remove the G-K stars)
- r-K vs. g-z and point source

  (to remove the galaxies at z<1)

z～5 Selection

- i-z vs. r-i or i-y vs. r-i

  (to remove the stars)
- H-K vs. z-J

  (to remove the M stars)
- r-K vs. g-z and point source

  (to remove the galaxies at z<1.4)