狭帯域フィルターを用いた金属欠乏星探査観測および分光追観測

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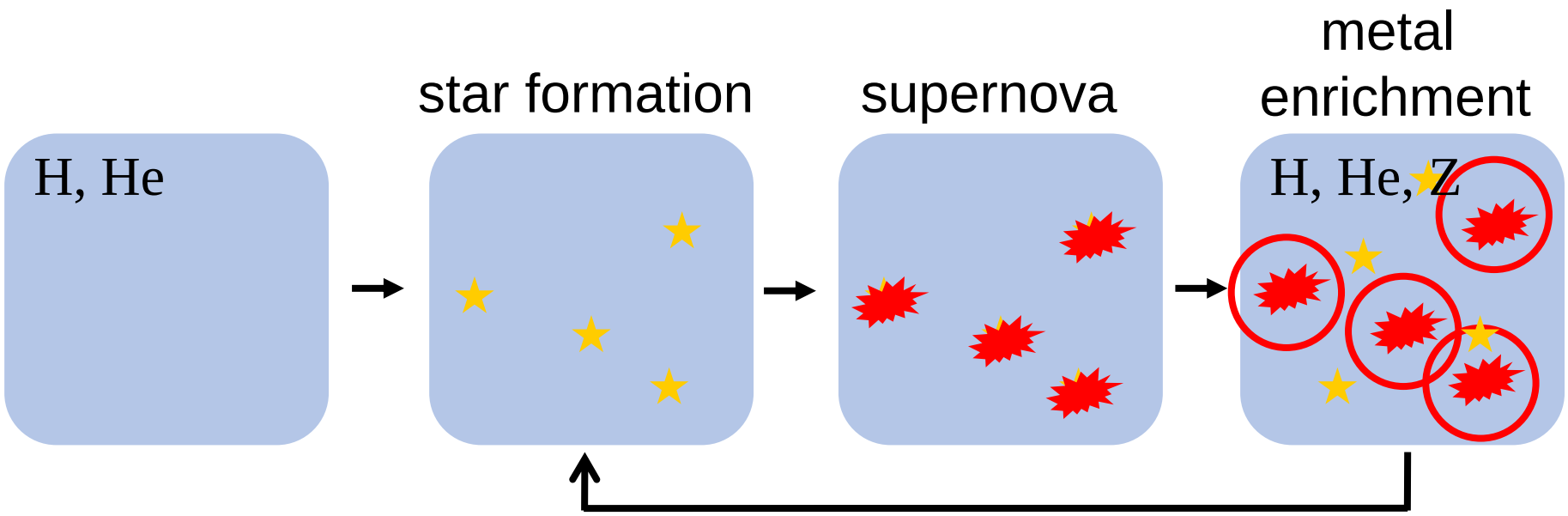
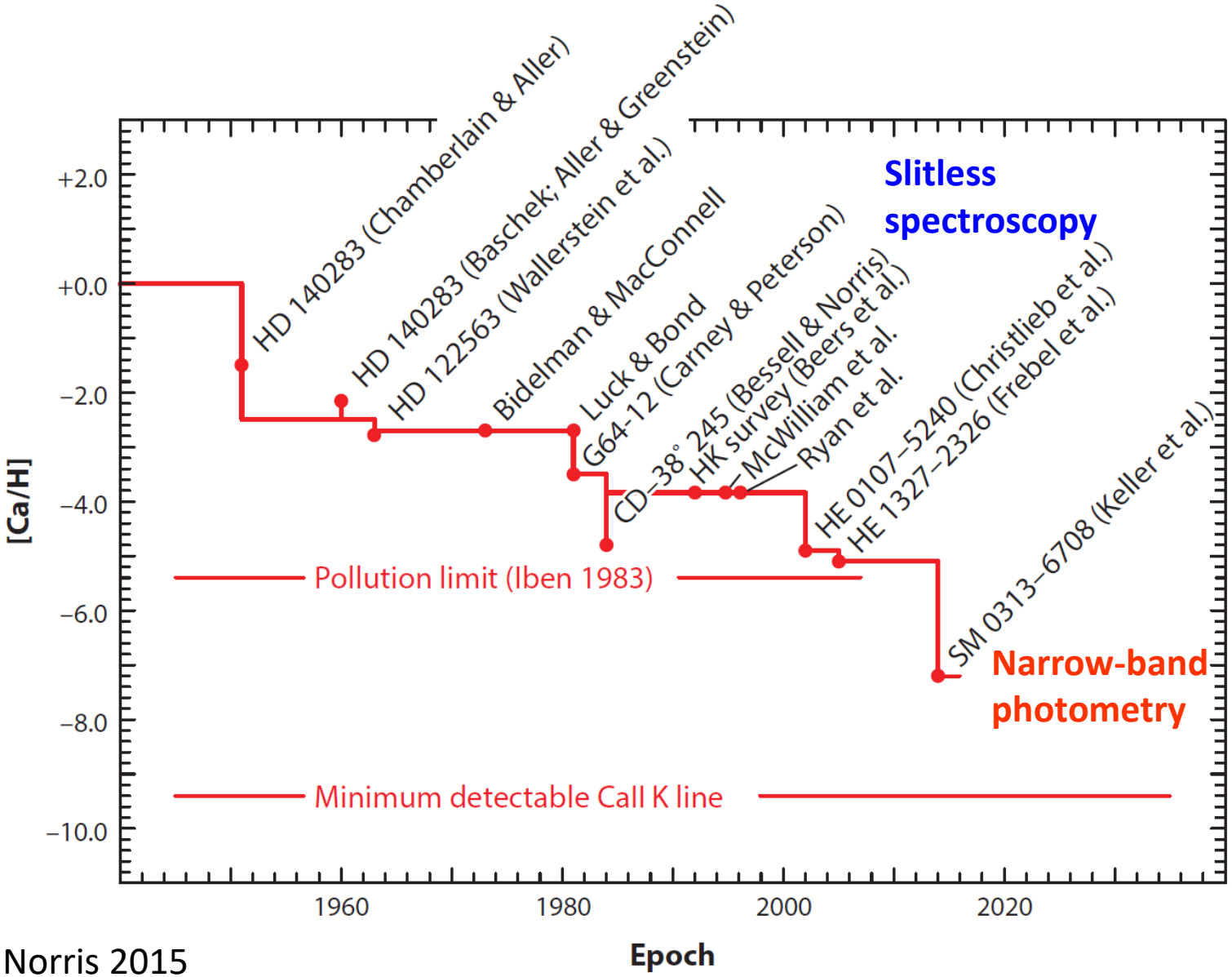
Metal-poor stars



