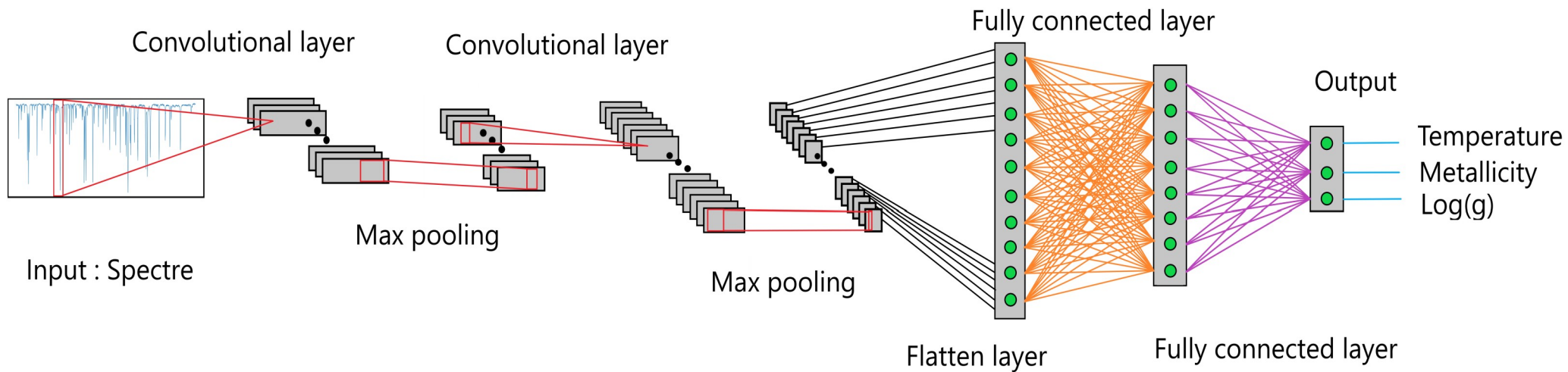# Deep learning determination of stellar fundamental parameters
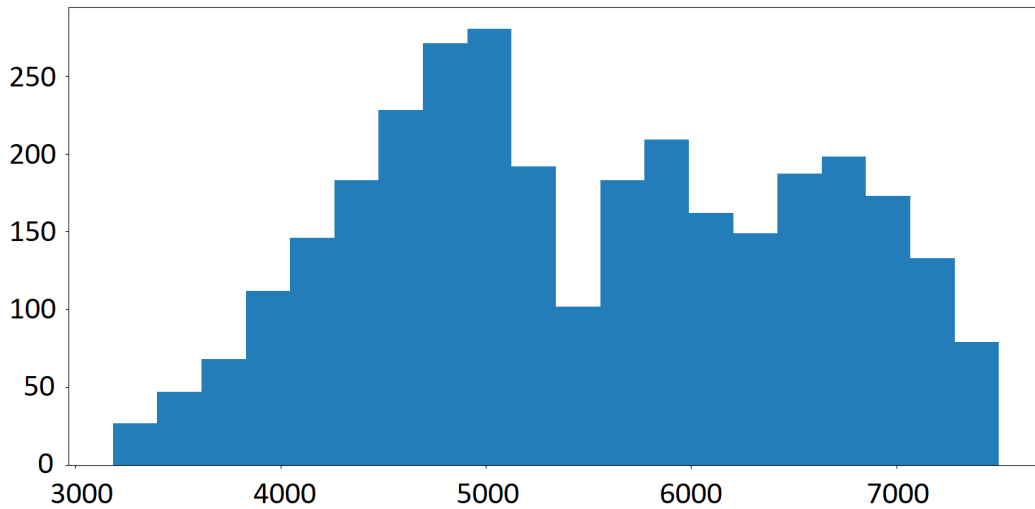

