

Machine Learning techniques applied to cosmological problems.

Martín de los Rios

Director: Dr. Mariano Domínguez

Resumen

1

Introduction to Machine Learning techniques.

2

The MeSsI (Merging Systems Identification) Algorithm.

3

Derived Results.

- A2029/2033.
- A1204.
- A267.
- Statistical analysis of the magnetic fields in merging clusters.

4

CosmoMl:Machine Learning techniques applied to the CMB.

- Construction of the data set.
- Supervised methods.
- Cosmological parameters Angular distributions.

5

DM- γ interactions.

6

Conclusions.

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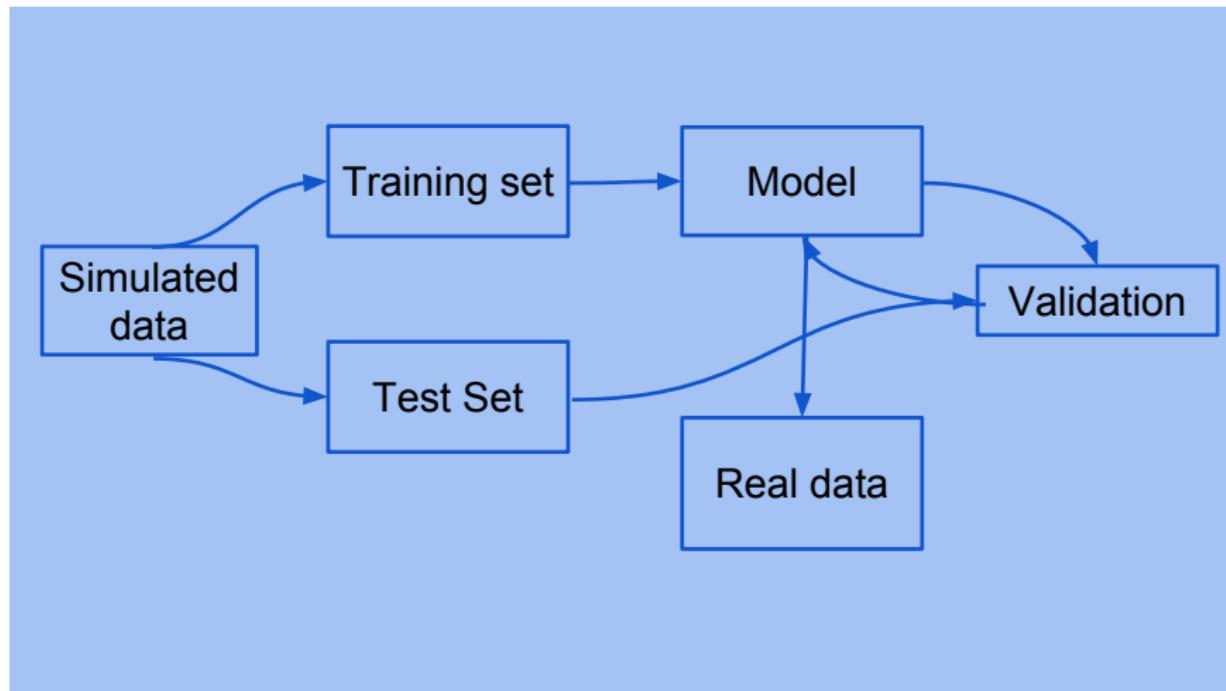
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A computer program learns to perform a task T , based on a training E and taking into account a measure P of its performance, if this measure P when making T improves with the training E.

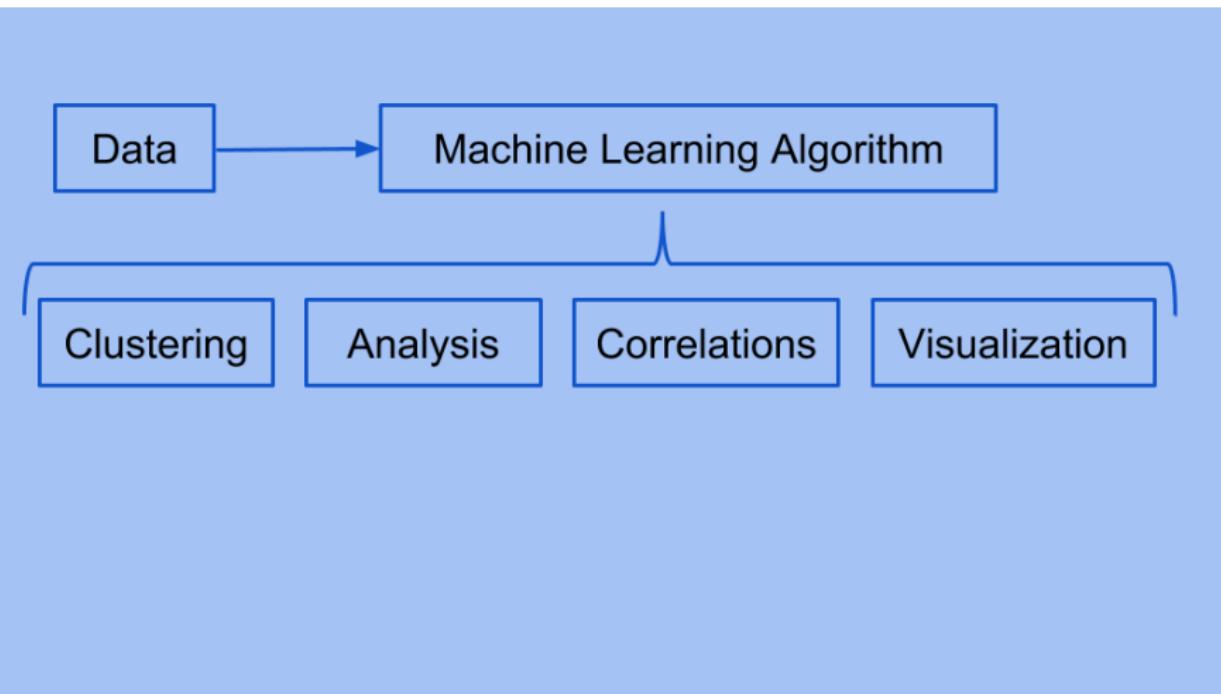
Supervised Learning.



