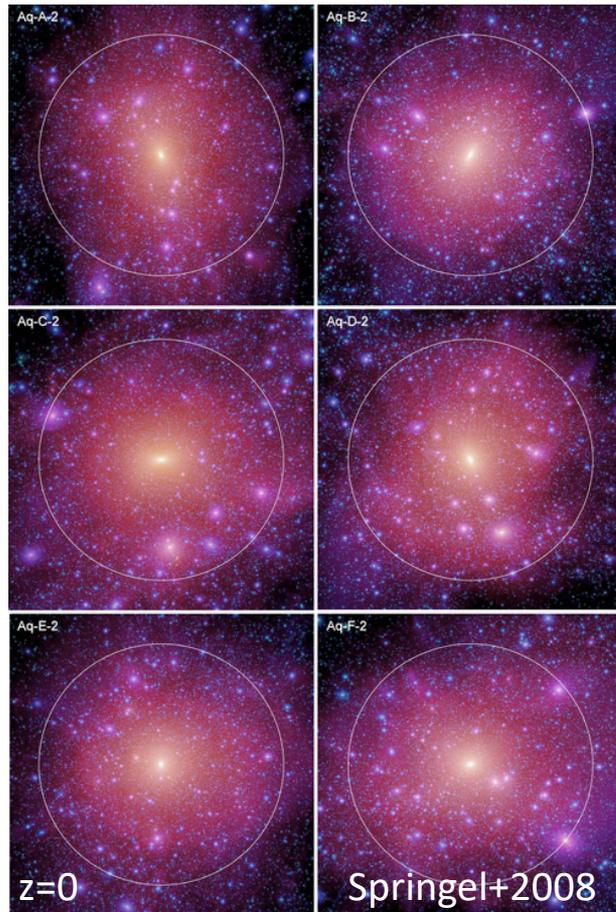


Intensive Program report: S19A-Q1060
Subaru Near-Field Cosmology Survey

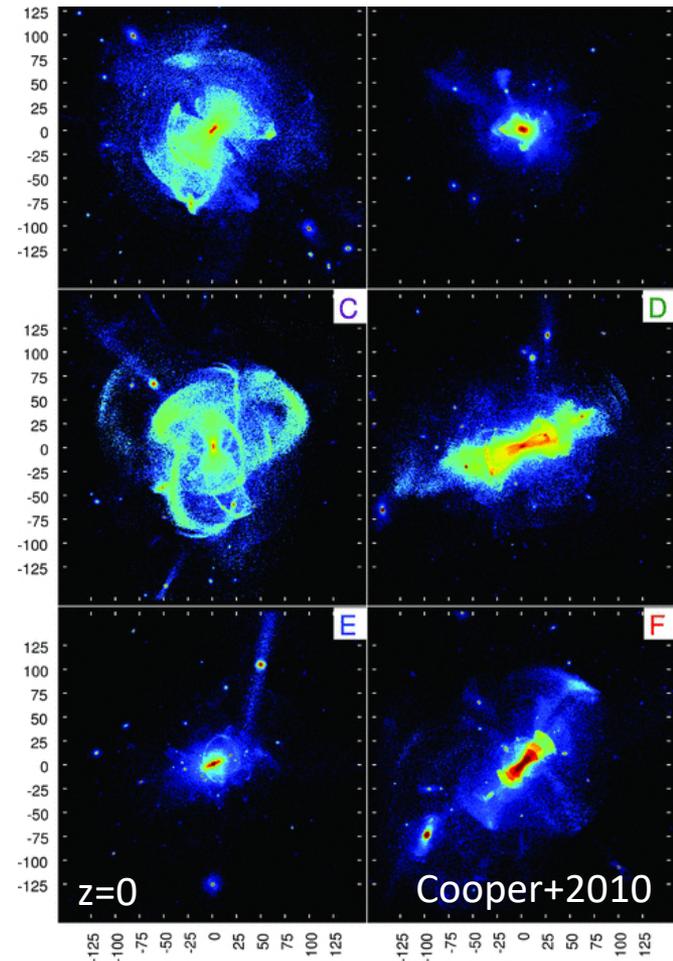
Sakurako Okamoto
Subaru Telescope/NAOJ

N. Arimoto (NAOJ), A. Ferguson (Edinburgh), M. Irwin (Cambridge) M. Chiba (Tohoku), K. Komiyama (NAOJ),
M. Tanaka (Hosei) M. Tanaka (NAOJ), J. Koda (Stony Brook), M. Rich (UCLA), M.G. Lee (Seoul),
I.S. Jang (AIP), J. Kang (Seoul), J. W. Lee (Seoul), R. Zemaitis (Edinburgh)

