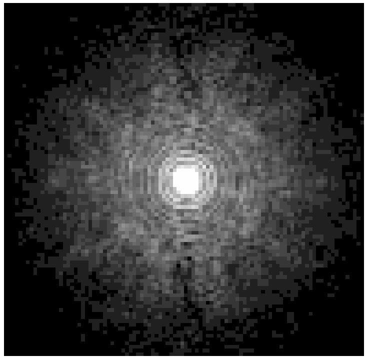
Some details on the simulations...

Technical data

- **J, H, K-band Laser Tomography AO (LTAO) simulated PSFs** (DRM technical database):

D=42m, 6 LGS, seeing = 0.8” at 0.5μm, zd = 0 (zd = 30,60 only for the K-band)

- Pixel scale: 2, 2.6, 3.5 mas (PSF sampling) and 5 mas



- Fov = 2” × 2” :

✓ The PSF does not vary in the region

✓ No contamination by field stars and galaxies

Technical data

Variable background

Variable background is due to stellar light reflected by dust:

unresolved background, variation lenghtscale smaller than the PSF FWHM

↓

additional source of noise

Typical emission nebulosity has blue colors: **(J-H) ~ -0.9, (H-K) ~ -0.6**

Background level of J ~ 23.9, H ~ 24.8 and K ~ 25.4

Scientific inputs

Input star catalog:

- Chabrier (2005) Initial-Mass-Function + Baraffe (2003) evolutionary tracks for an age of 5 Myr and solar metallicity:

100 stars from 2 to 0.003 M⊙ uniformly distributed in a circular area with **R ≈ 1 arcsec**

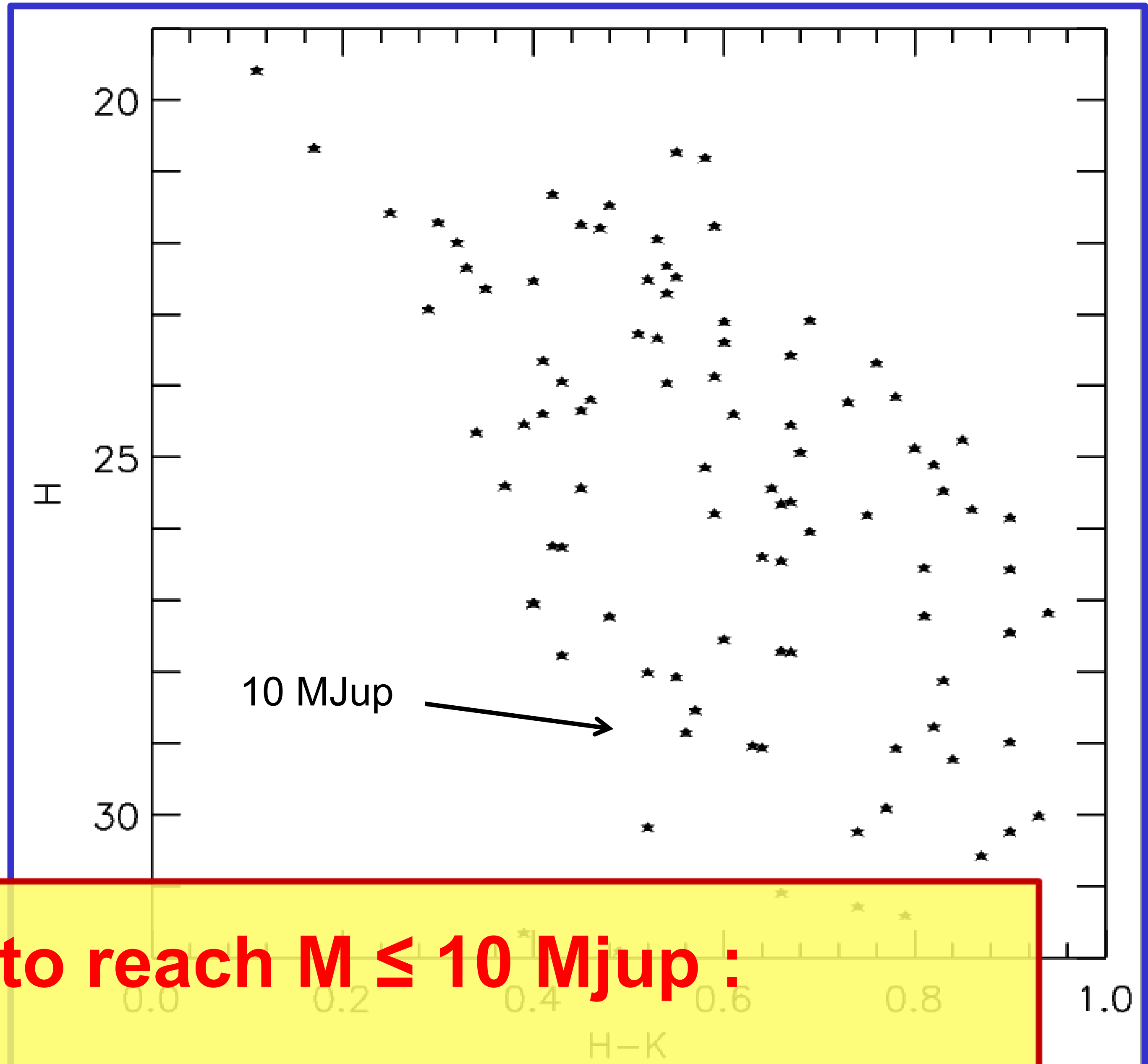
+

DM0 = 18.5 (LMC, Freedman et al. 2001)