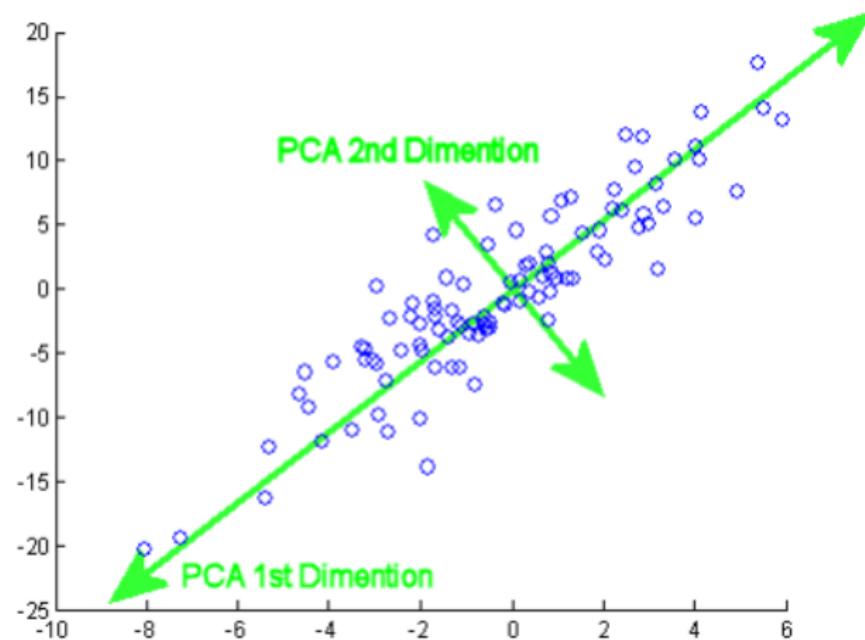
Random Forest

Support Vector Machines

Unsupervised Learning.



Principal Components Analysis.



Mixture of Gaussians

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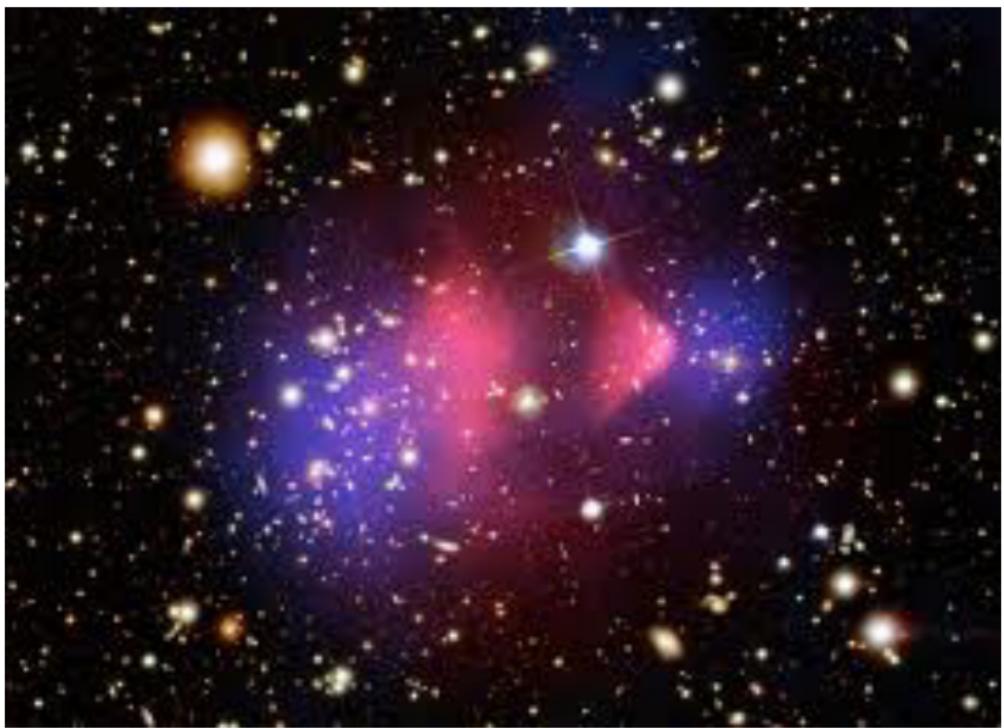
The MeSSI (Merging Systems Identification) Algorithm & Catalogue.

Martín de los Ríos¹*, Mariano J. Domínguez R.¹*, Dante Paz, Manuel Merchán^{1,2,3}.