Metallicity increases with time

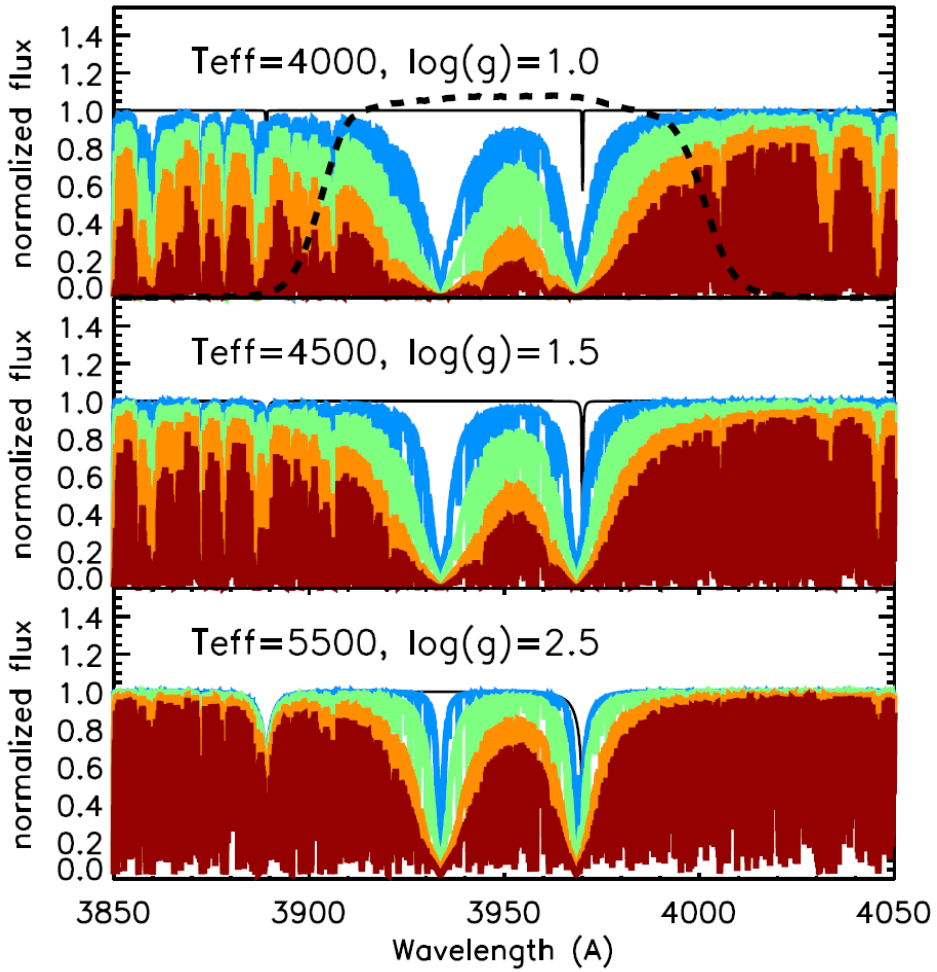
$[Fe/H] = \log(Fe/H) - \log(Fe/H)_{\odot}$

