

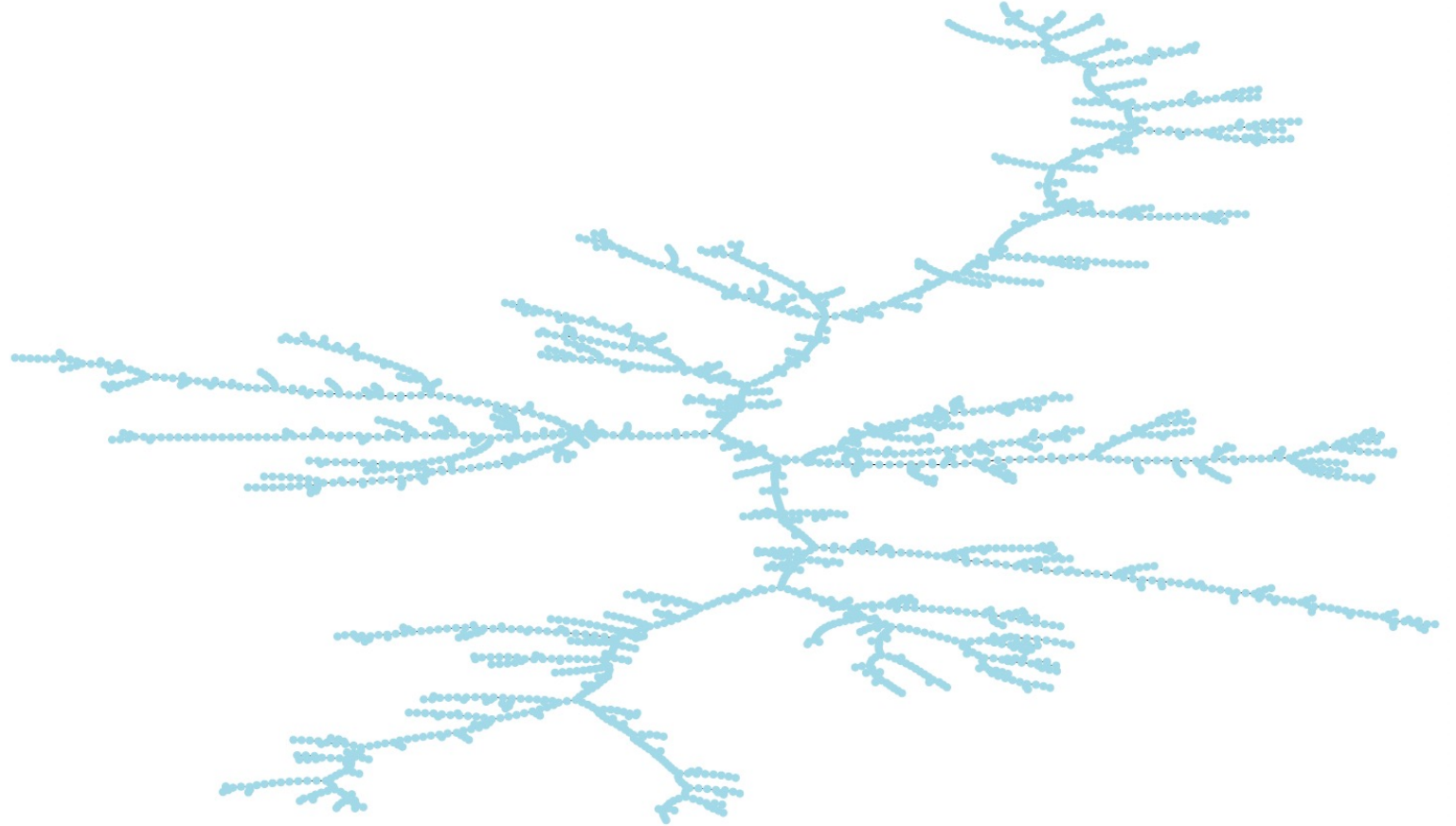
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# The pulsar tree: Visualizing the Pulsar population. Applications from Millisecond Pulsars to Fast Radio Bursts

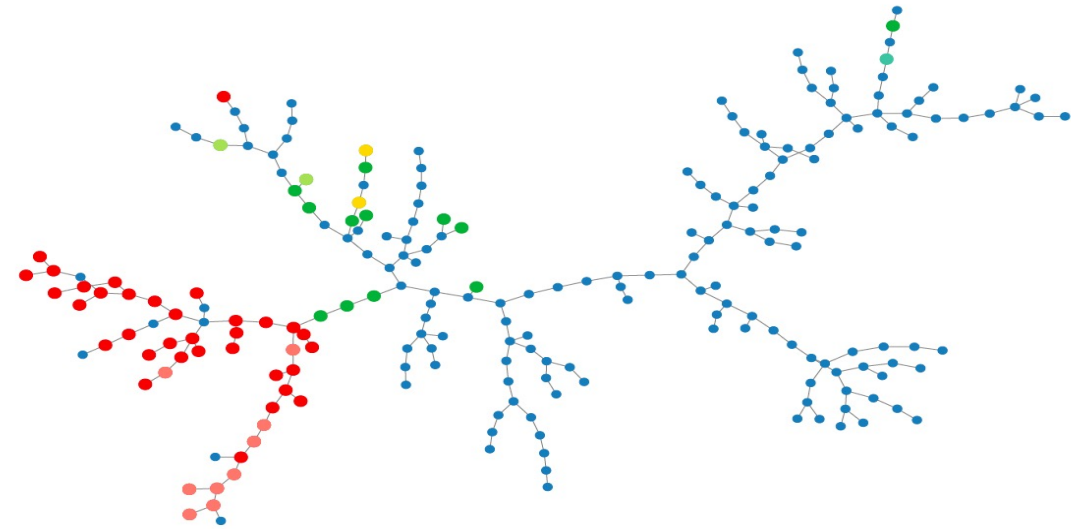
Carlos R. García, in collaboration with Diego F. Torres and  
other collaborators