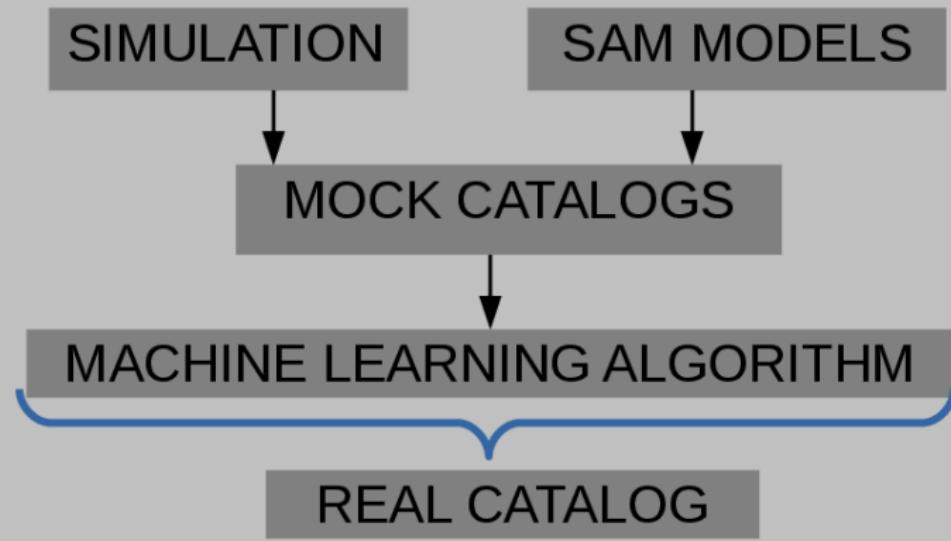
¹ Instituto de Astronomía Teórica y Experimental (CCT Córdoba, CONICET, UNC), Laprida 854, X5000BGR, Córdoba, Argentina.

² Observatorio Astronómico de Córdoba, Universidad Nacional de Córdoba, Laprida 854, X5000BGR, Córdoba, Argentina.

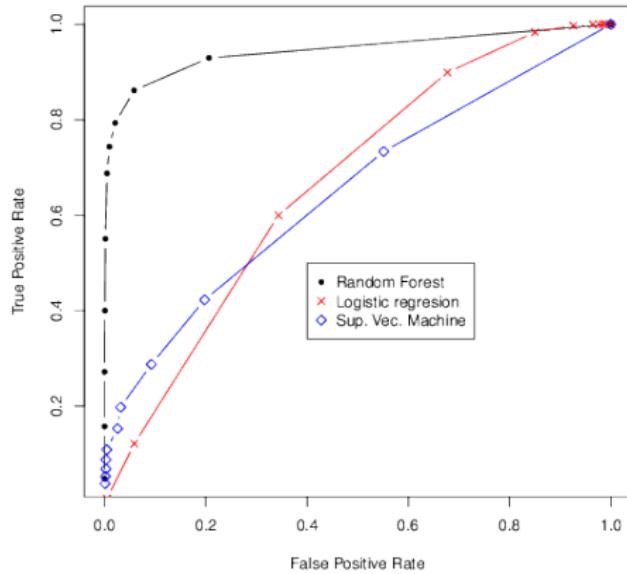
³ Consejo Nacional de Investigaciones Científicas y Técnicas, Rivadavia 1917, C1033AAJ Buenos Aires, Argentina.



$$\frac{\sigma}{m} < 0.47 \text{ m/s}^2$$



- Dressler-Shectman test.
- Non gaussianity test.
- Color.
- Number of galaxies.



- We found 61 candidates to merging clusters.
- In 32 of these we were able to identify the colliding substructures.
- 21 of these were previously classified as merging clusters by other authors.

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I. Analysis of candidates for interacting galaxy clusters

A1204 and A2029/A2033

Elizabeth Johana Gonzalez ^{1,2}, Martín de los Ríos^{1,2}, Gabriel A. Oio^{1,2}, Daniel Hernández Lang⁴, Tania Paez Tagliaferro^{1,2}, Mariano J. Domínguez R.^{1,2}, José Luis Nilo Castellón^{3,4}, Héctor Cuevas L.⁴, and Carlos A. Valotto^{1,2}

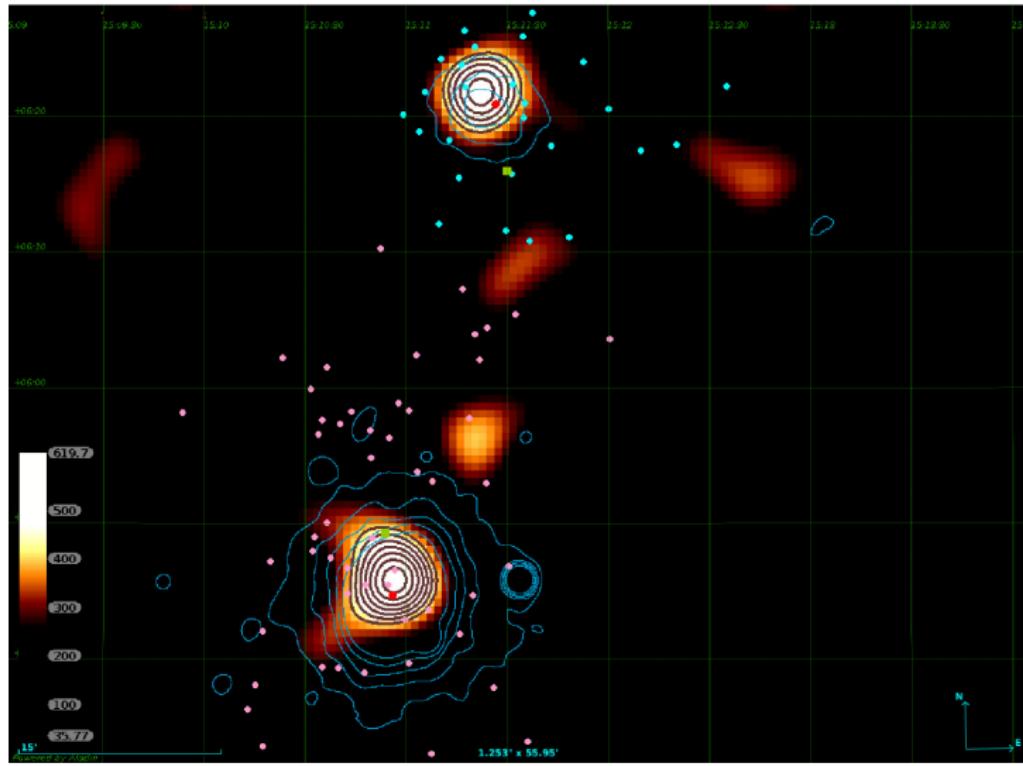
¹ Instituto de Astronomía Teórica y Experimental, (IATE-CONICET), Laprida 854, X5000BGR, Córdoba, Argentina.