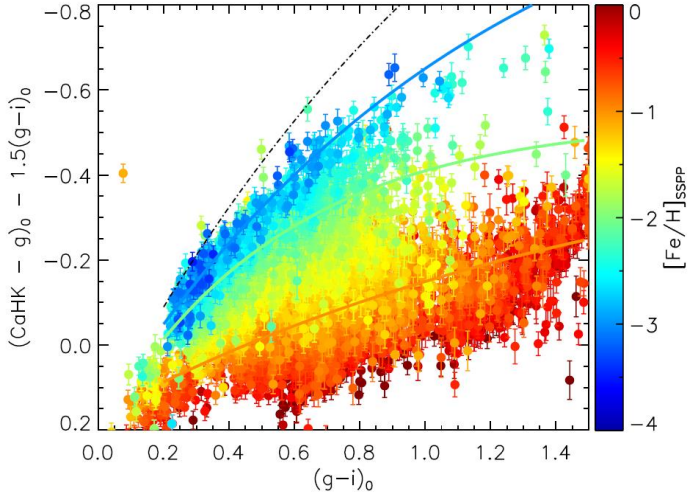
Ca abundance of Fe-poor stars

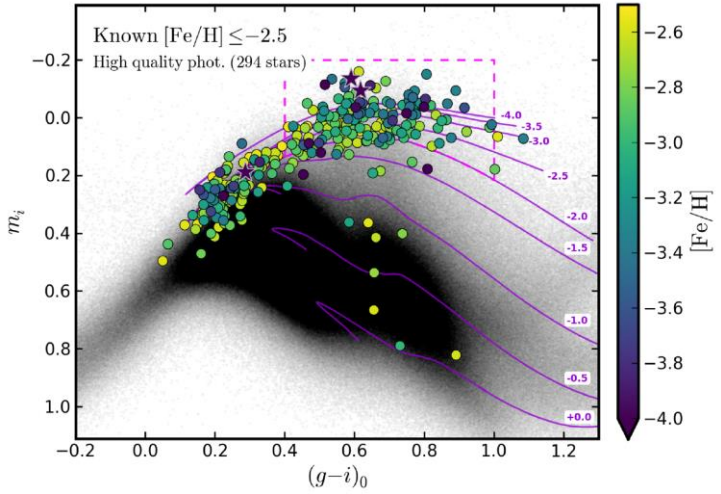


Frebel & Norris 2015

Narrow band surveys
Pristine survey & Skymapper survey

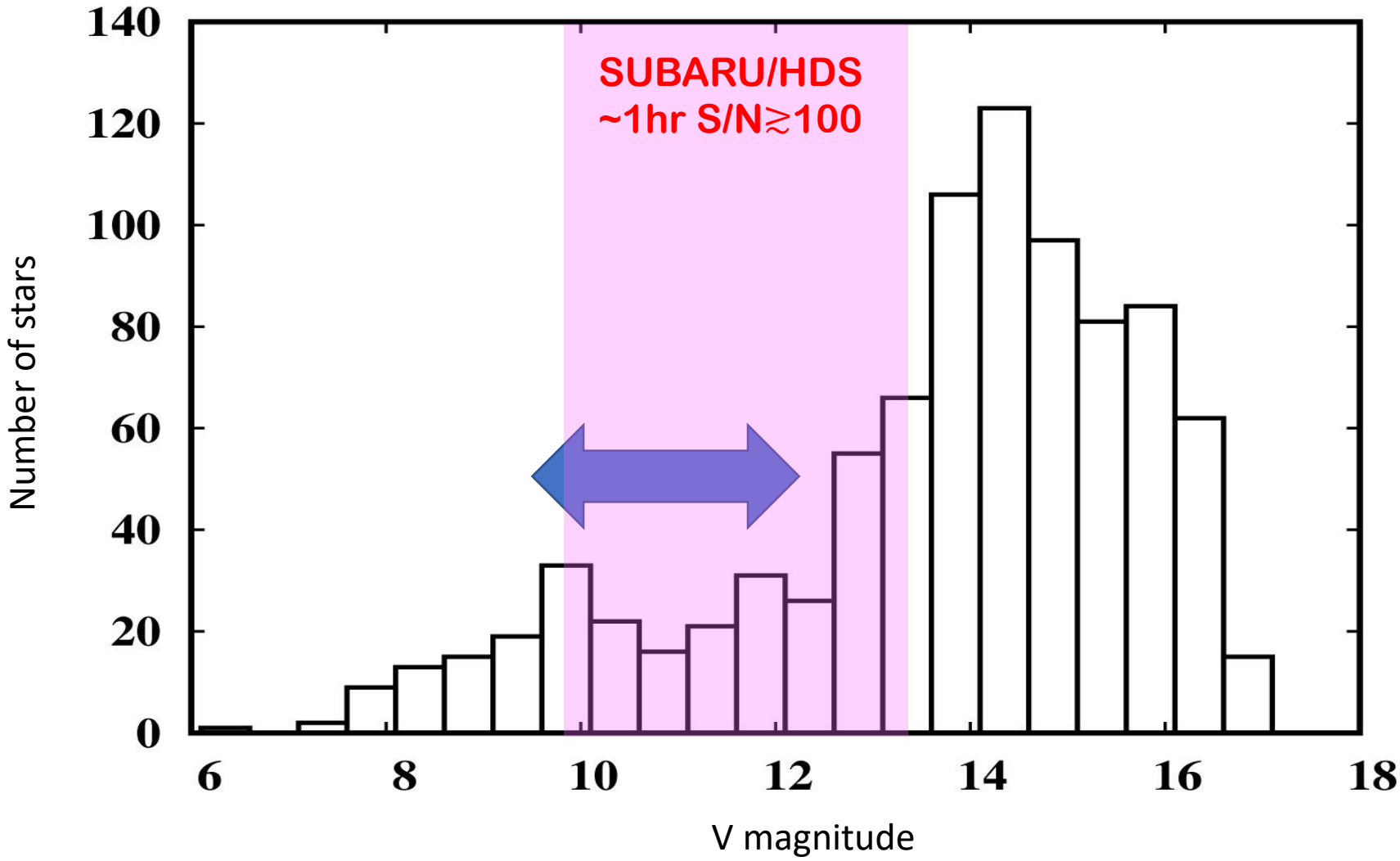




