銀河系ハローにおける ミラ型変光星探査

Tsuyoshi Sakamoto (Japan Spaceguard Association)

Collaborators Matsunaga, N. (Kiso observatory)

Hasegawa, T. (GAO), Mito, H. (Kiso observatory),

Nakada, Y. (University of Tokyo)

Motivation

- 銀河系ハロー

  -古い(～13Gyr)星が支配的。10Gyrより若い星も存在。

  -金属量が欠乏

- ミラ型変光星

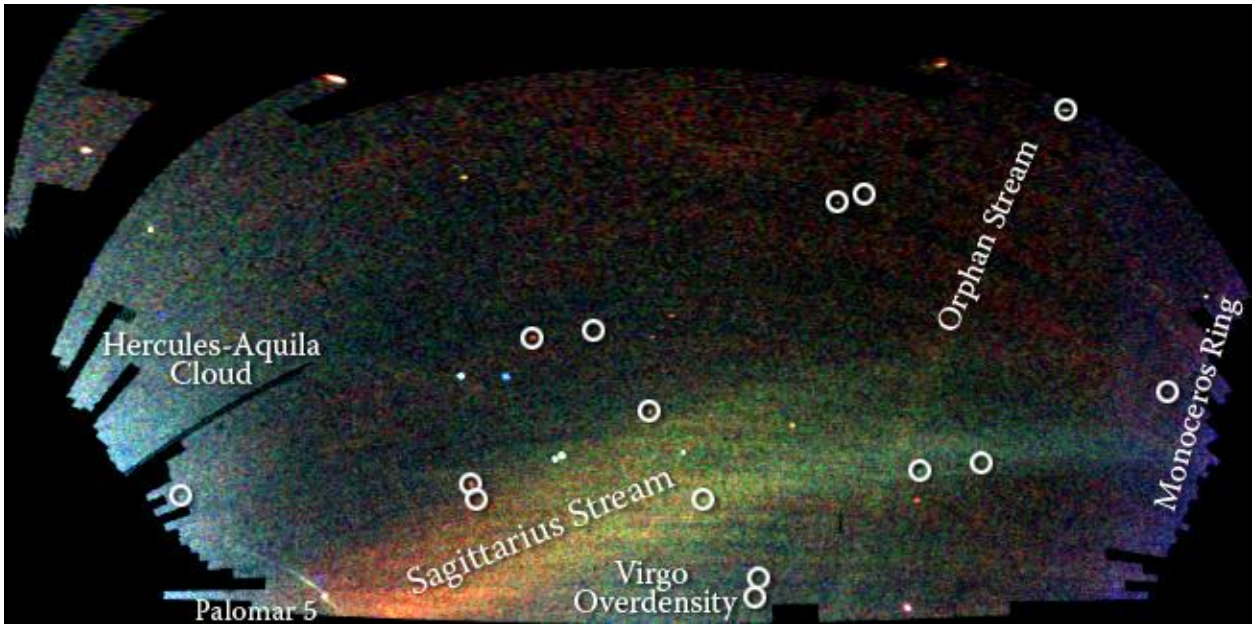
  0.5-10 Gyr

- 最近10Gyrにおける銀河系ハローの進化史への制限
- 金属量の枯渇したミラ型変光星の性質(周期や星周ダストの有無)への制限

大規模なストリーム構造

- SDSS found large stellar streams up to 100kpc by old stars.

Belokurov et al. (2008)



- Galactic halo was partly formed via recent accretion of dwarf galaxies.

Previous works on halo stars

- Previous works focused on old stars (e.g., HB stars)
- Intemediate-age stars(e.g.,C-rich AGB stars, RC,RGB) were also detected.

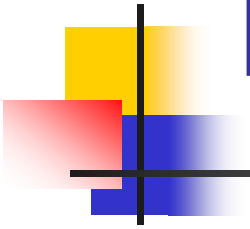
However, the sample of intemediate-age stars have

- large uncertanty in distance (C-rich stars,RGB stars)
- relatively large contamination
- strongly biased to the age and chemical abundance of Sgr dSph RC/RGB stars

⇒・Their spatial distribution still remains unclear.

