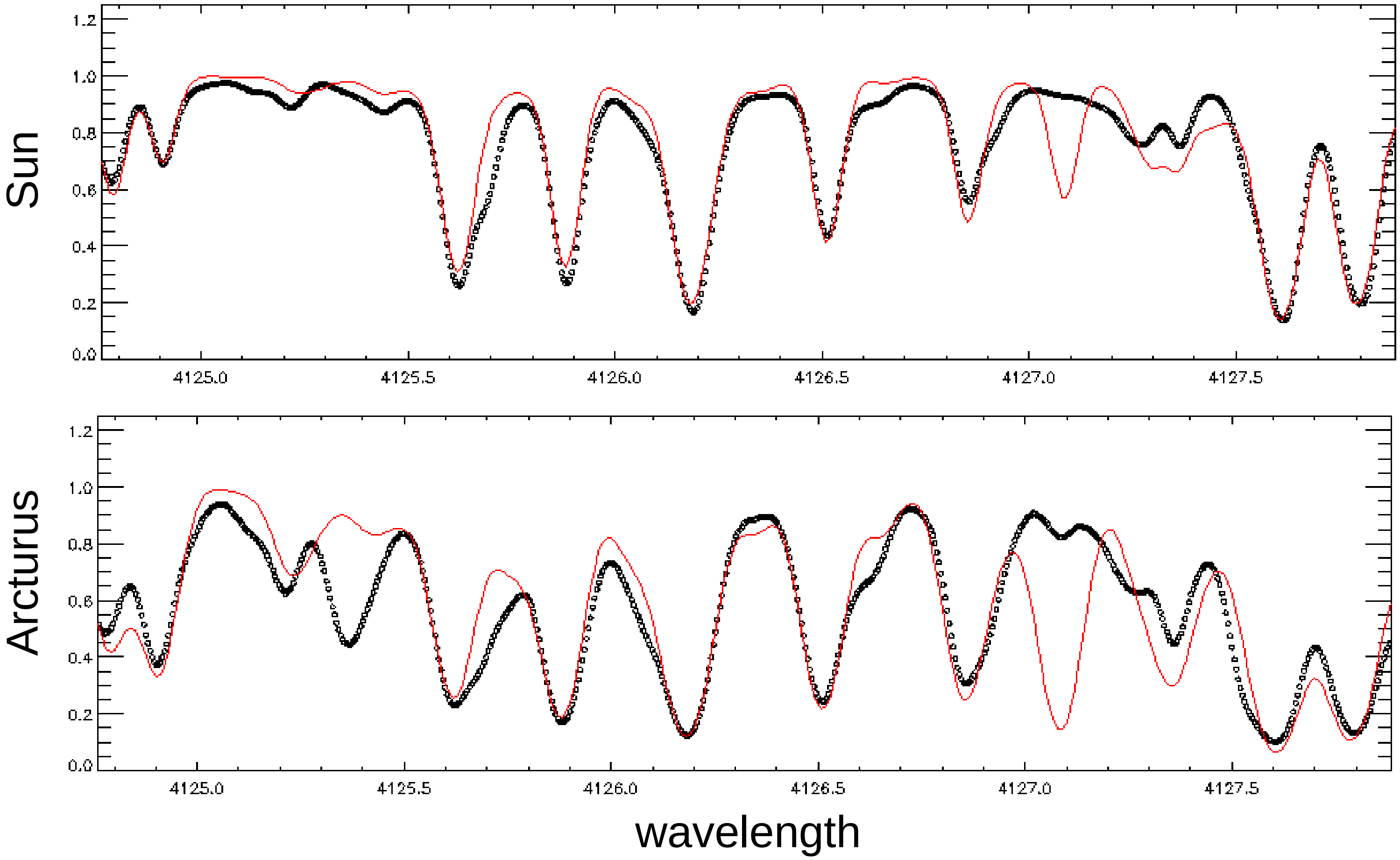
Stellar spectral models are imperfect.



