Intensive Program Report
S19A-QI060
Subaru Near-Field Cosmology Survey

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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.
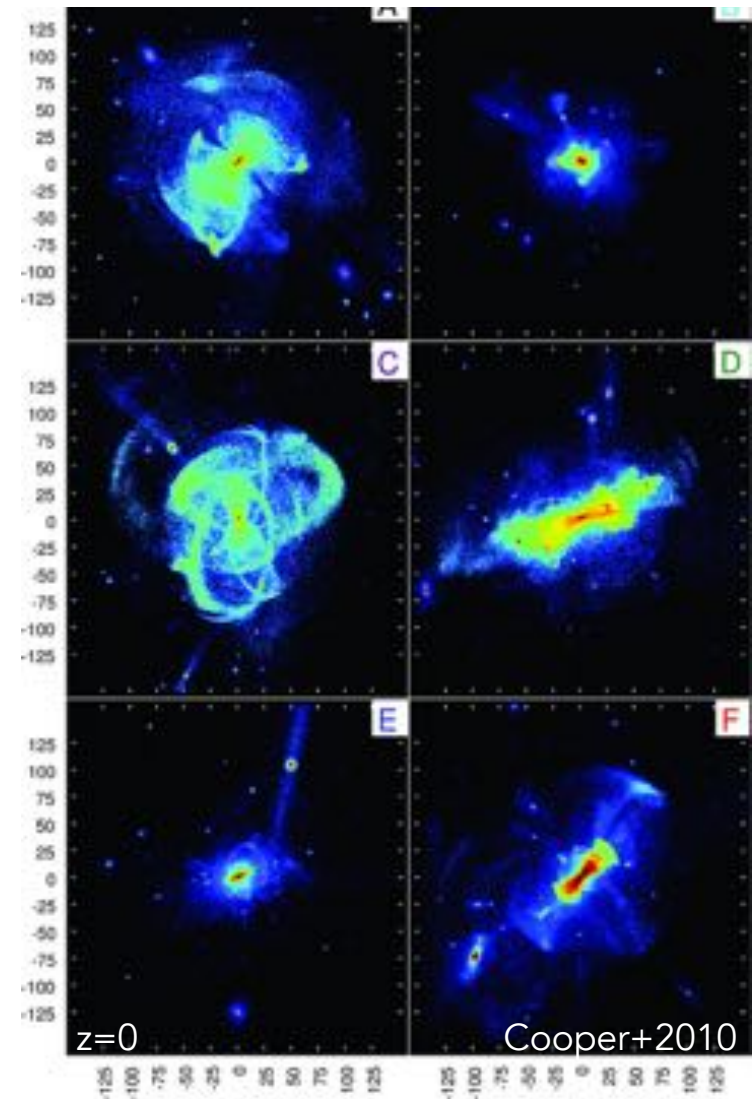Compare halo radial profiles (power-low like MW/M31/M81?)
Thick disks of edge-on targets (N247,N253,N4244,N4236)

