CONICET

Instituto de Tecnologías en Detección y Astropartículas

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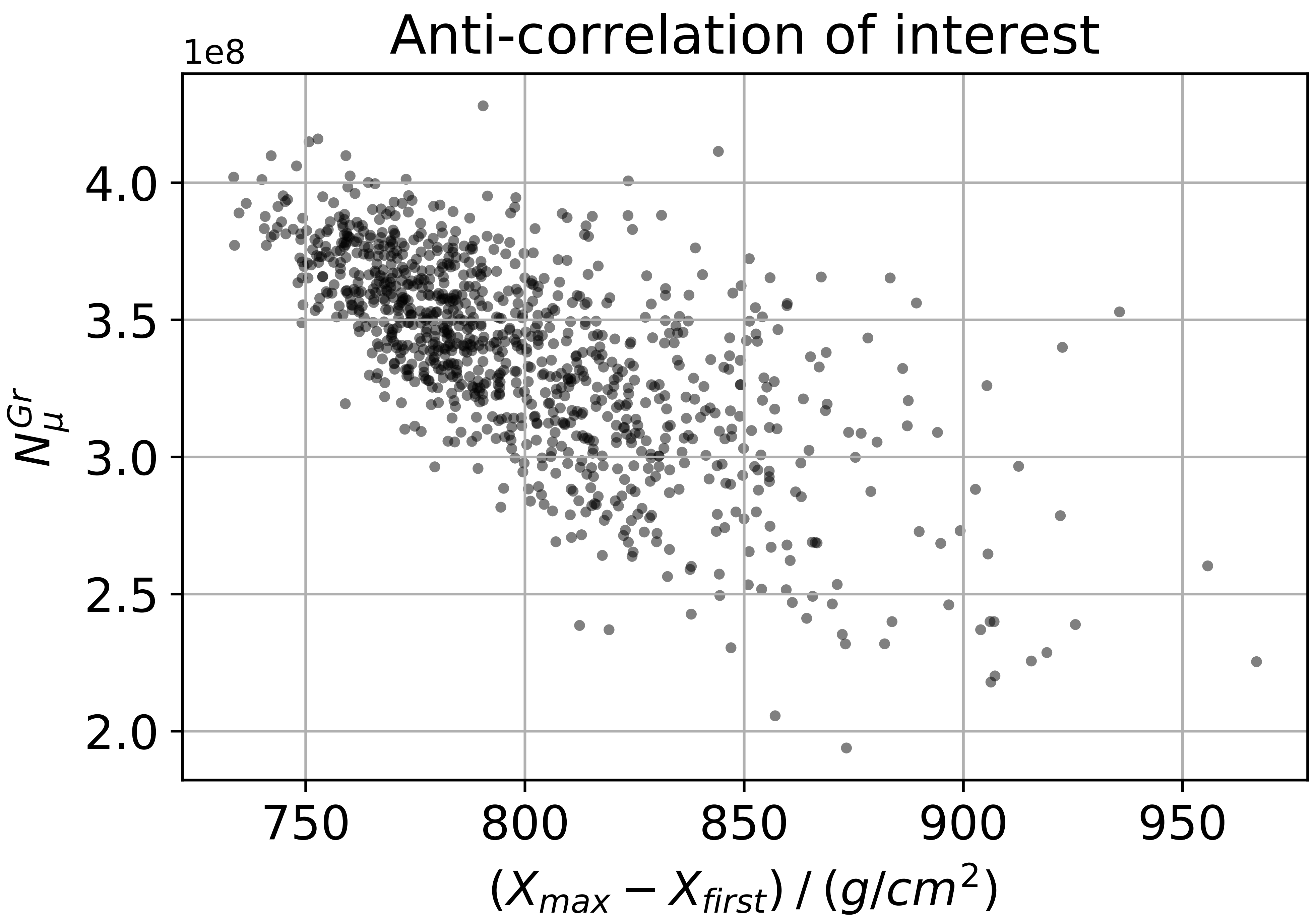
27/11/20

