GRUPO DE RADIOASTRONOMÍA
UNIVERSIDAD DE VALENCIA

Binary Stars in the AB Doradus Moving Group

R. Azulay, J.C. Guirado, J.M. Marcaide (Universidad de Valencia, Valencia, Spain)
I. Martí-Vidal (Onsala Space Observatory, Onsala, Sweden)
E. Ros (Max Planck Institut für Radioastronomie, Bonn, Germany)

ABSTRACT: We present a study of the radio emission and kinematics of a sample of stars belonging to the AB Doradus moving group through VLBI observations. The main aim of our study is to obtain precise estimates of the dynamical mass of young, low-mass stars, which in combination with photometric measurements provide precise benchmarks for calibrating pre-main-sequence (PMS) stellar evolutionary models. Previous studies show that model predictions are in disagreement with experimental results for masses below 1.2 $M_\odot$. Among the stars included in our study, we emphasize the results obtained in two of them: AB Dor B and HD 160934, from which we have measured both the relative and absolute orbital motion. Accordingly, we obtained precise estimates of the mass of the components of these binaries (ranging from 0.25 to 0.7 $M_\odot$). Comparisons of the dynamical masses with the prediction of PMS evolutionary models show that the models underpredict the dynamical masses of the binary components by 10-40%.

THE AB DORADUS MOVING GROUP

The study of binary stars belonging to young, moving groups is a reasonable approach to increase the number of PMS stars with mass dynamically determined. The AB Doradus moving group is the most suitable to carry out the study, as it is the closest one, the estimated age is relatively accurate, and it contains stars with significant emission at radio wavelengths. This last feature is essential because it allows the use of radio interferometry techniques to obtain astrometric information. Thereby, we initiated a VLA/VLBI program dedicated to monitor known and possible young binary systems hosting low-mass companions, and which are likely to present radio emission.

AB DOR B AND HD 160934 OBSERVATIONS

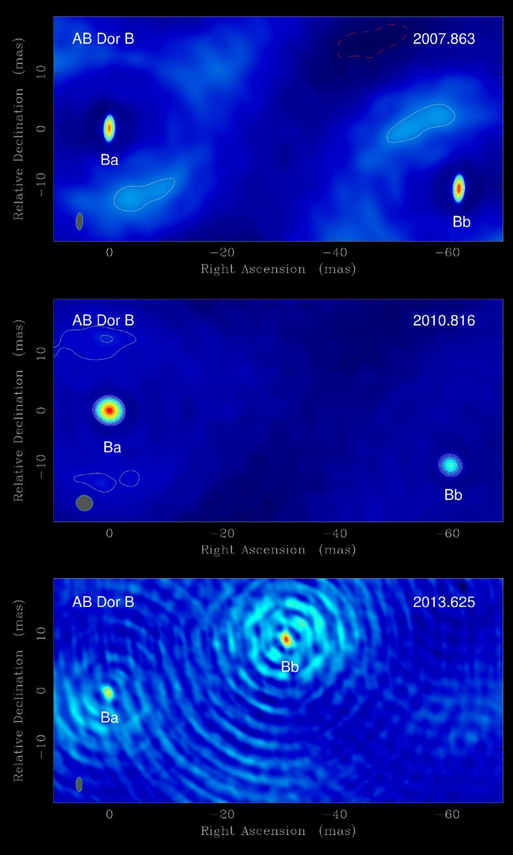

Fig. 1: Maps of AB Dor B

AB Dor B and HD 160934 are close binary systems (AB Dor Ba/Bb, separated ~50 mas; HD 160934 A/c, separated ~200 mas). We observed AB Dor B between 2007 and 2013 with the Australian Long Base Array (LBA) at 8.4 GHz and HD 160934 between 2012 and 2014 with the European VLBI Network (EVN) at 5 GHz. Phase referenced maps are shown in Fig. 1 and 2. These are the first VLBI images of both systems where we confirm that all components are compact and strong radio emitters.

With the images of each pair of stars, we can determine the relative position of one component respect to the other and the absolute position of each component respect to an external quasar. We also included NIR data available in the literature to determine simultaneously both the relative and the individual orbits of each pair. Thereby, we calculate the masses of the components, that are 0.28±0.05 $M_\odot$ and 0.25±0.05 $M_\odot$ for AB Dor Ba and AB Dor Bb, respectively, and 0.70±0.07 $M_\odot$ and 0.45±0.04 $M_\odot$ for HD 160934 A and HD 160934 c, respectively.