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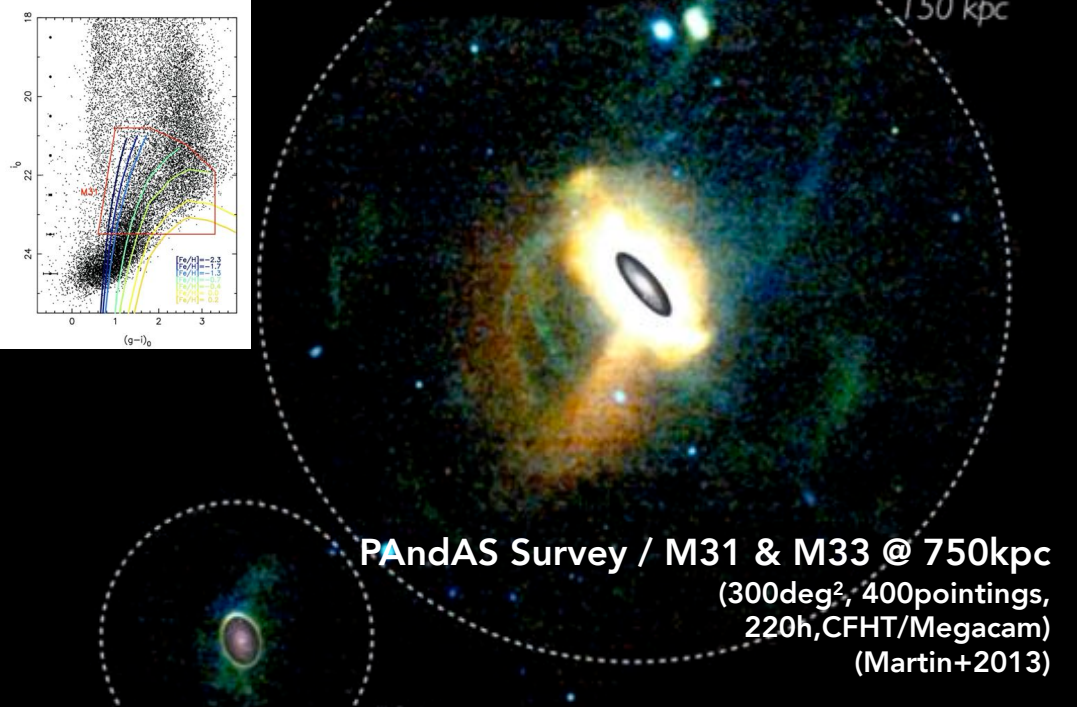halo-to-halo scatter of the satellite abundance?

**DM densities of
MW-like galaxy halos**
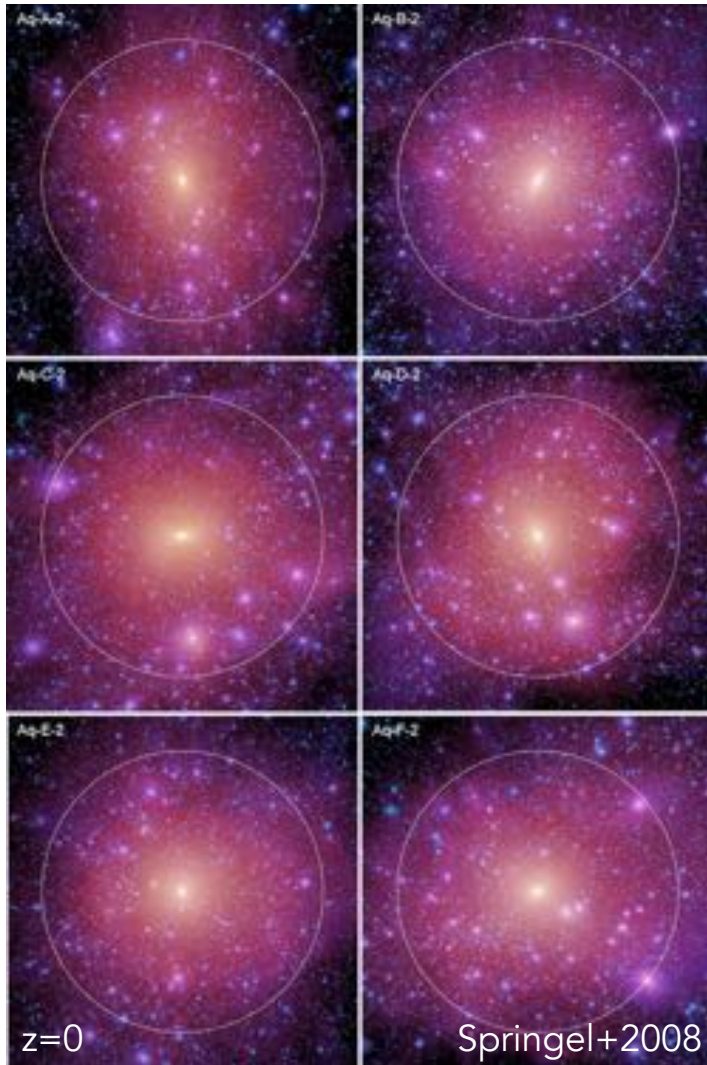
**Stars born in satellites but
now belonging to MW-like galaxies**

z=0   Springel+2008

z=0   Cooper+2010

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

PISCeS Survey / Centaurs A @ 3.8Mpc
(11deg^2, 80pointings, 175h, Magellan/Megacam)
(Crnojevic+2016)