STUDY OF $X_{max} - N_\mu$ ANTICORRELATION

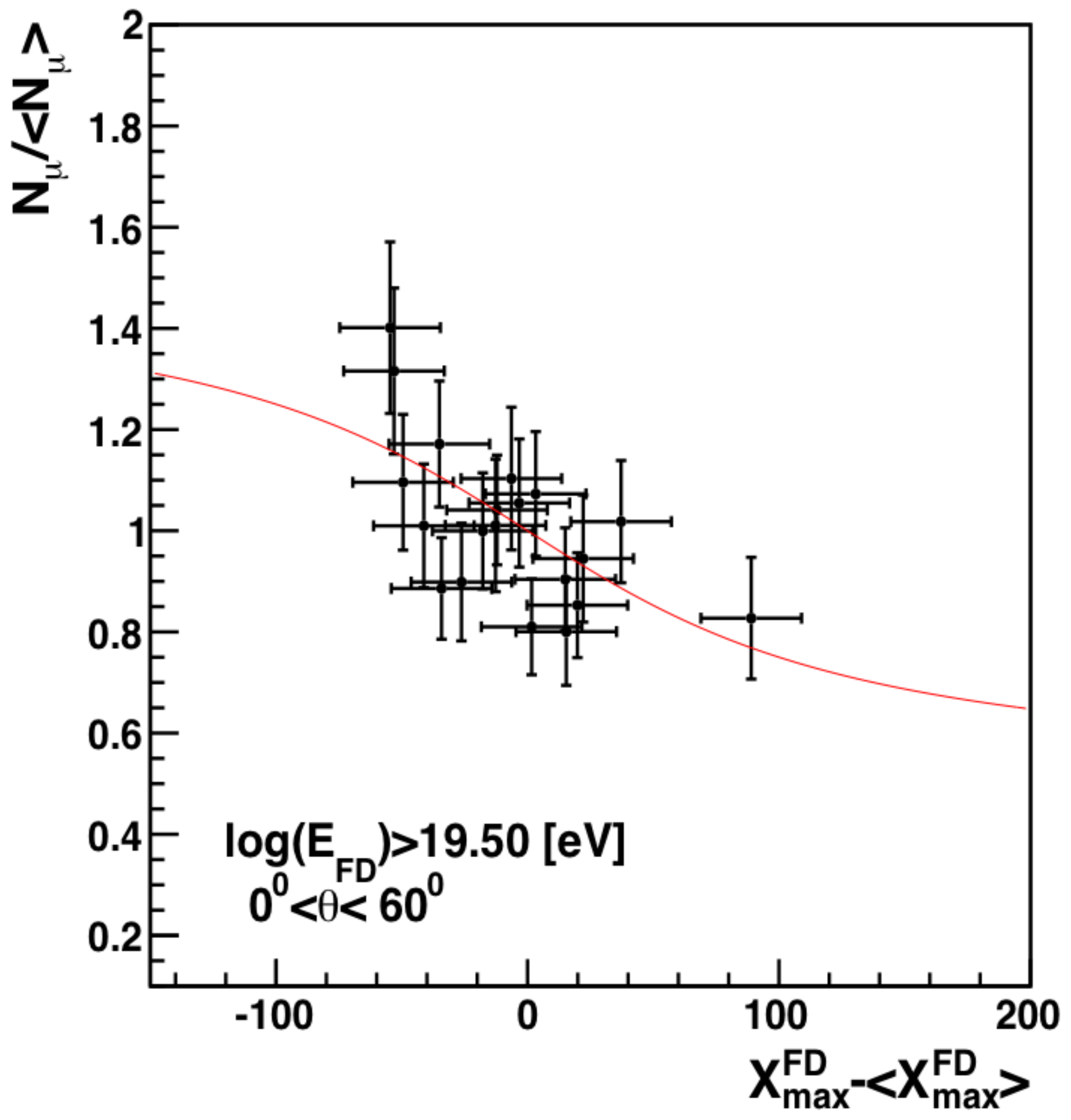
MOTIVATION



Theoretical interest: deduce something about physical parameters of the shower (mainly first interaction) and thus understanding the spread and the anti-correlation

