Astrometry and Narrow-band Imaging of the Galactic Center with ULTIMATE-Subaru

Shogo Nishiyama

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Summary

What I want to understand

1. Interaction between SMBH and stars
2. How Nuclear star cluster (NSC) evolved

Why we need Ultimate?

Strong Extinction and Confusion

What I want to do

Search for hypervelocity stars (HVSs)
Search for stellar cluster remnants

How to find them

(1) Astrometry
(2) Narrow-band Photometry

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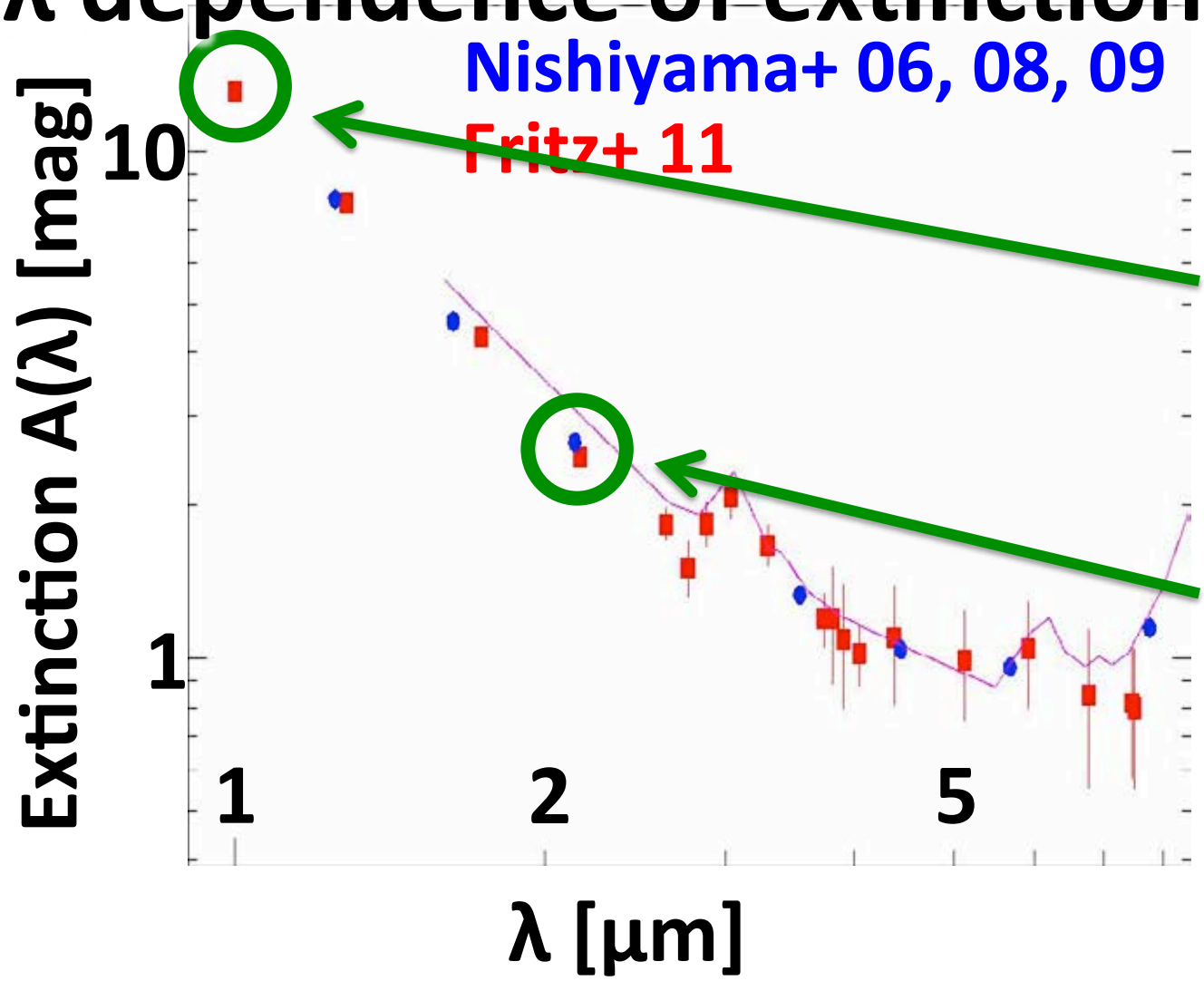
Observations of the GC