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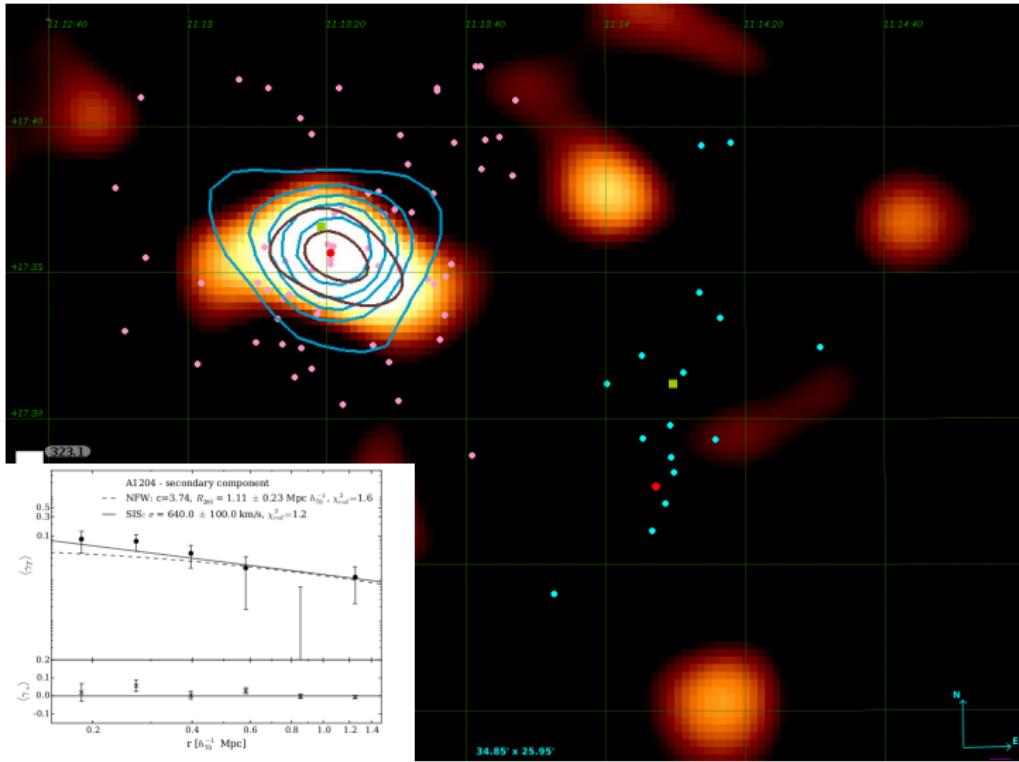
³ Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Universidad de La Serena. Benavente 980, La Serena, Chile.

⁴ Departamento de Física y Astronomía, Facultad de Ciencias, Universidad de La Serena. Av. Juan Cisternas 1200, La Serena, Chile.

A2029/2033



A1204



II. Analysis of candidates for interacting galaxy clusters: A267, a merging fossil group.

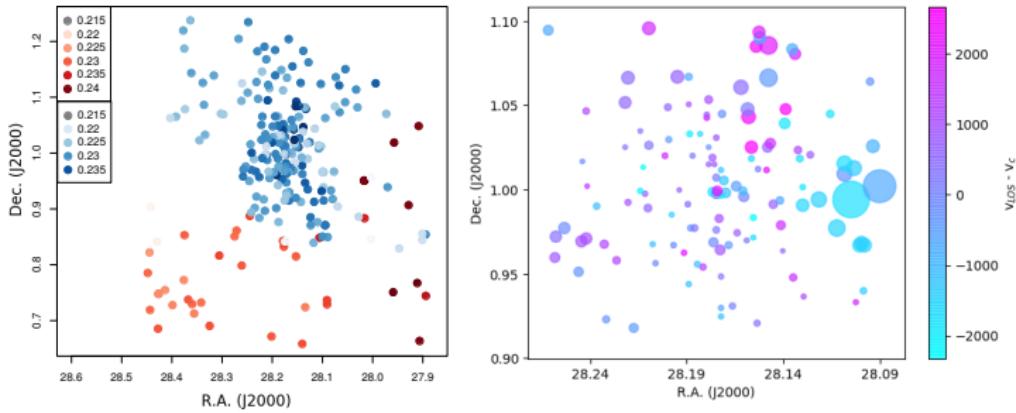
Elizabeth Johana Gonzalez ^{★1,2}, María Jose Kanagusuku^{1,2}, Martín de los Rios^{1,2}, Gabriel A. Oio^{1,2}, Daniel Hernández Lang⁴, Tania Aguirre Tagliaferro^{1,2}, Mariano J. Domínguez R.^{1,2}, José Luis Nilo Castellón^{3,4}, Héctor Cuevas L.⁴, and Carlos A. Valotto^{1,2}

