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Interferometric Aperture Synthesis of Altair: Gravity Darkening and Inclination Angle

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Summary. We perform a physically consistent analysis of all interferometric data available for Altair in order to estimate two important parameters for this rapid rotator : (1) a gravity-darkening compatible with the expected value for hot stars ($T_{\text{eff}} \propto g^{0.25}$; von Zeipel effect) and (2) an intermediate inclination for the rotation axis ($i = 55^\circ \pm 8^\circ$ for our best model).

1 Introduction and observations

Although Altair (α Aql, HR 7557, HD 187642) is known to be a rotationally flattened star, a self-consistent determination of the fundamental and apparent parameters related to its rapid rotation has yet to be performed.

Several interferometric observations of Altair exist. They include squared visibilities V^2 in the H and K bands from VLTI/VINCI (Domiciano de Souza et al. 2005; see also Domiciano de Souza in these proceedings), V^2 in the K band from PTI (van Belle et al. 2001), and V^2 , triple amplitudes, and closure phases in the visible from NPOI (Ohishi, Nordgren & Hutter 2004).

2 Results

Figure 1 shows the results of our physically consistent analysis of these rich data set using our interferometry-oriented model for fast rotators. This model includes Roche approximation, limb-darkening from Claret (2000), and a von Zeipel-like gravity-darkening law: $T_{\text{eff}} \propto g^\beta$, with $\beta = 0.25$ for hot stars with radiative external layers (von Zeipel 1924) and $\beta = 0.08$ for cold stars with convective external layers (Lucy 1967). Further details on the model are given by Domiciano de Souza et al. (2002) and the complete description of this analysis of Altair's data is given by Domiciano de Souza et al. (2005).

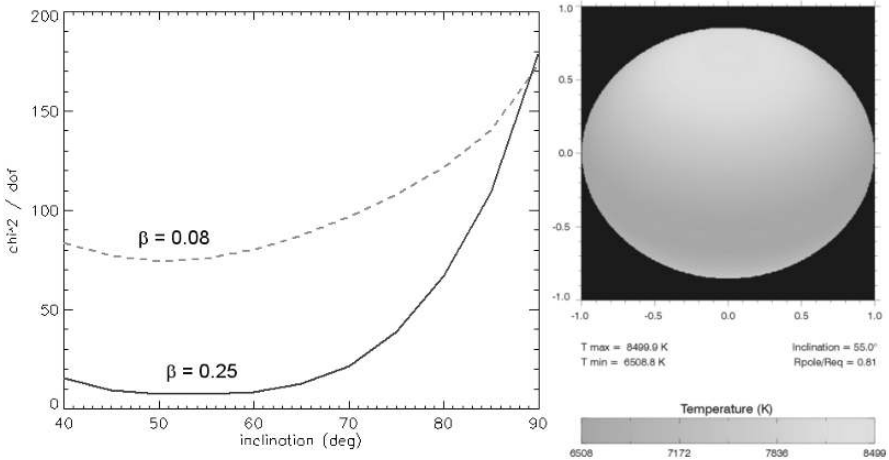


Fig. 1. *Left:* Reduced χ^2 (χ^2/dof) as a function of the stellar inclination i computed from all interferometric observations of Altair for the two test models (radiative and convective limits for the gravity-darkening; $T_{\text{eff}} \propto g^\beta$). These values correspond already to the best equatorial angular diameter and major axis orientation for a given i . Clearly, models with $\beta = 0.25$ (solid curve) are preferred compared to models with $\beta = 0.08$ (dashed curve). The minimum χ^2/dof ($\chi_{\text{min}}^2/\text{dof} = 7.3$) is obtained for $\beta = 0.25$ and $i = 55^\circ \pm 8^\circ$. *Right:* Derived effective temperature map corresponding to $\chi_{\text{min}}^2/\text{dof}$. Note that 3 main effects are present in this best model: the stellar flattening (ratio between the equatorial and polar radii $R_{\text{eq}}/R_{\text{p}} = 1.24$), the stellar inclination ($i = 55^\circ \pm 8^\circ$), and the gravity-darkening ($T_{\text{eff}} \propto g^{0.25}$).

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