Why NIR? Interstellar Extinction

λ dependence of extinction



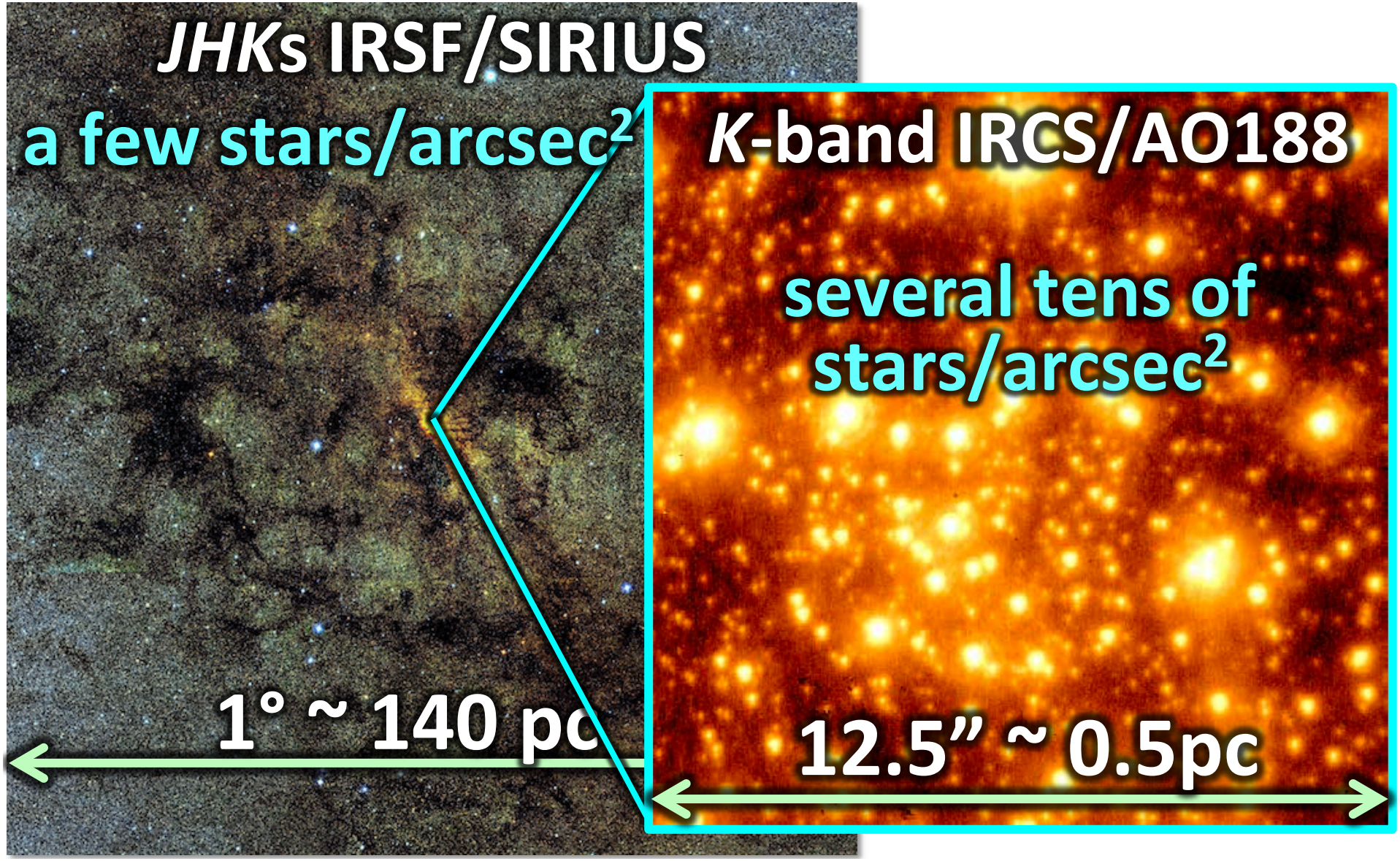
Optical (0.5 μm)
→ ～30 mag
→ 10^-12

NIR (1 μm)
→ ～10 mag
→ 10^-4

NIR (2.2 μm)
→ ～2.5 mag
(Schodel+ 10)
→ 1/10

Observations of the GC