Machine learning of stellar spectra: The Cannon

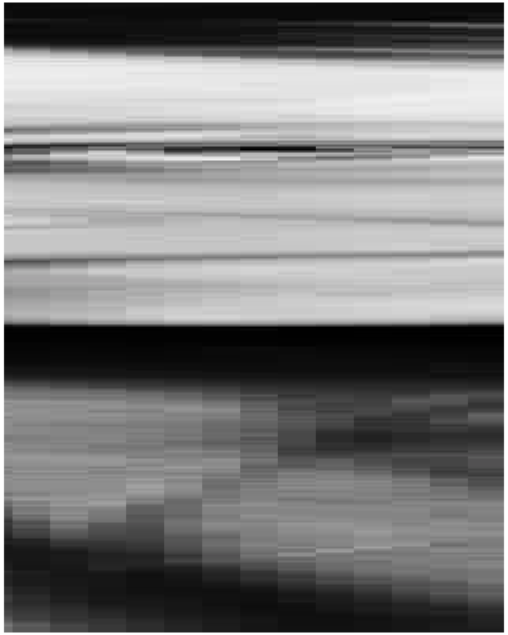
Annie Jump Cannon

$$f_{n\lambda} = \boldsymbol{\theta}_\lambda^T \cdot \boldsymbol{\ell}_n + \text{noise}$$

$$\boldsymbol{\ell}_n \equiv \Big[1,\, T_{\text{eff}},\, \log\ g,\, [\text{Fe/H}],\, T_{\text{eff}}^2,\, T_{\text{eff}} \cdot \log\ g,\, T_{\text{eff}} \cdot [\text{Fe/H}],\, \log\ g^2,\, \log\ g \cdot [\text{Fe/H}],\, [\text{Fe/H}]^2\Big].$$

Ness et al. 2015, ApJ, 808, 16

Machine learning of stellar spectra: The Payne



Cecilia Payne-Gaposchkin

$$f_\lambda = w \cdot \sigma(\tilde{w}^i_\lambda \sigma(w^k_{\lambda i} \ell_k + b_{\lambda i}) + \tilde{b}) + \bar{f}_\lambda$$

$$\sigma(x) = 1/(1 + e^{-x})$$

T_{eff}, $\log g$

[Fe/H]

v_{micro}

v_{macro}

C_{12}/C_{13}

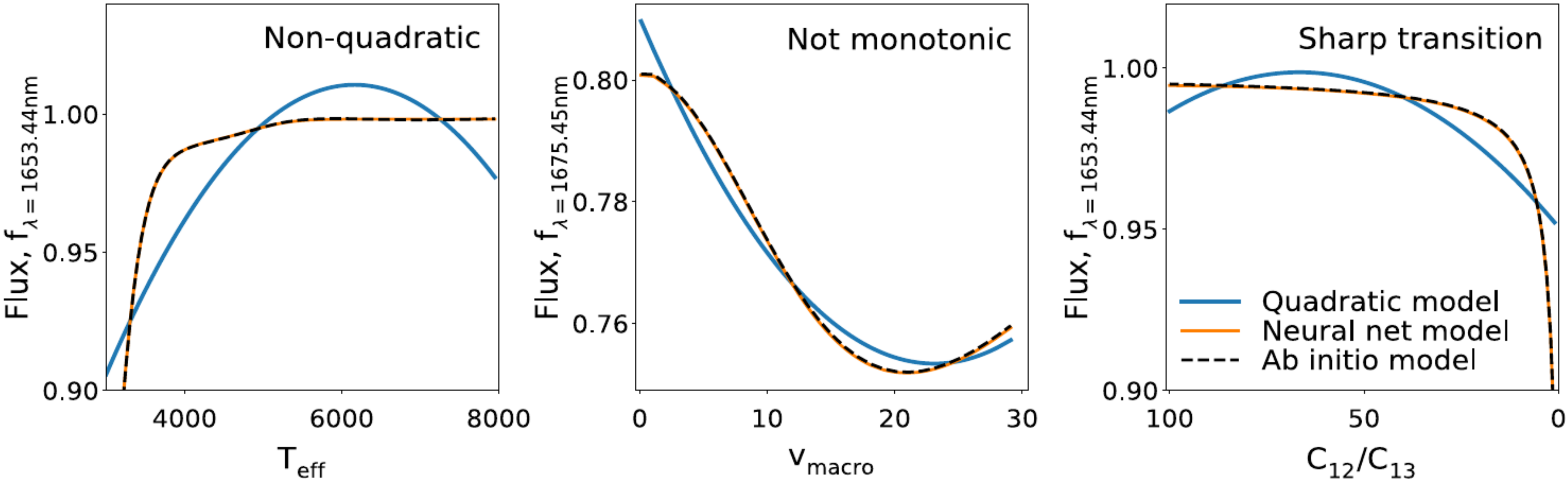
[X/Fe]