750 kpc

30 kpc

PAndAS Survey / M31 & M33 @ 750kpc
(300deg^2, 400pointings, 220h, CFHT/Megacam)
(Martin+2013)

M81/M82 @ 3.6Mpc
(6.5 deg^2, 7pointing, 7nights, Subaru/HSC
(Okamoto+2015))

young MS, MS+cHeB

RGB

NGC4631 @ 7.4Mpc
(1.8deg^2, 1pointing, 18h, Subaru/HSC)
(Tanaka+2017)
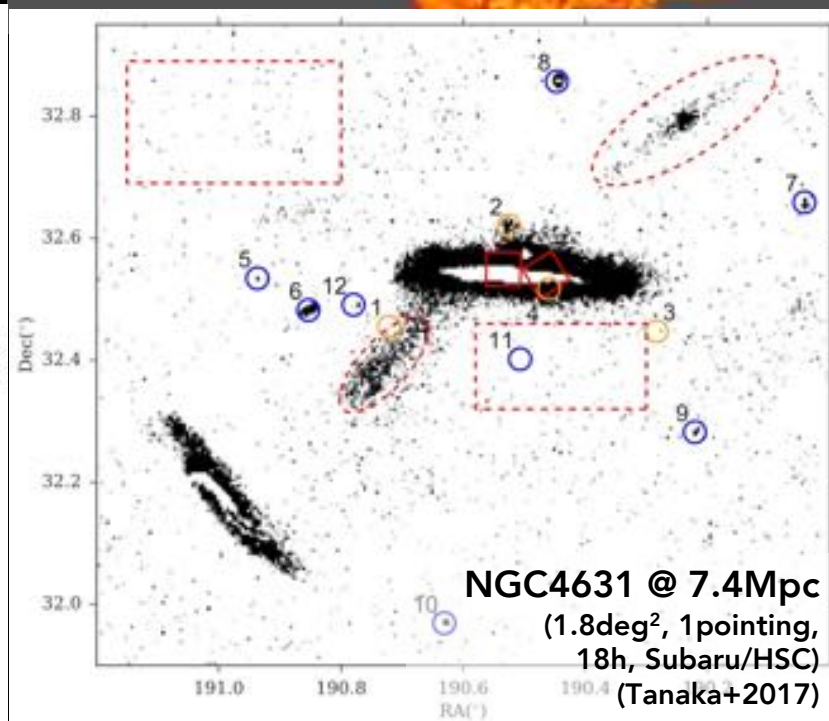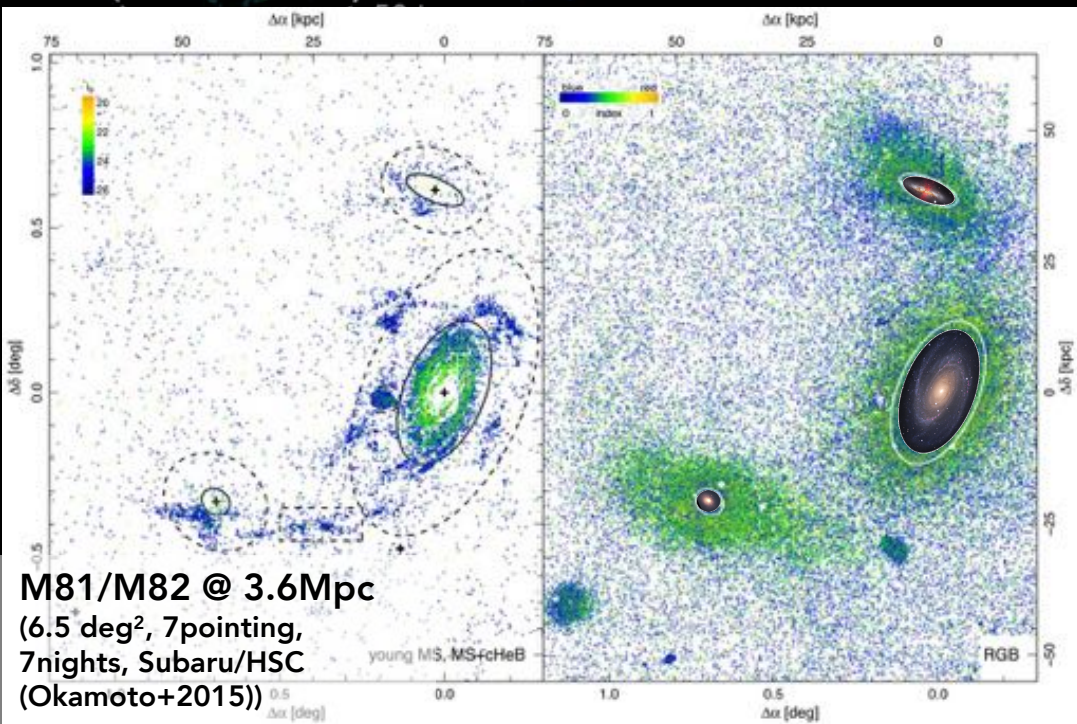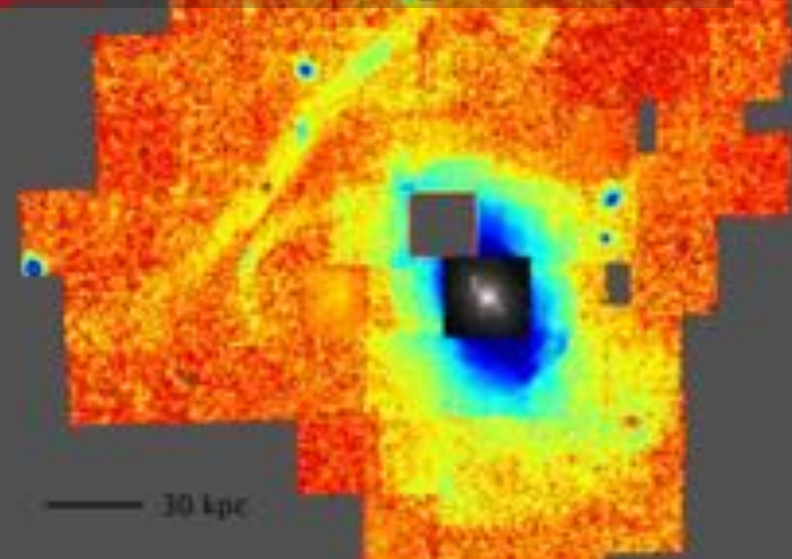
Integrated Surface Photometry:

  a significant number of galaxies
  lack of stellar halos?

Resolved Stellar Photometry:

  ✧ Reach well below the sky level (>34mag/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
    (< a few Mpc)

  ✧ Require both image depth and wide FoV

Dragonfly telephoto array (Merritt+2016)

(Merritt+2016)
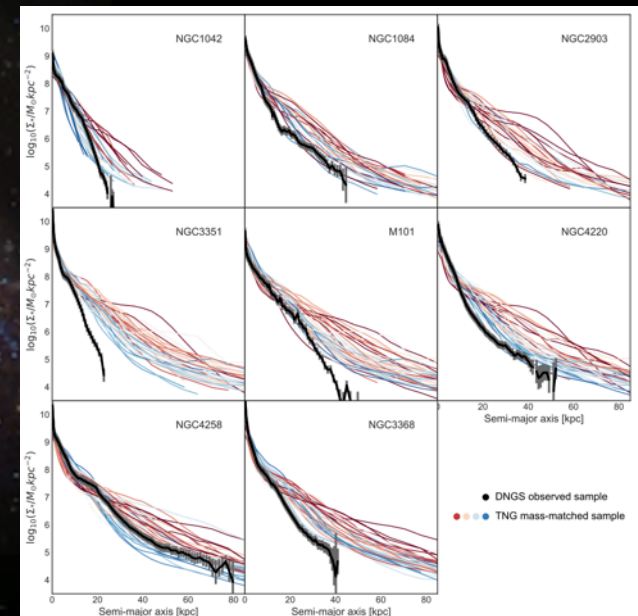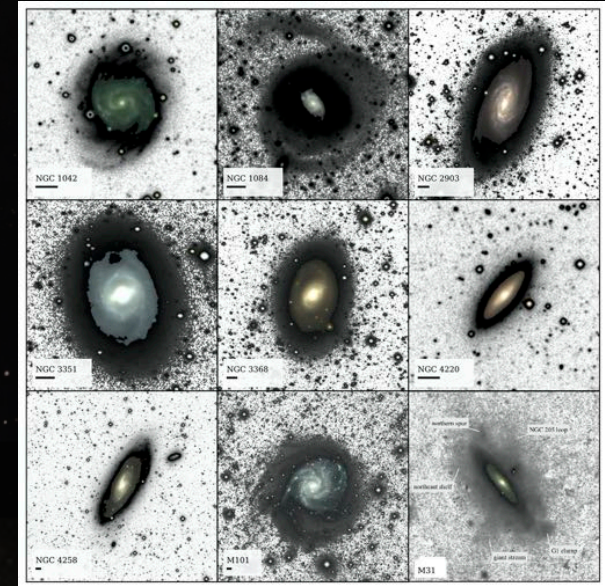
SNFC: Targets