Why GLAO? Confusion



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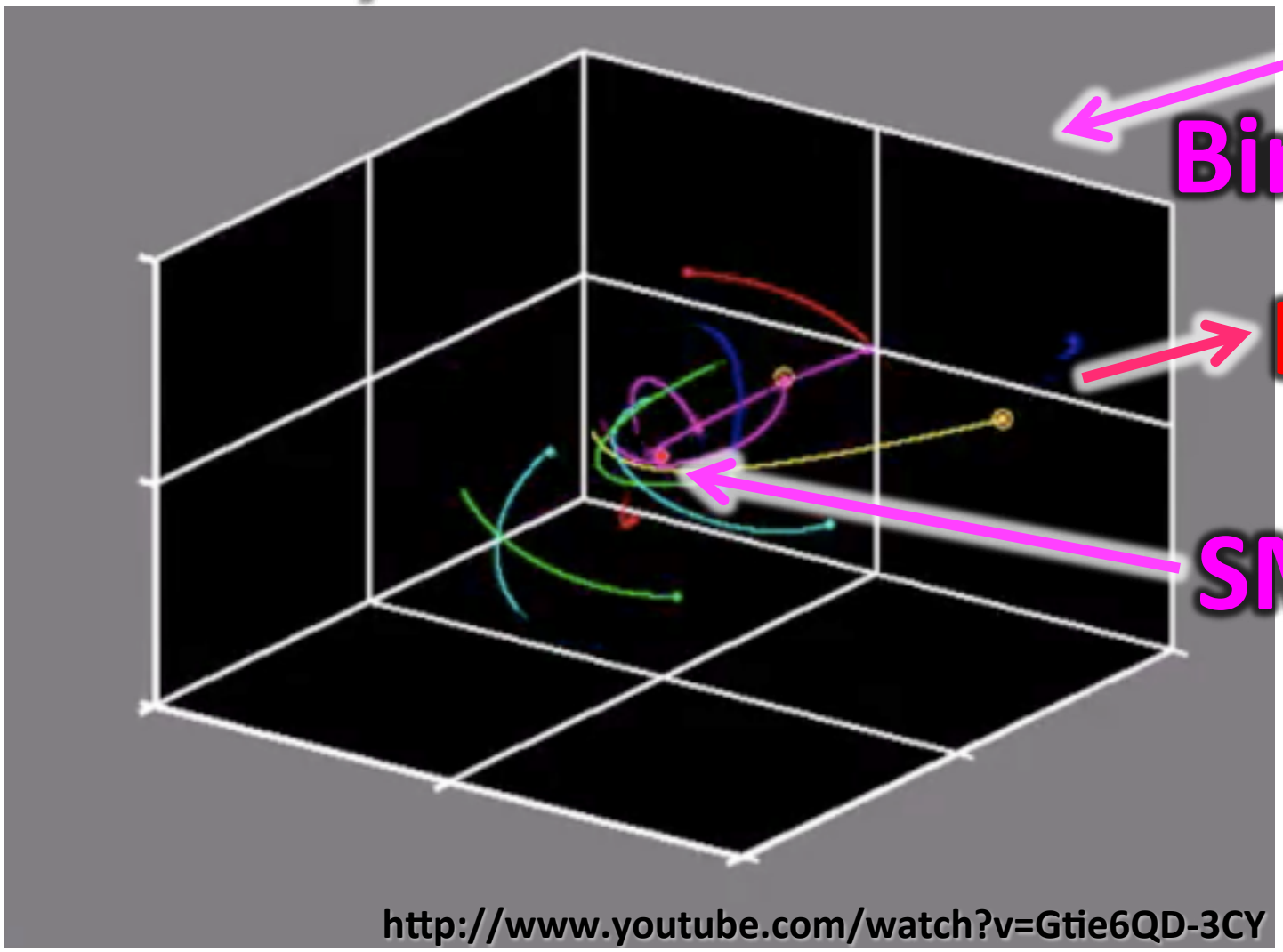
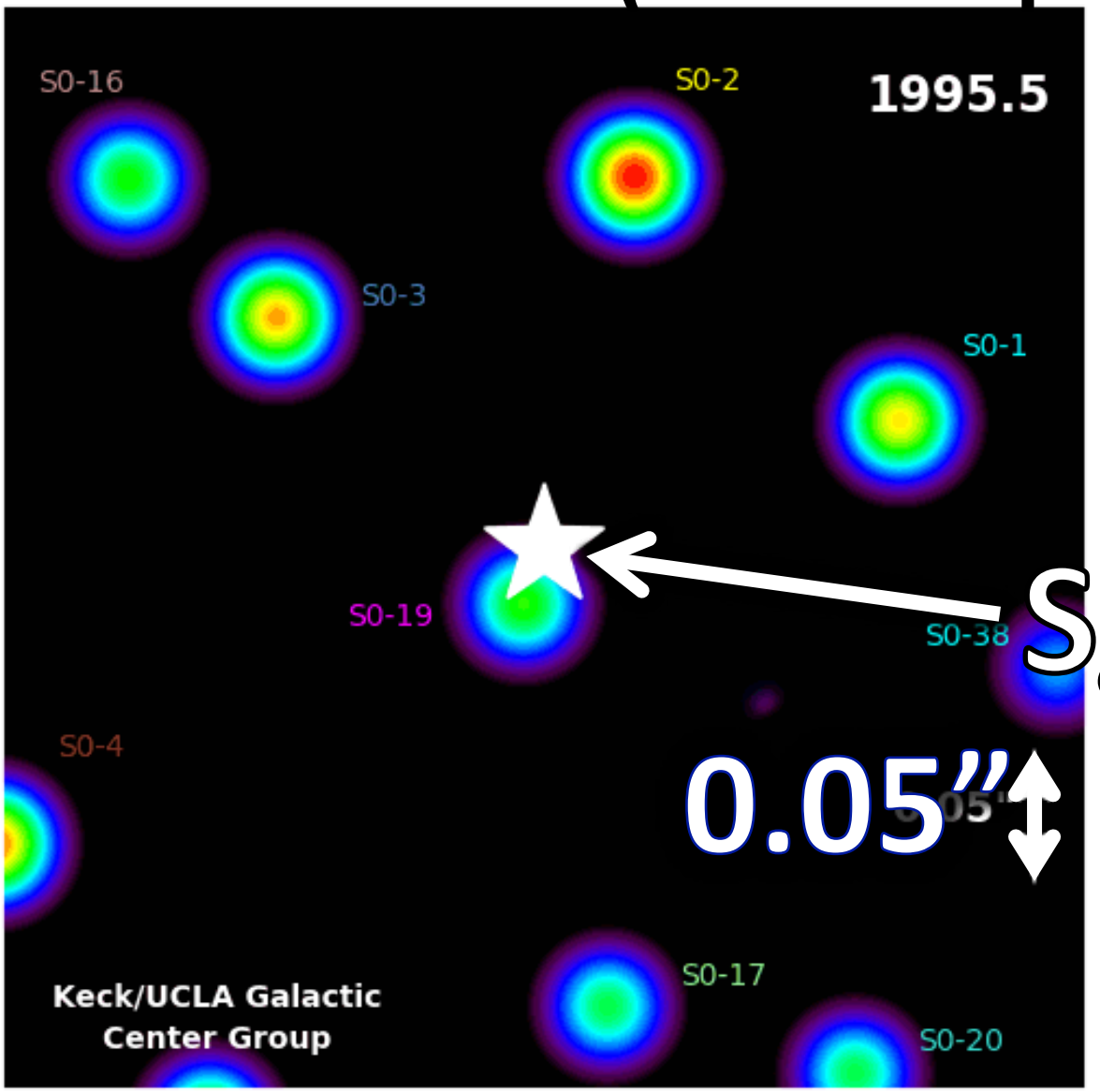
Hypervelocity Stars

Hypervelocity stars (HVS; Brown+05, 06, 07, 09)