Neural network solves for

$$(w,\ \tilde{w}^i_\lambda,\ \tilde{b},\ w^k_{\lambda i},\ b_{\lambda i},\ \bar{f}_\lambda)$$

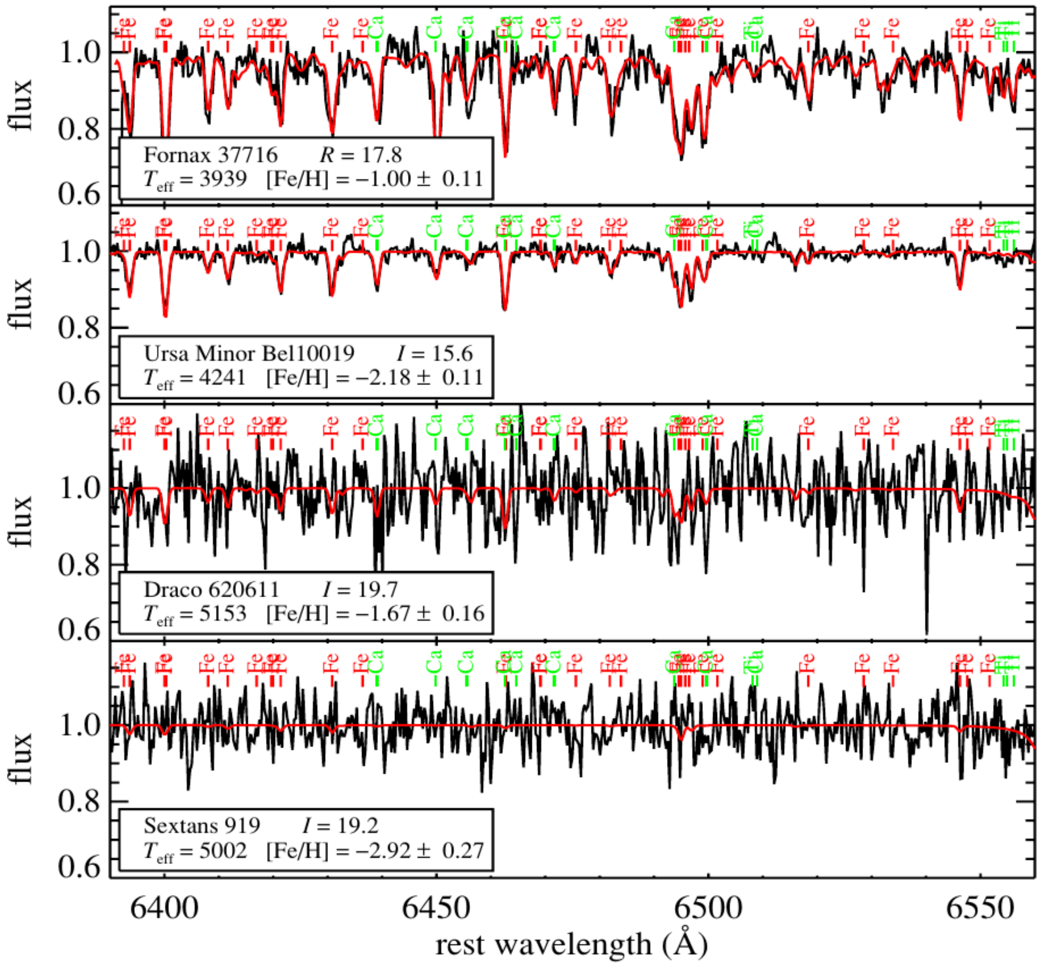
Ting et al. 2019, ApJ, 879, 69

Machine learning of stellar spectra: The Payne



Ting et al. 2019, ApJ, 879, 69

Real data: Keck/DEIMOS



CMS 273: Deep learning applied to Keck spectroscopy

- Is a convolutional neural network appropriate for this application? Is there information to be gained?
- Do we have a training set of sufficient size and trustworthiness?
- What other machine learning methods would be appropriate?