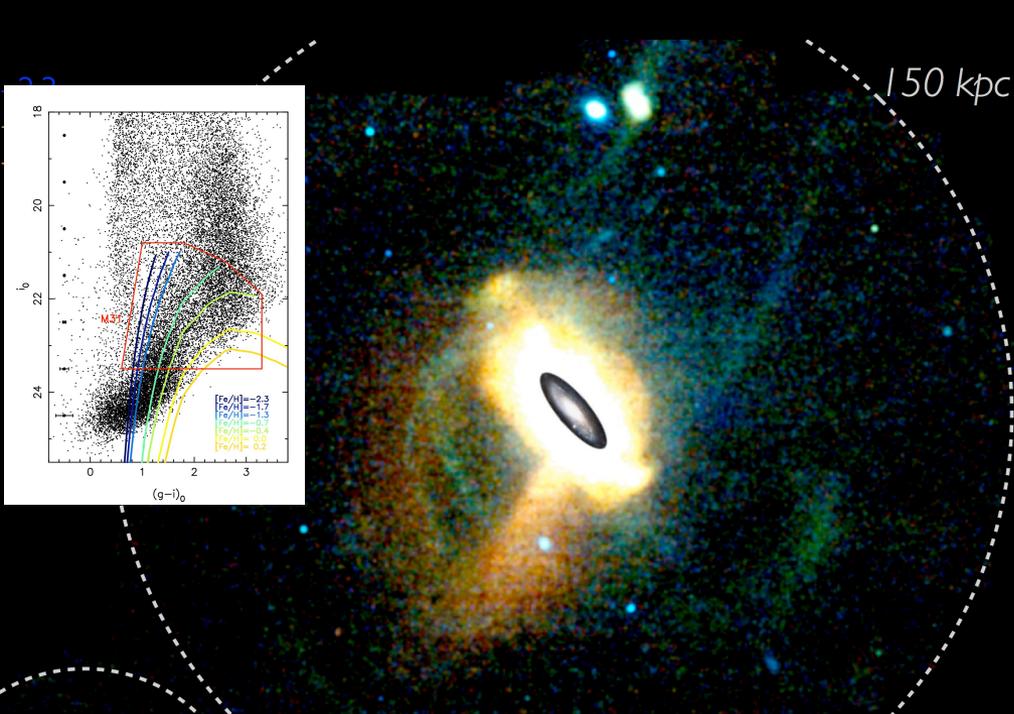
DM densities of MW-like galaxy halos



Stars formed in satellites but belonging to halo of MW-like galaxies



In Λ CDM framework, galaxies having similar total mass may have different stellar halo fraction, radial density, the radial metallicity profiles, and the richness of substructures.



PAndAS Survey / M31 & M33
 (300deg², 400pointings,
 220h, CFHT/Megacam)
 (Martin+2013)