Scientific inputs

random extinction

from Av = 0 to 10 mag

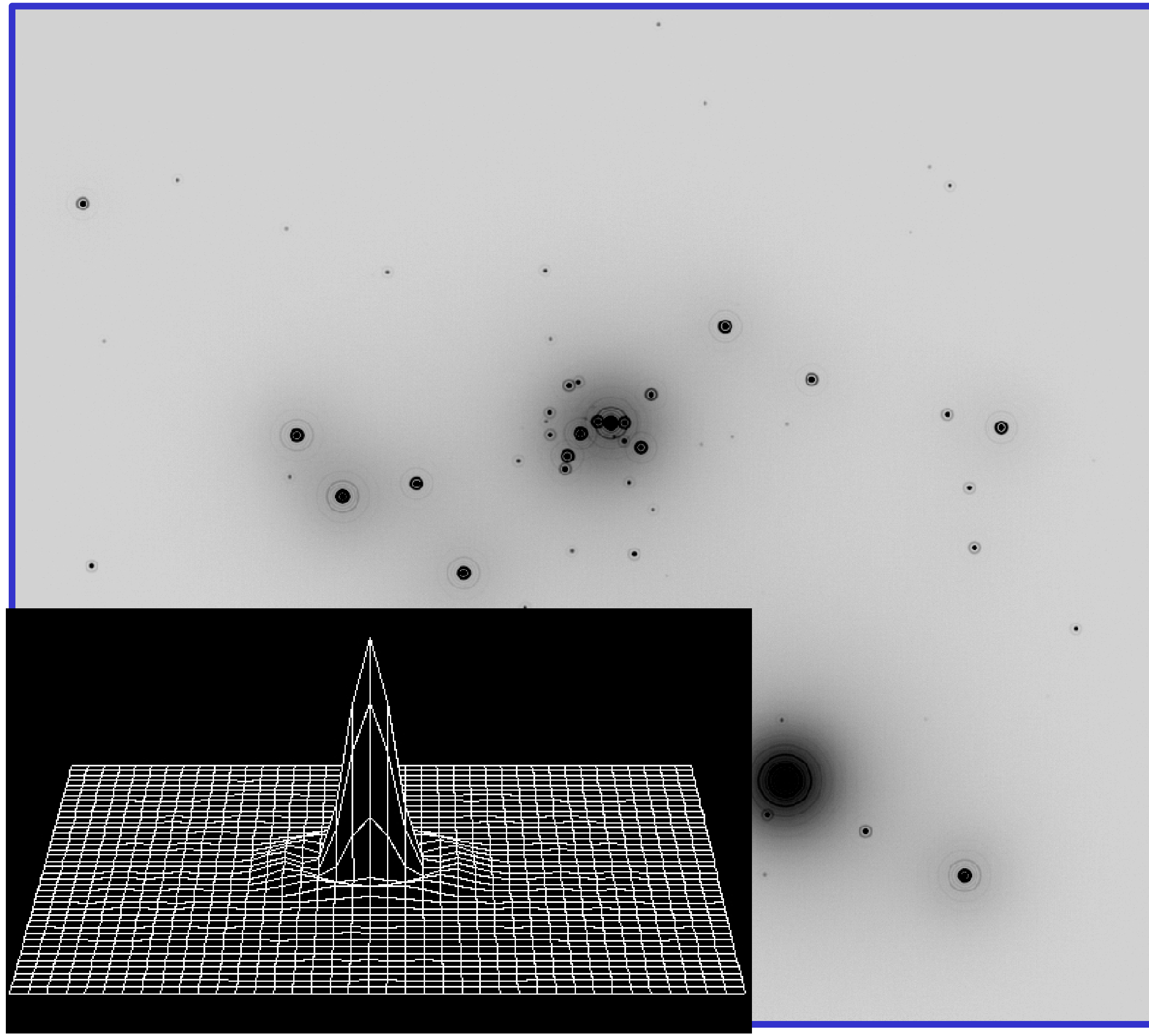


Need to reach M ≤ 10 Mjup :

J ~ 29.1, H ~ 28.7 and K ~ 28.2 with S/N=10

10 J-band images

Uniform background



2”

t_{exp} = 1h

Sky = 16 mag/arcsec^2

Pixel scale = 2 mas

PSF-photometry with DAOPHOTIV (Stetson):

- Analytical + numerical

Moffat function (β = 2.5)

Residual matrix

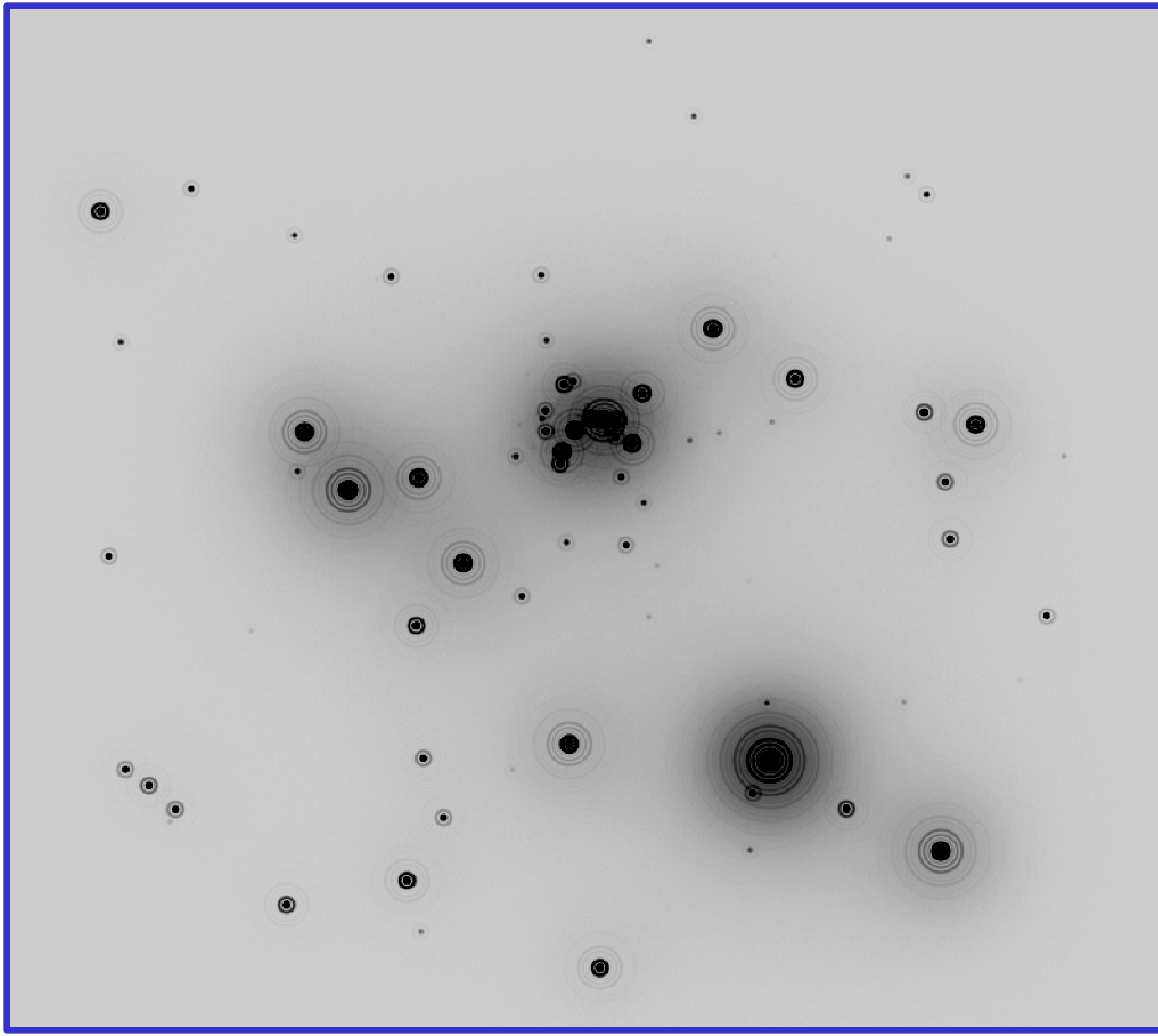
25 H-band images

Uniform background

t_{exp} = 1h

Sky = 14 mag/arcsec^2

Pixel scale = 2.6 mas



2”

