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Abstract: I present a comprehensive evaluation of radial velocity observing strategies to be considered for future planet-hunting surveys with the Automated Planet Finder, a new 2.4-m telescope at Lick Observatory. Observing strategies can be optimized to mitigate stellar noise, which can mask and imitate the weak Doppler signals of low-mass planets. I estimate and compare sensitivities of five different observing strategies to planets around main sequence stars of five spectral types ranging from G2-M2. I first test nightly observations over a one-year period with either a single 15-minute exposure or three 5-minute exposures spaced two hours apart. I compare this to observing every 3 nights over 4 consecutive years with the same two intra-night approaches. I also test a 5-year strategy of 10 observations per year that is analogous to an ongoing RV survey at Keck. RV noise models are constructed for five stars, taking into account acoustic, granulation, and magnetic activity modes. Synthetic RV time series are produced by injecting a planet signal onto the stellar noise sampled according to each observing strategy. Thousands of planet injection-recovery trials are carried out over a range of planet parameter space and the detection sensitivity is determined as a function of orbital period, minimum mass, and eccentricity. After repeating these trials for each star and each observing strategy, I find that the four-year strategies are sensitive to planets ~25 – 40% lower in mass than the corresponding one-year strategies, for stars of all tested spectral types. The dominant quasi-coherent noise modes associated with stellar magnetic activity become incoherent on these longer timescales and therefore produce weaker Doppler signals. Moreover, three 5-minute exposures provide a ~ 10% gain in sensitivity over the corresponding single 15-minute exposure strategies. 5-minute exposures are sufficient to average out the high frequency p- modes. All strategies are sensitive to planets of lowest mass around the modeled K7 dwarf, which has the least magnetic activity. This study indicates that APF surveys adopting the four-year strategies should be able to detect Earth-mass planets on < 10-day orbits around quiet late-K dwarfs. Such surveys should also be sensitive to 1.5-Earth-mass planets in the habitable zones of these late K stars.

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