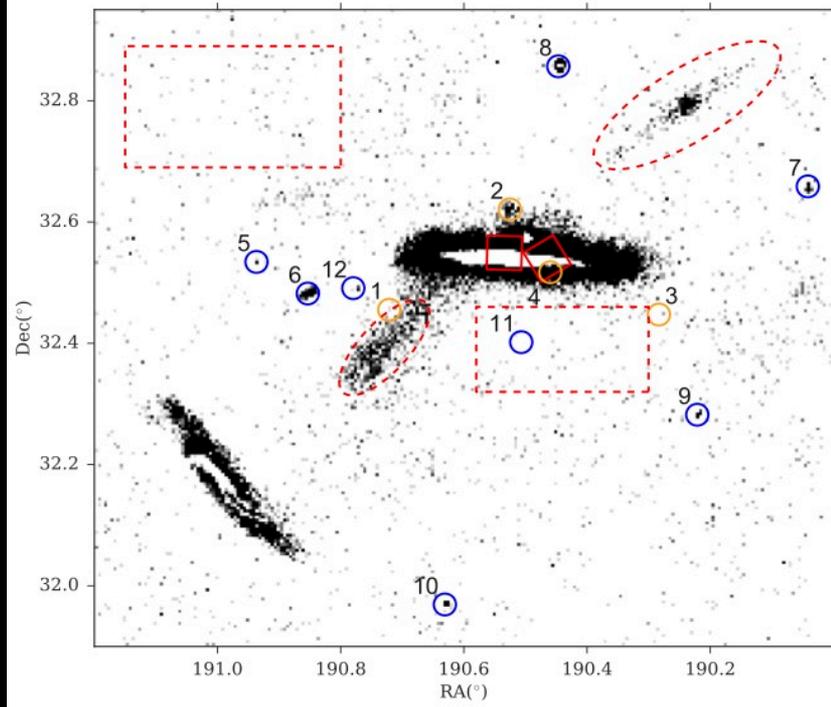
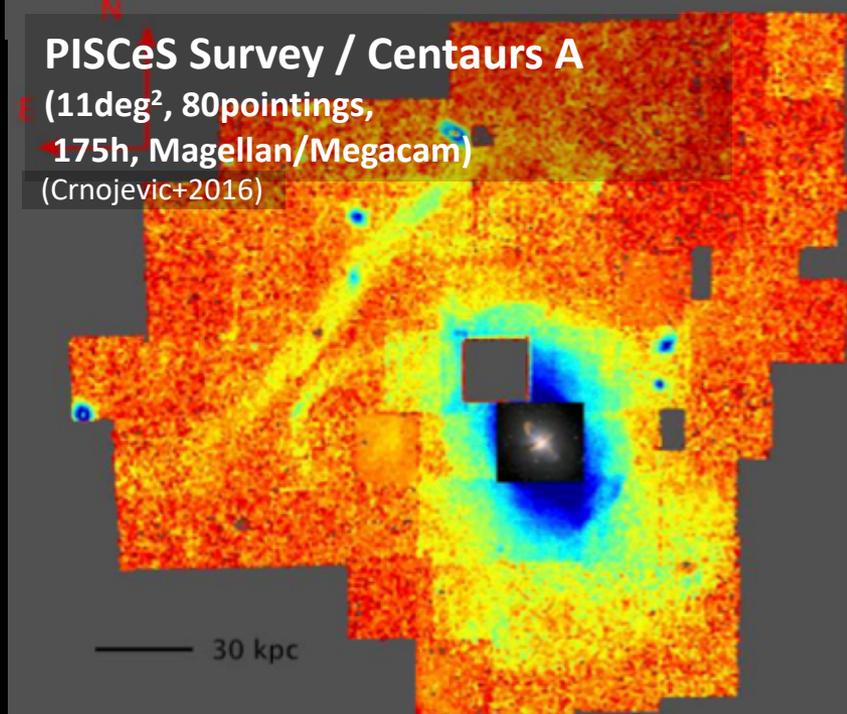
50 kpc

**only a few nearby
 galaxies data are
 available in details**

NGC4631
 (1.8deg², 1pointing,
 18h, Subaru/HSC)
 (Tanaka+2017)

PISCeS Survey / Centaurs A

(11deg², 80pointings,
 175h, Magellan/Megacam)
 (Crnojevic+2016)

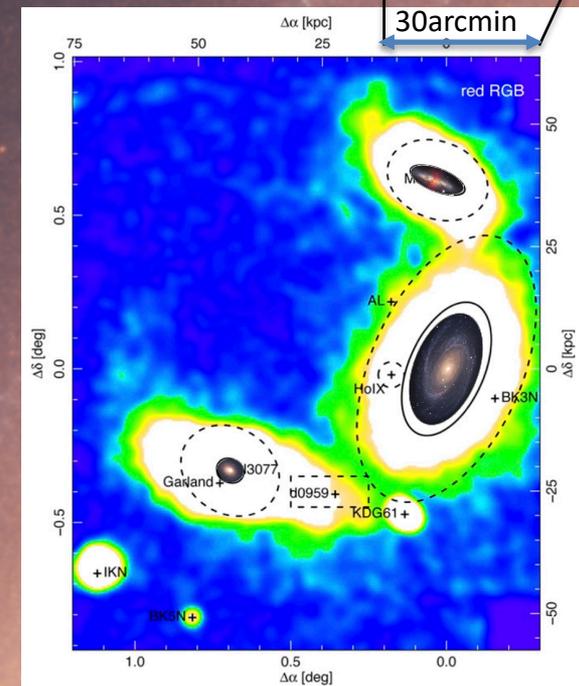
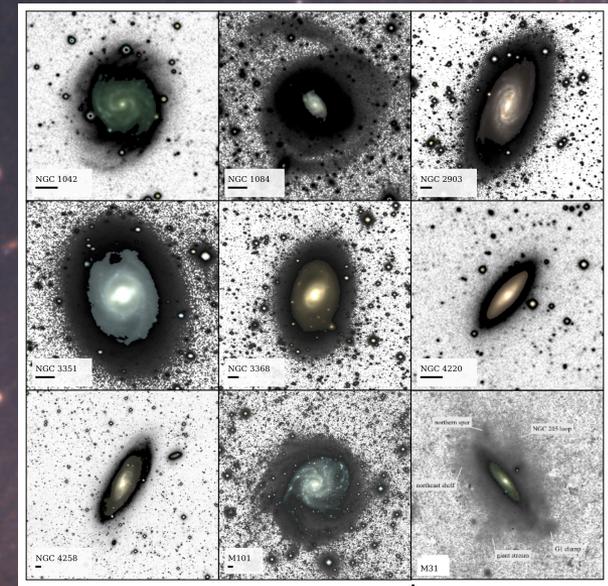


Integrated surface photometry:

a significant number of galaxies
lack of stellar halos?

