Referee report on Ciuca et al. paper

This paper is combining age and chemo-dynamical information about stars observed by APOGEE, to infer the mechanisms of formation of the thick and thin discs of the Milky Way. The topic is quite timely and interesting. They develop a Bayesian neural network to obtain the ages of 17,305 stars. Their main result is that the galactic disc stars can be divided in three components: 1) the old alpha-enhanced thick disc stars; 2) the young low [alpha/Fe] thin disc stars; 3) the Bridge, namely a region of transition between the thick and thin discs.
They conclude that the thick disc forms early and in the inner regions (this is not new), and then that the inner disc transforms smoothly into the thin disc. They also find that the thin disc is forming inside-out (not new).
The interpretation of the Bridge is not clear in the paper. The first main question is therefore: what is really new in this analysis?
On the other hand, the data analysis seems quite precise and detailed, the paper deals with an important topic and is well written, therefore it deserves publication after highlighting the novelty of theresults as well as clarification of some important points.

Detailed comments:

--In the Introduction, it is mentioned the two-infall model of Chiappini, Matteucci & Gratton (1997) as a semi-analytical model. This is not correct, that model is a numeical chemical evolution model, please correct. Besides that paper, the authors should quote more recent ones adopting the two-infall model, in particular Grisoni et al. (2017) in which a parallel model for the formation of thick and thin discs is also suggested, and Spitoni et al. (2019) in which a revised version of two-infall model is adopted to explain APOGEE chemical data of the thick and thin discs.

--When mentiong the inside-out thin disc formation it would be fair to give credit to the paper Matteucci & Francois (1989) where this mechanism, based on chemodynamical results of Larson (1976), was suggested in order to reproduce the abundance gradients along the thin disk.

– The alpha-elements are always mentioned without specifying which alpha-elements. Please clarify

--The APOKASC-2 dataset for the derivation of asteroseismic ages is not yet published (Miglio et al. in preparation). Would it be possible to show in this paper the age-metallicity relation derived for this dataset?

--The original data are divided into two groups, the training and testing data. The assumed criteria for this choice should be better explained.

--In Figure 9 there are “schematic chemical evolution paths”. It is not clear how these paths have been derived. Are they obtained by means of models? Please explain. The path of the local thin disc in Figure 9 stops at [Fe/H]=0.0 dex. Which is the origin of the stars between the local and inner path for [Fe/H]> 0?

– In the two-infall models of Grisoni et al. (2017) and Spitoni et al. (2019), applied to the thick and thin discs, there is a gap in the star formation process due to the delay with which stars in the thin disc start forming and this delay is produced by assuming a threshold gas density for star formation . The authors seem not to find such a gap but instead a Bridge. The meaning of this Bridge is not clear and it should be better discussed. Do the Bridge stars form from the gas remaining after the formation of the thick disc? Then out of which gas does the thin disc form?

--Figure 6, right panel, shows that the Bridge stars are particularly concentrated in the region with the lowest [Fe/H]. In the text it is mentioned an age gradient but this effect is not discussed. In general, it is not clear the interpretation of the Bridge and the authors should discuss it also in comparison with the possible gap in star formation, suggested by observational papers (Gratton et al. 1996 and Fuhrmann 1998) and found by theoretical papers (Chiappini et al. 1997, Grisoni et al. 2017, Spitoni et al. 2019). The young stars with low [Fe/H] could be related to a gas dilution operated by the gas which is going to form the thin disk? Such a dilution has been suggested by several papers such as Calura & Menci (2009), Spitoni et al. (2019) and Buck (2020). Please discuss this important point.

--Page 8. The authors mention stellar migration in the solar region from inner and outer regions. The statement is too qualitative: can they say how many stars are expected to migrate?

--The assumed Galactic potential well has been assumed to be constat in time? If this is the case it does not appear correct. Please discuss this point.