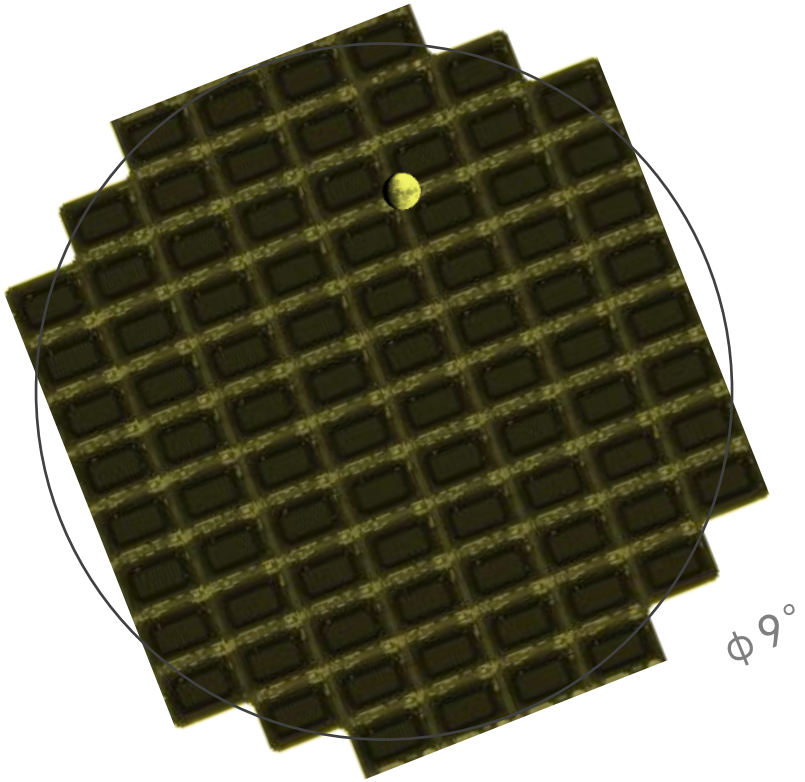


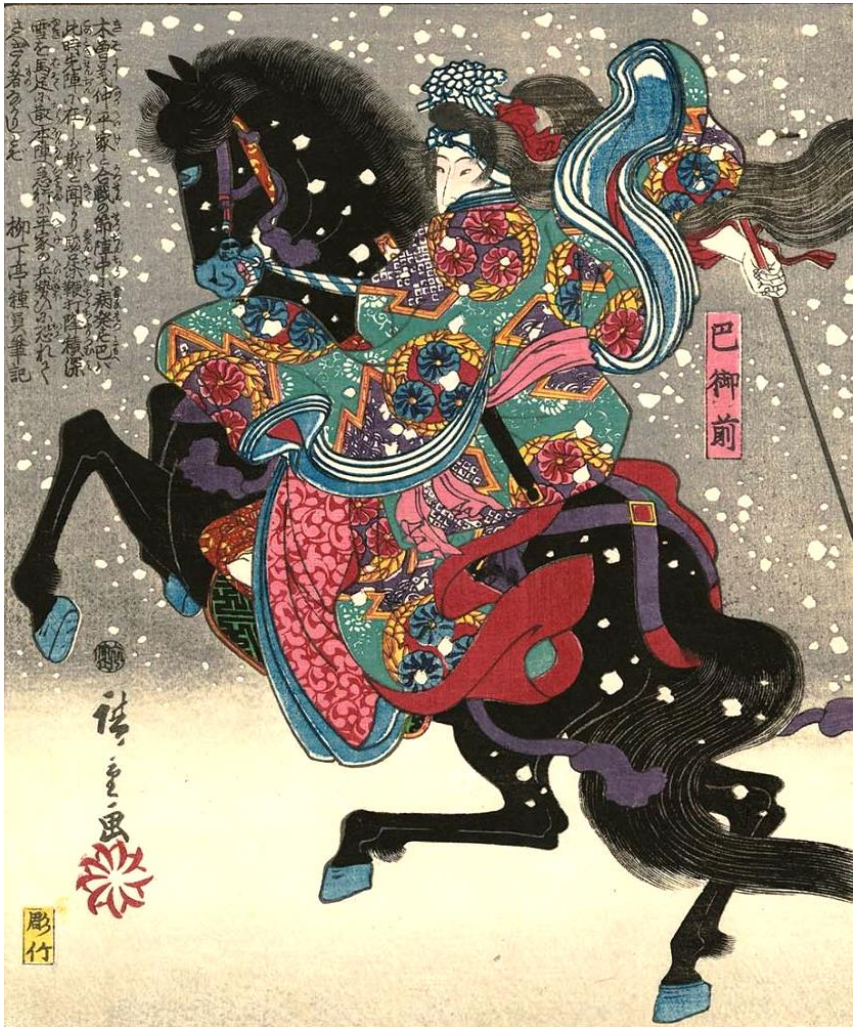
Starkenburg+17; Da Costa+19

Number of stars with [Fe/H]<-2



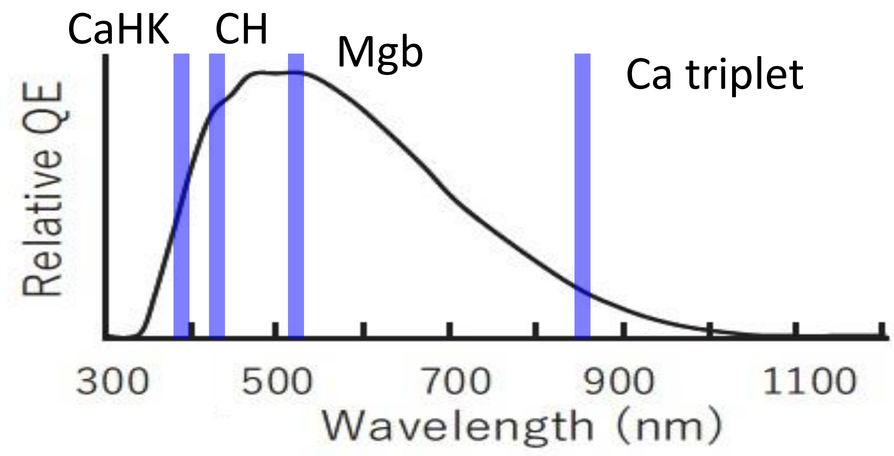
Tomo-e Gozen Project



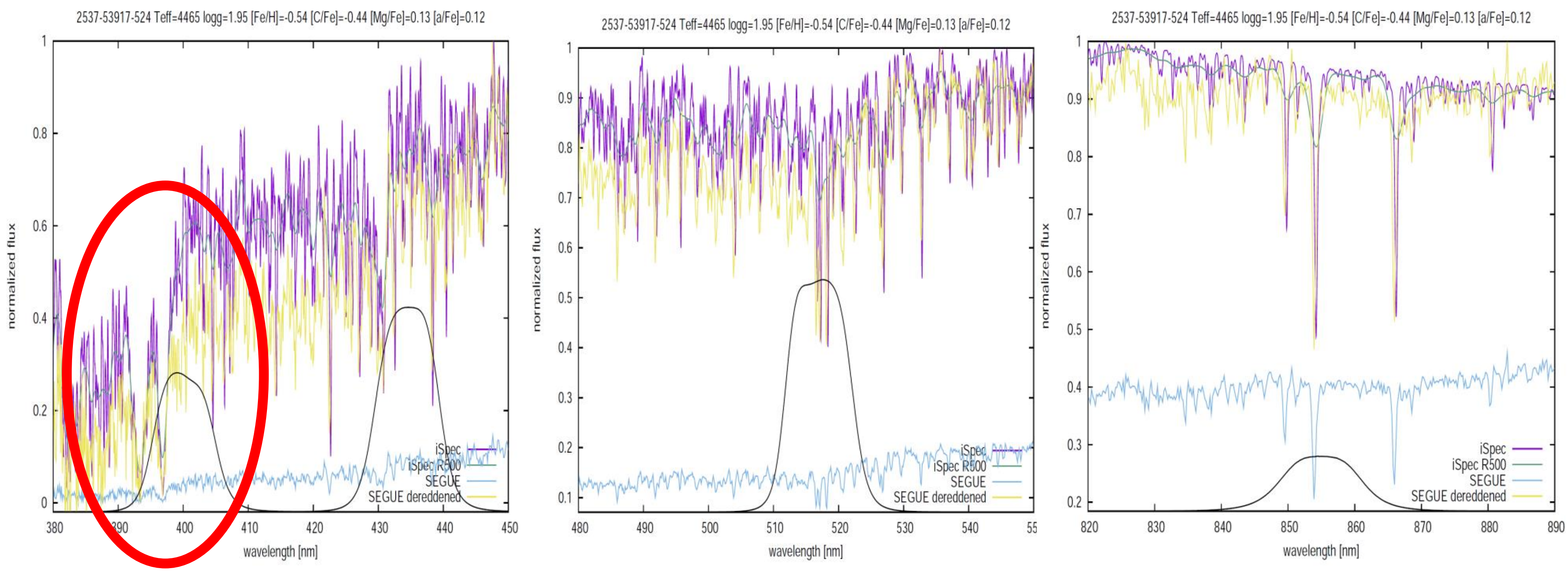