Resolved Stellar Photometry:

- ✧ Reach well below the sky level ($>34\text{mag/arcsec}^2$)
- ✧ Direct proof of faint (sub-)structures
- ✧ Better constraint on Age/Metallicity of individual stars
- ✧ Less foreground/background contaminations
- ✧ Less influence of foreground cirrus and sky-subtraction
- ✧ Limited number of target galaxies ($< \text{a few Mpc}$)
- ✧ Require both **image depth** and **wide FoV**



Subaru Near-Field Cosmology Survey (SNFC, S19A-QI060)



NGC247

A tilted, irregular galaxy with a yellowish core and a diffuse, multi-colored (blue, red, green) structure.



NGC253

A tilted, irregular galaxy with a yellowish core and a diffuse, multi-colored (blue, red, green) structure.



NGC4244

A tilted, irregular galaxy with a yellowish core and a diffuse, multi-colored (blue, red, green) structure.



NGC7793

A tilted, irregular galaxy with a yellowish core and a diffuse, multi-colored (blue, red, green) structure.



NGC4736(M94)

A face-on, regular spiral galaxy with a yellowish core and blue/red spots in the spiral arms.



NGC5236(M83)

A face-on, regular spiral galaxy with a yellowish core and blue/red spots in the spiral arms.



NGC4236

A tilted, irregular galaxy with a yellowish core and a diffuse, multi-colored (blue, red, green) structure.

Subaru Near-Field Cosmology Survey (SNFC; S19A-QI060)

Cover 6 nearby disk galaxies with HSC 2 or 4 pointings each with g,i-bands

Elucidate **the dependence of stellar halos and thick disk properties** in late-type galaxies based on **the homogeneous observations/reductions/analyses** by the same group

For individual galaxies:

Verify **stellar halo and thick disk existence** and reveal their **stellar populations**

Search new satellites, (sub-)structures, GCs, outlying young stellar systems

Radial metallicity distributions of old population by RGB colors

Using all target galaxies + existing samples:

Clarify **the dependence of stellar halos and thick disk properties** in late-type galaxies on the luminosity/morphology/environment.

Compare halo radial profiles (power-law like MW/M31/M81?)

Thick disks of edge-on targets (N247,N253,N4244,N4236)

Address the missing satellite problem with LFs/MDFs of satellites
halo-to-halo scatter of the satellite abundance?

SNFC: Targets

Initial Targets:

- Nearby galaxies $D < 5$ Mpc
- Not “dwarf” $M_B < -18.0$
- Visible from MK more than 3hours/night
- Galactic latitude $|b| > 30$ degree

N247, N253, N7793, ~~N4449, N4736 (M94),~~

N4244, N5236 (M83), N4236, ~~N5068~~

(from UNGC: Karachentsev+2013)

Further constraints:

- total request time , Galaxy type, properties,,,,

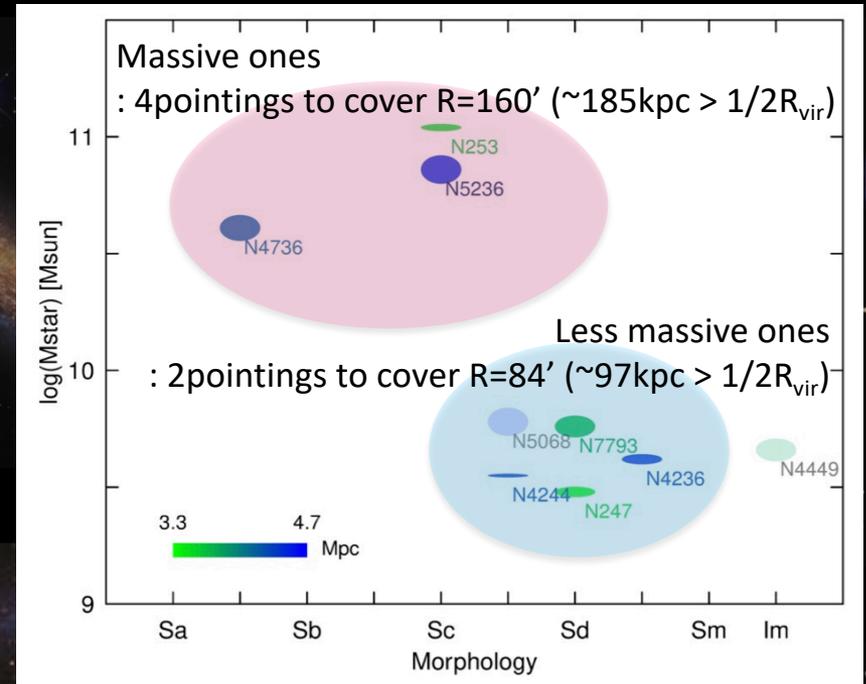
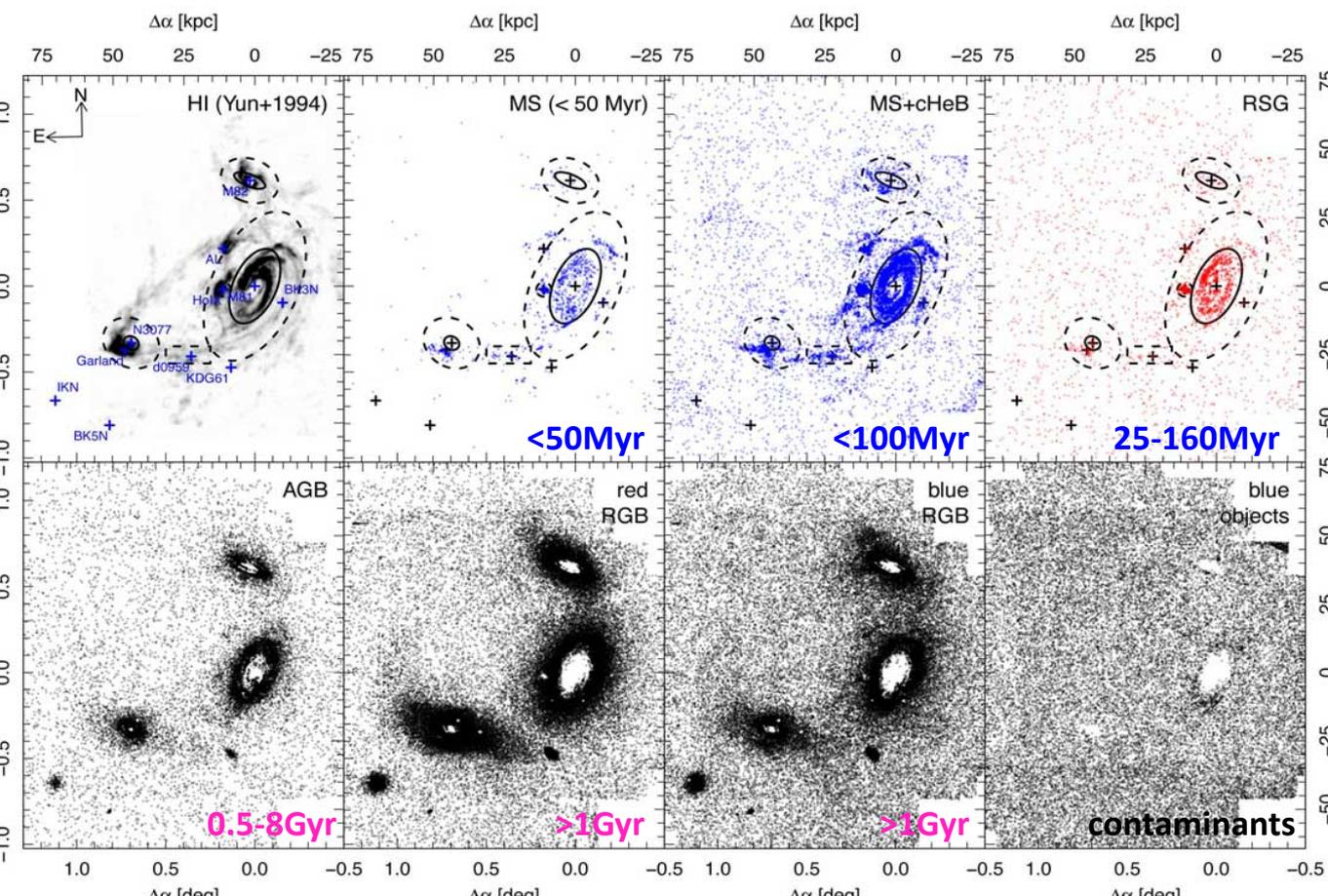
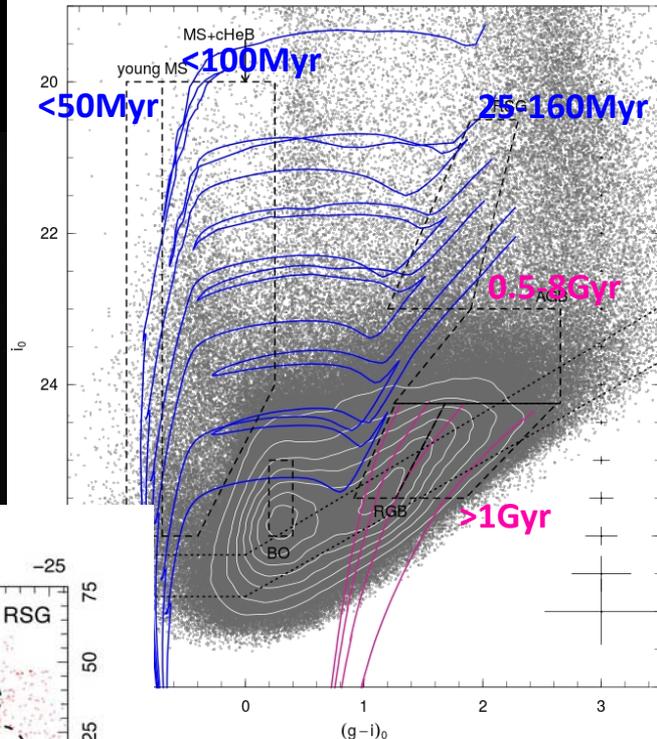