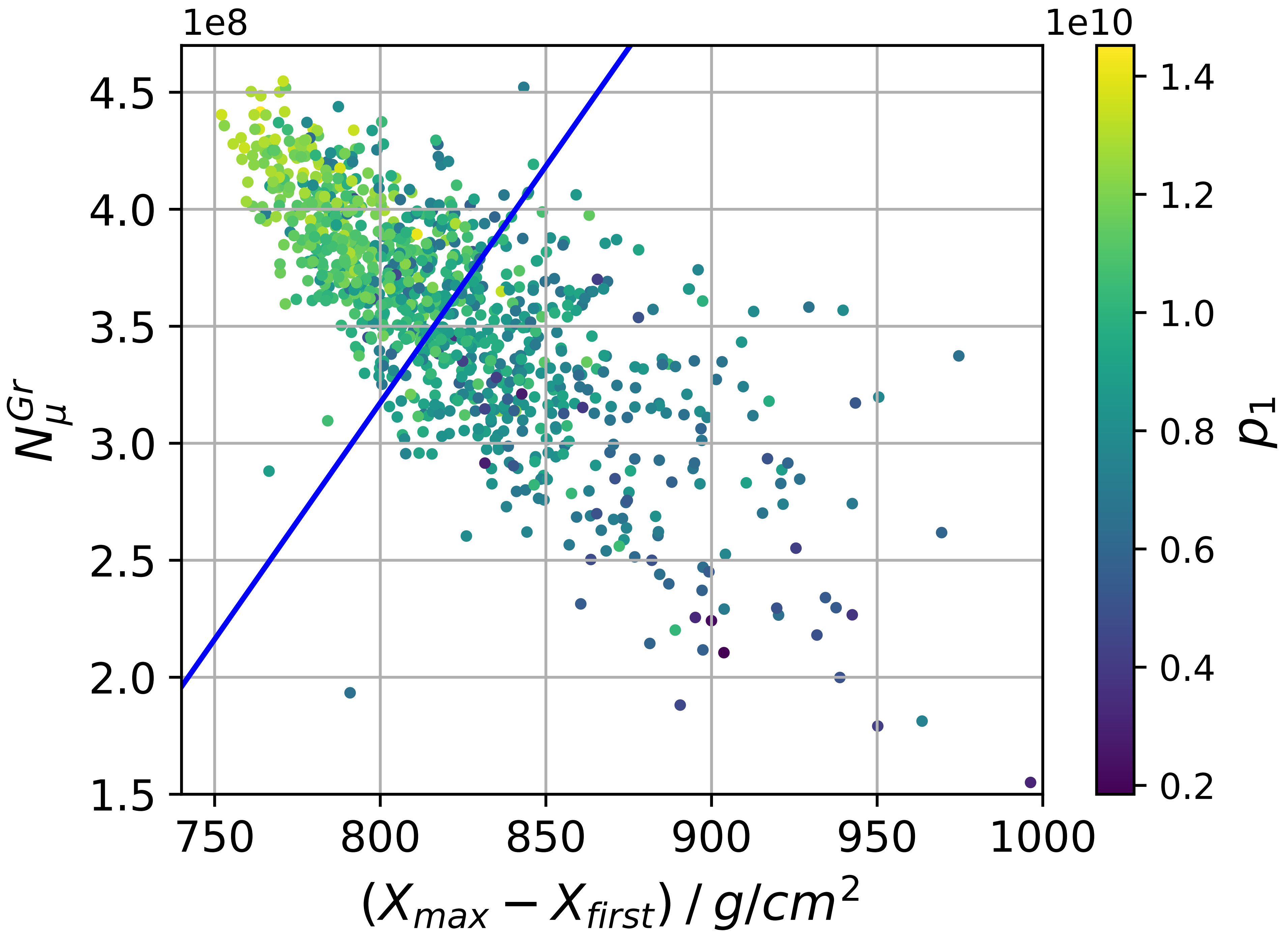
Practical interest: incorporate this new knowledge in the reconstruction of showers