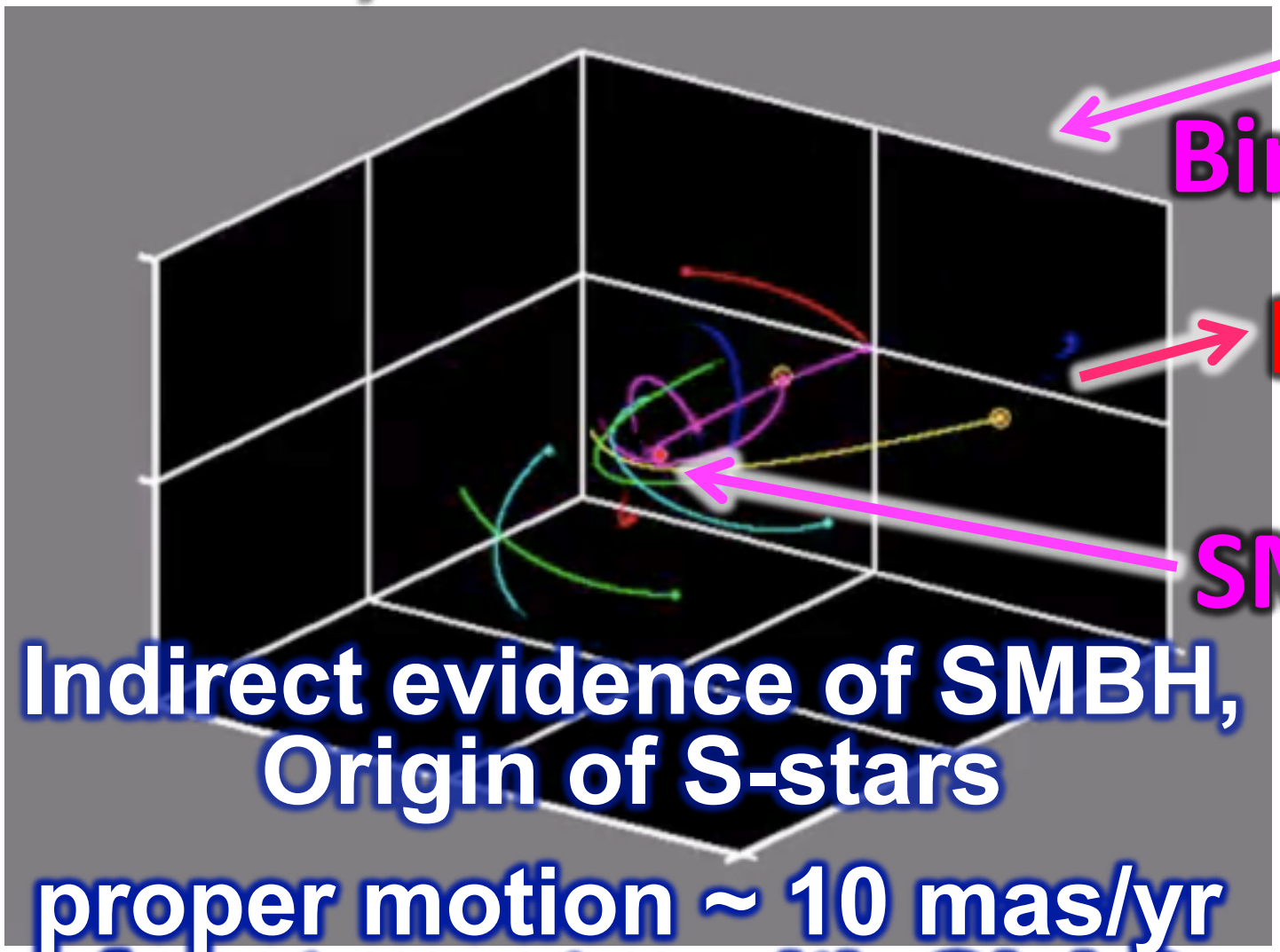
Hypervelocity Stars

Orbits of S-stars (<1”=0.04pc)



Hypervelocity Stars

Hypervelocity stars (HVS; Brown+05, 06, 07, 09)