Table 1: The target galaxies

Name	# ^a	term ^b	D (Mpc) ^c	group ^d	M_B	class ^e	b/a	$M_*(M_\odot)$ ^f	image	comments
NGC0247	2	B	$3.4 \pm 0.06^{(1)}$	ScI	-18.5	Sd	0.32	3×10^9	HSC ^g	
NGC0253	5	B	$3.5 \pm 0.1^{(2)}$	ScI	-21.3	Sc	0.22	1×10^{11}	CFHT	two satellites ^h
NGC7793	2	B	$3.7 \pm 0.1^{(2)}$	ScI	-18.5	Sd	0.68	5.8×10^9	Gemini	
NGC4736	5	A	$4.2 \pm 0.3^{(2)}$	M94	-19.9	Sab	0.81	4.1×10^{10}	n/a	
NGC4244	2	A	$4.4 \pm 0.2^{(2)}$	M94	-18.2	Scd	0.11	3.6×10^9	HSC ^g	no stellar halo?
NGC4236	5 2	A	$4.5 \pm 0.3^{(4)}$	M81	-18.6	Sdm	0.32	4.2×10^9	n/a	extended UV disk
NGC5236	5	A	$4.5 \pm 0.3^{(5)}$	M83	-20.6	Sc	0.89	7.2×10^{10}	HSC ^g	HI, satellite ^h