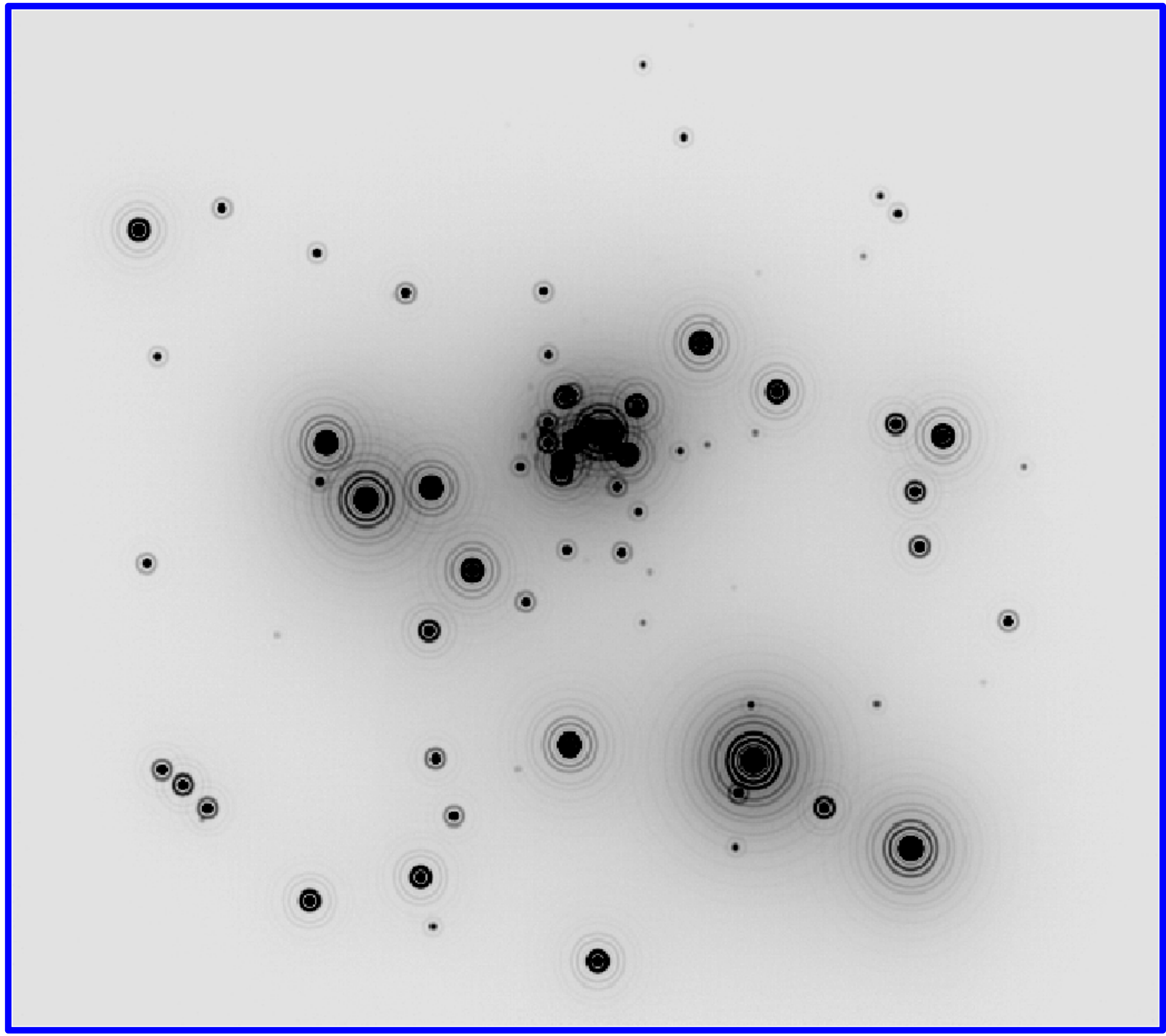
25 K-band images

t_{exp} = 1h

Sky = 13 mag/arcsec^2

Pixel scale = 3.5 mas

Uniform background



2"

Magnitude scatter:

$$S = \sqrt{\frac{1}{N}\sum(input - recovered)^2}$$

Band	Pix scale (mas)	Lim . Mag (S/N~4)	Scatter 0.2 mag	Scatter 0.1 mag
Juni	2	30.1	**29.5**	**29.0**
Jvar	2	29.0	**28.7**	**28.0**
Jvar	5	26.0	25.5	24.0
Huni	2.6	29.6	**29.2**	**28.0**
Hvar	2.6	29.0	**28.6**	**27.3**
Hvar	5	27.6	25.8	24.0
Kuni	3.5	29.8	**29.3**	**27.6**
Kvar	3.5	29.5	**28.8**	**27.5**
Kvar	5	28.4	27.8	26.2
Kzd30	3.5	28.8	28.6	28.6
Kzd60	3.5	28.6	28.3	27.5

