Bright metal-poor star survey

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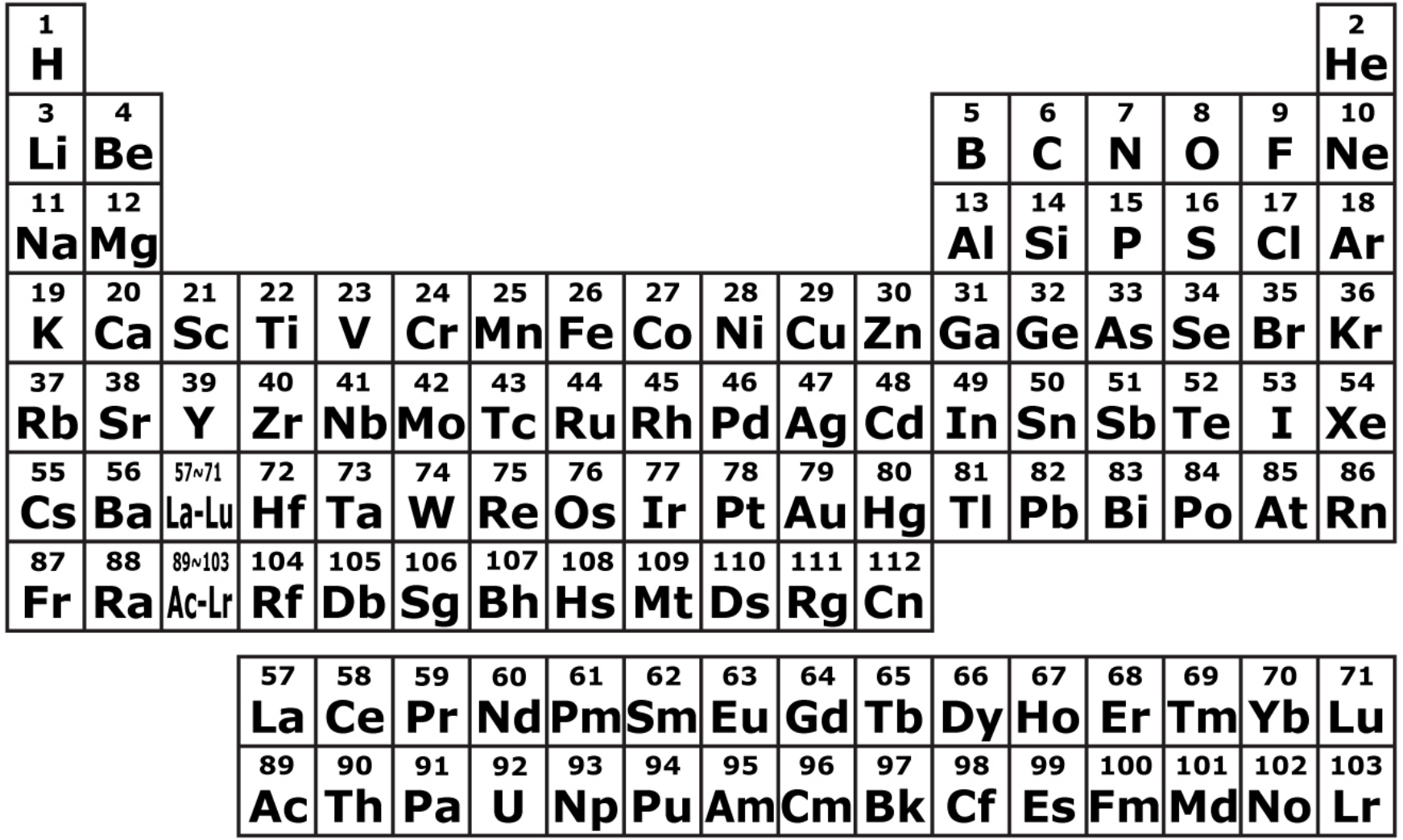
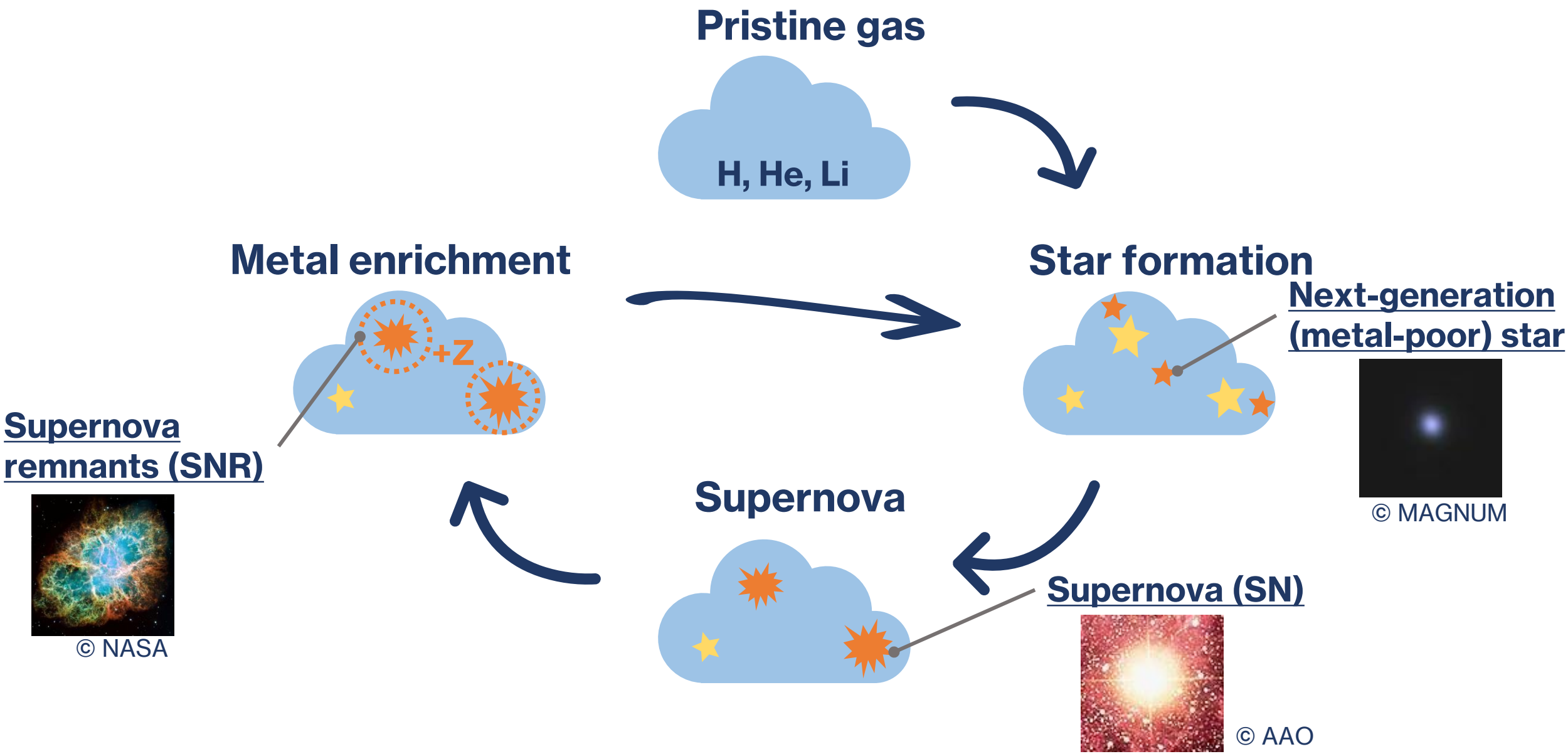
Origin of element