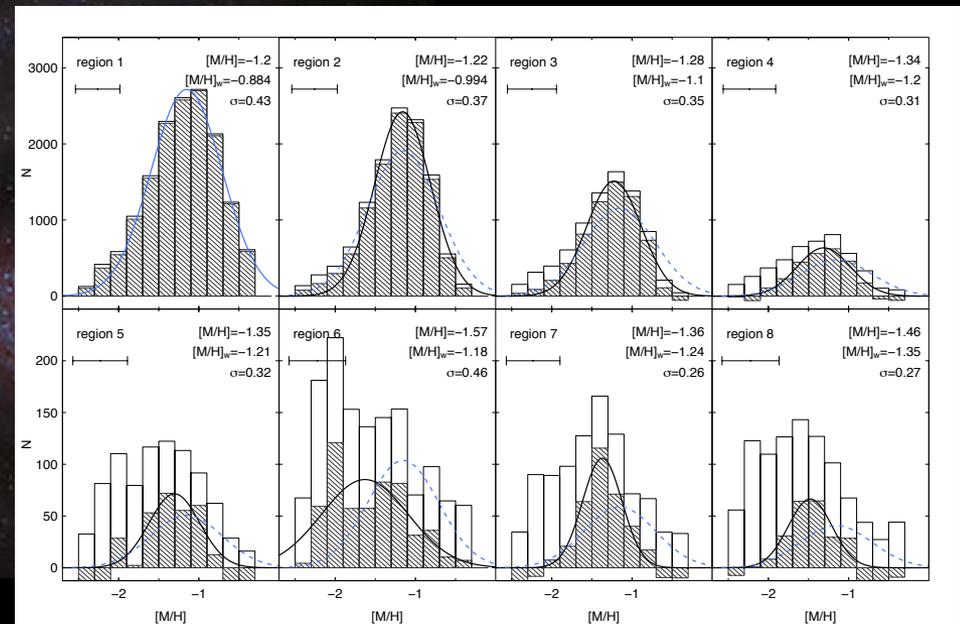
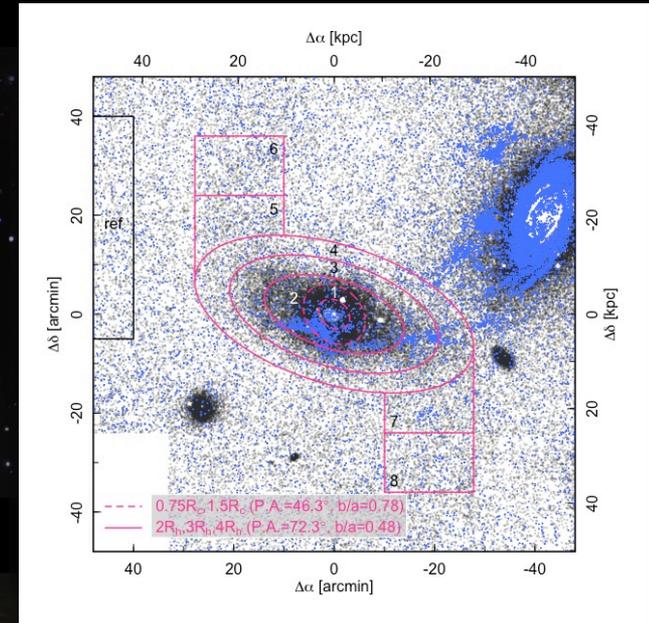
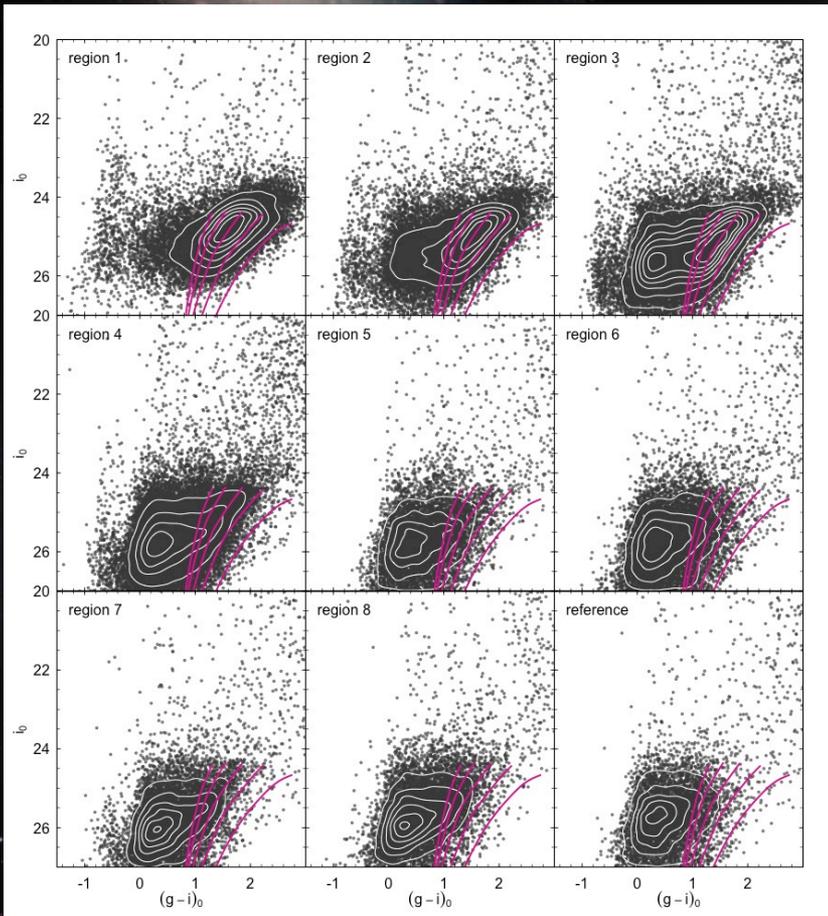
SNFC: age constraints