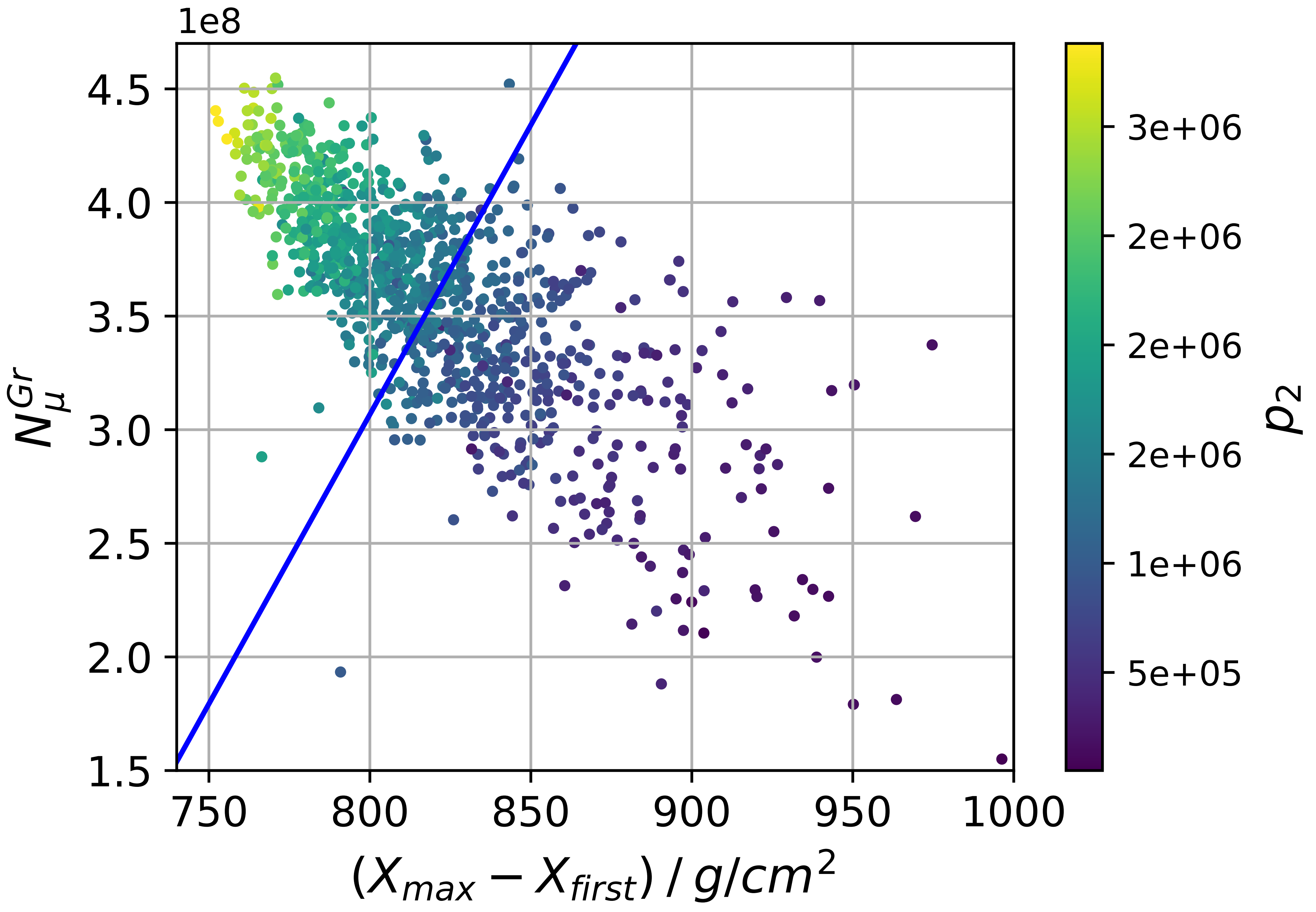
GAP2013, Ave, Bertou



$$N_\mu/\langle N_\mu\rangle = 1. + \arctan\Big(\big(\langle X_{max}\rangle - X_{max}\big)/100\Big)/\pi$$