Raphaël Kou, Pascal Petit, Logithan Kulenthirarajah
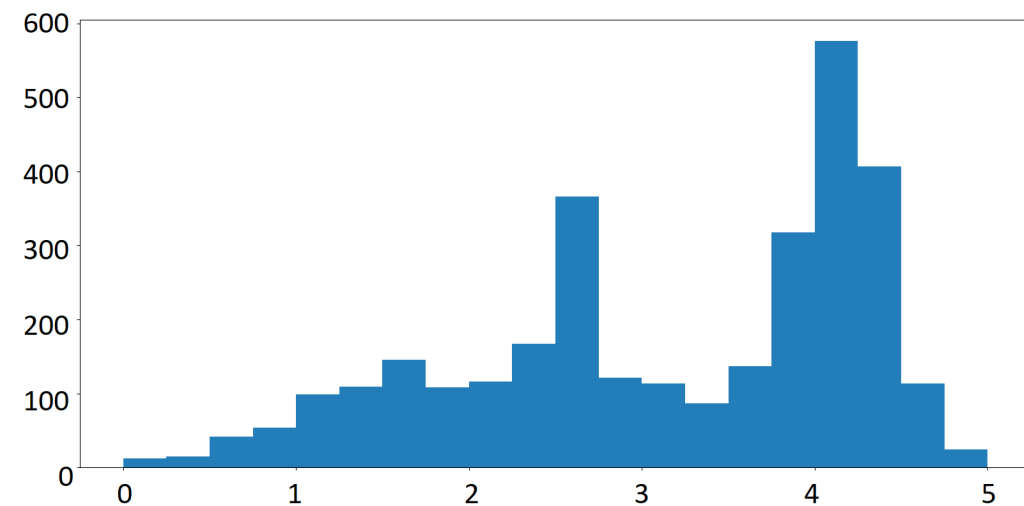
In short :
Training dataset
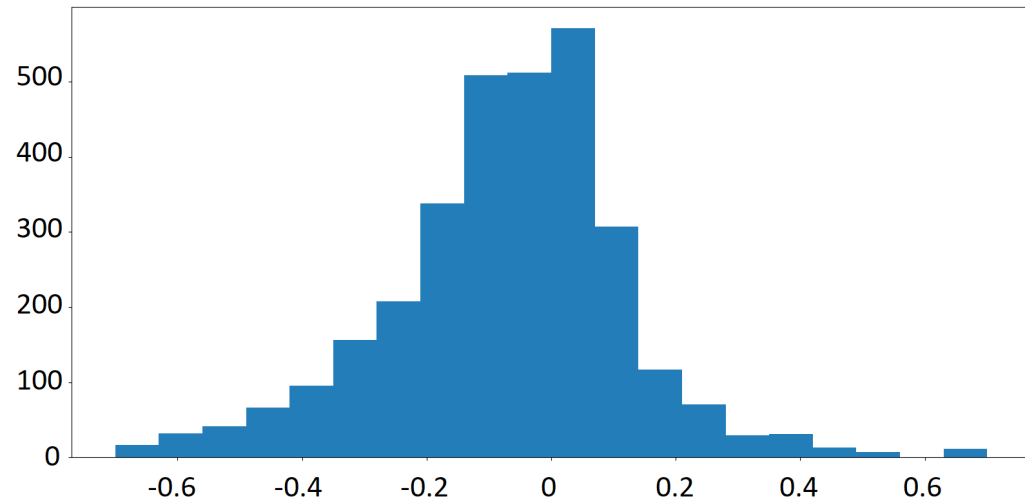

Temperature distribution of the training dataset

- 1332 stars from Polarbase and ELODIE
- 3129 spectra (until 5 spectra per star)
- Metallicity : from -0.7 to 0.7
- Temperature : from 3182K to 7500K
- Log(g) : from 0 to 5
- Parameters learnt are the medians from Vizier