- 20deg^2 in ϕ9deg
- 84 CMOS chips
- 2Hz readout

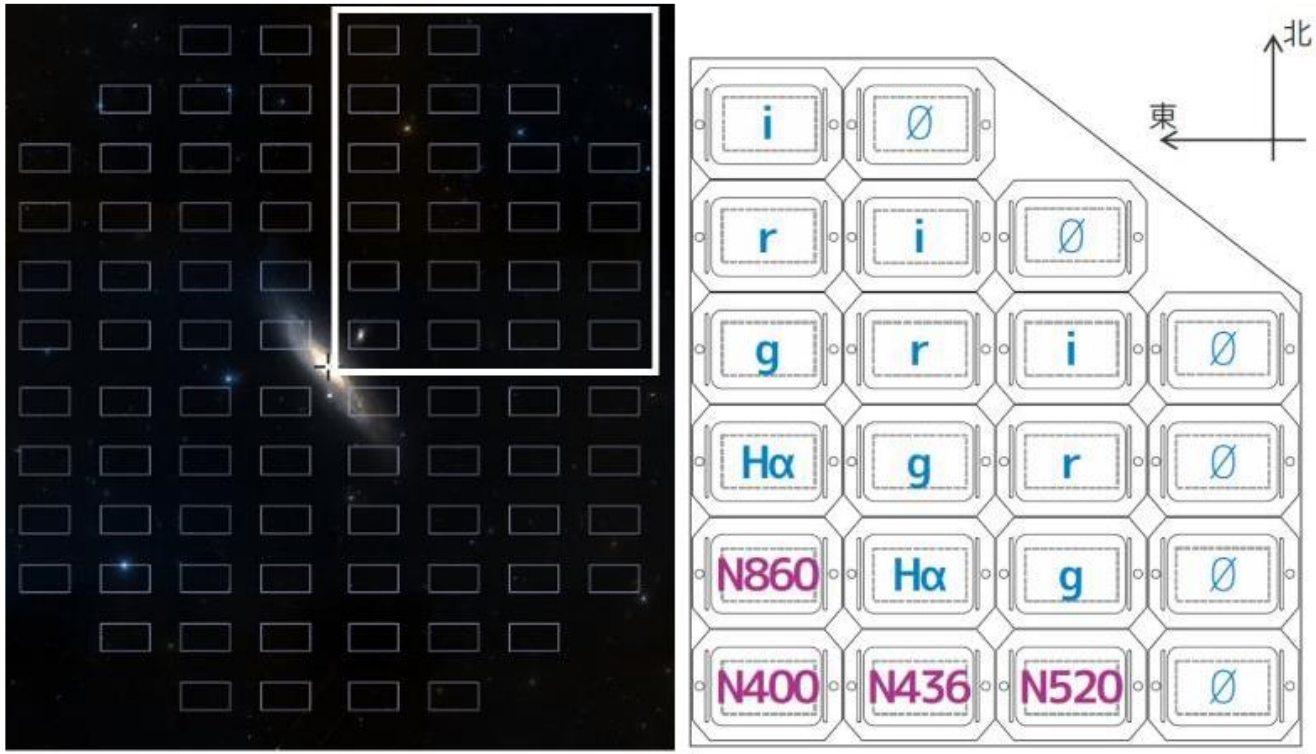
Pilot study with ready-made filters



Wavelength	Lines
400nm	CaHK
436nm	CH
520nm	Mgb
860nm	Ca triplet



Pilot study with ready-made filters