・Star formation history and chemical evolution of the progenitor of the stream still remains unclear.

Mira variable stars



- Very luminous
- 0.5-10 Gyr
- Period-luminosity relation provides accurate distances.
- No wide-area survey in Galactic halo

2KCCD,2009-2012

- We monitor only the very red stars in Galactic halo, and explore the spatial distribution of intermediate-age stars by detecting Mira variable stars
- 2009-2012 105cm telescope+2KCCD
- I-band, once a month
- Observations in narrow-band filters (777,813nm) for Mira variable stars with no spectra->C-rich/O-rich classification
- Our targets

RA=0-3h,8h-16.5h,21h-24h,b>30°

2MASS J-H>0.7,H-K>0.3,K<13.5

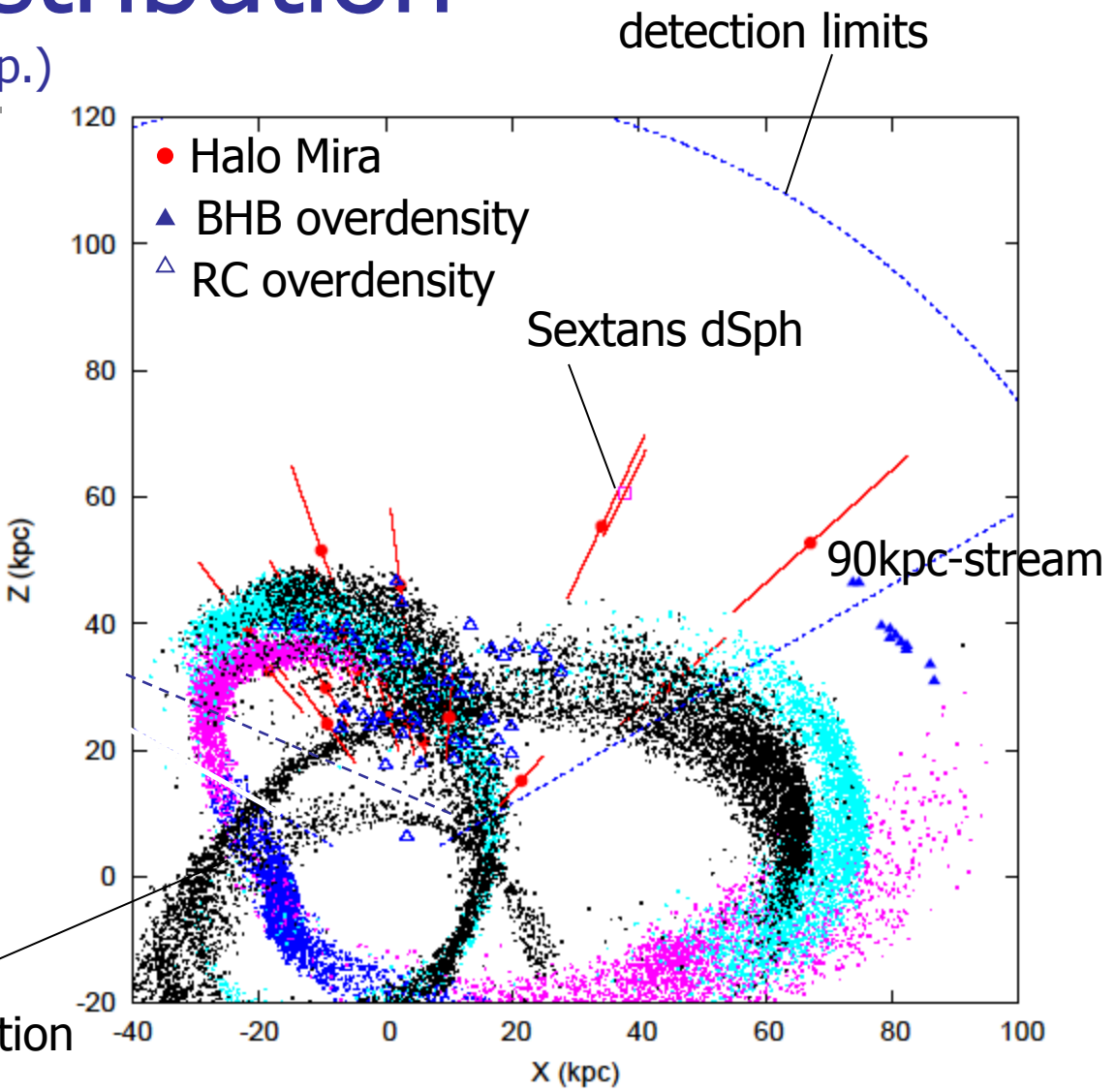
SDSS g'-r'>0.8,r'-i'>0,i'<18.5

The sample is spatially unbiased.

Spatial distribution

(Sakamoto et al. in prep.)

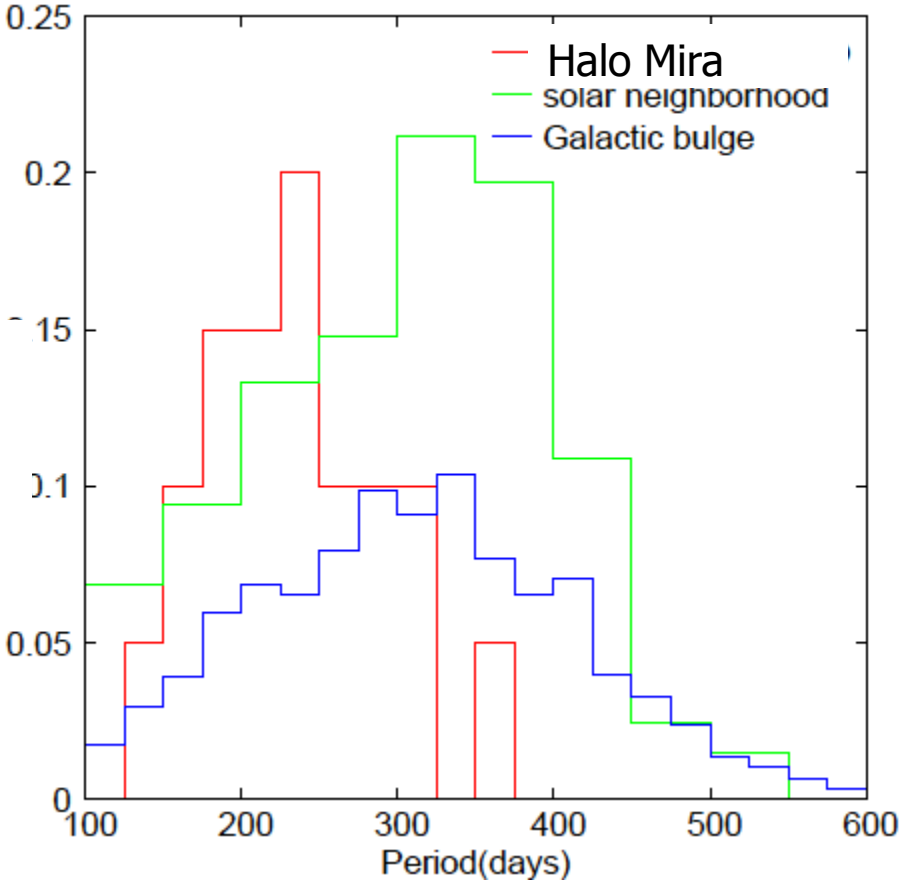
- Most Miras are located on only Sgr streams, although our sample is unbiased to these regions.
- Intermediate-age stars were formed in recently accreted massive dwarf galaxy?
- Distant Miras (d~ 70-90 kpc) are also discovered.



