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Validation of transting planet candidates: a Bayesian view

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Abstract. Transiting candidate validation is essentially a Bayesian model comparison problem: different models, all explaining the observations comparably well, compete for the support of the available data. The basic characteristics of the planet validation problem are discussed and the different approaches taken to tackle its difficulties are reviewed.

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Transiting candidate validation consists in securing the planetary nature of a transiting candidate not by a dynamical measurement of its mass, but by accumulating enough evidence for the planetary hypothesis with respect to all possible false positive (FP) scenarios. This technique is particularly relevant for faint transit host stars, such as those from the CoRoT and Kepler surveys.

Planet validation is therefore essentially a Bayesian model comparison problem, and consists in computing the odds ratio between the planetary hypothesis and H_{FP}, the probabilistic union of all FP scenarios†. Three particularities of planet validation render the task very complex and difficult to tackle: i) the relevant data sets are of diverse nature (transit light curves, broad band photometry, radial velocity measurements, etc.), ii) the prior information is non-trivial, and involves knowledge of the subjects such as stellar formation rate and evolution, and galactic structure, and iii) the computation of the models representing each hypothesis is in some cases very time-consuming.

Despite its clear Bayesian nature, the planet validation problem has received in the past mainly a frequentist treatment (Torres *et al.* 2011). The VESPA code (Morton 2012) computes Bayesian odds ratios but employs simplistic models that increase speed but only partially exploit the available datasets. The Planet Analysis and Small Transit Investigation Software (Diaz *et al.* 2014) was developed keeping the characteristics of the problem in mind. It computes the Bayesian evidence for a full set of FP scenarios and the planet hypothesis, modelling all the available data self-consistently to produce rigorous Bayes factors. Its object-oriented architecture allows constructing a vast set of FP models easily. An early PASTIS result on a CoRoT Neptune-size candidate is presented by Moutou *et al.* (2014).

References

Díaz, R. F., Almenara, J. M., Santerne, A., *et al.* 2014, *MNRAS*, 441, 983
Morton, T. D. 2012, *ApJ*, 761, 6
Moutou, C., Almenara, J. M., Díaz, R. F., *et al.* 2014, *MNRAS*, 444, 2783
Torres, G., Fressin, F., Batalha, N. M., *et al.* 2011, *ApJ*, 727, 24

† See ancillary material for a graphical representation of all FP scenarios.