Chemical evolution



What observation tell us?

Supernovae

OISTER

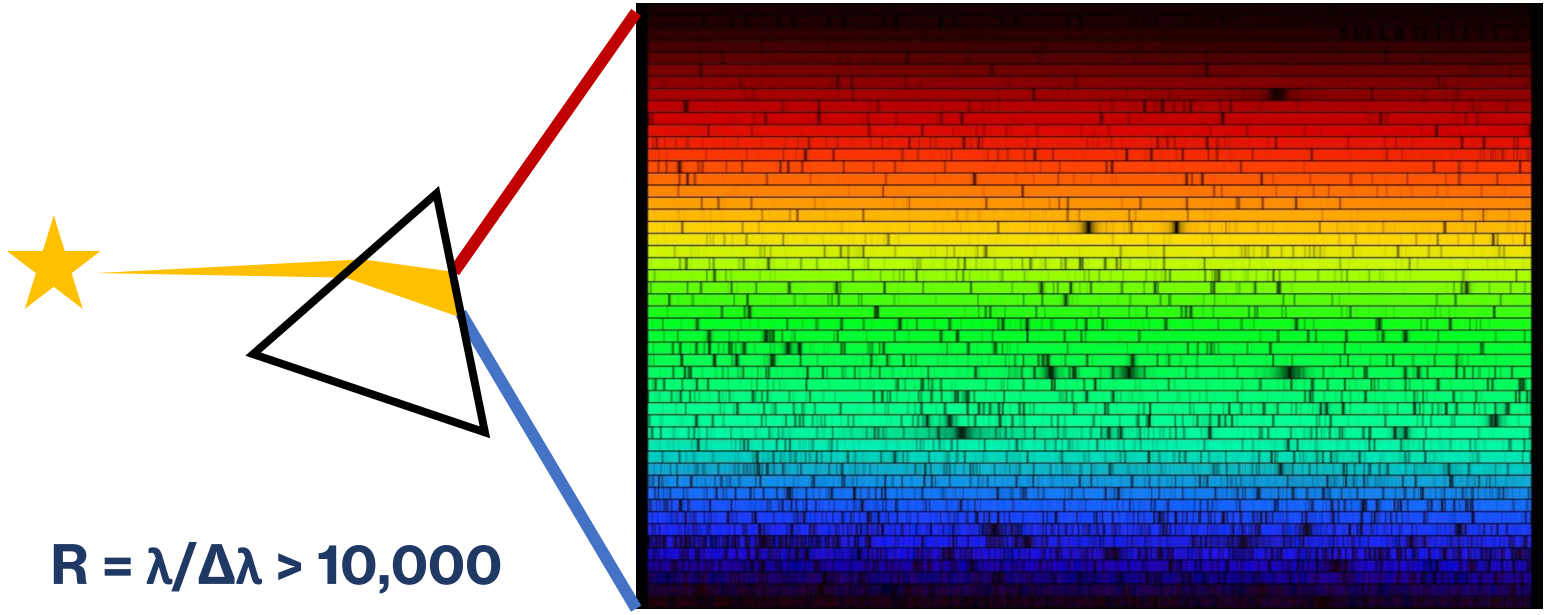
- **Observables:**
  light curve, spectrum, polarization
- **Pros:**
  Nucleosynthesis in a single SN can be measured
- **Cons:**
  Abundance of only major elements (O, Si) is available
- Only for SNe in the **nearby** Universe

Metal-poor stars

- **Observables**:
  spectrum
- **Pros**:
  Detailed abundance including minor elements can be measured
- **Cons:**
  It can be a superposition of multiple SNe
- Only for SNe in the **early** Universe

The detailed abundances in metal-poor stars are complementary with the transient observation by multi-messenger astronomy.