Sgr-stream simulation (Law et al. 2008)

Period distribution

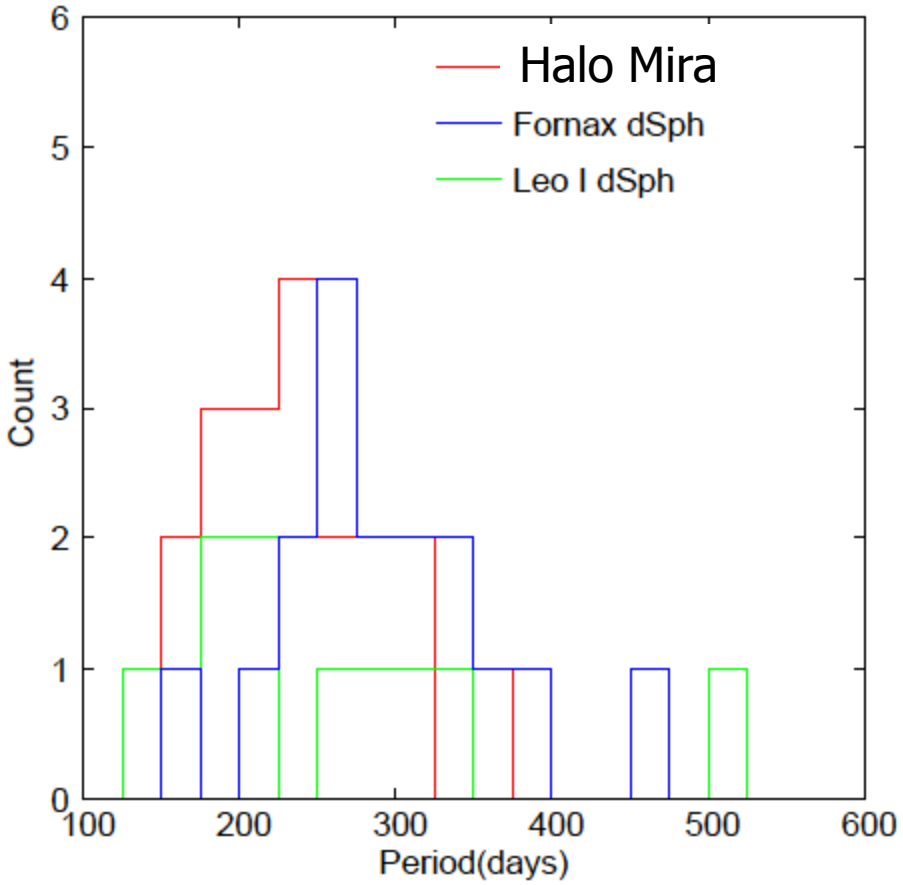
- 16 Miras (P>100 days,ΔI>1mag) are discovered