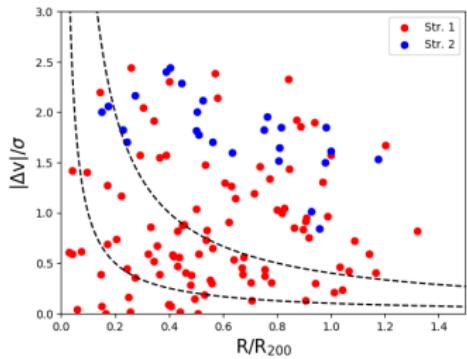
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- $\approx 40\%$ Fossil groups have a major merger $z < 0.8$.
- $\approx 15 - 25\%$ Fossil groups have a major merger $z < 0.3$.

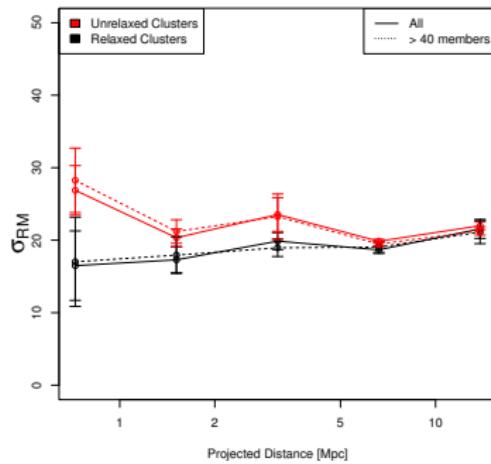
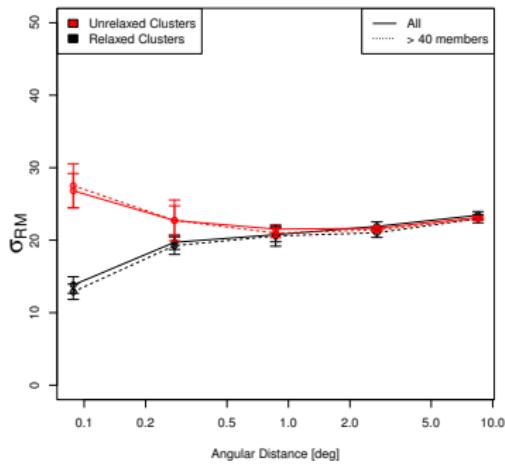
Faraday Rotation Measure dependence with galaxy clusters dynamics

F.A. Stasyszyn^{1,2*} & M. de los Rios^{1,2,3}

¹ Instituto de Astrofísica Teórica y Experimental (IATE), Laprida 854, Córdoba, Argentina

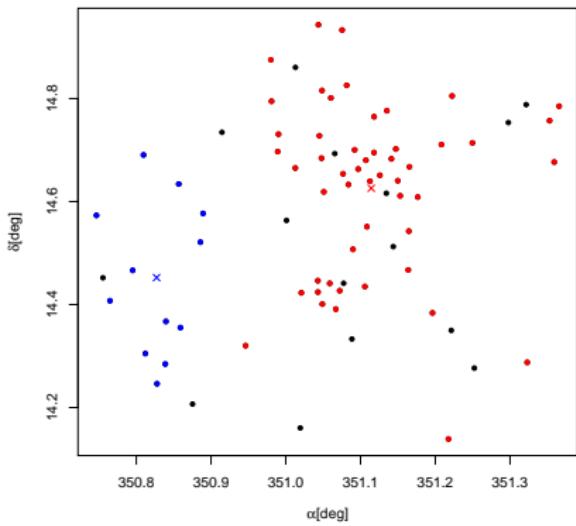
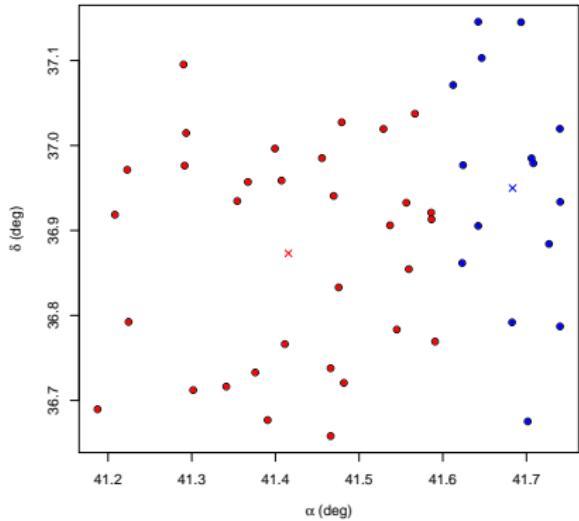
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Future work

A376



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CosmoML: Machine Learning techniques applied to the Cosmic Microwave Background.

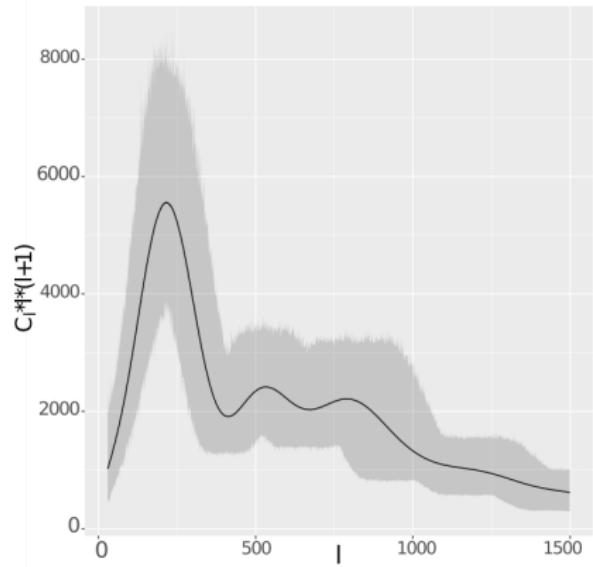
Martín de los Ríos[★], Mariano J. Domínguez R.^{★ 1,2,3}.

