Linear and Neural Network Estimates of Magnetic Filling Factors on Sun-Like Stars

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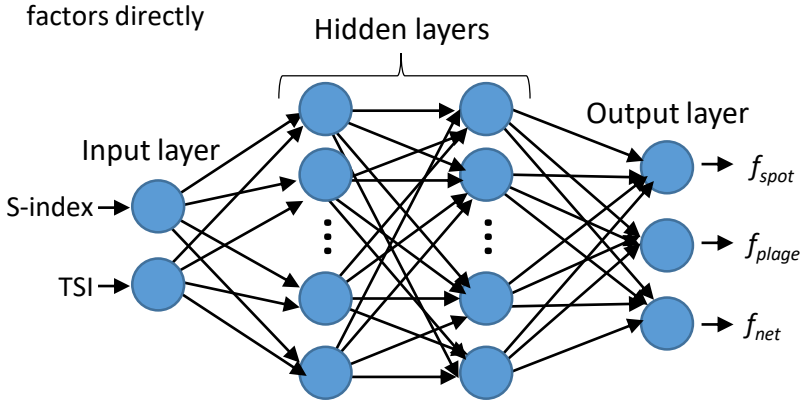
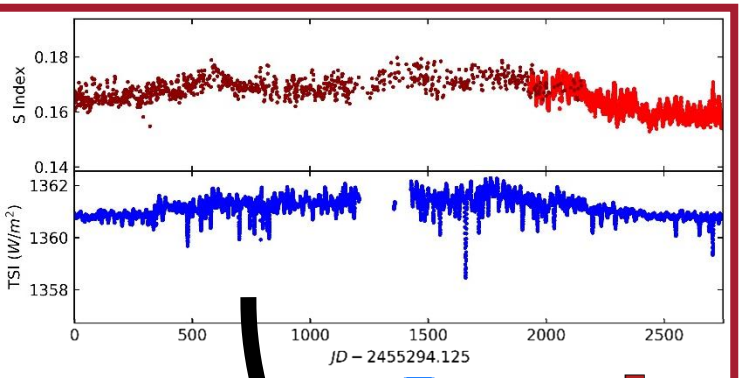
Use Available Solar Observations to Estimate Magnetic Filling Factors

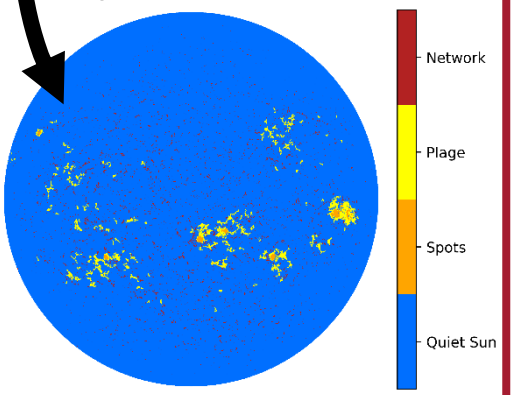
Use combination of **solar S-index** and **TSI** to reproduce **SDO/HMI filling factors** of specific magnetic features:

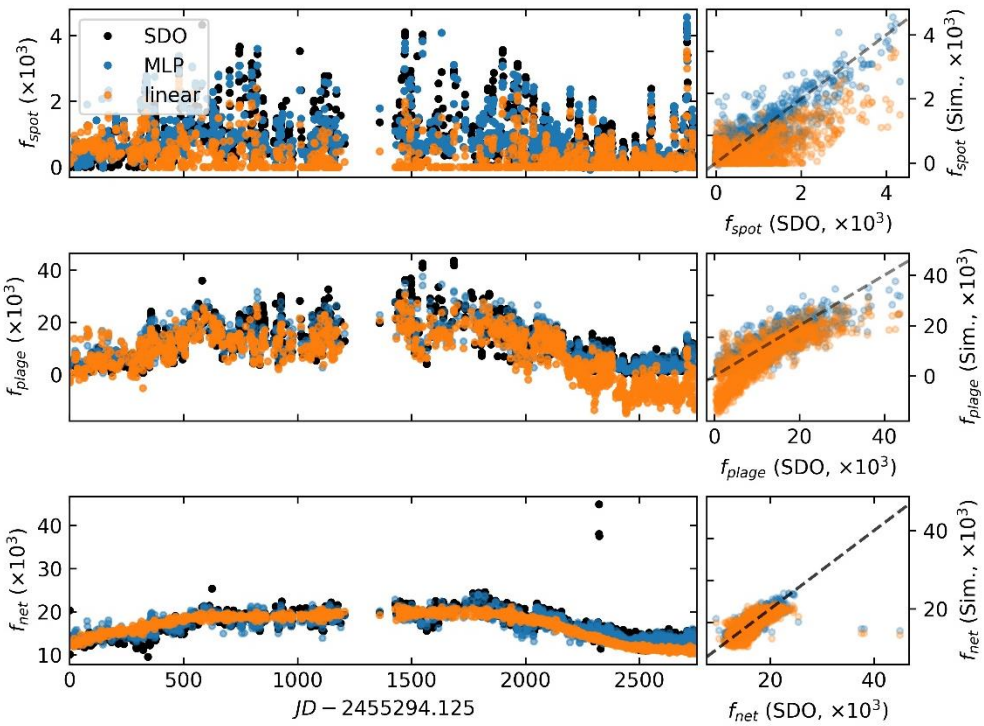
- Linear fit of S-index to TSI → Plage
- Fit residuals → Spots
- Time information → Network

Also train multilayer perceptron to extract filling factors directly









Results

Both techniques produce filling factors highly correlated with HMI-derived values. But does this help with RVs? Expected activity-driven RVs to depend on active region size (Milbourne et al. 2019):

- RV RMS: 1.82 m/s
- Decorrelating with S-index: 1.37 m/s
- Decorrelating with estimated filling factors: 1.37 m/s
- Decorrelating with HMI filling factors: 1.23 m/s

These techniques are good first step, but further work is needed!