Filippo Contenta
(f.contenta@surrey.ac.uk)

J. Petts, E. Balbinot, I. Claydon, M. Collins, M. Delorme, M. Gieles, A. Gualandris, J. Penarrubia, J. Read

Eridanus II: a cored dwarf galaxy?

Core or cusp dark matter profile?

Background:

The recently discovered Eridanus II (Eri II) ultra-faint dwarf is unique in that it has a central star cluster of stellar mass $\sim$4000 $M_{\odot}$ and half-light radius of 13 pc that lies $\sim$45 pc from the centre of Eri II in projection.

Fig.1: Figure 4 from Crnojević et al. (2016). LEFT: Image centered on Eri II, the red dashed ellipse marks its half-light radius. RIGHT: Zoom on the Eri II's star cluster.

Dwarf galaxy model for Eri II:

We estimate for Eri II a halo mass of $\sim 5 \times 10^8\ M_{\odot}$, based on Read et al. (2016a,b) and assuming that Eri II formed stars for 9 Gyr. With a fixed star formation time, there are two models of interest: a cusped model where cusp-core transformations don't occur and a model where they do.

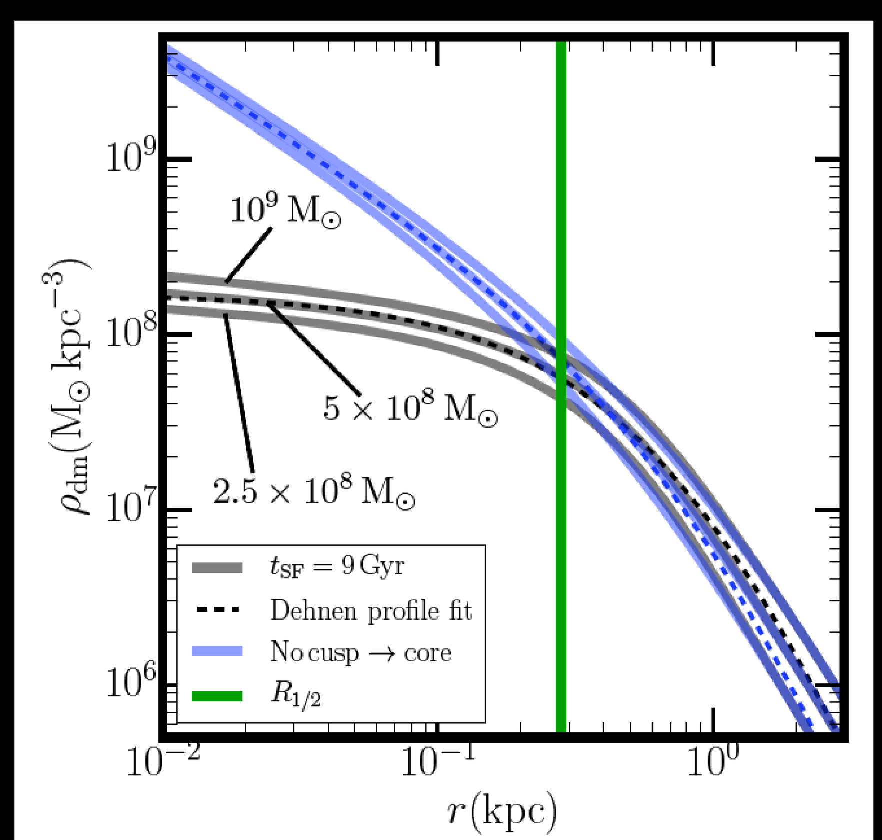

Fig.2: Estimated dark matter density profiles of Eri II. In blue the cuspy models, where the dashed blue line is the best fit with a Dehnen model with $\gamma = 1$. In grey the core models, where the dashed black line is the best fit with a Dehnen model with $\gamma = 0$. We show that changing the virial mass of the galaxy ($2.5 \times 10^8\ M_{\odot}$ and $10^9\ M_{\odot}$) produces relatively small effects. The green line is the half-light radius of Eri II.

The N-body simulations:

To study Eri II's star cluster we performed a suite of direct N-body simulations, in two Dehnen models (Dehnen 1993) shown in Fig. 2., using NBODY6df (Nitadori & Aarseth 2012; Petts et al. 2016), which include dynamical friction.

The initial galactocentric distance, size and mass of the cluster were explored in our grid of models. We analyse the results comparing the half-mass radius and the mass of the cluster with the observation uncertainties, taking into account that the cluster is close to the centre of Eri II in projection.