Indirect evidence of SMBH, Origin of S-stars

proper motion ~ 10 mas/yr
← astrometry with GLAO

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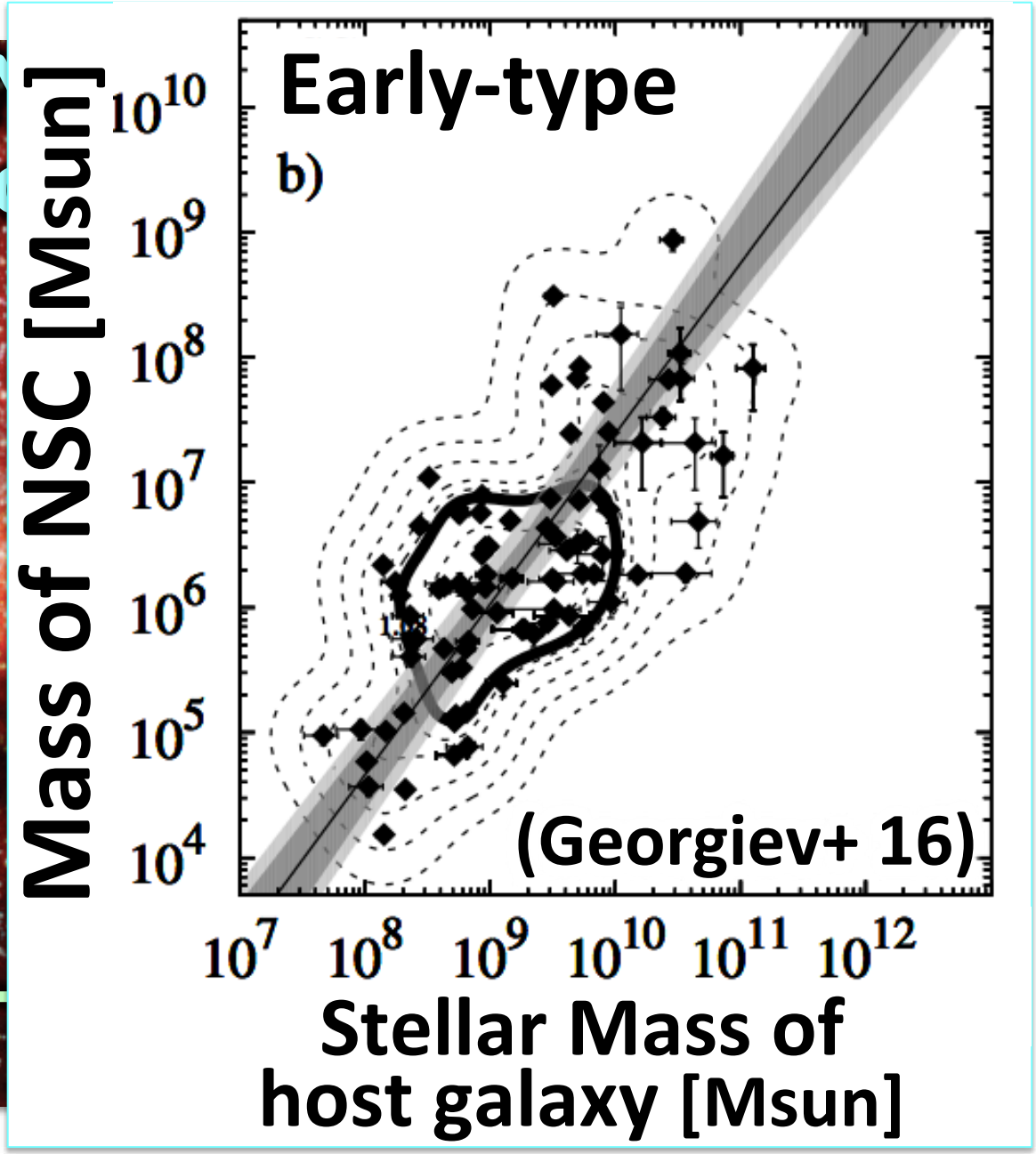
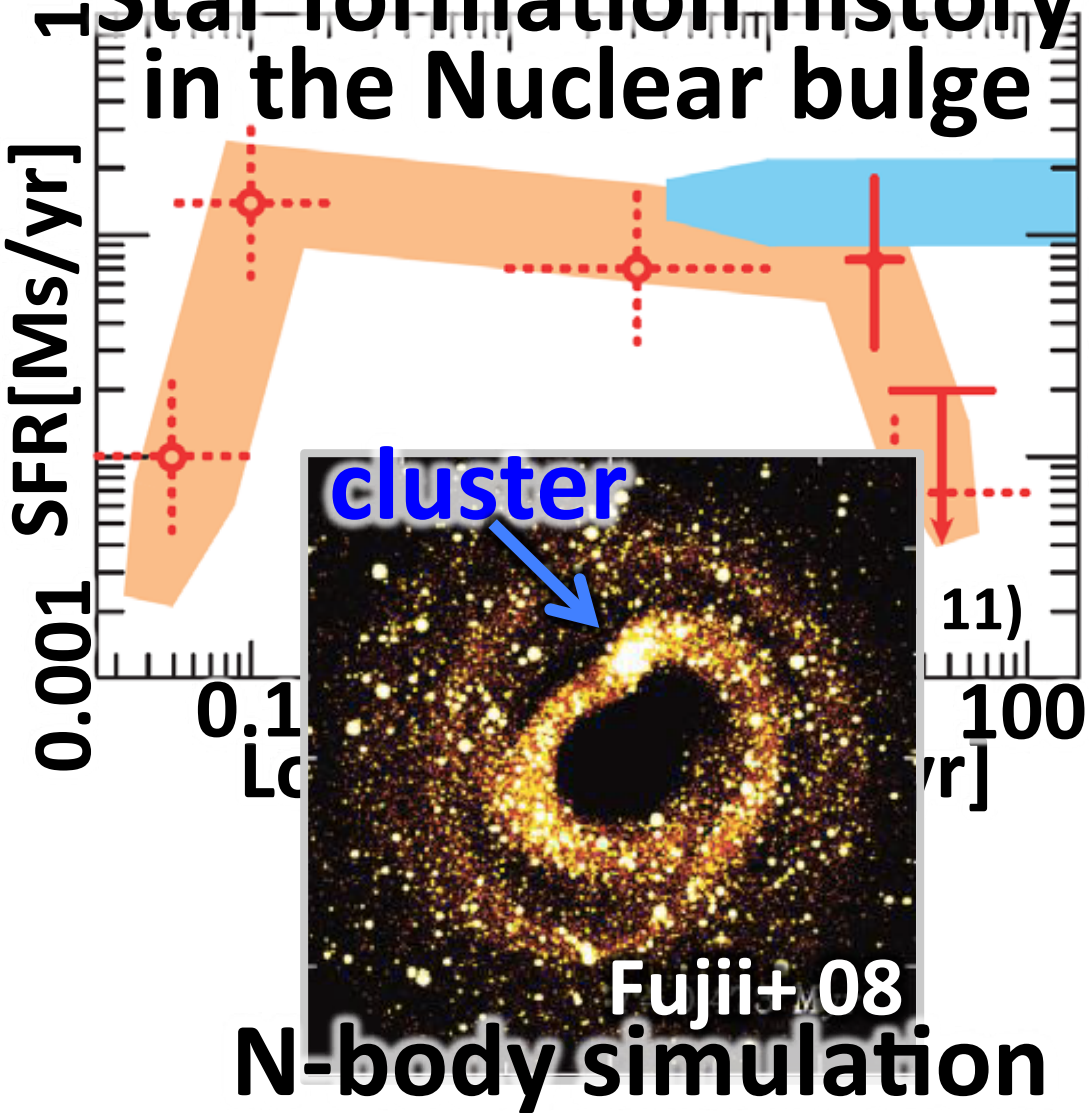
The Galactic NSC



The Galactic NSC

How NSC evolved?