INTERESTING PARAMETERS

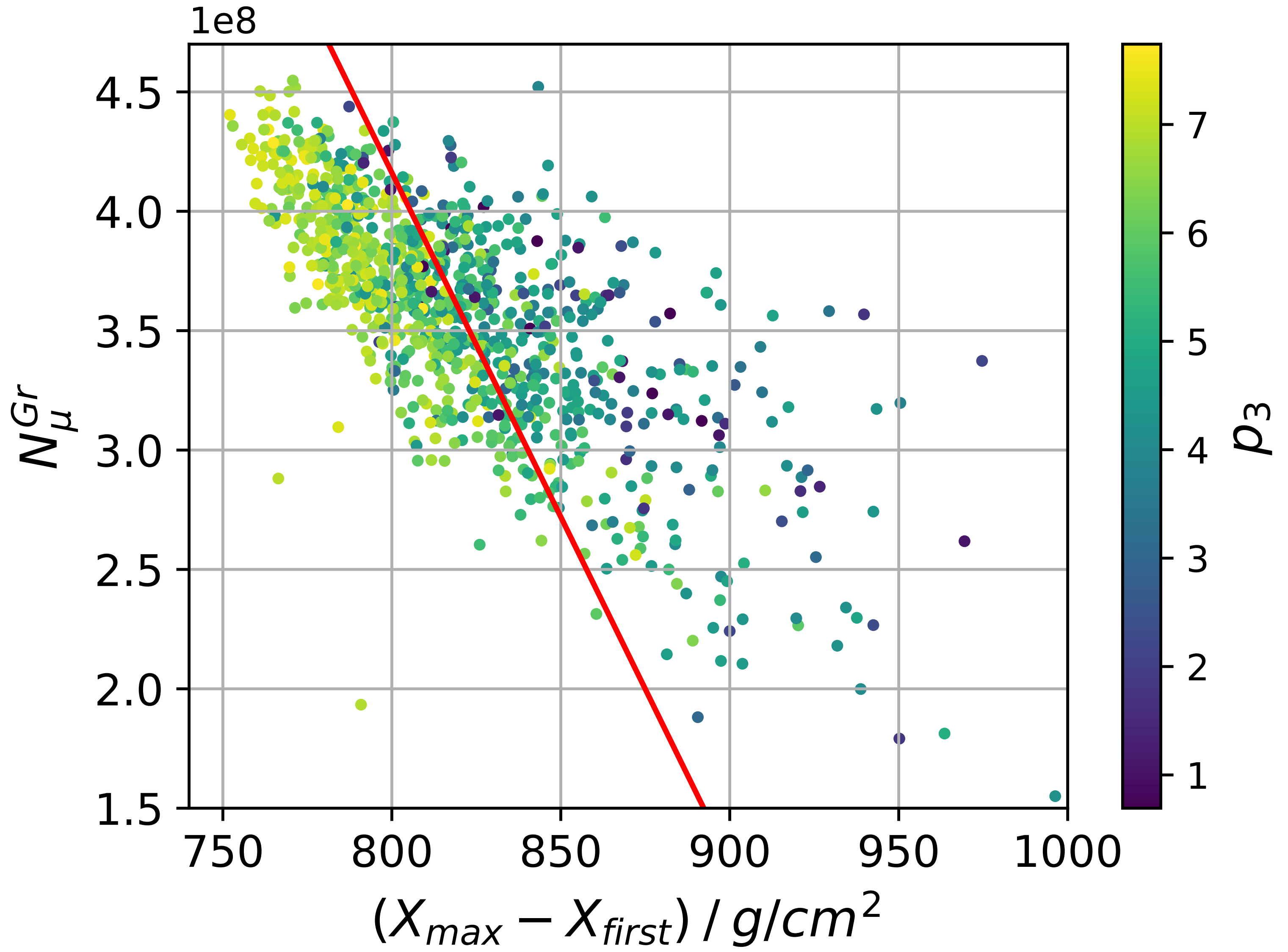




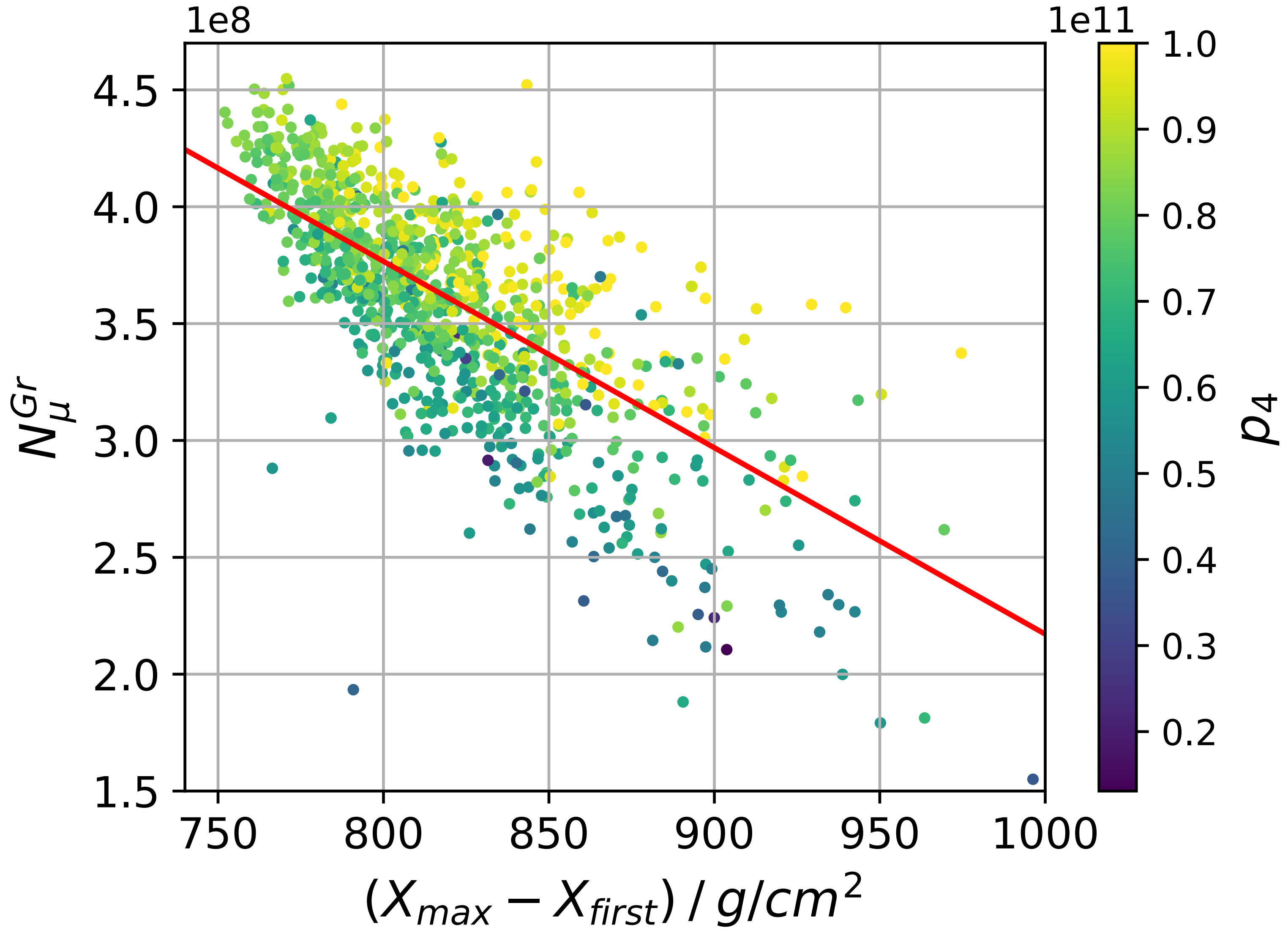
$$p_1 = E_0 \cdot f^1_{Ehad}(no\ LP) \cdot (f^{HM}_{Ehad})^{n-1}$$
$$+E_0 \cdot f^1_E(only\ LP) \cdot (f^{HM}_{Ehad})^{n_{LP}-1}$$

$$p_2 = E_0 \cdot f^1_{Ehad}(with\ LP) \cdot (f^{HM}_{Ehad})^{n_{(X_{max}-X_{first})}-1}$$