Survey area
4 NB: 31deg^2
>=1 NB: 46deg^2

Num of bright stars (<12mag)
4 NB: ~1100
>=1 NB: ~20000

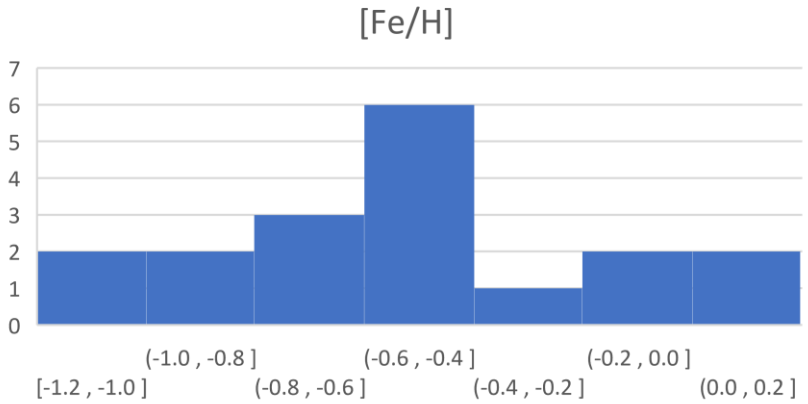
Targets: metal-poor stars with [Fe/H]<-2

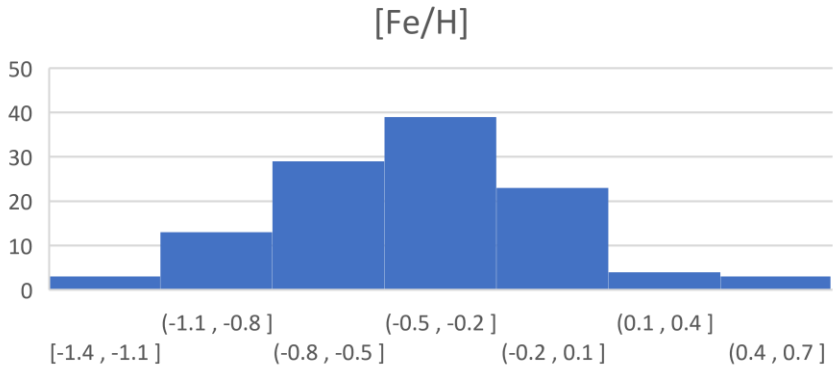