Results for the cored model:

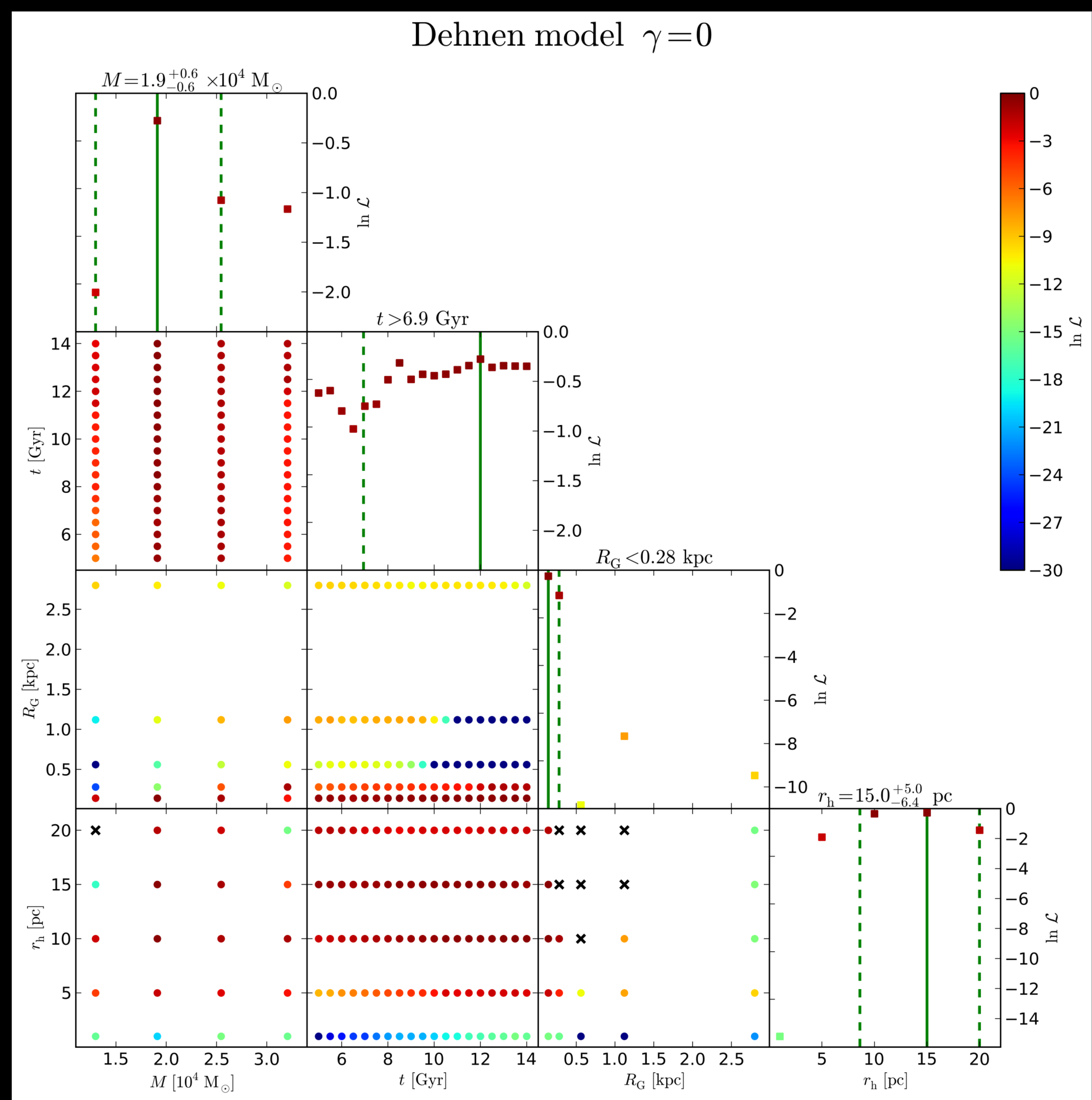

Fig.3: Triangle plot summarising our suite of simulations. Every point is a simulation and is colour-coded by its likelihood of fitting the observations. While the 'x' is a simulation that dissolve rapidly (< 5 Gyr). The diagonal panels show the marginalized likelihood for each explored parameter and the green solid and dashed lines are the best-fit and 1σ confidence intervals.