Star formation history in the Nuclear bulge



N-body simulation

Star formation rate

～ 0.075 Msun/yr

@central 400 pc

(Yusef-Zadeh+ 09, Matsunaga+ 11)

→ dozens clusters

(several % of M_{NSC})

but

2 clusters known

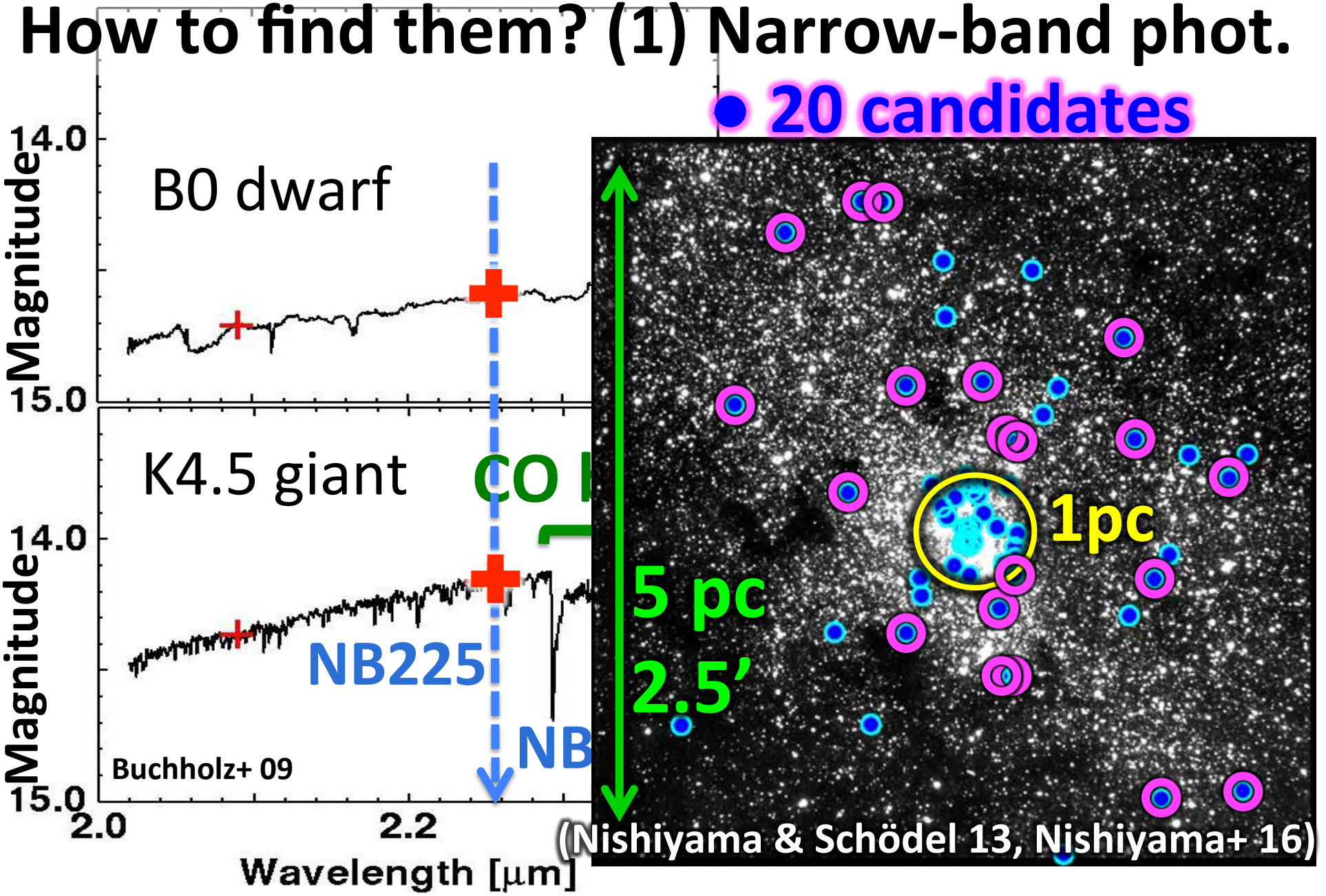
→ so far unknown

cluster remnants

& tidal streams

Observations: Narrow-band

How to find them? (1) Narrow-band phot.