High-resolution spectroscopy



$R = \lambda/\Delta\lambda > 10{,}000$

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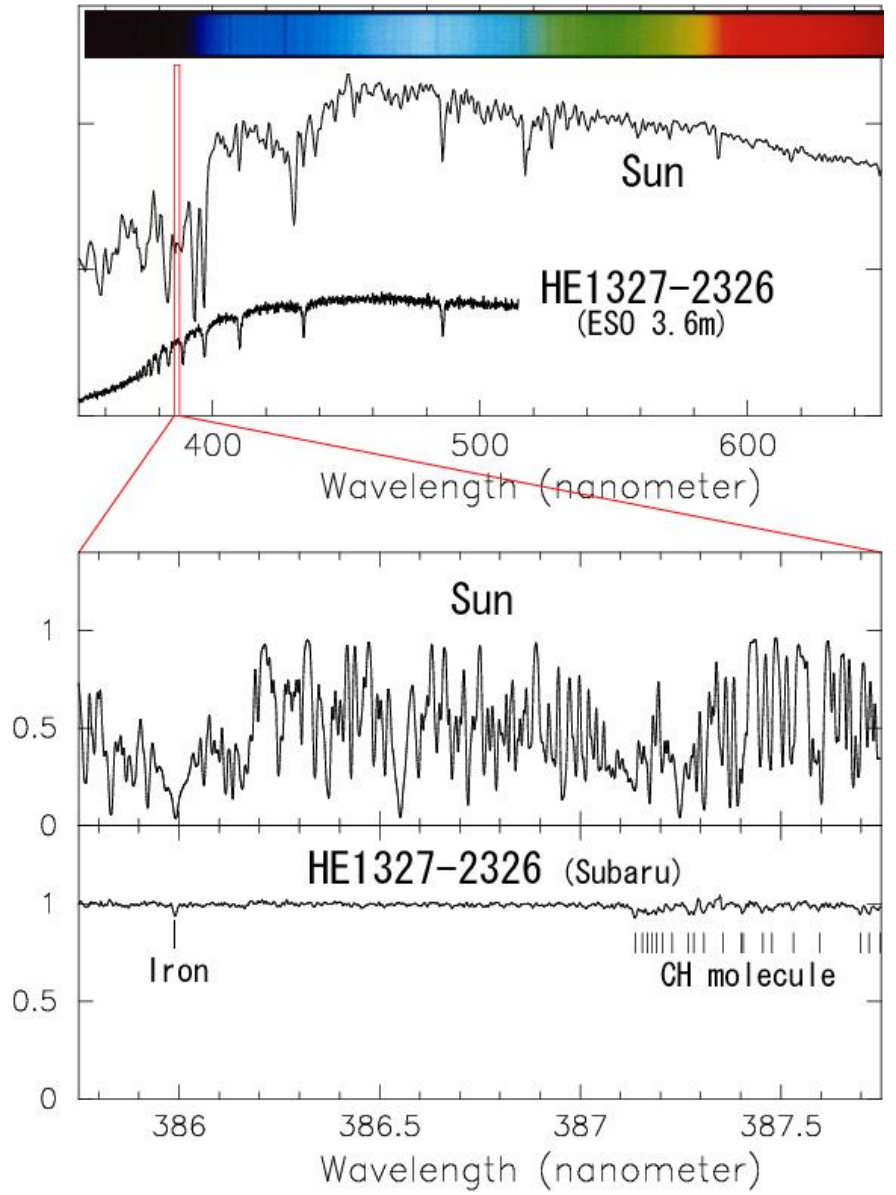
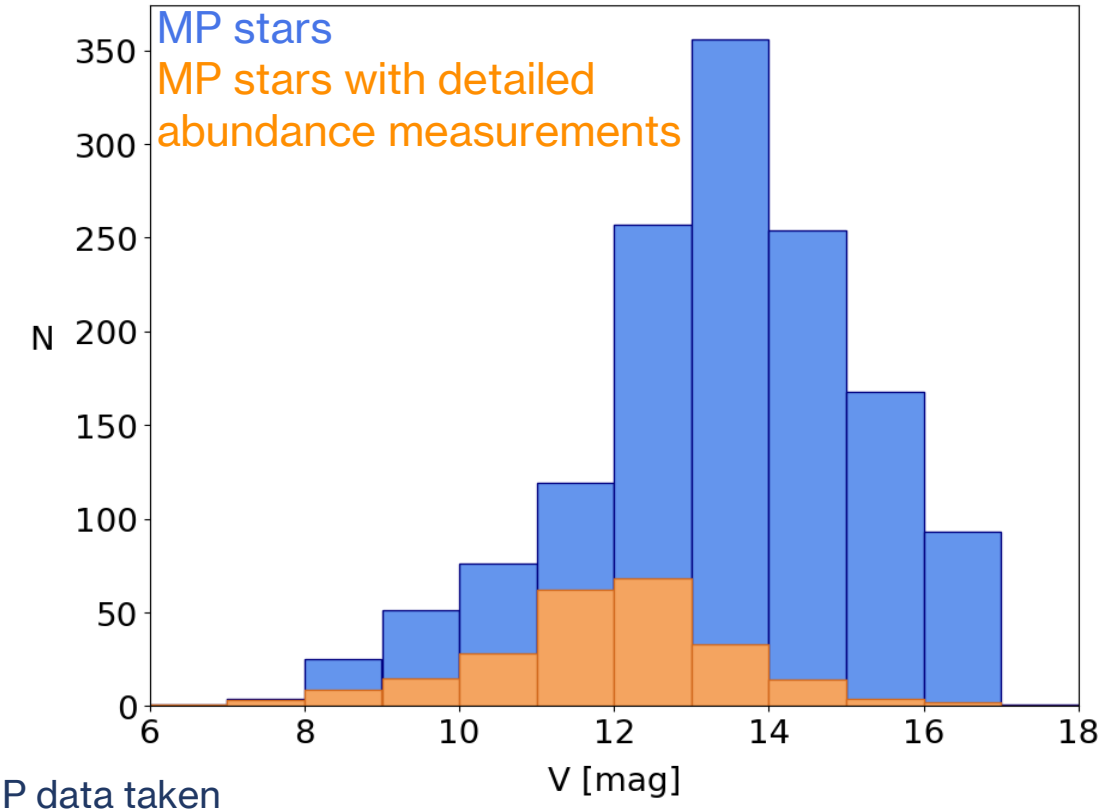


