Shaking the Pot of Modelling Tools: Some Open Problems in the Field

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Abstract. To inspire and provoke lively discussions, I argue that the accuracy of the basic physical properties of stars, based on analyses of well-observed detached binaries, might be worse than usually believed. I offer some ways how to deal with the situation. I end with a few comments on the studies of extra-solar planets.

Keywords. stars: fundamental parameters (classification, colors, luminosities, masses, radii, temperatures, etc.), (stars:) binaries: general, (stars:) binaries (including multiple): close, (stars:) binaries: eclipsing, stars: planetary systems, stars: evolution, stars: atmospheres

1. Introduction

Let me begin this talk in a somewhat personal tone. When many of us met at the IAU Symp. 240 Binary Stars as Critical Tools and Tests in Contemporary Astrophysics in 2006, we had the chance to welcome there Mirek J. Plavec, a Czech stellar astronomer who spent the last few decades of his life in the USA. Mirek was a teacher and friend of several of us, who are present in this audience. In one of his excellent review talks (Plavec 1983) he made a statement, which I believe will be very appreciated by the colleagues studying the wealth of data coming from the space observatories like MOST, CoRoT or Kepler:

“I think it is fair to say that a theory or a model is always the closer to being worshipped the fewer are the observational data.”

My intention, as an astronomer who tries to analyze observations in an effort to learn something new about stars, is to inspire lively discussions during this meeting. I shall touch on some problems worth considering and ask various questions, to which I hope to hear answers and/or comments from the experts, who met here.

2. How accurately do we know the masses, radii and other basic physical properties of stars?

Andersen (1991) claimed the errors in stellar masses and radii smaller than 2% and Torres et al. (2010) relaxed this accuracy to better than 3% in their excellent review of the properties of 95 well detached binary systems. I am afraid, however, that this estimate is still too optimistic as detailed below. Besides, we should keep in mind the current strong selection effect, namely that we have most observations for the systems seen roughly equator-on. It will be very interesting to study also spectroscopic binaries seen under lower inclination when the interferometry will become a widely used technique to see whether our theoretical models of the gravity and limb darkening are sufficiently sophisticated or not.