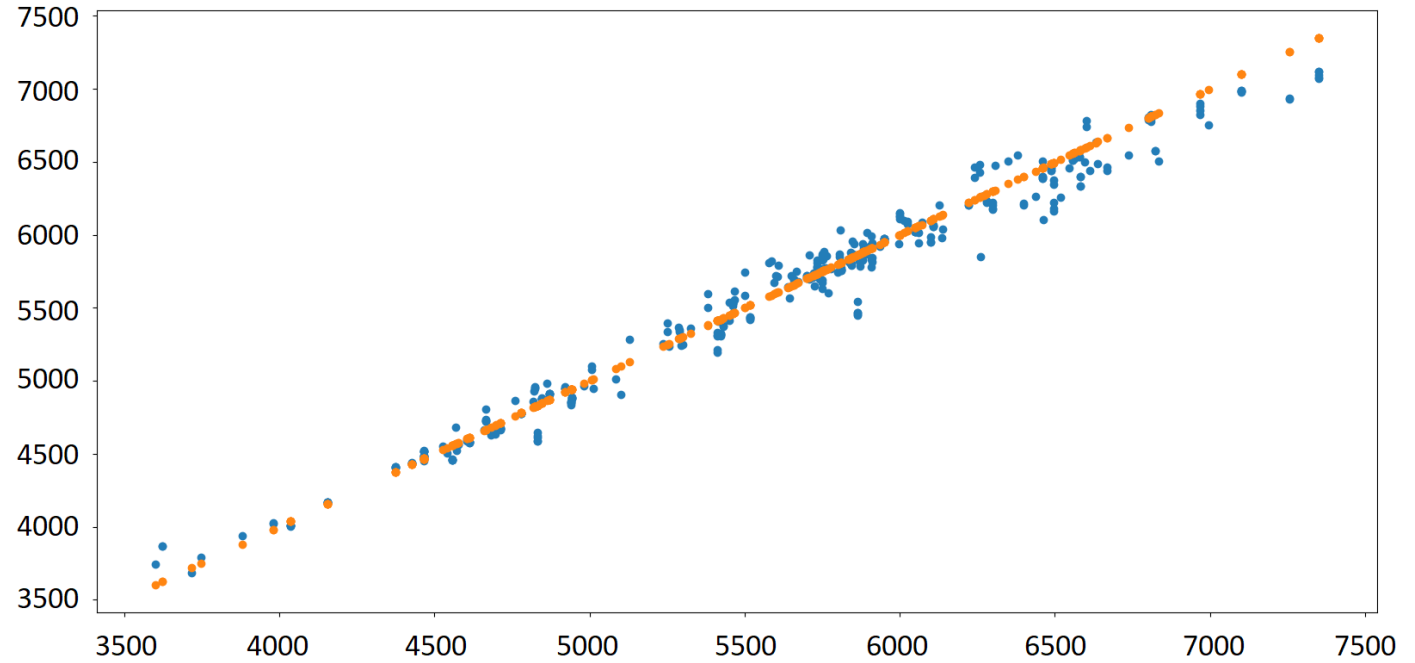

Log(g) distribution of the training dataset

Metallicity distribution of the training dataset

In short :
Main results

Orange (y=x) : temperature given by Vizier

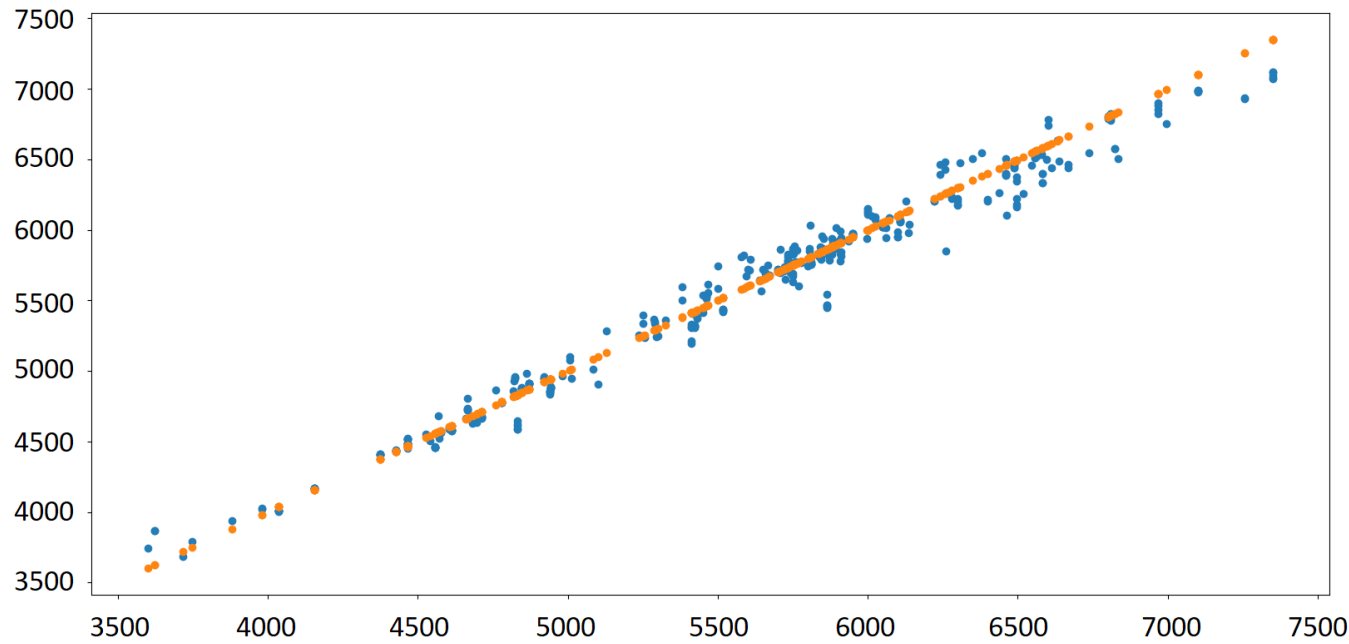Blue : temperature predicted by our neural network