- Visualizing the pulsar population using graph theory



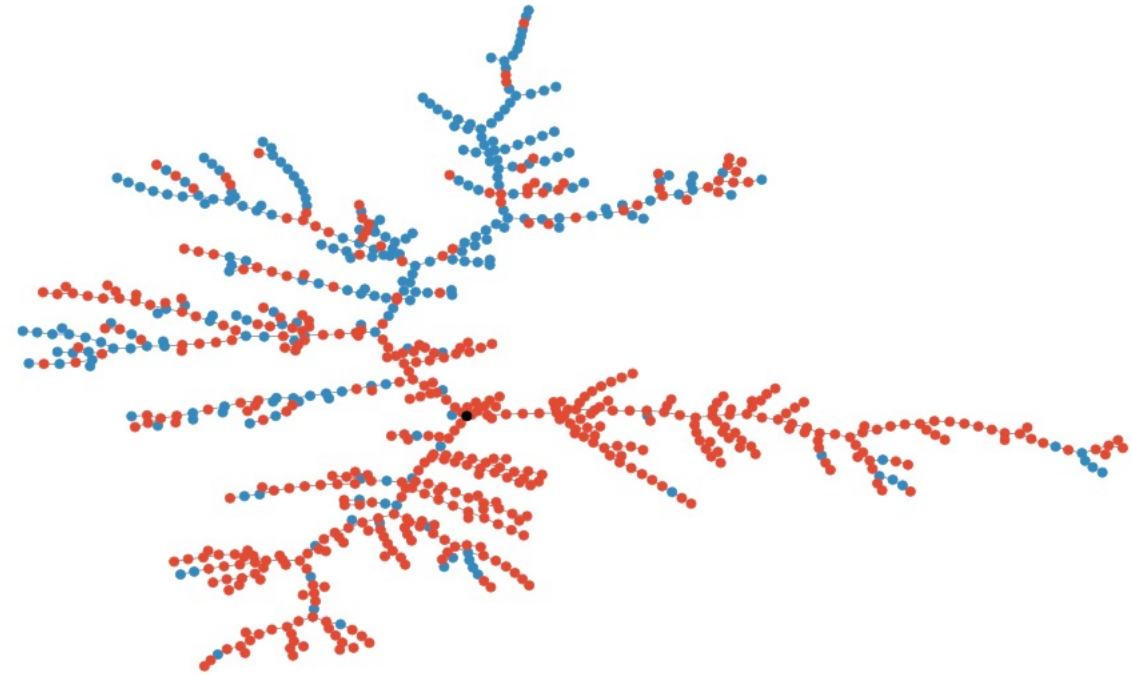
**Figure 4.** A different look at the pulsar population. MST-graph (2509,2508) based on the complete, undirected and weighted graph  $G(2509, 3146286)$  for the 2509 pulsars and their full combination of weights computed from their Euclidean distance among 8 normalized variables (or the equivalent 2 PCs). Each node in the MST represent a pulsar. Branches group pulsars with particular characteristics.

- Millisecond pulsars phenomenology under the light of graph theory



**Fig. 4.** Minimum spanning tree of the binary pulsar population defined as  $T(218, 217)$  based on the complete, undirected, and weighted graph  $G(218, 23653)$  computed from the Euclidean distance among ten scaled variables (or the equivalent four PCs that describe their whole variance). Each node in the MST represents a pulsar. The MST separately notes confirmed BWs (red), RBs (green), and tMSPs J1023+0038 and J1227-4853 (yellow), respectively. Also, the BWs and RBs in globular clusters (light red and light green, respectively) are highlighted. The RBs J1622-0315 (green) and the RB candidate J1302-3258 (light teal) are also noted in the rightmost branch of the MST. The unclassified ones appear in blue. See Table A.1 for more details.

- Separating repeating fast radio bursts using the minimum spanning tree as an unsupervised methodology



**Figure 3.**  $T(750, 749)$  computed from the Euclidean distance based on the combination of peak frequency, rest-frame frequency width, and brightness temperature. Repeaters are shown in blue and non-repeaters in red. The most central node in terms of betweenness centrality appears in black.



Thank you for your attention!



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