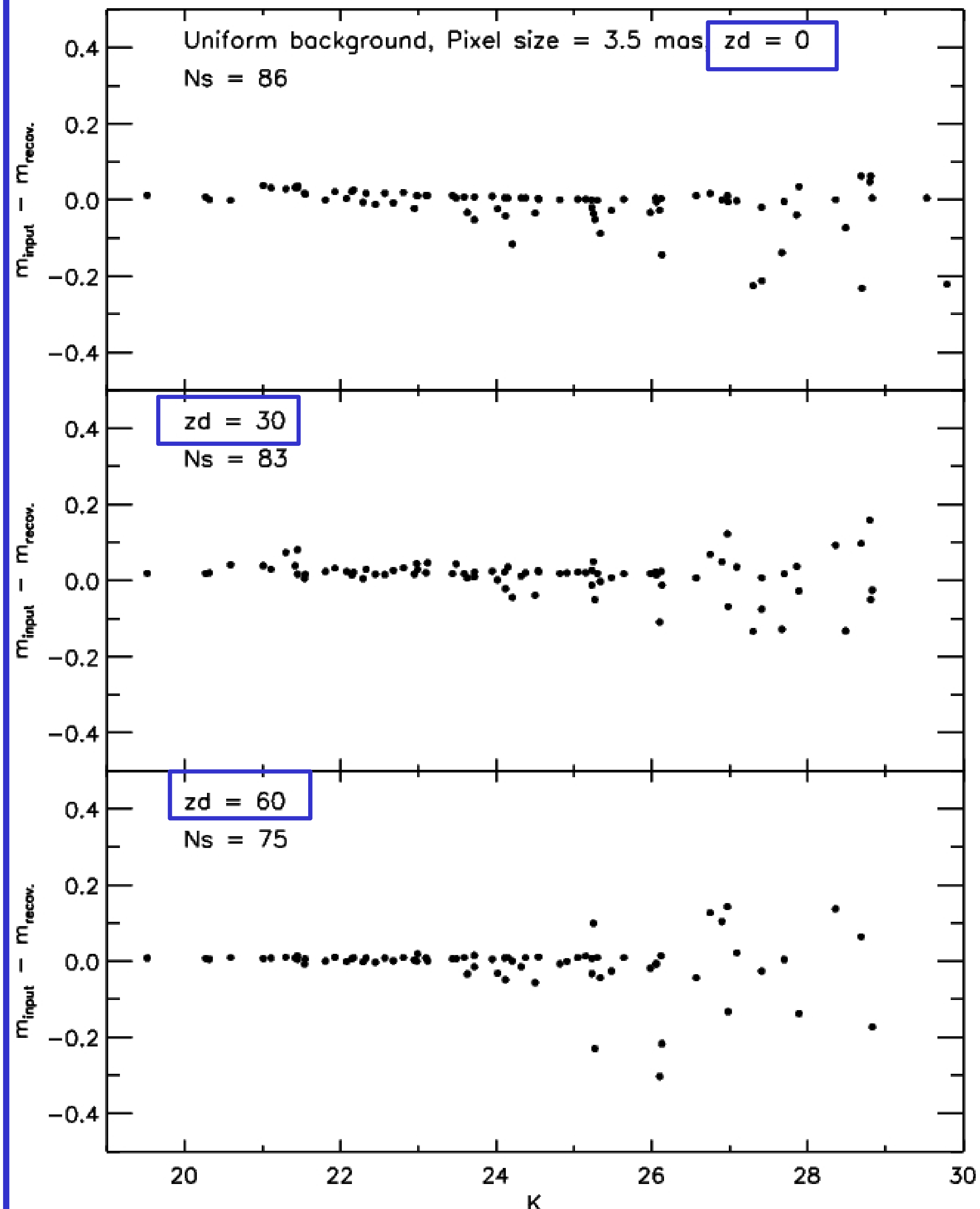
Zenith distance

Limit. Magnitude

decreases of ~ 1 mag

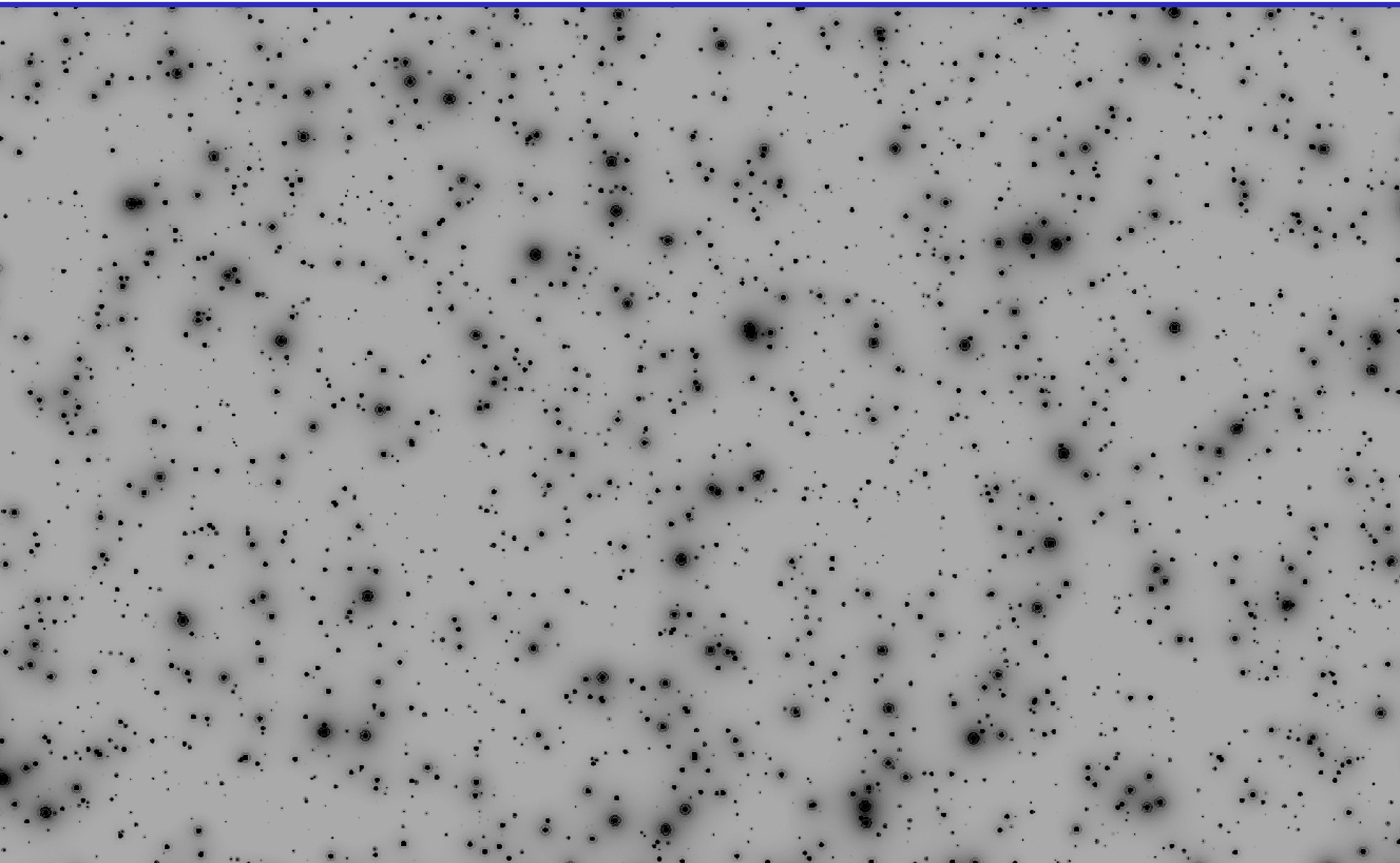
Scatter increases for

