

Exit report for CASPEN

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## Exploring how transformation of the matter density field can enhance cosmological information extraction

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## 21cm intensity mapping modelling methods

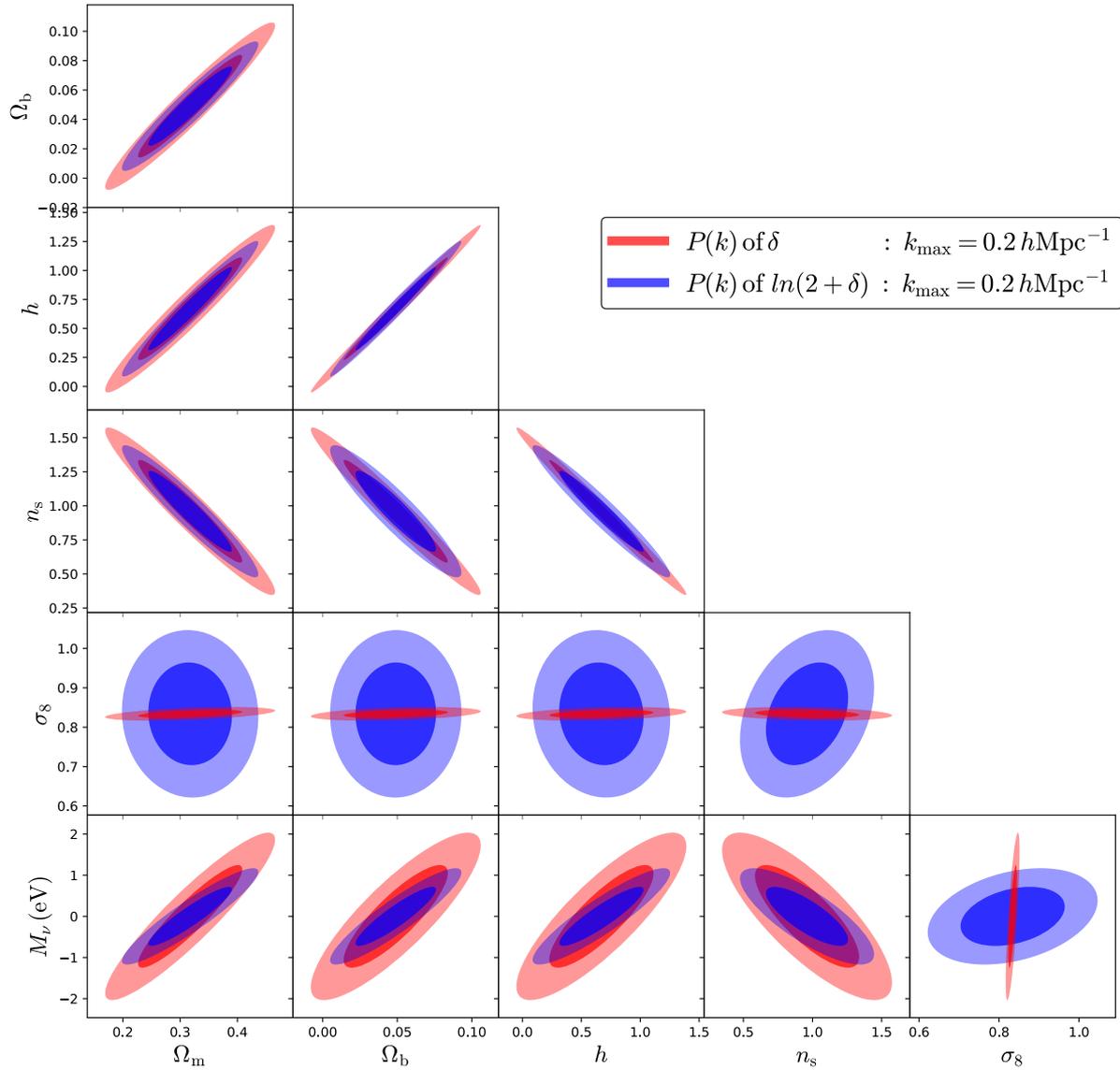
My fruitful stay at CCA can be summarised in two main topics: I have started a new project with Francisco and David Spergel on quantifying the available cosmological information in the full non-linear regime, and I advertised and discussed my on-going work on the modelling of the cosmological signal in 21cm intensity maps.

In the next years, an incredible wealth of experimental data will be available for cosmology and large scale structure studies, by means of both space- and ground-based facilities (Euclid, LSST, SKA just to name a few). Extracting information from these missions will allow us to provide answers to fundamental questions like what is the nature of dark energy? and what is the sum of the neutrino masses? Unfortunately, we still do not know what is the fraction of the available information embedded into different observables in the non-linear regime (e.g. the matter field power spectrum). We want to quantify the information that can be extracted from the matter density field itself and from an algebraic transformation of it. Inspired by theoretical works available in the literature, we first investigated the possibility of performing a logarithmic transformation of the density contrast, in order to ‘linearised’ also the small scale. We did so using the 15000 Nbody simulation of 1 Gpc per  $512^3$  particles run in the context of the Quijote project (PI: Francisco). Preliminary results are shown in the figure attached to the end of this document. These results are encouraging and we would like to pursue this project (adding redshift space distortion in the picture, playing around with other possible transformations and quantitatively comparing them, ...). We foresee the writing of a paper about this work in the near future.

During my stay at CCA I gave informal talks during the cosmology group meeting and during the journal club of the nearby New York University. Moreover, I participated in the workshop: ‘Cosmology and Astrophysics with Intensity Mapping’ held at CCA from 20 to 22 February, where I was invited as speaker, the title of my contribution being: ‘The 21cm IM

signal at  $z < 6$ : modelling, dependence on cosmology, synergies with other probes'. During the workshop I was able to interact with most of the US/Canadian intensity mapping community.

This work was supported by a collaborative visit funded by the Cosmology and Astroparticle Student and Postdoc Exchange Network (CASPEN).



**Fig 1:** 1 and 2 sigma constraints on the cosmological parameters forecasted using a Fisher matrix analysis. The red color correspond to the traditional power spectrum statistics, the blue one to the power spectrum of a logarithmic transformation of the same field.