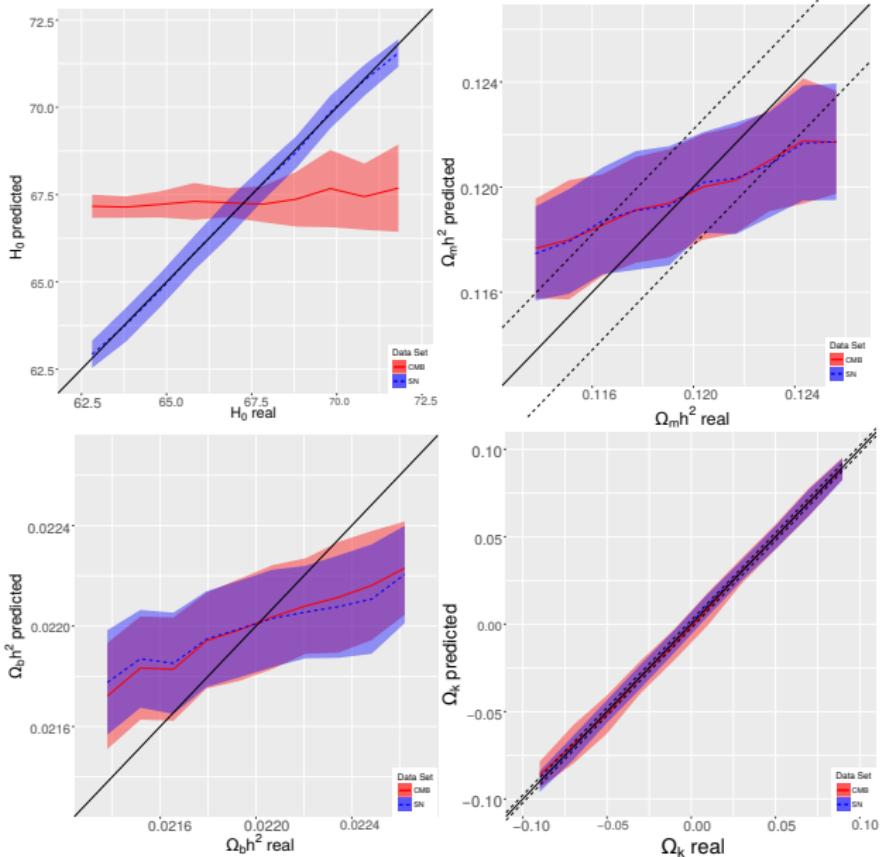
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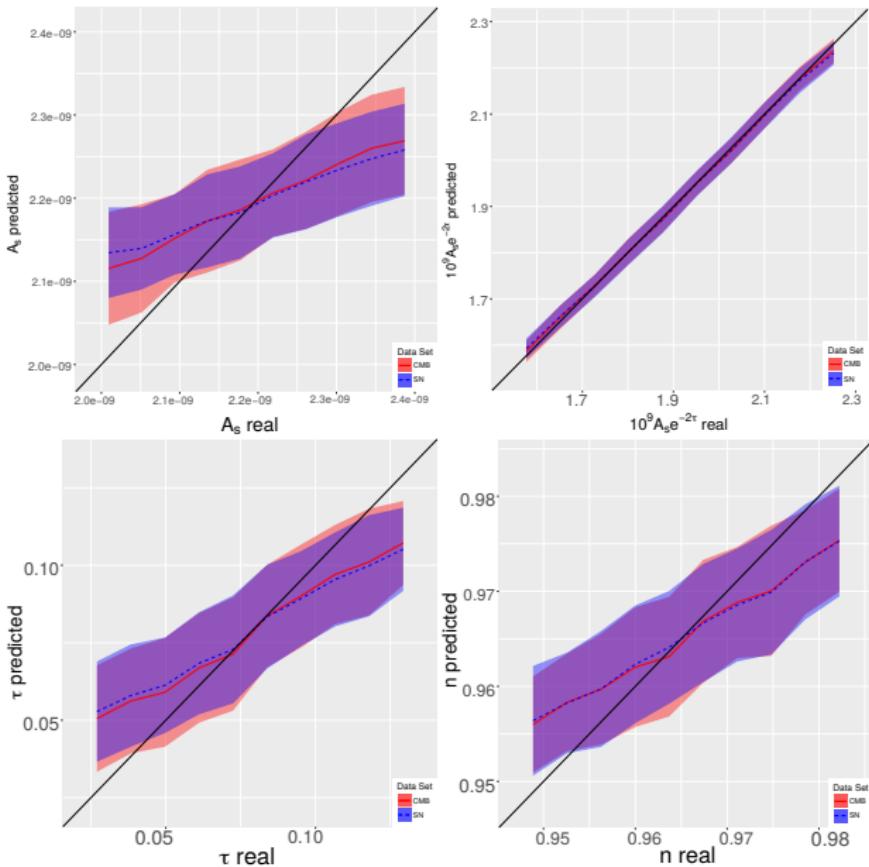
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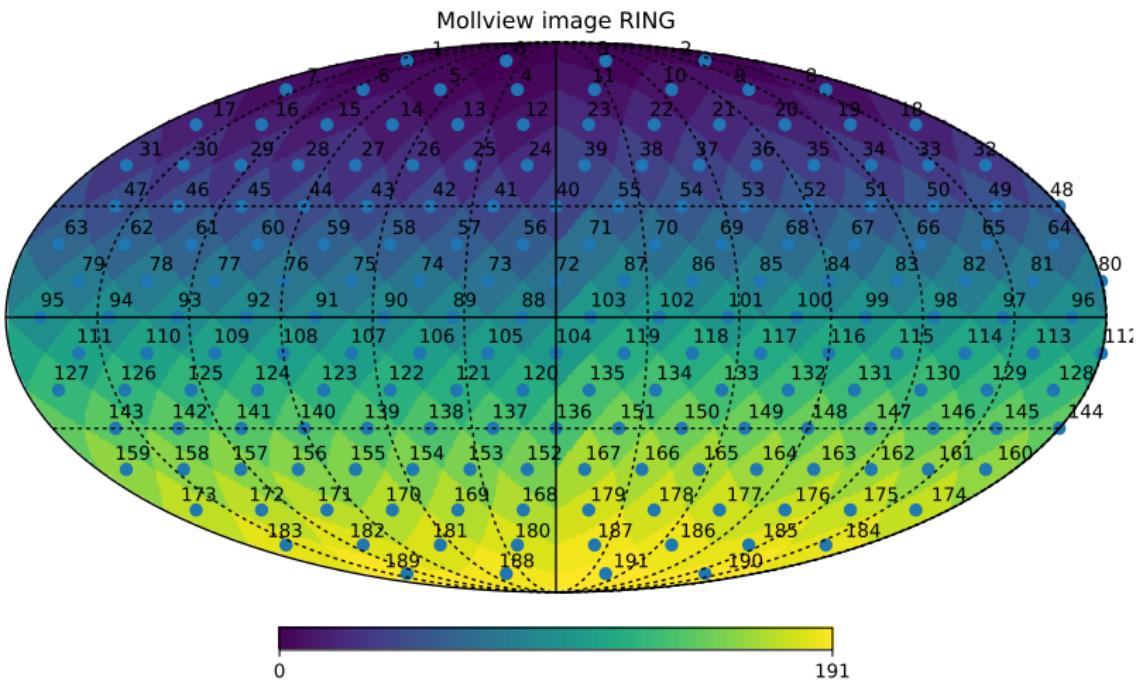
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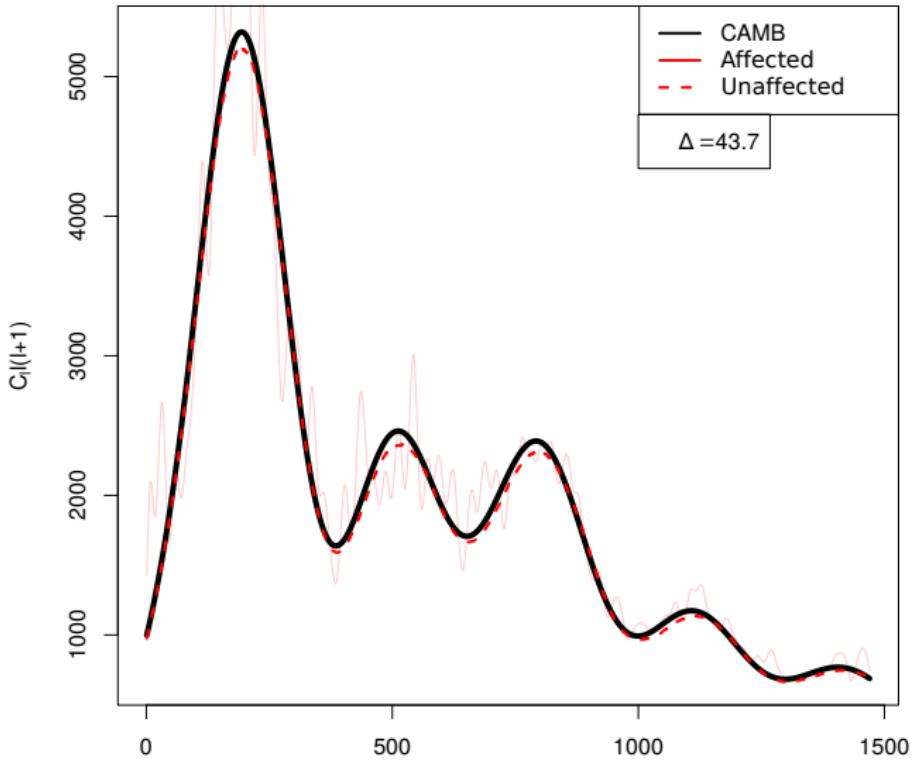
Parameter	Minimum	Maximum	Planck
$\Omega_m h^2$	0.1131	0.1263	0.1197
$\Omega_b h^2$	0.02131	0.02269	0.022
Ω_k	-0.1	0.1	0
H_0	62.31	72.31	67.31
n	0.9469	0.9841	0.9655
A_s	$1.988 * 10^{-9}$	$2.408 * 10^{-9}$	$2.198 * 10^{-9}$
τ	0.021	0.1349	0.078