The detailed abundances in stars are measured by high-resolution spectroscopy.

The high-resolution spectroscopy distributing the photons to large number (> 10,000) of parts is only possible for **bright objects**.

Importance of bright metal-poor stars

Bright metal-poor stars enable
① Measurement of **rare elements** such as r-process elements (Furutsuka-san's talk)
② Measurement of **low abundance** or **stringent upper limit**

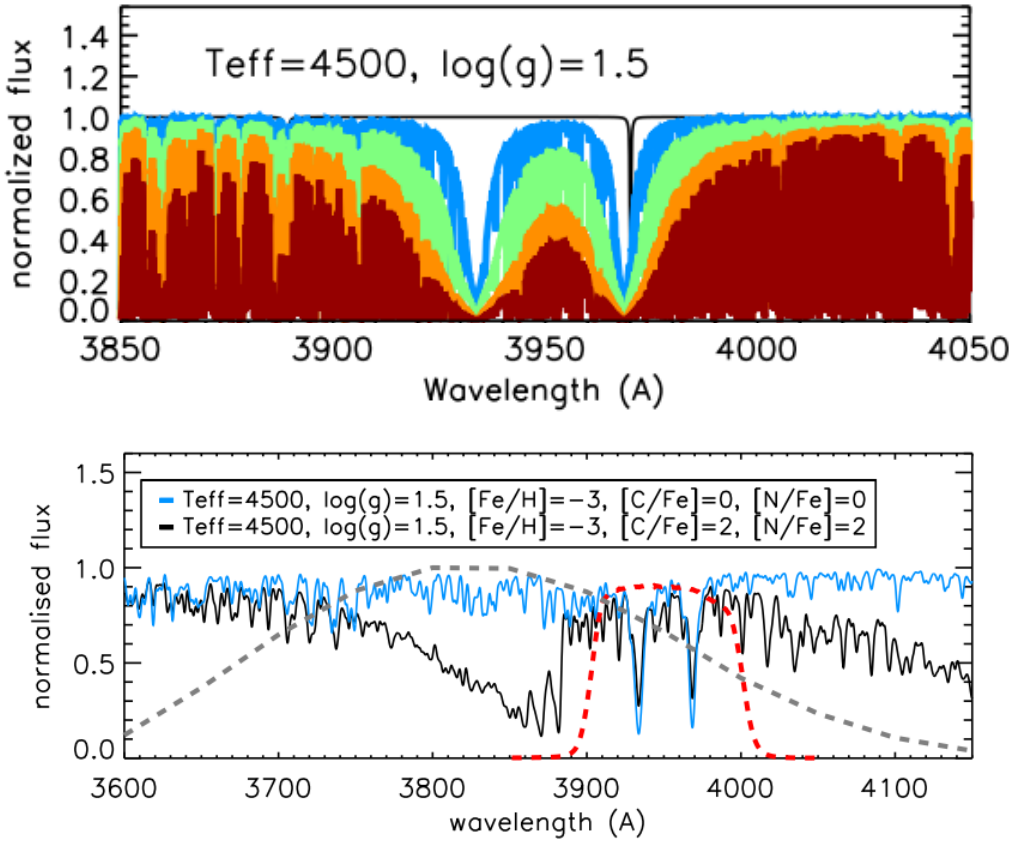


MP data taken
by SAGA database (Suda et al. 2017)

Detailed abundances are available for MP stars ([Fe/H] < -2) with V < 12, but they are still rare.