Results for the cuspy model:

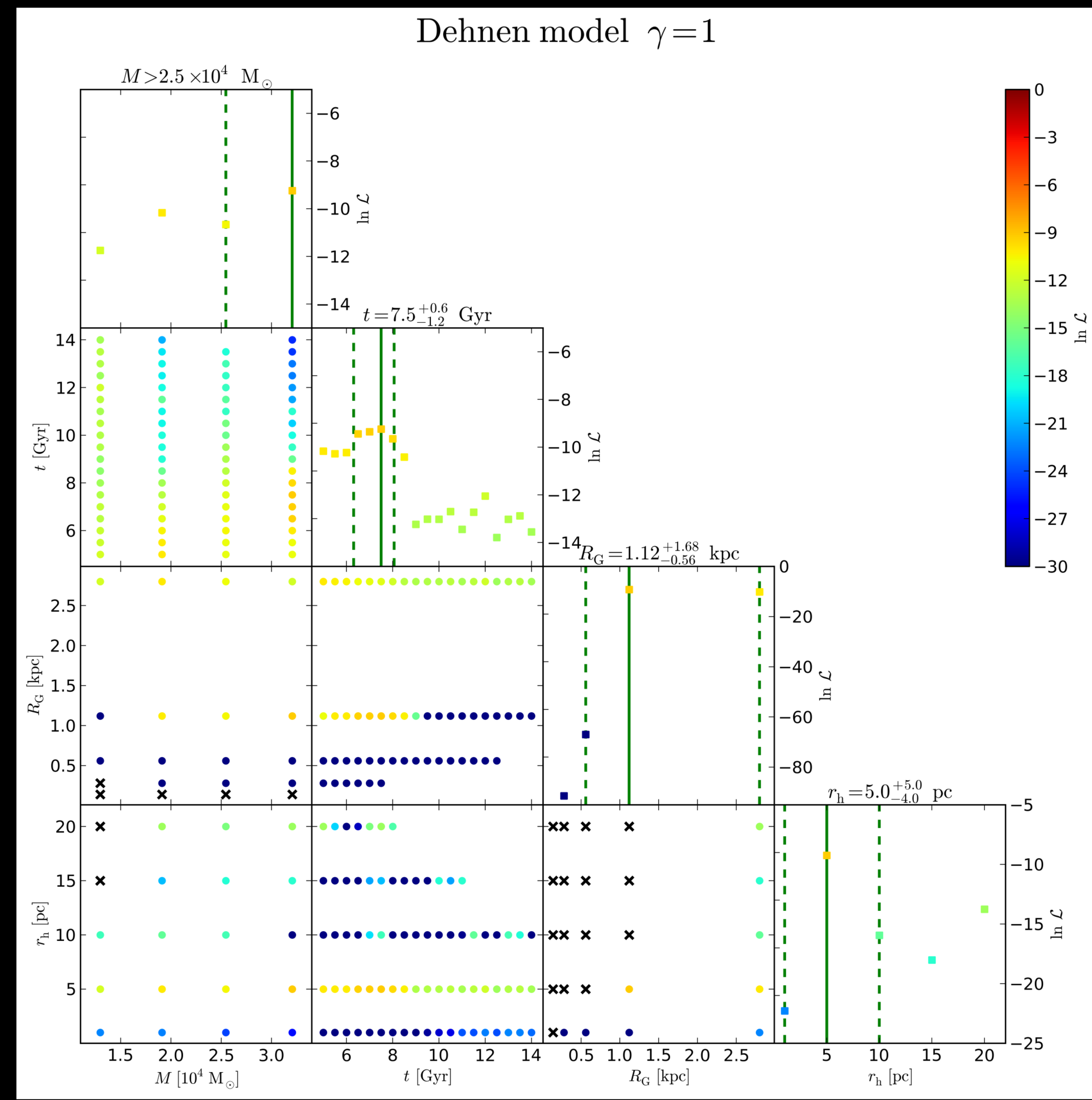

Fig.4: Triangle plot summarising our suite of simulations. Every point is a simulation and is colour-coded by its likelihood of fitting the observations. While the 'x' is a simulation that dissolve rapidly (< 5 Gyr). The diagonal panels show the marginalized likelihood for each explored parameter and the green solid and dashed lines are the best-fit and 1σ confidence intervals.

Conclusion:

In conclusion, Fig. 3 and 4 show us that a cored dark matter potential is favoured to fit the observational data, taking into account that the cluster lies close to the centre of Eri II in projection.

REFERENCES:
Crnojević D., Sand D. J., Zaritsky D., Spekkens K., Willman B., Hargis J. R., 2016, ApJ, 824, L14; Dehnen W., 1993, MNRAS, 265, 250; Nitadori K., Aarseth S. J., 2012, MNRAS, 424, 545; Petts J., Read J. I., Gualandris A., 2016, MNRAS, 463, 858; Read J. I., Agertz O., Collins M. L. M., 2016a, MNRAS, 459, 2573; Read J. I., Iorio G., Agertz O., Fraternali F., 2016b, submitted in MNRAS, arXiv e-print: 1607.03127