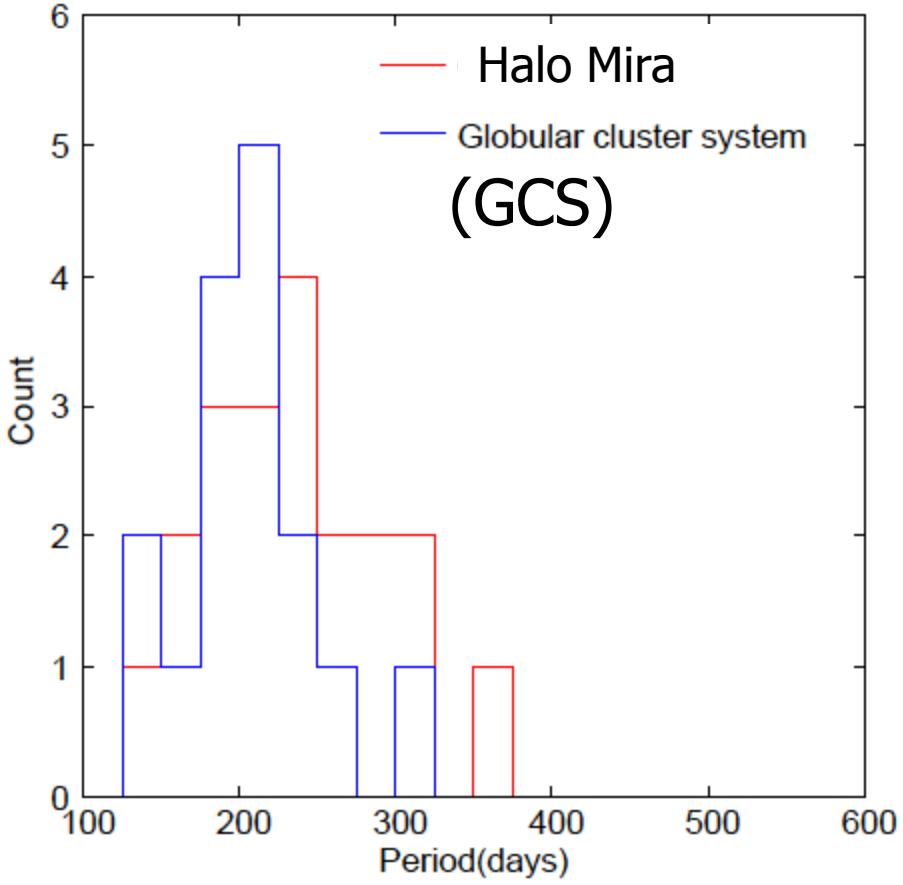


Halo Miras, mainly in Sgr stream, have shorter periods than solar-neighborhood and bulge Miras does.

The intermediate-age stars in the halo might be older and/or metal-poor than those in the disk and bulge.

Period distribution

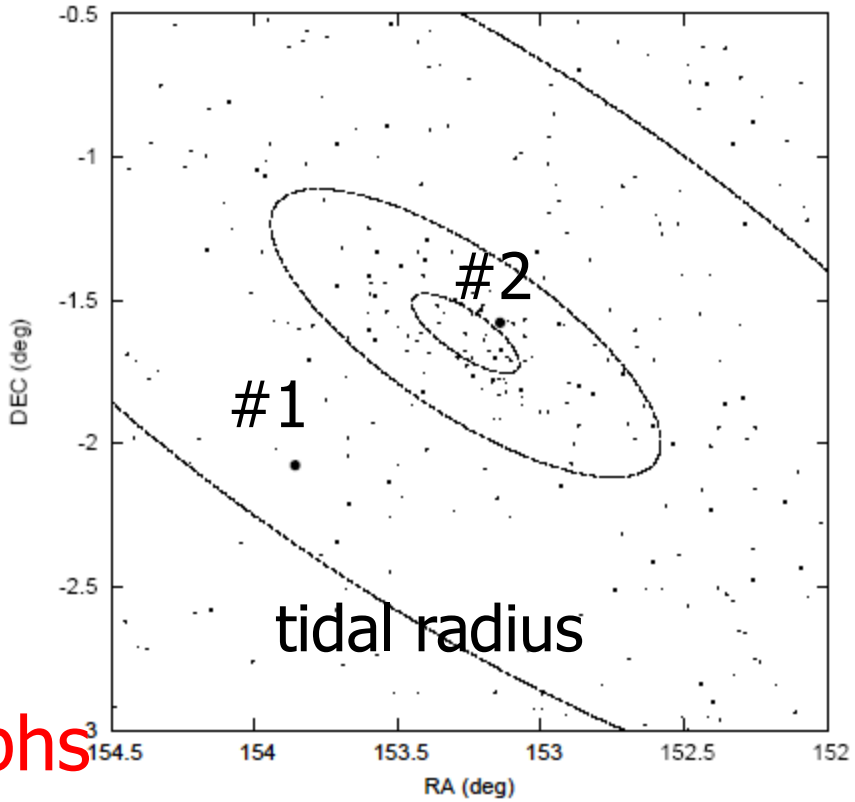




Halo Miras are similar to Galactic-dSph and GCS Miras.

Sextans dSph

(Sakamoto et al. submitted)



- [Fe/H]~-1.9(Battaglia et al. 2011)
  cf.LMC –1~-0.5
- Two Miras are discovered.