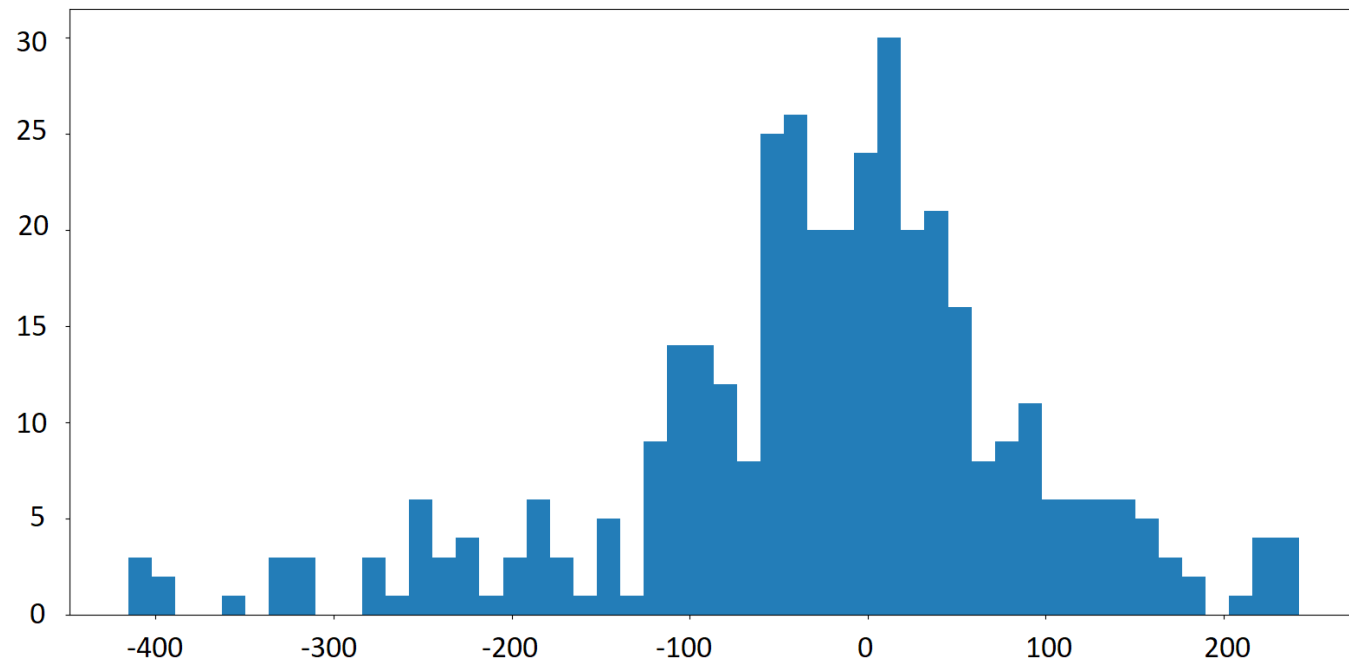| Parameter	Mean error	Median error	95 % of errors are lower than
Temperature	84,52K	55,90K	247,43K
Log(g)	0,110	0,092	0,266
Metallicity	0,070	0,061	0,162

Validation dataset :
- 196 stars
- 379 spectra (until 5 spectra per star)