Photometric calibration and photometric classification

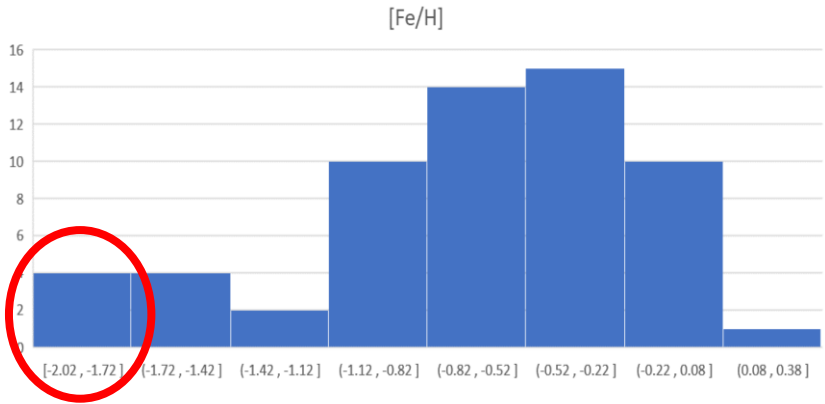
- NB400, NB436, NB520, NB820 from Tomo-e
- BVugrizY from APASS
- G, Gbp, Grp from Gaia
- JHKs from 2MASS
- ugriz from SDSS
- FUV, NUV from GALEX-AIS