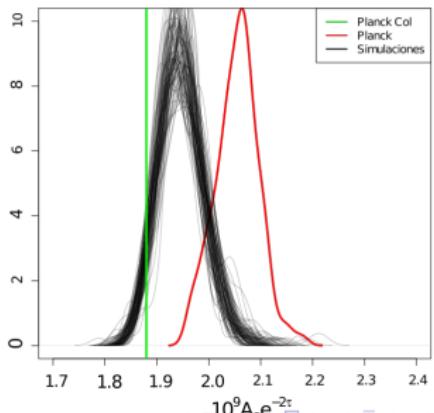
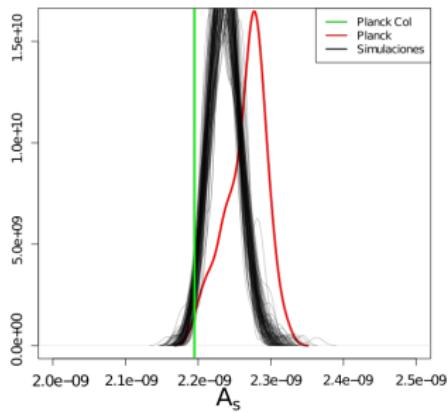
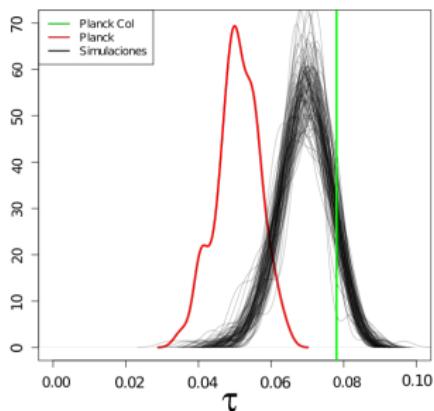
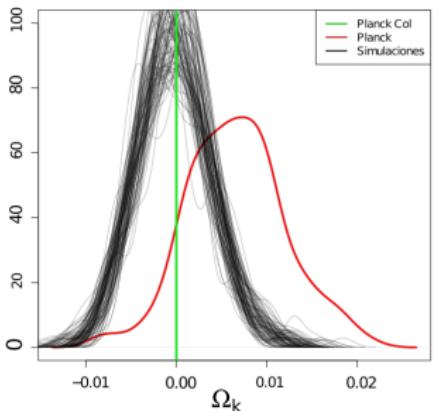






