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Reading the Sky - From Starspots to Spotting Stars

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Abstract

This thesis encompasses two research fields in astronomy: astrometry and astronomy education and they are discussed in two parts. These parts represent two sides of a coin; astrometry, which is about constructing 3D representations of the Universe, and AER, where for this thesis, the goal is to investigate university students' and lecturers' disciplinary discernment vis-à-vis the structure of the Universe and extrapolating three-dimensionality.

Part I presents an investigation of stellar surface structures influence on ultra-high precision astrometry. The expected effects in different regions of the HR-diagram were quantified. I also investigated the astrometric effect of exoplanets, since astrometric detection will become possible with projects such as Gaia. Stellar surface structures produce small brightness variations, influencing integrated properties such as the total flux, radial velocity and photocenter position. These properties were modelled and statistical relations between the variations of the different properties were derived. From the models it is clear that for most stellar types the astrometric jitter due to stellar surface structures is expected to be of order 10 μ AU or greater. This is more than the astrometric displacement typically caused by an Earthsized exoplanet in the habitable zone, which is about 1–4 μ AU, making astrometric detection difficult.

Part II presents an investigation of disciplinary discernment at the university level. Astronomy education is a particularly challenging experience for students because discernment of the 'real' Universe is problematic, making interpretation of the many disciplinary-specific representations used an important educational issue. The ability to 'fluently' discern the disciplinary affordances of these representations becomes crucial for the effective learning of astronomy. To understand the Universe, I conclude that specific experiences are called for. Simulations could offer these experiences, where parallax motion is a crucial component. In a qualitative study, I have analysed students' and lecturers' discernment while watching a simulation video, and found hierarchies that characterize the discernment in terms of three-dimensionality extrapolation and an Anatomy of Disciplinary Discernment. I combined these to define a new construct: Reading the Sky. I conclude that this is a vital competency needed for learning astronomy and suggest strategies for how to implement this in astronomy education.

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