K > 26 mag

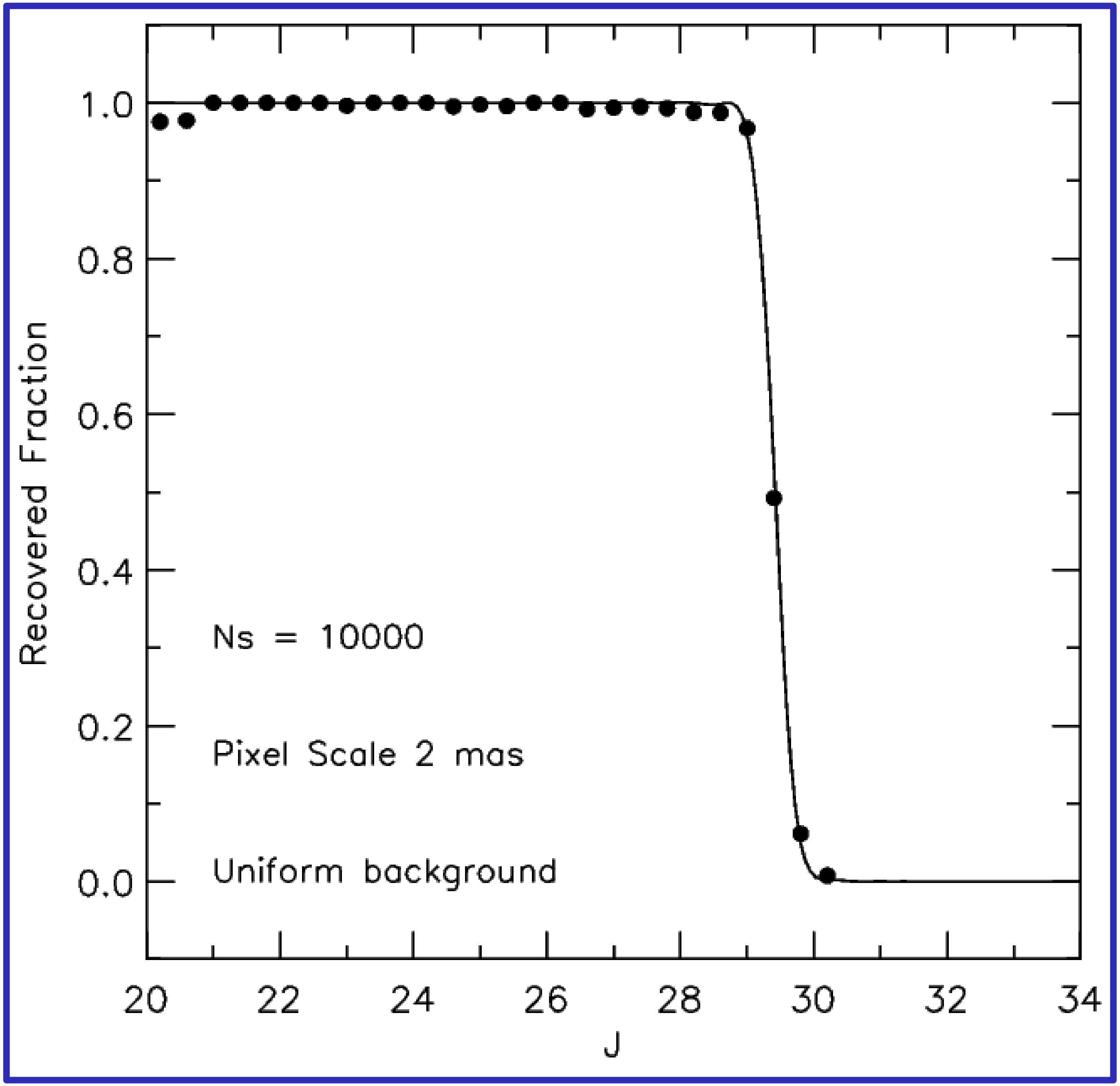


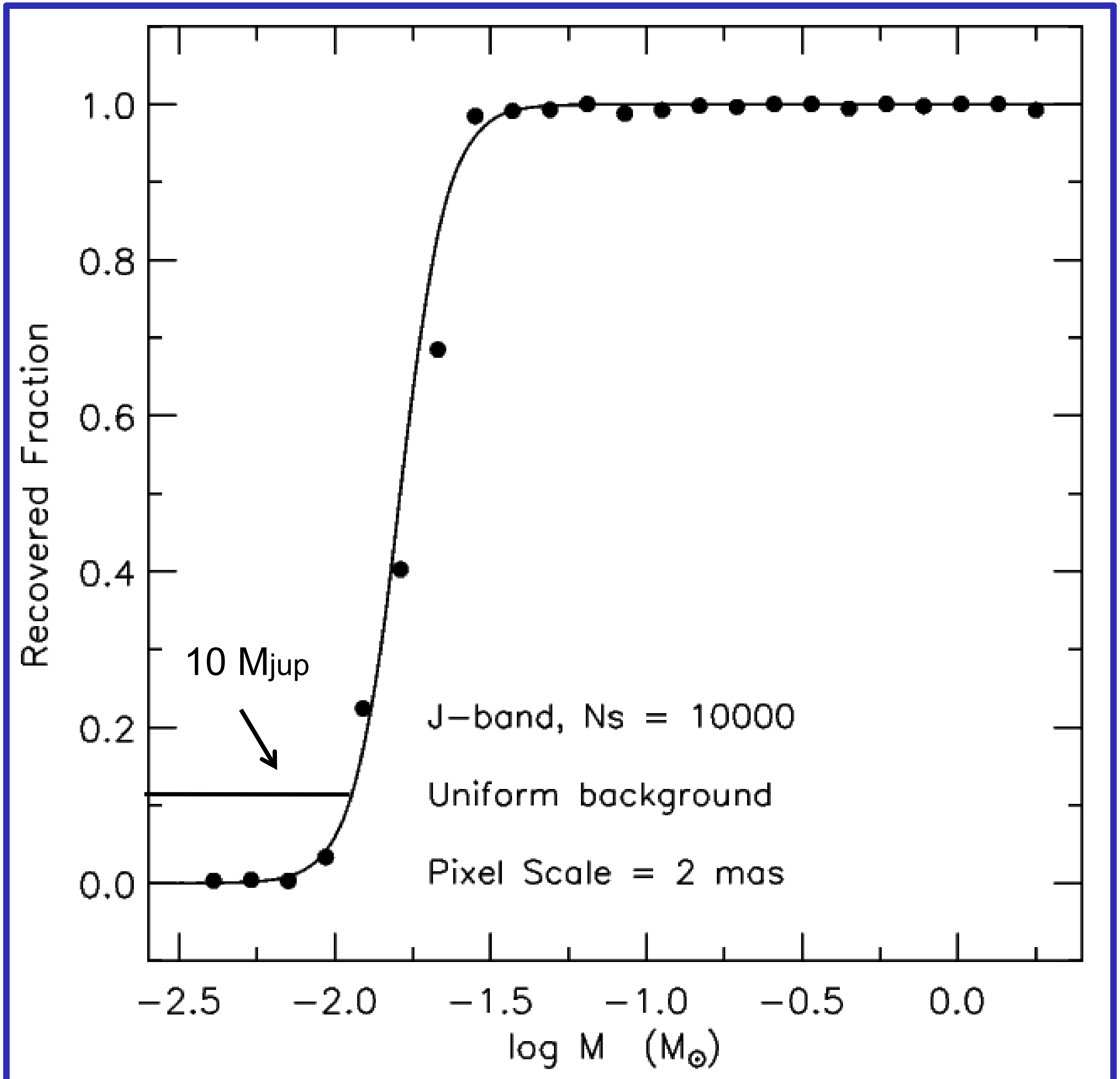
To increase the statistics: 10,000 stars in a circle of radius 10”