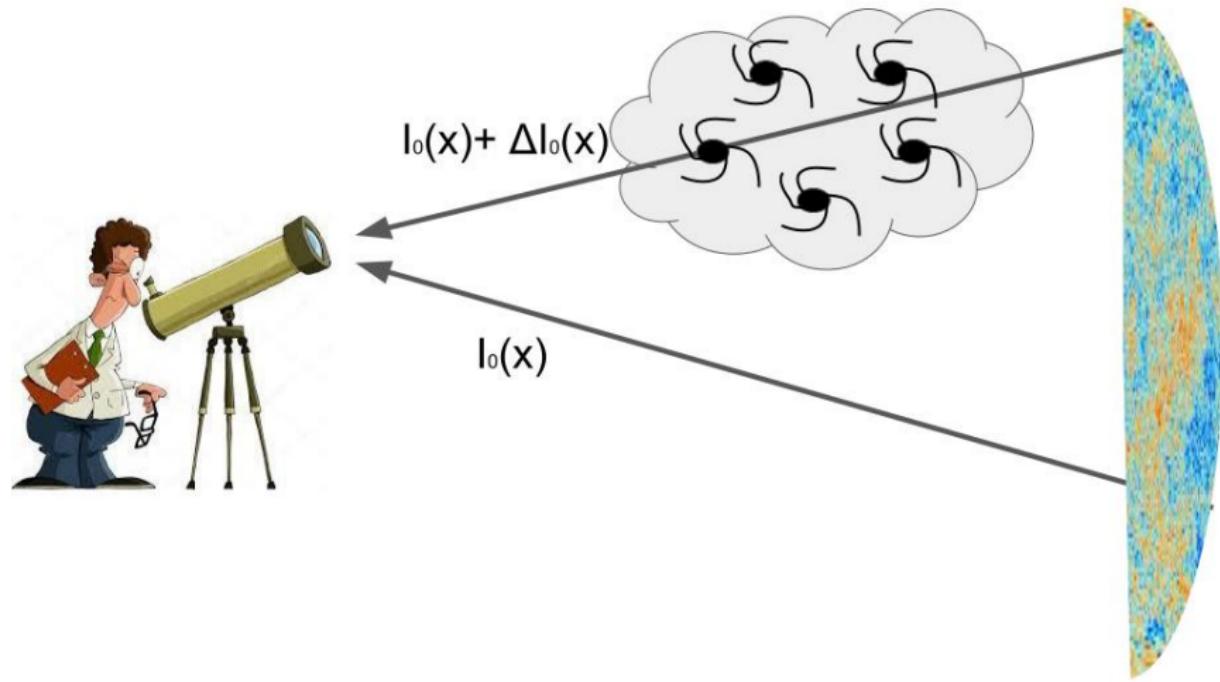






DM- γ interactions (work in progress)

In collaboration with Celine Bœhm



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- We studied the angular distributions of the cosmological parameters without finding anything unexpected in the standard cosmological model, with the possible exception of the parameter $10^9 A_s e^{-2\tau}$.
- We studied the effect that a possible interaction between CMB photons and DM haloes may produce in the CMB spectral distribution.

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- They can be very useful for classification and regression problems, achieving, in most of the problems, better results than the traditional methods in lower computational time.
- Taking into account the large amount of data that will be recorded by the future surveys, this technique will be essential for their analysis.



THANK YOU