Follow-ups with Nayuta/MALLS and improvement of candidate selection

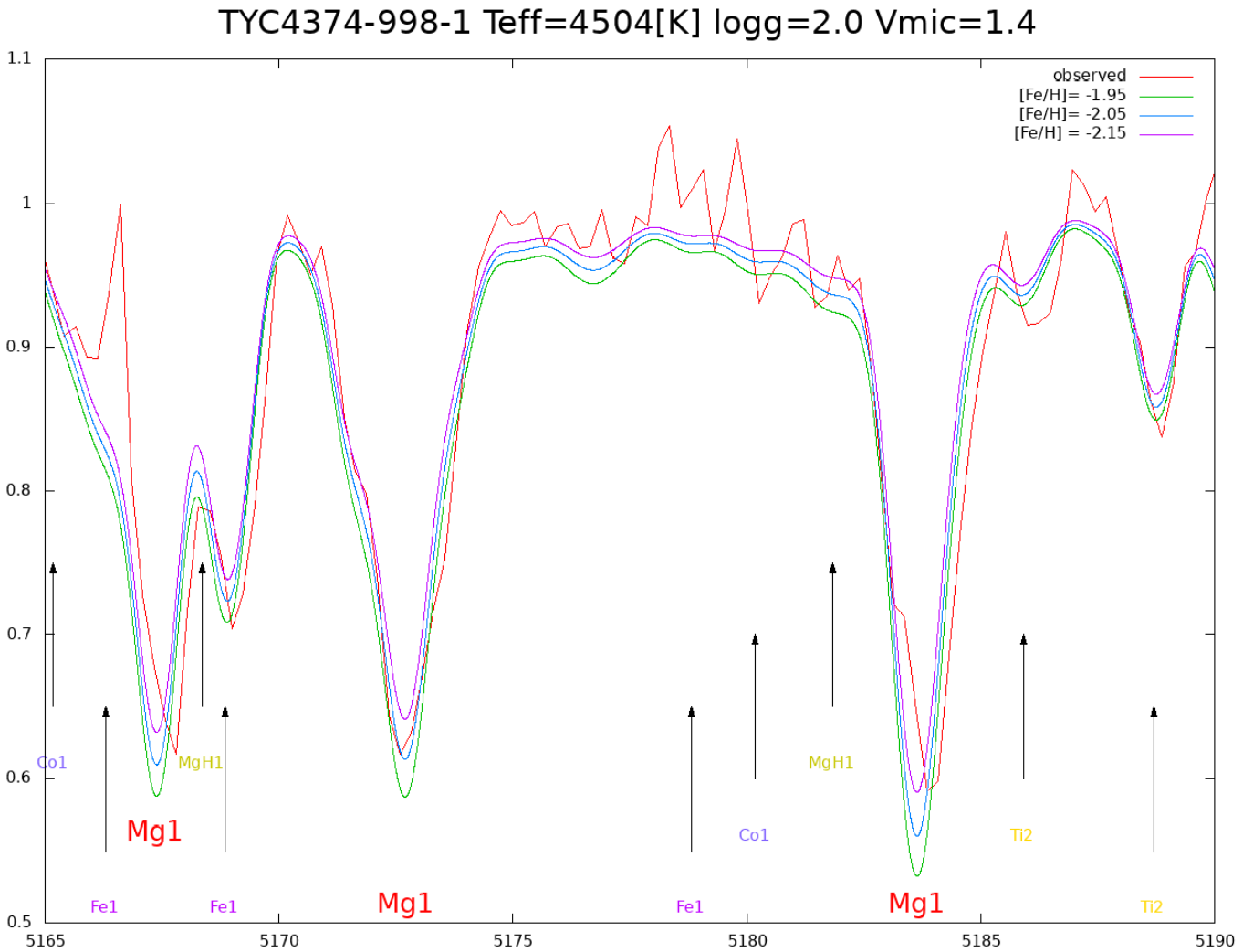
- Feb 20
  - ~18 stars w/ ~10-12mag
  - ML: NN & RF
  - Training: ~50 stars (Tomo-e)
- Sep 20
  - 117 stars w/ < 10mag
  - ML: NN, RF, XGB, & LGBM
  - Training: ~160,000 iSpec model
- Dec 20
  - 70 stars w/ ~10-12mag
  - ML: NN, RF, XGB, & LGBM
  - Training: ~6000 stars (Tomo-e)







Most metal-poor star found in our pilot survey and Nayuta follow-up



Summary

- 1 star with [Fe/H]<-2 and 1 star with [Fe/H]~-1.8 are found after improvements of candidate selection.
- Further improvement is needed.
  - Improvement of machine learning
  - Flux calibration of Tomo-e observation
    - Importance of u-band observation
  - Calibration of iSpec models
    - Enhancement of iSpec models with various abundance
  - Custom-made filters for important lines
- C.f. the success rates of Pristine survey and Skymapper survey are >85% and 93%, respectively.
- 基盤研究A（代表：青木和光）2021-2024年度「明るい金属欠乏星の全北天域探査による初代星元素合成と初期銀河系形成の解明」
  2022-2023年~ 本観測