Evolution of stellar magnetic activity: probing planet engulfment by red giants

It has been observed that the fraction of low-mass (LM) red giants (RGs) showing photospheric activity in their light curve is larger on the horizontal branch (HB) than during the previous red giant branch (RGB) phase, while the opposite trend has been observed for intermediate-mass (IM) stars. One hypothesis is that LM RGs ($M \leq 1.6\ M_{\odot}$) engulf more planets than IM RGs, which results in a faster surface rotation and a higher magnetic activity. This hypothesis is based on the fact that LM stars reach a maximum radius at the RGB tip that is much larger than for IM stars, making them more likely to engulf planets. However, we need to study the evolution of the active star fraction along the RGB to firmly check this hypothesis.

We use independent indicators tracing the activity level in the chromosphere based on LAMOST spectral lines for ~ 3000 RGs whose evolutionary stage has been identified by asteroseismology with the *Kepler* mission. We find that the fraction of active LM stars decreases along the RGB more weakly compared to that of IM stars. This is not explained by models of single-star evolution and is consistent with the hypothesis that LM stars engulf more planets than IM stars. The studied RGB stars are not evolved enough to reach radii that differ significantly. Instead, our results show that LM stars host, and therefore engulf, more planets than IM stars, as predicted by the theory of planet formation. Characterizing planet engulfment by RGs provides insights into the evolution and fate of most planetary systems, since ~ 97% of stars pass through the RG evolution stage.