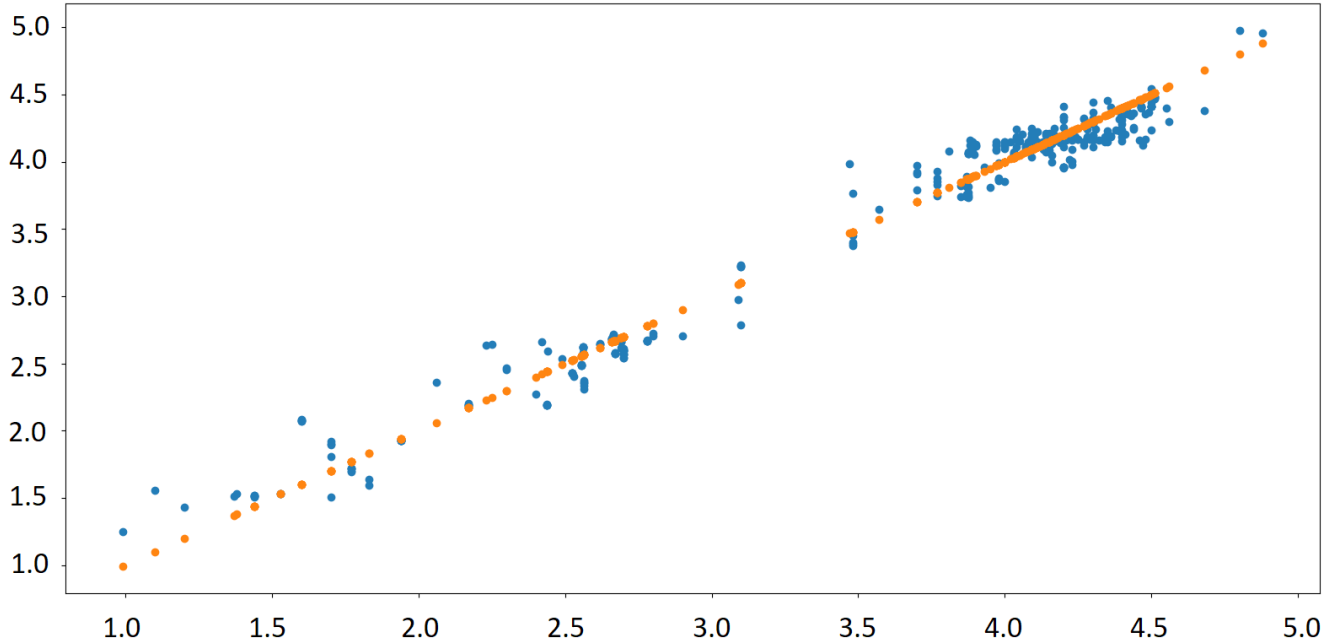# In more details : Temperature result

Orange (y=x) : temperature given by Vizier

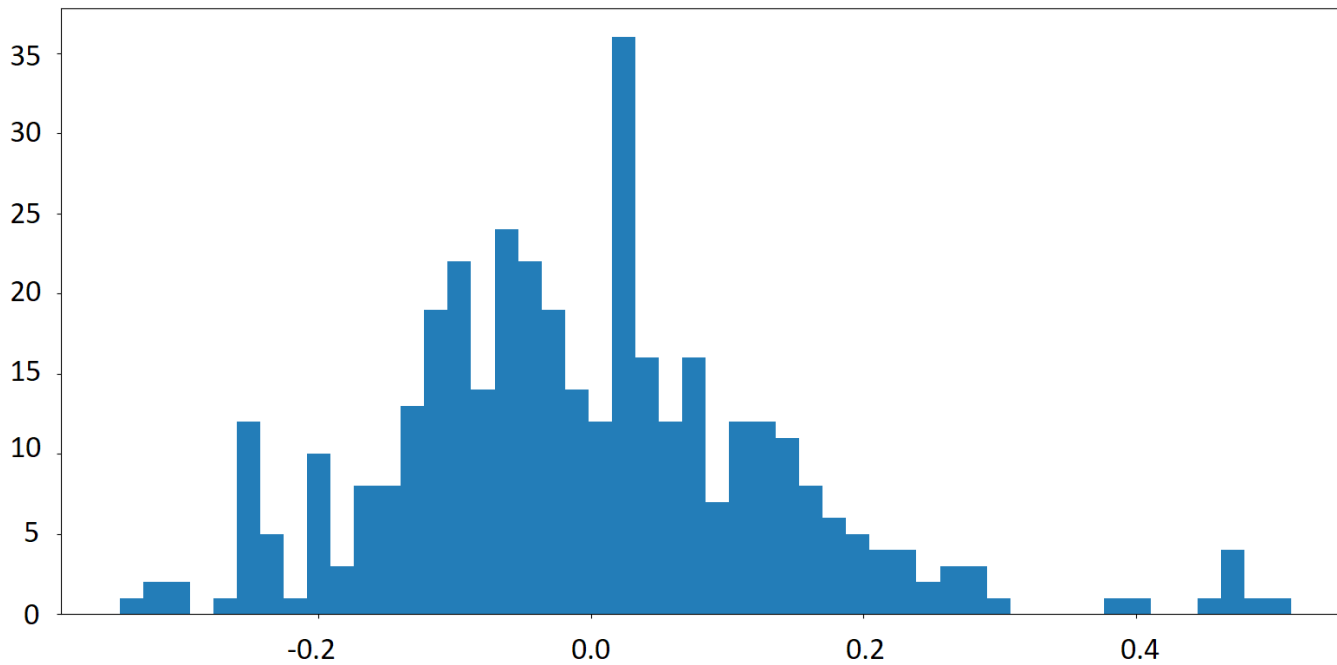Blue : temperature predicted by our neural network