to preserve the stellar density

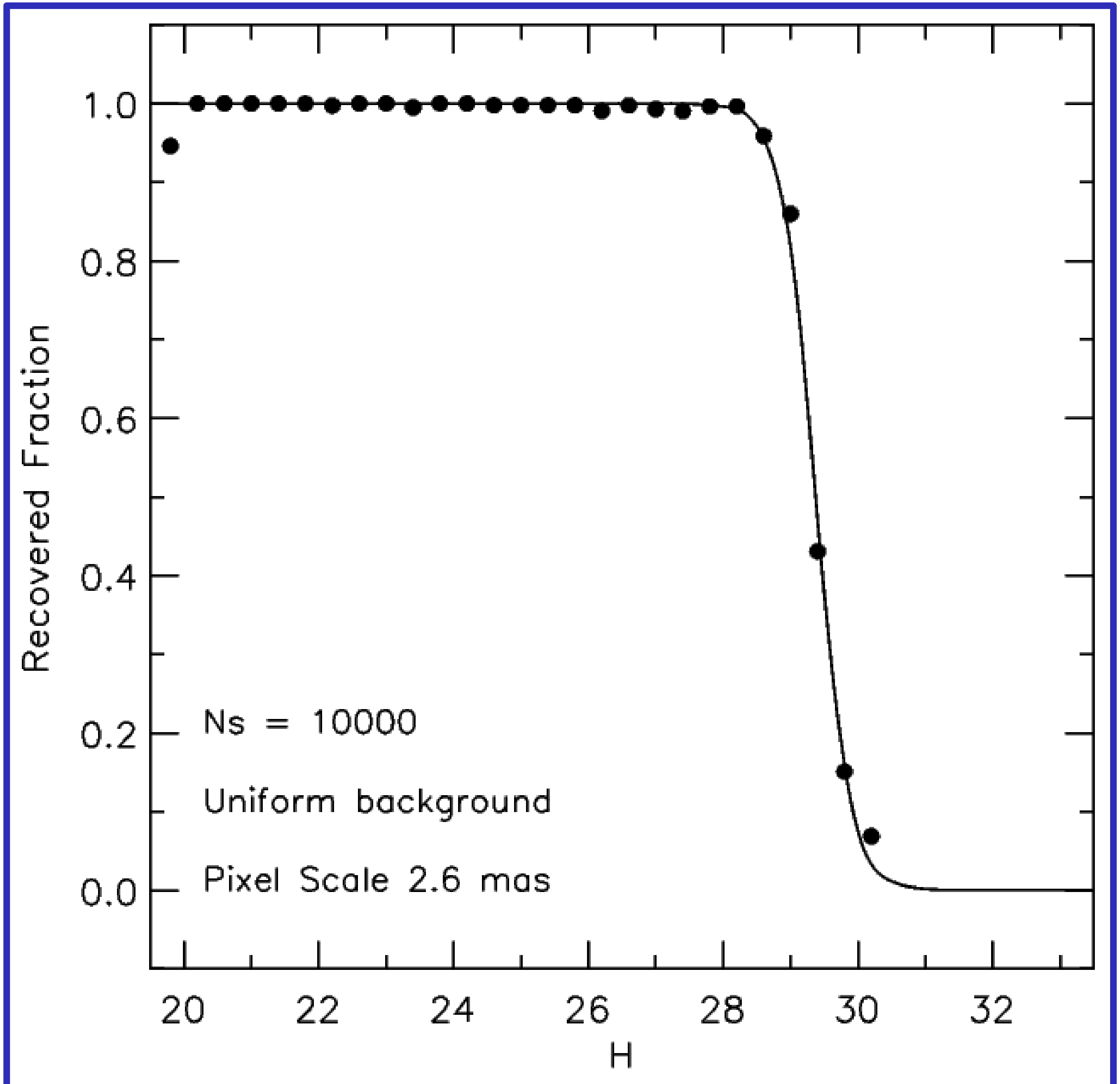


Completeness

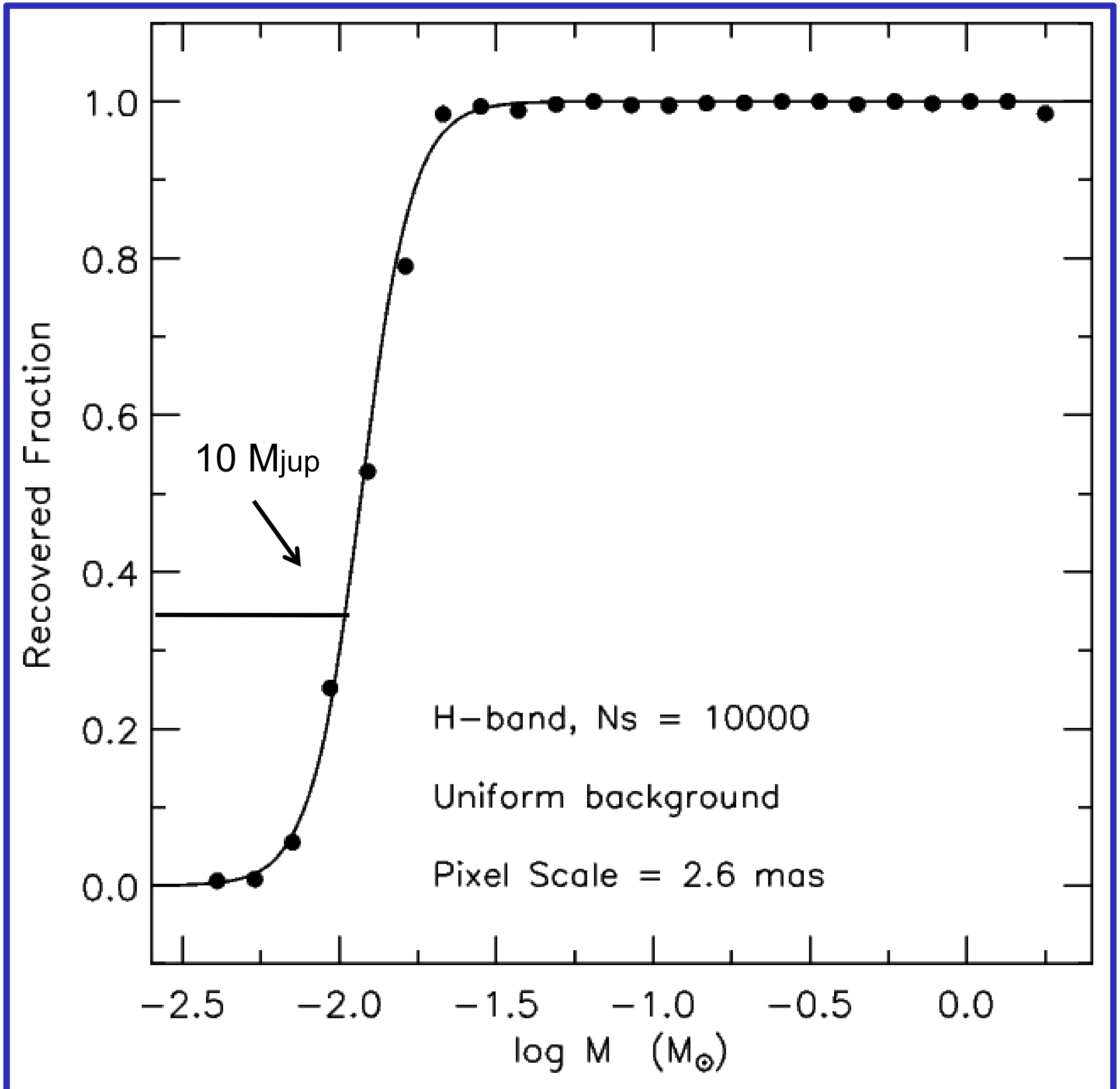