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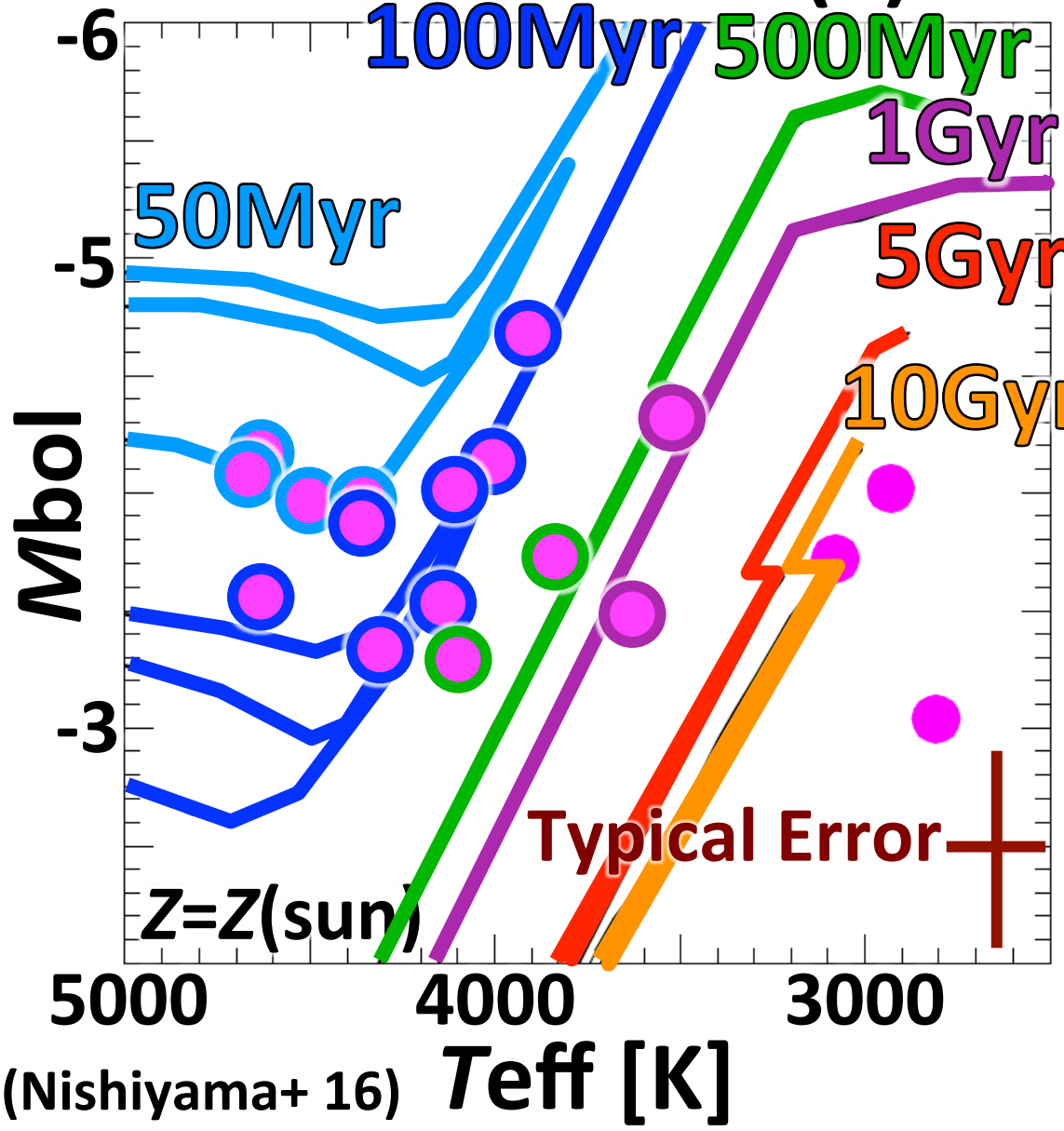


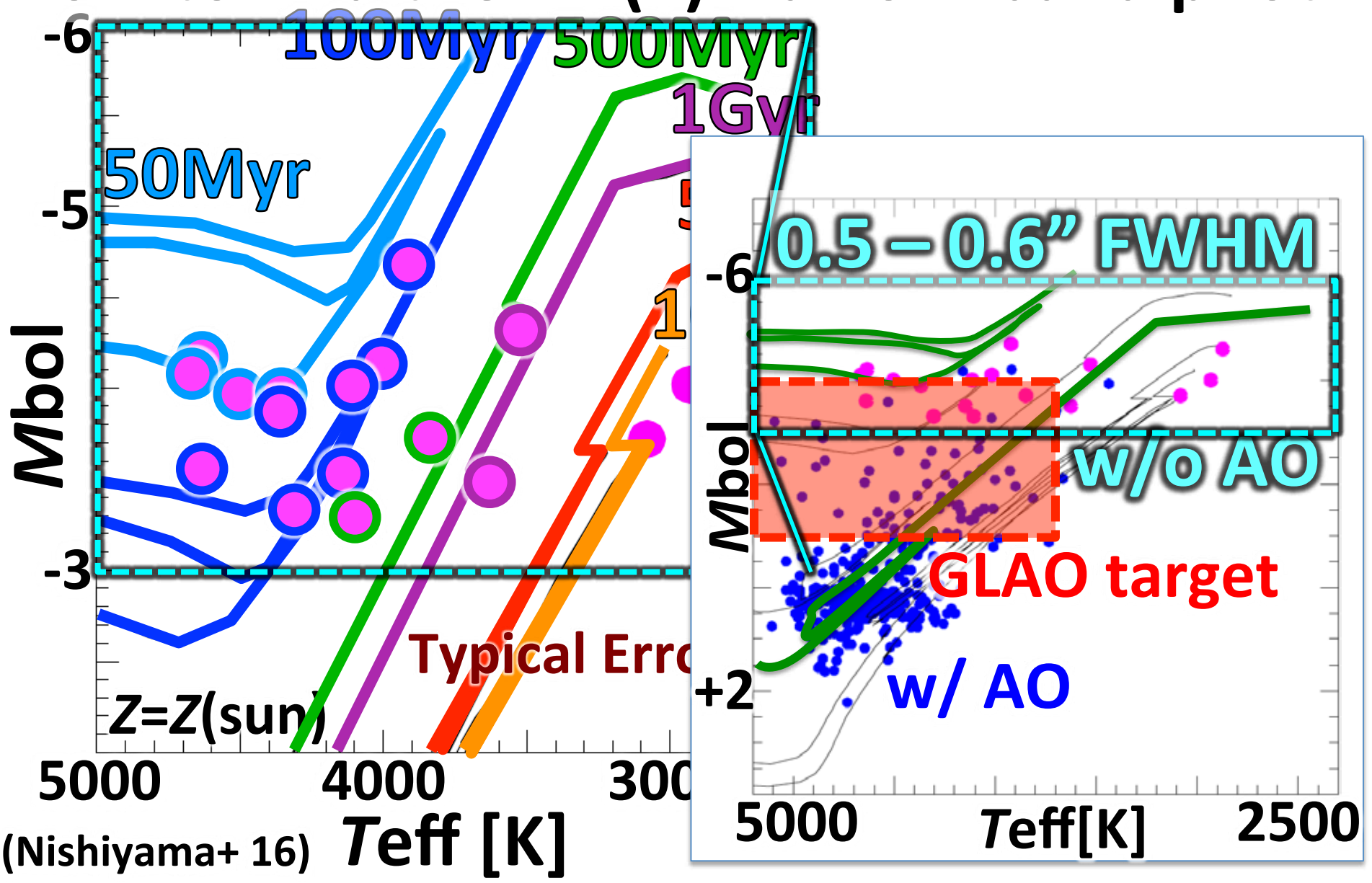
(Nishiyama+ 16)