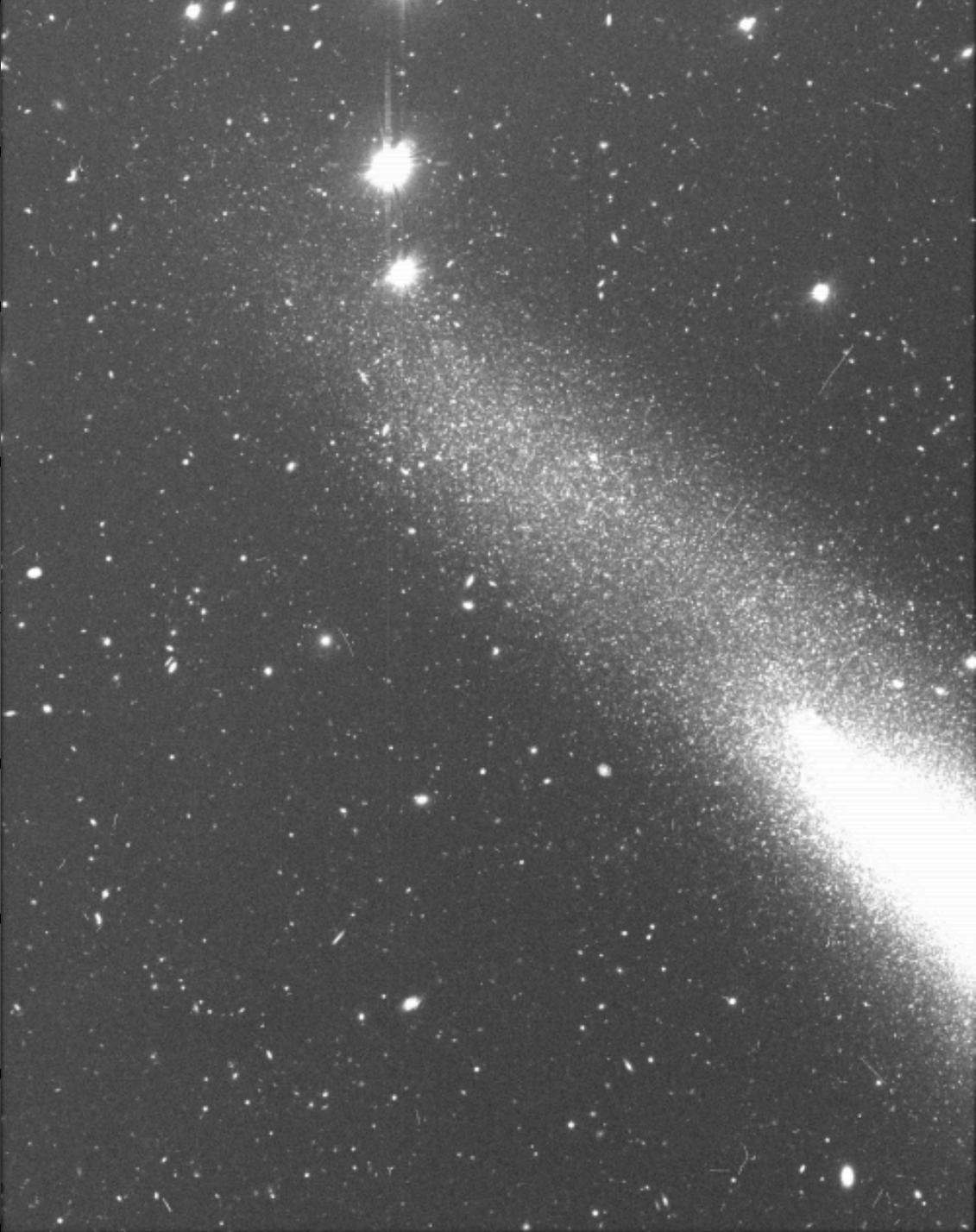
Location of point-sources in CMD:
Young / intermediate / Old age



SNFC: metallicity constraints

(g-i) color of individual RGBs:
Metallicity Distribution Function in
different spatial area in a galaxy





Subaru Near-Field Cosmology Survey

Legacy values:

Homogeneous stellar catalogues of nearby bright galaxies containing various generations of stars

The best ground-based images even compared with LSST 10-year coadded data

(SNFC: $g \sim 28$ w/ $SNR=10$ vs. LSSTcoadded: $g \sim 27$ w/ $SNR=5$)

All high-level data will be released to the public:

Processed fits image, Raw photometry catalogue, filtered stellar catalogues, etc.

Roles and data flowchart:

HSC Queue Observation

Data processing
with pipeline @NAOJ

Okamoto @ Subaru
Komiya, Tanaka @NAOJ

Processed images
Source catalogue

Project based analyses
of individual galaxies
@ each institute
and university

Publish papers

Data release

3-6 months after observations

3-12 months after data processing

After project completed

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