Error distribution on temperature
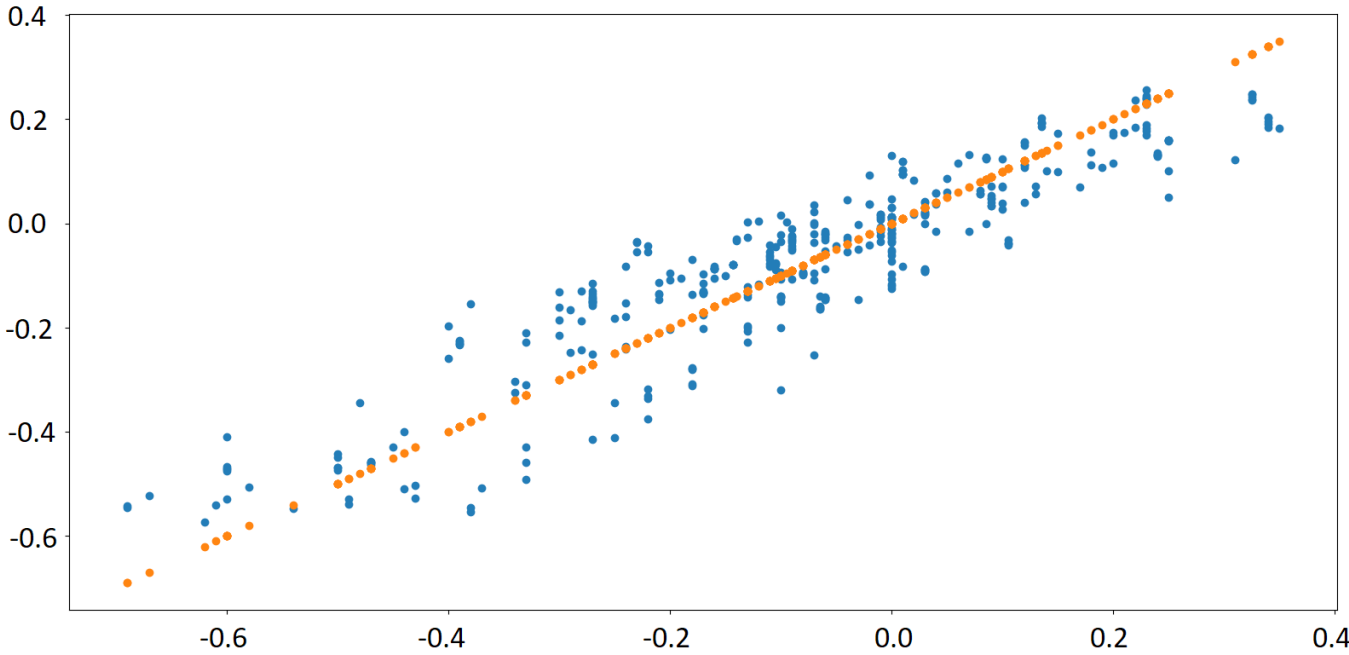
In more details : Log(g) result