11/20 candidates
→age < 100 Myr

isochrones: Padova code
Marigo+08,
Marigo & Girardi 07

Observations: Narrow-band

How to find them? (1) Narrow-band phot.



Observations: Astrometry

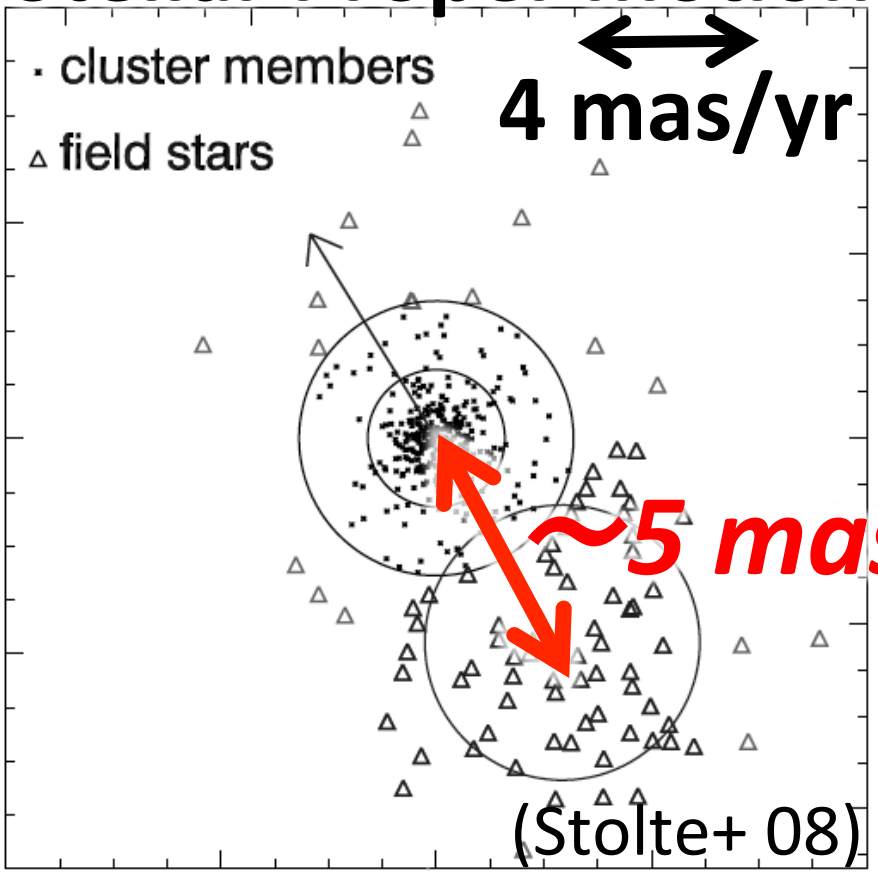
How to find them? (2) Astrometry

Relaxation timescale > O (Gyr) (Alexander 05)

<< 1Gyr stars ← not dyn. relaxed

HST/NICMOS/NB
(Dong+ 11)
FWHM:
～200mas@1.9μm
SN=20: ～16 mag
δp ～40 mas
100 observations
(accuracy∝1/√N)
→ ～4 mas
> 5σ for 4 yrs

Stellar Proper motion



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100 x 100 pc (40')
1-min × 100obs
× 3×3 FoV = 15h
→ 8 (-half) nights/yr
(50% efficiency)

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Questions

Q1. Coevolution between SMBH/NSC & the Galaxy
Q2. Wide-field camera with NB filters (~2.3μm)
Q3. NB imaging: possible but not competitive
Astrometry: pixel scale not enough
Q4. --

Q5. Smaller pixel sampling is better for astrometry.
Q6. interested in a tunable filter
Q7.
Q8. Yes! (IRCS/IRD, but for different science cases)