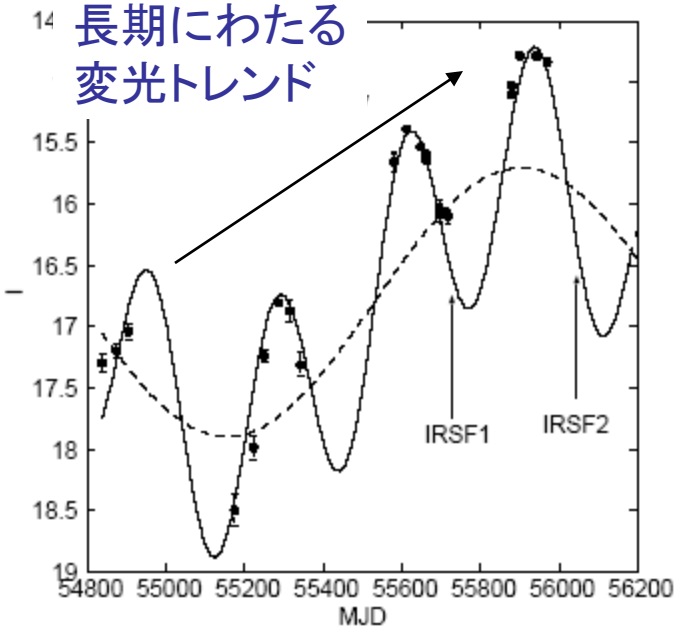
most metal-poor in known dSphs

- Presence of the dust shells around C-rich Mira

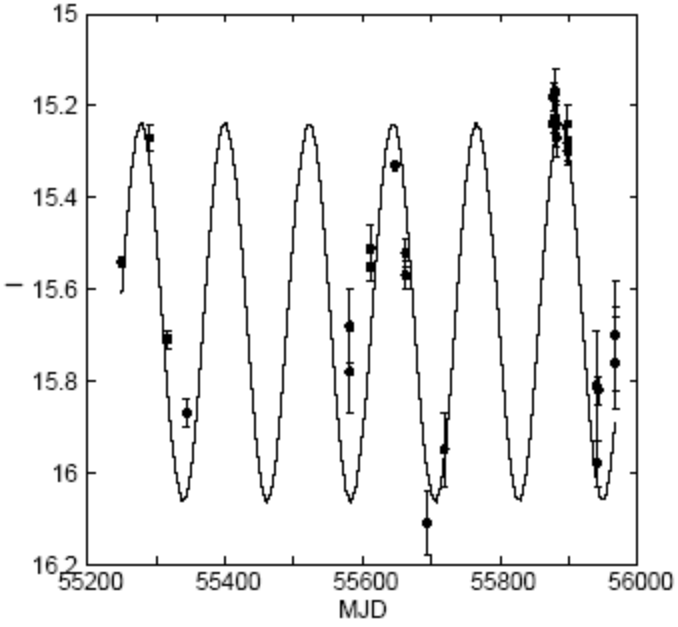
天体名	距離 (kpc)	視線速度 (km s^{-1})	周期 (日)	C-rich or O-rich	星周ダストが存在
#1	$72.0^{+12.3}_{-10.3}$	202±12	314	C-rich	J-K~2.2
#2	$78.8^{+11.2}_{-9.9}$	228±2	121	O-rich	-
Sextans dSph	$90.0^{+10.0}_{-10.0}$	226±8.4	-	-	-

Light curve in the Sextans dSph

#1



#2



Summary and future work

- 2KCCDで銀河系ハローを広域にわたってミラ型変光星を探査した
- 40kpc以内のミラはほとんどSgr streamに付随している
- 周期は銀河系バルジや太陽近傍ミラよりも
  短く、近傍矮小銀河や球状星団系ミラに似る
- Sextans dSphに2つのミラを発見。非常にmetal poor([Fe/H]=-1.9)の環境下で初めてcircumstellar dustの存在を示唆。
- KWFCでもさらにサーベイを進めたい