Orange (y=x) : log(g) given by Vizier

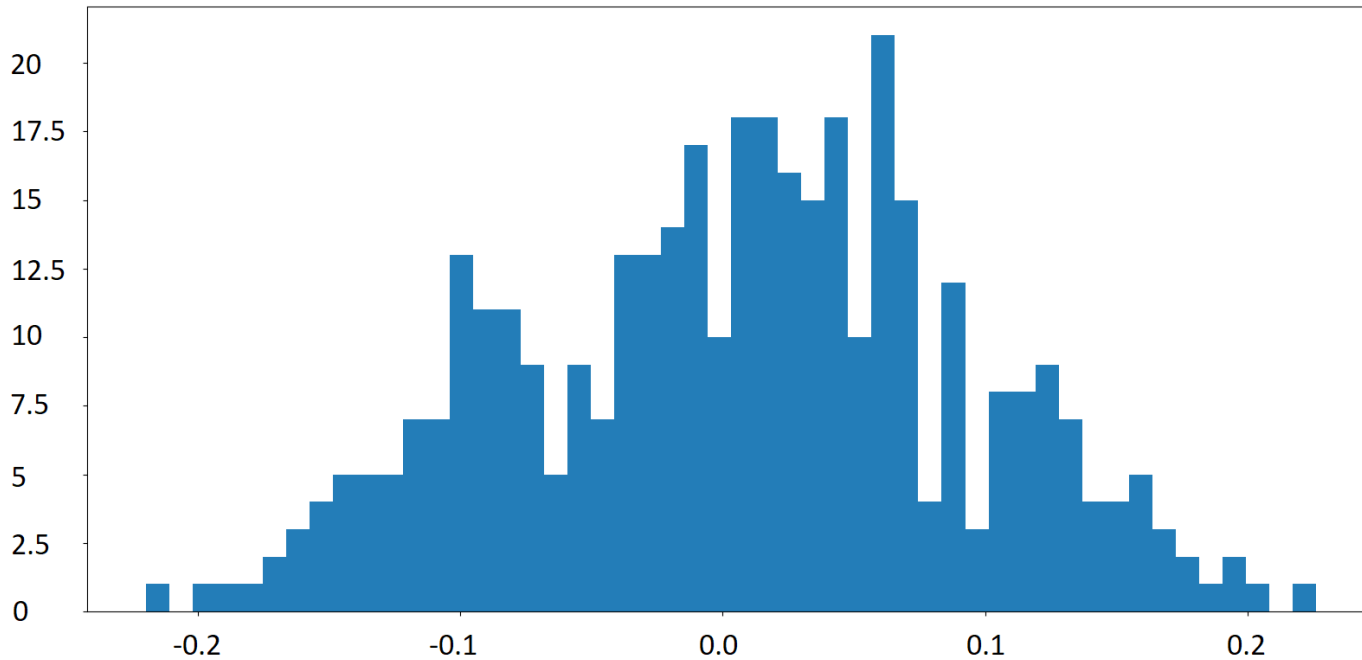Blue : log(g) predicted by our neural network

Error distribution on log(g)

In more details : Metallicity result

Orange (y=x) : metallicity given by Vizier

Blue : metallicity predicted by our neural network

Error distribution on metallicity

In more details : Synthetic spectra (1)

Our neural network has also been trained with synthetic spectra generated thanks to PHOENIX atmospheric models.

- 58250 spectra used for training
- Metallicity : from -0.4 to 0.4
- Temperature : from 5000K to 5900K
- Log(g) : from 4.2 to 4.8
- Vsin(i) : from 0km/s to 15km/s
- Macrotubulence : from 0km/s to 10km/s

Comparison of a synthetic and a reel spectra

In more details : Synthetic spectra (2)

Parameter	Mean error	Median error	95 % of errors are lower than
Temperature	36,65K	26,02K	97,85K
Log(g)	0,044	0,033	0,119
Metallicity	0,026	0,020	0,057

Results obtained when trying to predict the fundamental parameters of 100 **synthetic spectra** not used for the training (different vsin(i), macrotubulence velocity and different noise).

Parameter	Mean error	Median error	95 % of errors are lower than
Temperature	53,02K	30,53K	221,33K
Log(g)	0,12	0,055	0,644
Metallicity	0,066	0,036	0,213

Results obtained when trying to predict the fundamental parameters of 73 **observed spectra**.