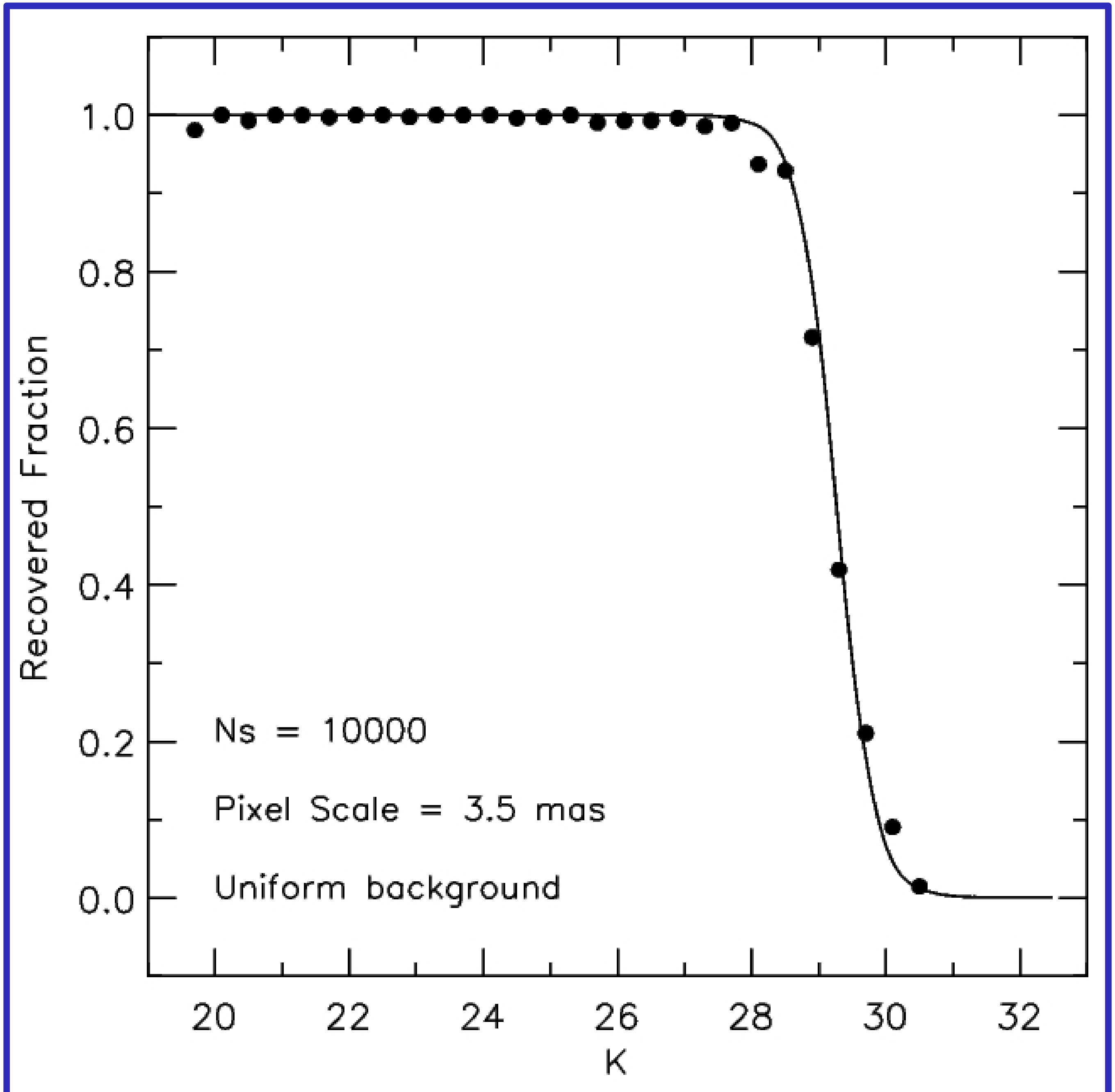


Recovered Fraction
log M (M⊙)
10 Mjup
J-band, Ns = 10000
Uniform background
Pixel Scale = 2 mas