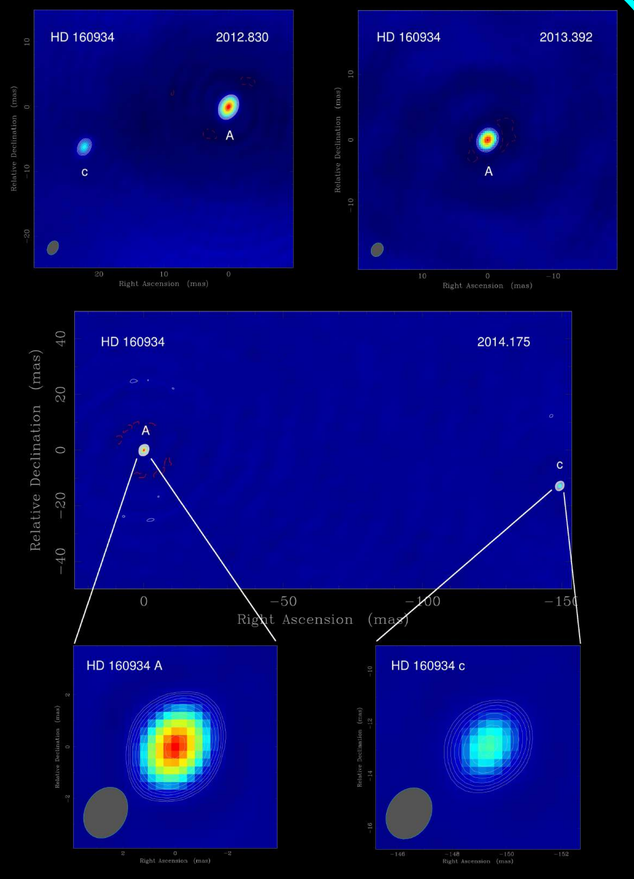

Fig. 2: Maps of HD 160934

COMPARISON WITH THEORETICAL MODELS

Comparisons of the dynamical masses with the prediction of PMS evolutionary models (Fig. 3 and 4) show that the models underpredict the dynamical masses of the binary components Ba and Bb by 10–30% and 10–40%, respectively, and the components HD 160934 A and c by 10% and 20-40%, respectively, underlying the known tendency of these models to underpredict the masses, yet within 2-σ of the predicted values.

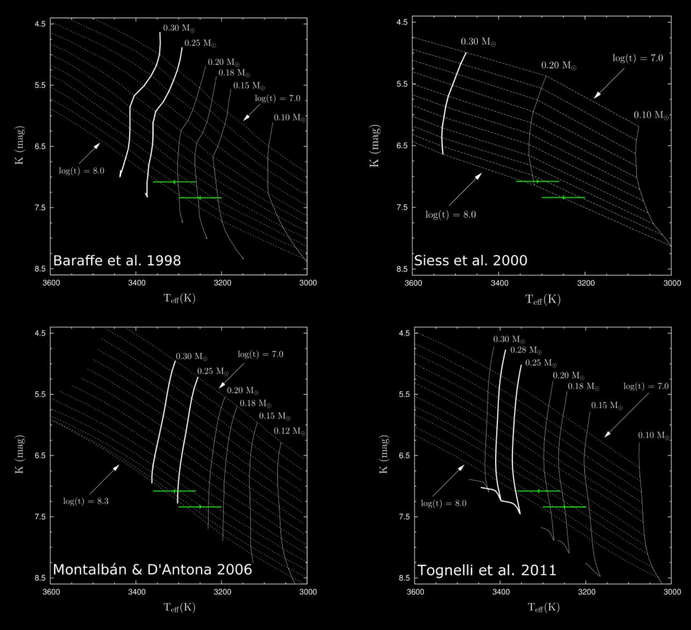

Fig. 3: Models for AB Dor B

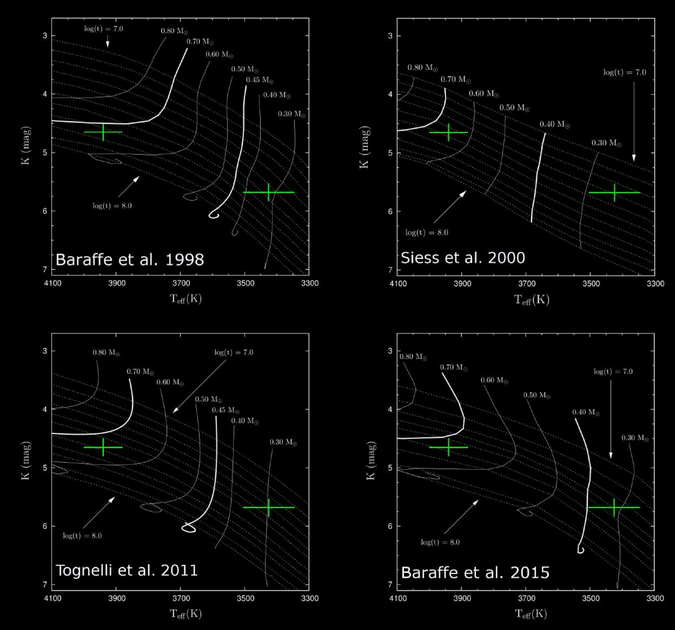

Fig. 4: Models for HD 160934

MORE STARS IN THE AB DORADUS MOVING GROUP

Also, we have observed other stars that belong to the AB Doradus moving group.

- **EK Draconis A/B:** detected with the EVN (flux density of 0.06 mJy); monitoring of the relative orbit that provides a value of the sum of the masses of 1.38±0.08 $M_\odot$.
- **PW Andromedae:** detected with the VLA and the EVN (flux density of 0.17 mJy).
- **LO Pegasus:** detected with the VLA, but not with the EVN.

REFERENCES

- Azulay et al. 2014, A&A, 561, A38
- Azulay et al. 2015, A&A, 578, A16