Selection:
- **Nearby galaxies   D < 5 Mpc**
- **Not "dwarf" M_B < -18.0**
- **Visible from MK more than 3hours/night**
- **Galactic latitude |b|> 30 degree**
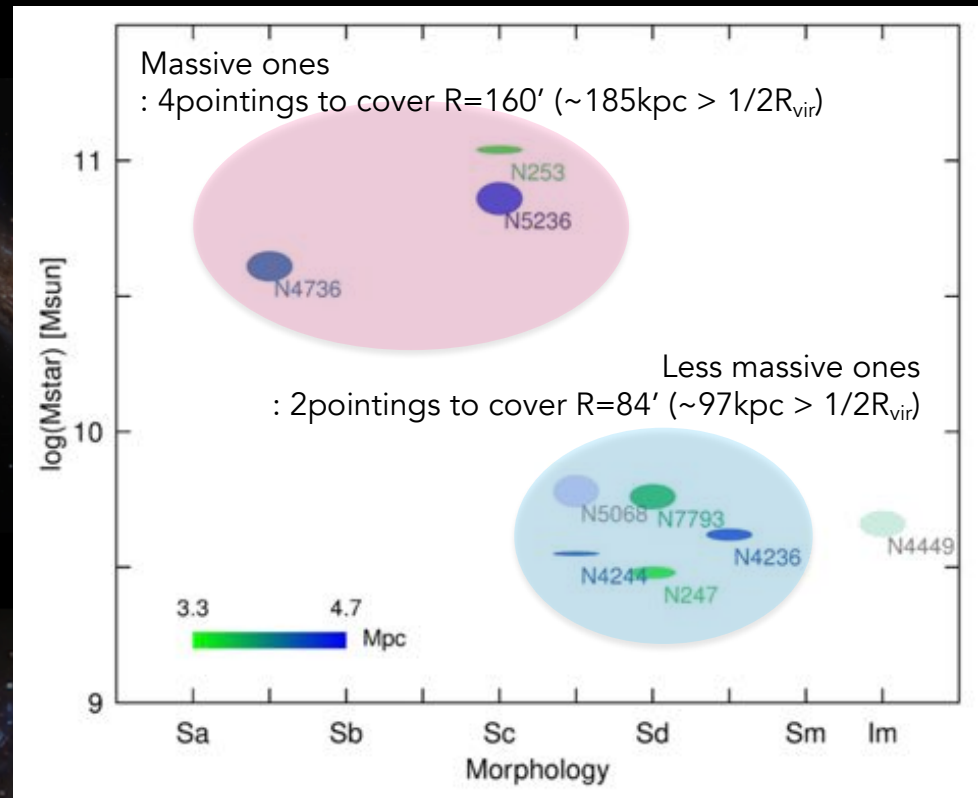- **Variety of Morphological type, Mass, etc.**

Massive ones
: 4pointings to cover R=160' (~185kpc > 1/2R_{vir})

Less massive ones
: 2pointings to cover R=84' (~97kpc > 1/2R_{vir})