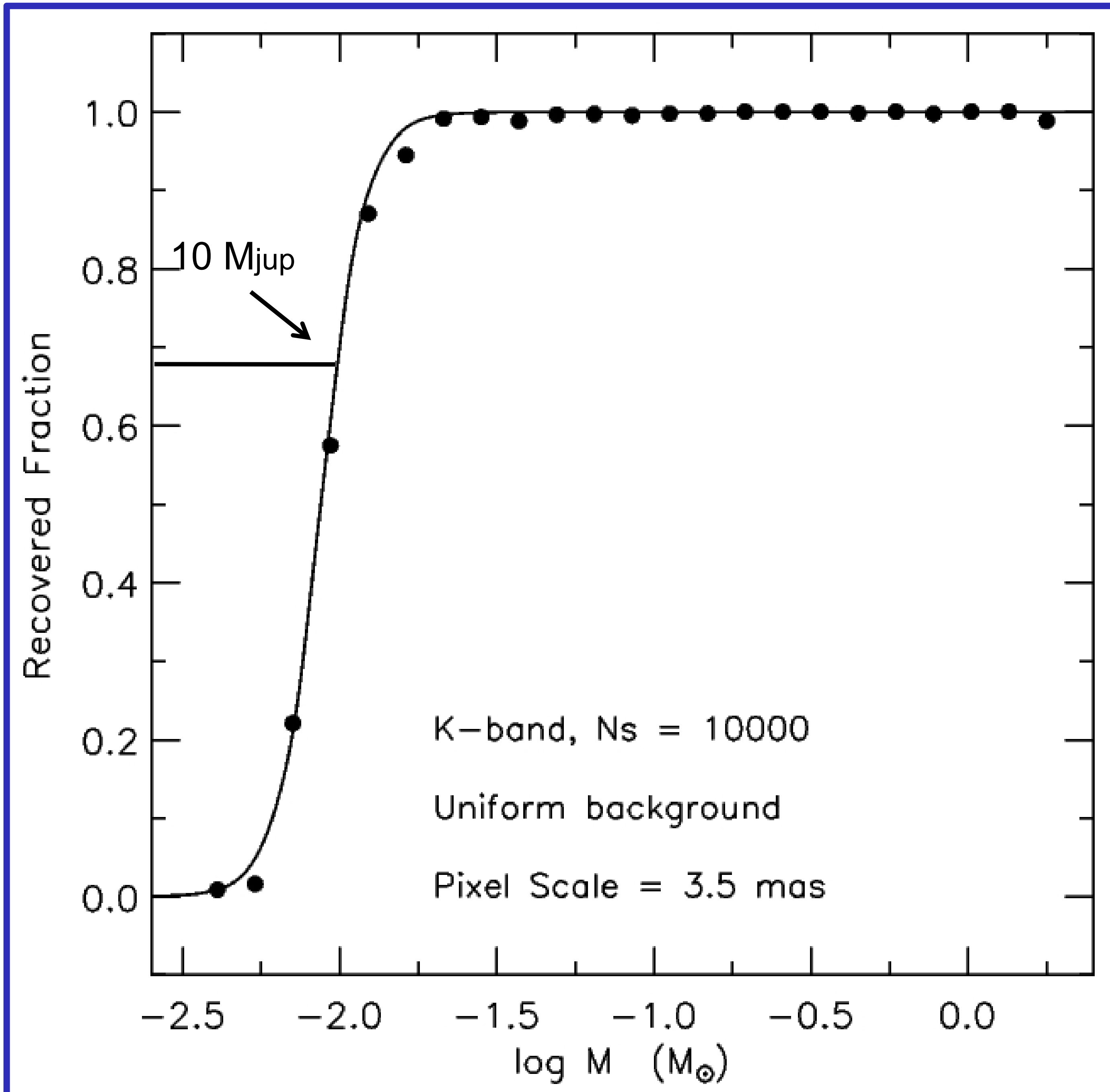


Recovered Fraction
H
1.0
0.8
0.6
0.4
0.2
0.0
20
22
24
26
28
30
32
Ns = 10000
Uniform background
Pixel Scale 2.6 mas


1.0
0.8
0.6
0.4
0.2
0.0
Recovered Fraction
10 Mjup
H−band, Ns = 10000
Uniform background
Pixel Scale = 2.6 mas
−2.5
−2.0
−1.5
−1.0
−0.5
0.0
log M (M⊙)



Recovered Fraction
1.0
0.8
0.6
0.4
0.2
0.0
20
22
24
26
28
30
32
K
Ns = 10000
Pixel Scale = 3.5 mas
Uniform background


10 Mjup
K−band, Ns = 10000
Uniform background
Pixel Scale = 3.5 mas
Recovered Fraction
log M (M⊙)
1.0
0.8
0.6
0.4
0.2
0.0
−2.5
−2.0
−1.5
−1.0
−0.5
0.0

Recovered fraction of stars at different magnitudes and masses

Band	90% mag	50% mag	90% MJup	50% MJup
J	29.15	29.4	24	16
H	28.8	29.4	18	12
K	28.6	29.3	17	9

t = 5 Myr

We partly accomplish proposal goal

What we find out with the simulations

How deep can we go in mass?

We reach J ~ 29.4 (16 Mjup), H ~ 29.4 (12 Mjup), K~29.3 (9 Mjup)

with S/N ≥ 5 and 50% completeness

Derive optimal parameters (pixel scale…): **pixel scale < 5 mas**

May or may not be possible depending on the chosen site:

increasing to zd =30 & zd = 60 loose 1 mag in K (*)

Photometric accuracy required at the ~0.1 mag level –is it at all possible given the brighter members of the region? **Yes, but reach J ~ 29, H ~ 28, K ~ 27.6 mag**

Effect of embedding reflection nebulosity: **larger in J where loose 1 mag, 0.6 mag in H, almost negligible in K**

Does it make sense scientifically?

Yes! We will observe:

- **Nearly complete sample of young brown dwarfs above the deuterium-burning limit ($M \sim 13\ M_{jup}$) in LMC and possibly in other galaxies and/or star cluster;**
- **Giant planet masses ($M \leq 10\ M_{Jup}$) in the LMC in favorable conditions**