

# **The Gaia-ESO Survey: Empirical determination of the precision of stellar radial velocities and projected rotation velocities**

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## **Abstract**

**Context.** The Gaia-ESO Survey (GES) is a large public spectroscopic survey at the European Southern Observatory Very Large Telescope. **Aims.** A key aim is to provide precise radial velocities (RVs) and projected equatorial velocities ( $v_{\text{ sini}}$ ) for representative samples of Galactic stars, which will complement information obtained by the Gaia astrometry satellite. **Methods.** We present an analysis to empirically quantify the size and distribution of uncertainties in RV and  $v_{\text{ sini}}$  using spectra from repeated exposures of the same stars. **Results.** We show that the uncertainties vary as simple scaling functions of signal-to-noise ratio (S/N) and  $v_{\text{ sini}}$ , that the uncertainties become larger with increasing photospheric temperature, but that the dependence on stellar gravity, metallicity and age is weak. The underlying uncertainty distributions have extended tails that are better represented by Student's t-distributions than by normal distributions. **Conclusions.** Parametrised results are provided, which enable estimates of the RV precision for almost all GES measurements, and estimates of the  $v_{\text{ sini}}$  precision for stars in young clusters, as a function of S/N,  $v_{\text{ sini}}$  and stellar temperature. The precision of individual high S/N GES RV measurements is 0.22-0.26 km s<sup>-1</sup>, dependent on instrumental configuration.

## **Keywords**

Stars kinematics and dynamics, Open clusters and associations general.