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 ± 0.06[1]	Scl	−18.5	Sd	0.32	3×10^9	HSC[g]	
NGC0253	5	B	3.5 ± 0.1[2]	Scl	−21.3	Sc	0.22	1×10^{11}	CFHT	two satellites[h]
NGC7793	2	B	3.7 ± 0.1[2]	Scl	−18.5	Sd	0.68	5.8×10^9	Gemini	
NGC4736	5	A	4.2 ± 0.3[2]	M94	−19.9	Sab	0.81	4.1×10^{10}	n/a	
NGC4244	2	A	4.4 ± 0.2[2]	M94	−18.2	Scd	0.11	3.6×10^9	HSC[g]	no stellar halo?
NGC4236	2	A	4.5 ± 0.3[4]	M81	−18.6	Sdm	0.32	4.2×10^9	n/a	extended UV disk
NGC5236	5	A	4.5 ± 0.3[5]	M83	−20.6	Sc	0.89	7.2×10^{10}	HSC[g]	HI, satellite[h]

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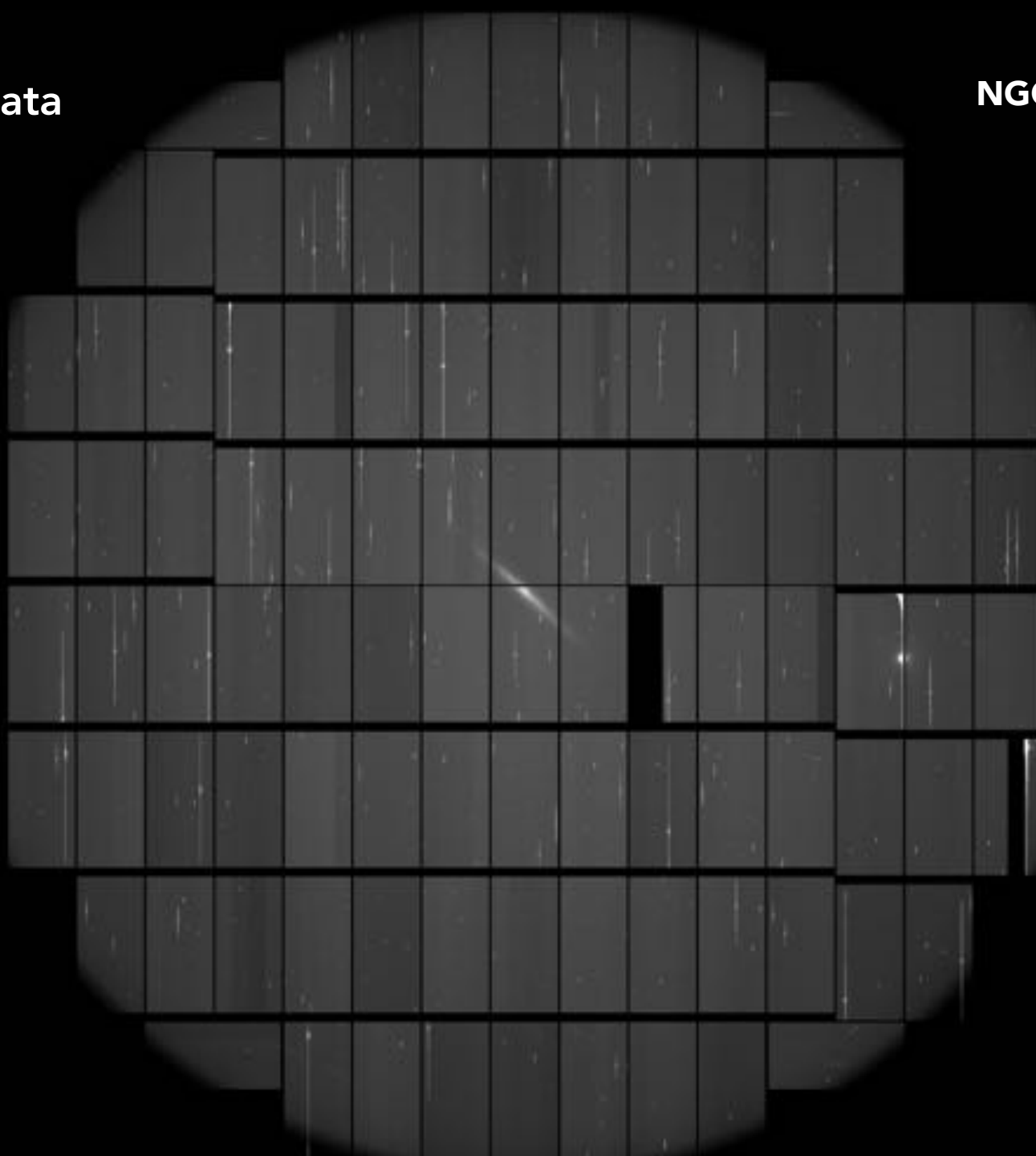# SNFC: Survey Status (as of March 1, 2021)