Wide (and shallow) survey is required to increase them.

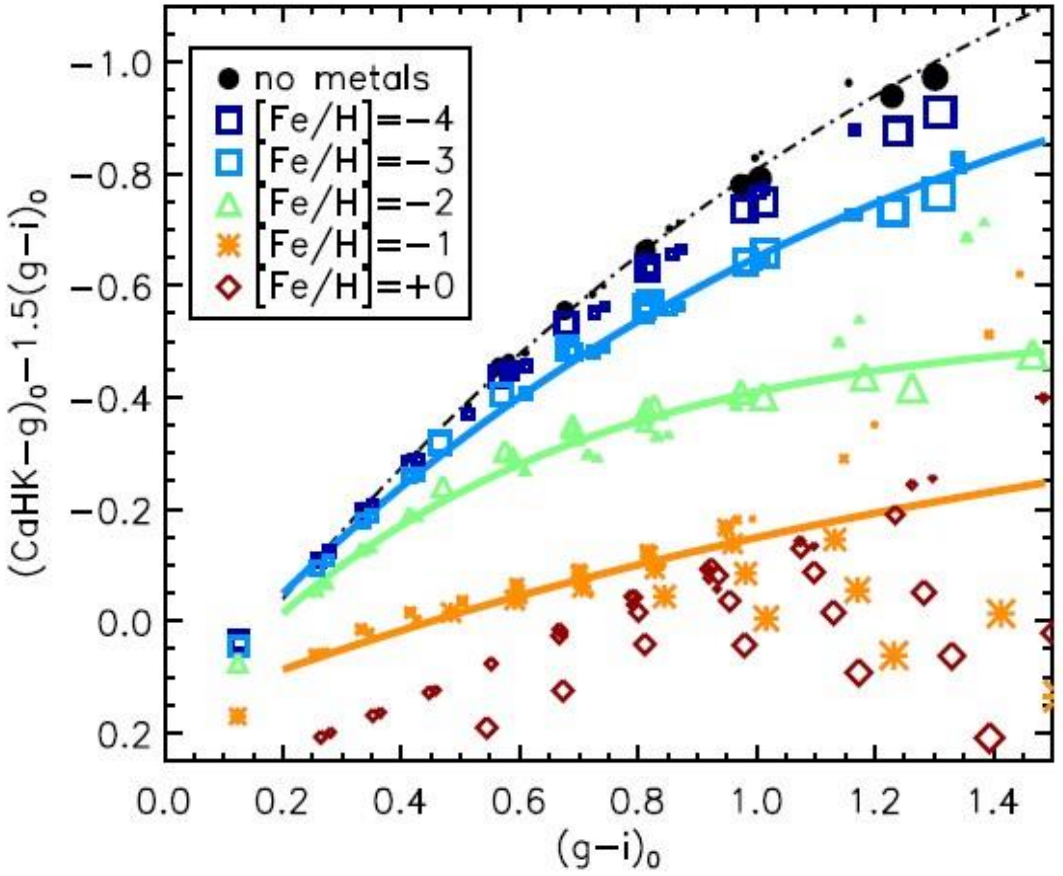
Survey method: narrow-band photometry



Pristine survey w/ CFHT (4 m)

