Reconstruction the Formation History of the Milky Way with Gaia, APOGEE
The RAVE Survey

- Spectroscopic high latitude survey of the MW (9 < I < 13)
- Gaia spectral range and resolution: Ca triplet region (8400-8800Å), $R_{\text{eff}}=7500$
- 6dF at the 1.2m UKST in Australia
  - 100-120 fibres
  - 38 sqdeg FoV
- Scheduled operation:
  - 4/2003 – 4/2013
  - 7 nights per lunation up to 8/2005
  - 25 nights per lunation since 8/2005
- 518 387 spectra for 451 738 stars
The Sixth Data Release of the Radial Velocity Experiment (RAVE) – I: Survey Description, Spectra and Radial Velocities

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high S/N cool dwarf
high S/N warm dwarf
high S/N hot dwarf
high S/N red clump star
high S/N giant star
moderately high S/N giant
low S/N giant
emission line cool dwarf
very cool star with molecular bands.

Steinmetz et al, 2020a, submitted
| $T_{\text{eff}}$ | $\log g$ | S/N  |
|----------------|---------|------|
| 4872 K         | 4.58    | 92   |
| 5607 K         | 4.08    | 81   |
| 9440 K         | 4.07    | 83   |
| 4815 K         | 2.44    | 79   |
| 4592 K         | 0.36    | 110  |
| 6475 K         | 1.84    | 51   |
| 4522 K         | 2.01    | 29   |
| 3925 K         | 4.30    | 48   |
| 3675 K         | 3.84    | 112  |

**Graph:**
- **Axes:**
  - Teff_BDASP vs. logg_BDASP
  - Wavelength (Å) vs. Wavelength (Å)
- **Colors:**
  - Peculiar
  - Cold
  - Binary
  - Carbon
  - Continuum
  - Emission
  - Hot
  - Normal
  - Wavelength

**Steinmetz et al., 2020a, submitted**
Steinmetz et al, 2020b, in prep.
Steinmetz et al, 2020b, in prep.
actual R, z

Steinmetz et al., 2020b
submitted
orbital $R_m$, $z_{\text{max}}$

Steinmetz et al, 2020b
submitted
deep learning with convoluted neural networks

- RAVE (R=7500), APOGEE DR16 (R=22500) have about 5000 stars in common

- train RAVE spectra using a convoluted neutral network (CNN) on APOGEE parameters

- if successful, can be serve as a prototype for:
  - Gaia RVS will provide $O(10^8)$ spectra of resolution and S/N similar to RAVE
  - train Gaia RVS on WEAVE/4MOST parameters

- proper coverage of the parameter space is essential!

Guglion et al, 2020, in preparation
Summary and Conclusion

• 6th data release of the RAVE survey
  ■ spectra + error spectra
  ■ repeat observations
  ■ stellar parameters using the reverse distance pipeline BDASP + Gaia priors
  ■ new abundance pipeline GAUGUIN
  ■ updated astroseismic giant sample (based on ~490 K2 stars)

• RAVE = „Milli Gaia-RVS“

• Convoluted neural network RAVE+APOGEE demonstrates the power of combining medium-low resolution with high-resolution survey
  ■ Gaia + 4MOST/WEAVE: detailed abundances for O(10^8) spectra
  ■ good coverage of parameter space essential