Overall completion rate = 32.1h/87h = 36% ...

S19A (2n)=50%,   S19B (3n)=35%,   S20A (3n)=36%,   S20B (2n)=47%,   S21A (2n)=??

target	Fields	visibility	filter	exp/F [s]	seeing	Field1	Field2	Field3	Field4
	2	mid7-end12	i	2500	1.0"	100.0%	0.0%		
			g	5500	1.0"	100.0%	0.0%		
	4	mid7-end12	i	2750	1.0"	100.0%	100.0%	0.0%	0.0%
			g	7650	0.8"	0.0%	0.0%	0.0%	0.0%
	2	mid7-end11	i	3825	1.0"	0.0%	0.0%		
			g	8400	1.0"	0.0%	0.0%		
	4	early12-end7	i	6250	1.0"	100.0%	100.0%	100.0%	1000%
			g	16800	0.8"	7.14%	0.0%	0.0%	0.0%
	2	end11-end7	i	7200	1.0"	100.0%	100.0%		
			g	15600	1.0"	100.0%	100.0%		
	2	early12-end6	i	7500	1.0"	100.0%	100.0%		
			g	8225	0.8"	29.18%	0.00%		
	4	early1-end6	i	7700	1.0"	0.00%	0.00%	0.00%	0.00%
			g	21000	0.8"	0.0%	0.0%	0.0%	0.00%