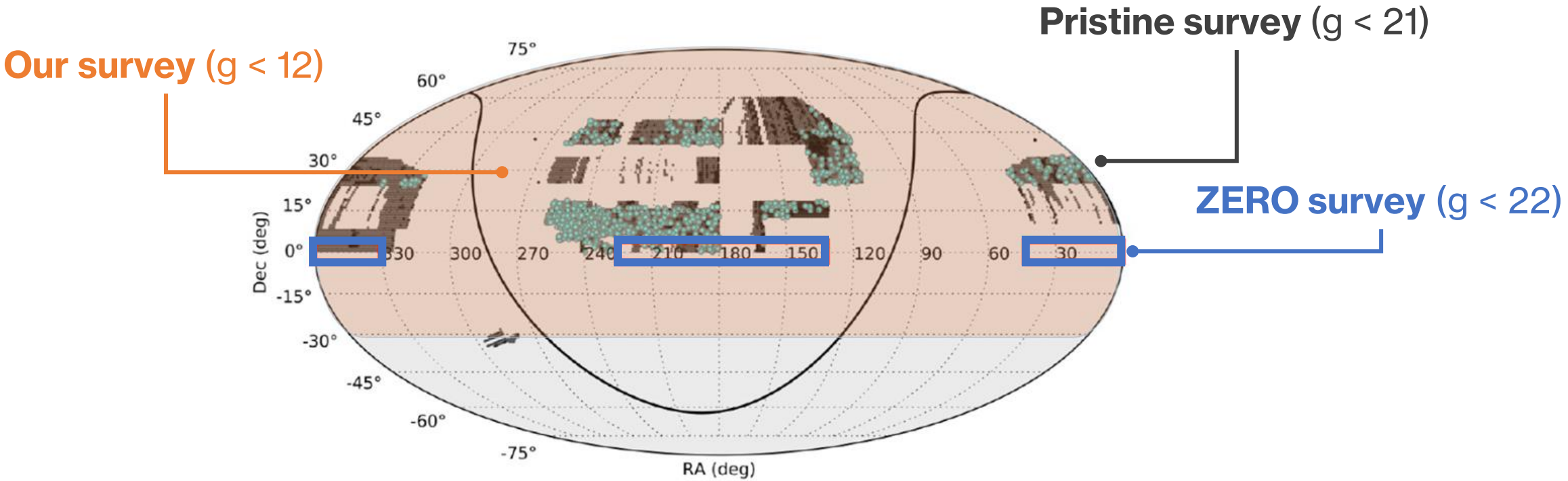
SkyMapper survey w/ SkyMapper (1.3 m)

Starkenburg et al. (2017)



Stars with lower metallicity have weaker CaHK lines and are located at the left top side in color-color diagram.

Northern-sky survey for bright metal-poor stars



Aims:

- Precise measurements of rare elements
- Understanding of the nature of first stars and the origin of element

Survey design

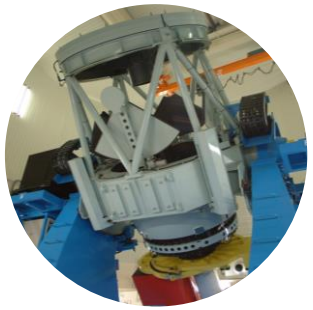
STEP 01

Kiso (1.05 m)

Survey

- Narrow-band photometry with Tomo-e Gozen
- Select bright MP candidates with [Fe/H] < -2

STEP 02



Nayuta (2 m)

Metallicity estimation

- Medium-res. Spectroscopy with MALLS
- R ~ 7500
- Opt. (4900-5300Å)
- Metallicity(Fe) and alpha(Mg) abundance

STEP 03

Seimei (3.8 m)

Abundance determination

- High-res. spectroscopy with GAOES-RV
- R ~ 65000
- Opt. (5160-5930 Å)
- Individual elements (Mg, Ca, Sc, Ti, Cr, Fe, Ni, Ba)

STEP 04

Subaru (8 m)

Detailed abundance determination

- High-res. spectroscopy with HDS
- R > 45000
- Opt. and UV
- Individual elements incl. rare elements

Survey status

Okada et al. in prep.

Follow-ups of MP candidates

Okada et al. in prep.

Status and Future plan

Okada et al. in prep.

Summary

The detailed abundance available only in metal-poor stars provides unique information on the origin of element, being complementary with the multi-messenger astronomy.

Search for bright MP stars to measure detailed chemical compositions is ongoing

Okada et al. in prep.