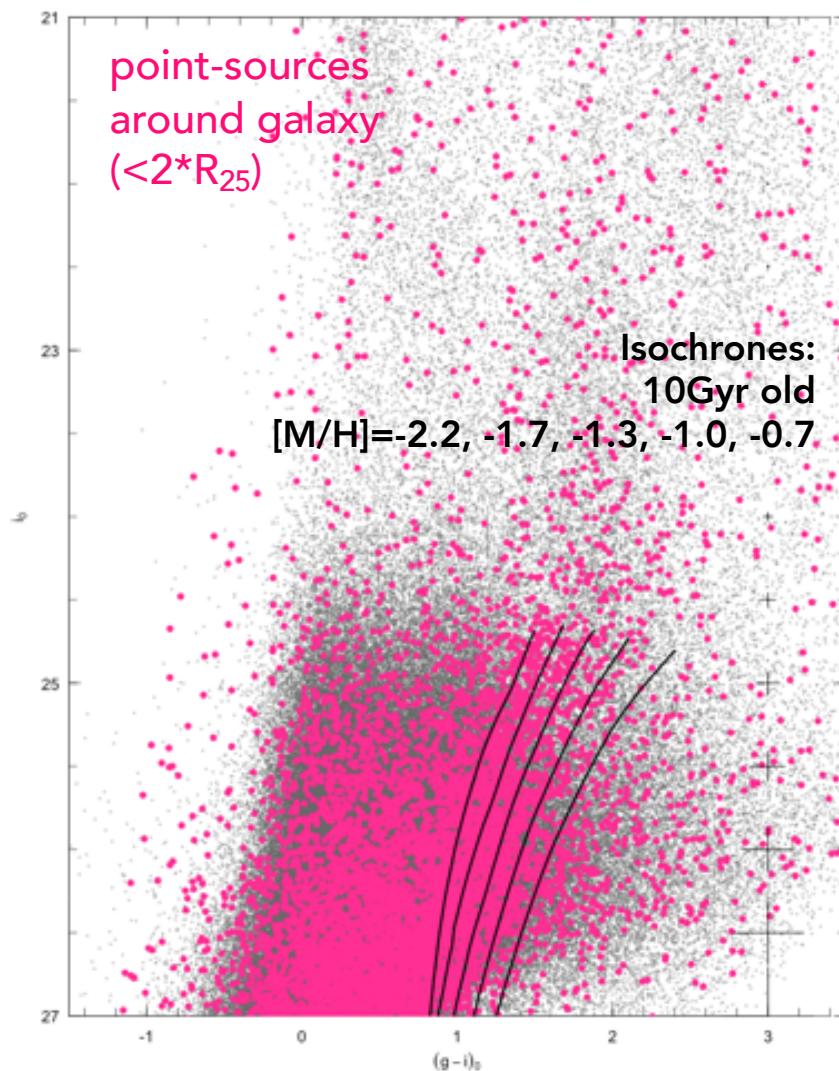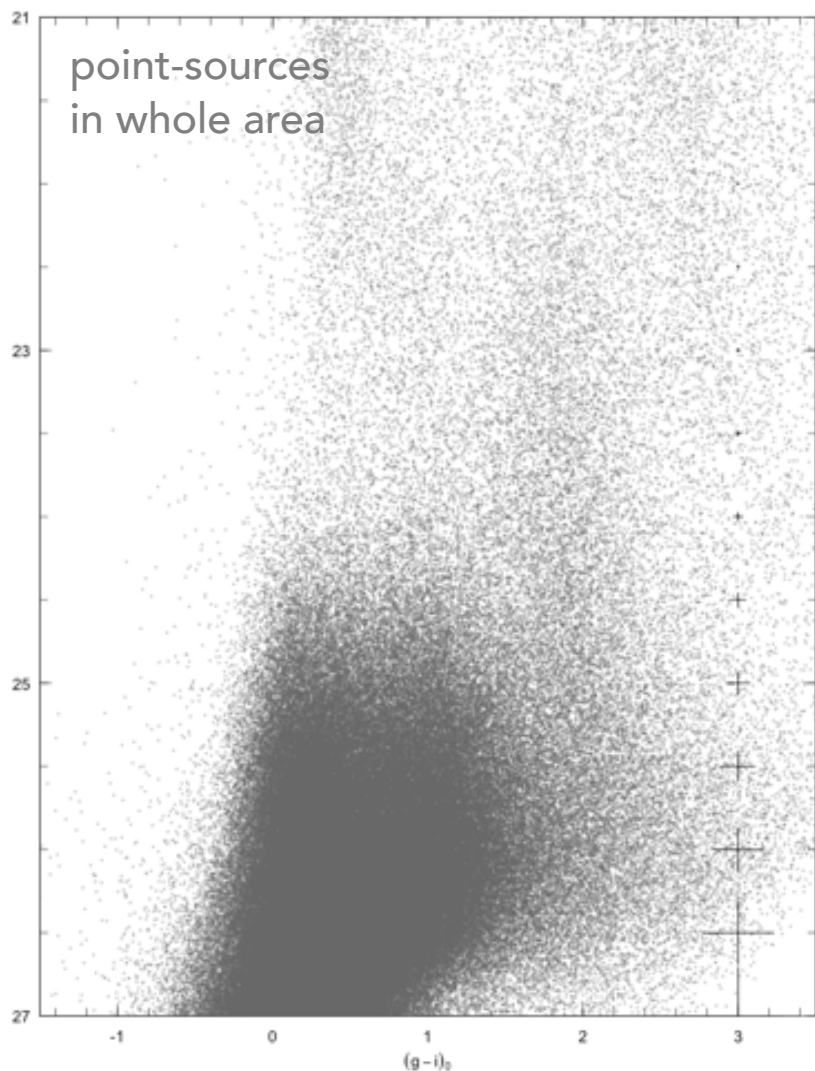
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NGC4244

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point-sources
in whole area

point-sources
around galaxy
$(<2*R_{25})$

Isochrones:
10Gyr old
[M/H]=-2.2, -1.7, -1.3, -1.0, -0.7

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- Overall completion rate is very low (36%),

   if this goes on, it is very difficult to achieve the objectives….

- NGC4244 analysis on-going

   old, metal-poor population does exist in the outskirt.

   halo fraction seems to be relatively small.

- Keen to complete N4236 and N4736 in S21A

   and get N253, N247 data in S21B as carry-over