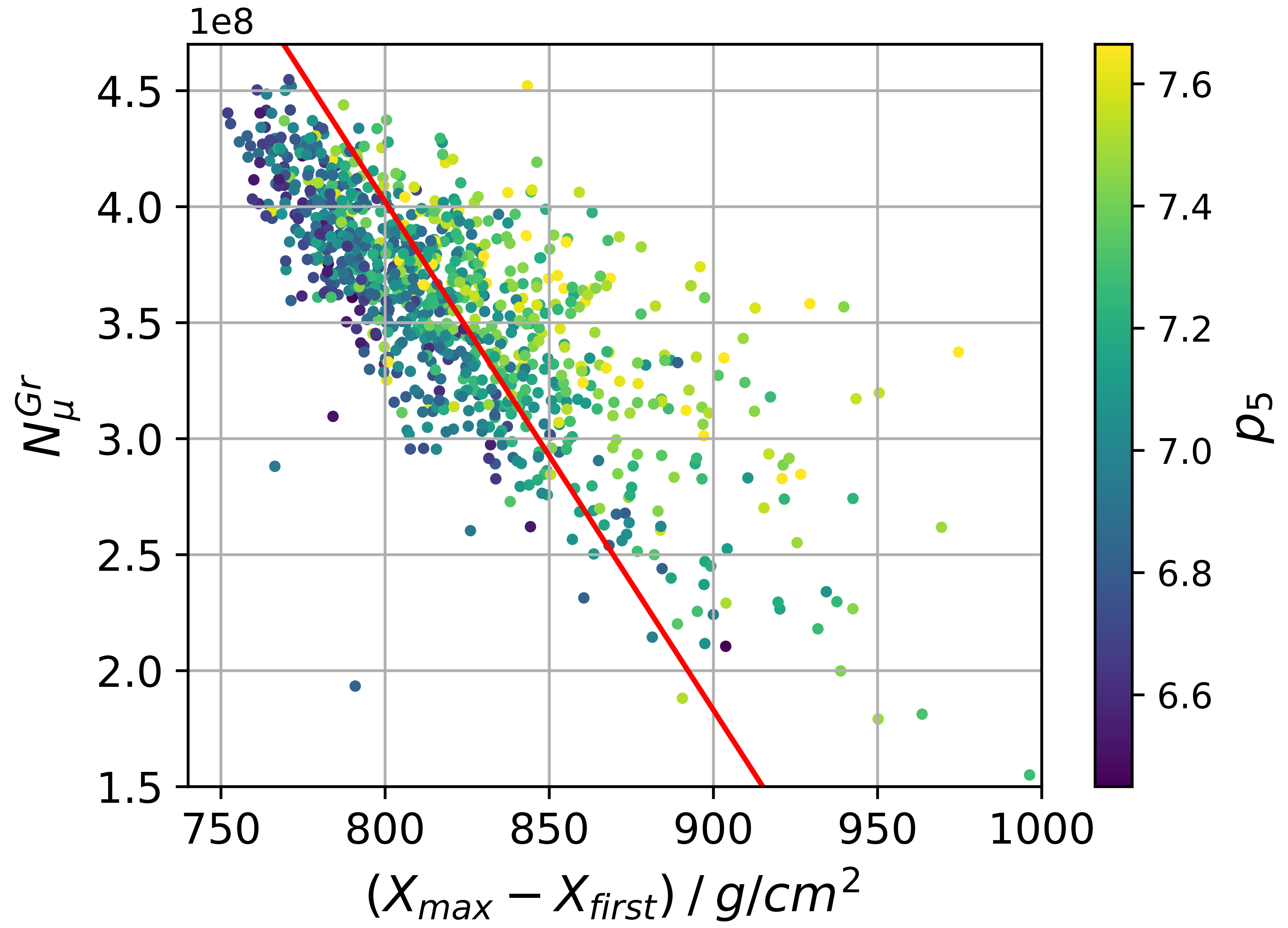
INTERESTING PARAMETERS



$p_3 = N^1_{had}$



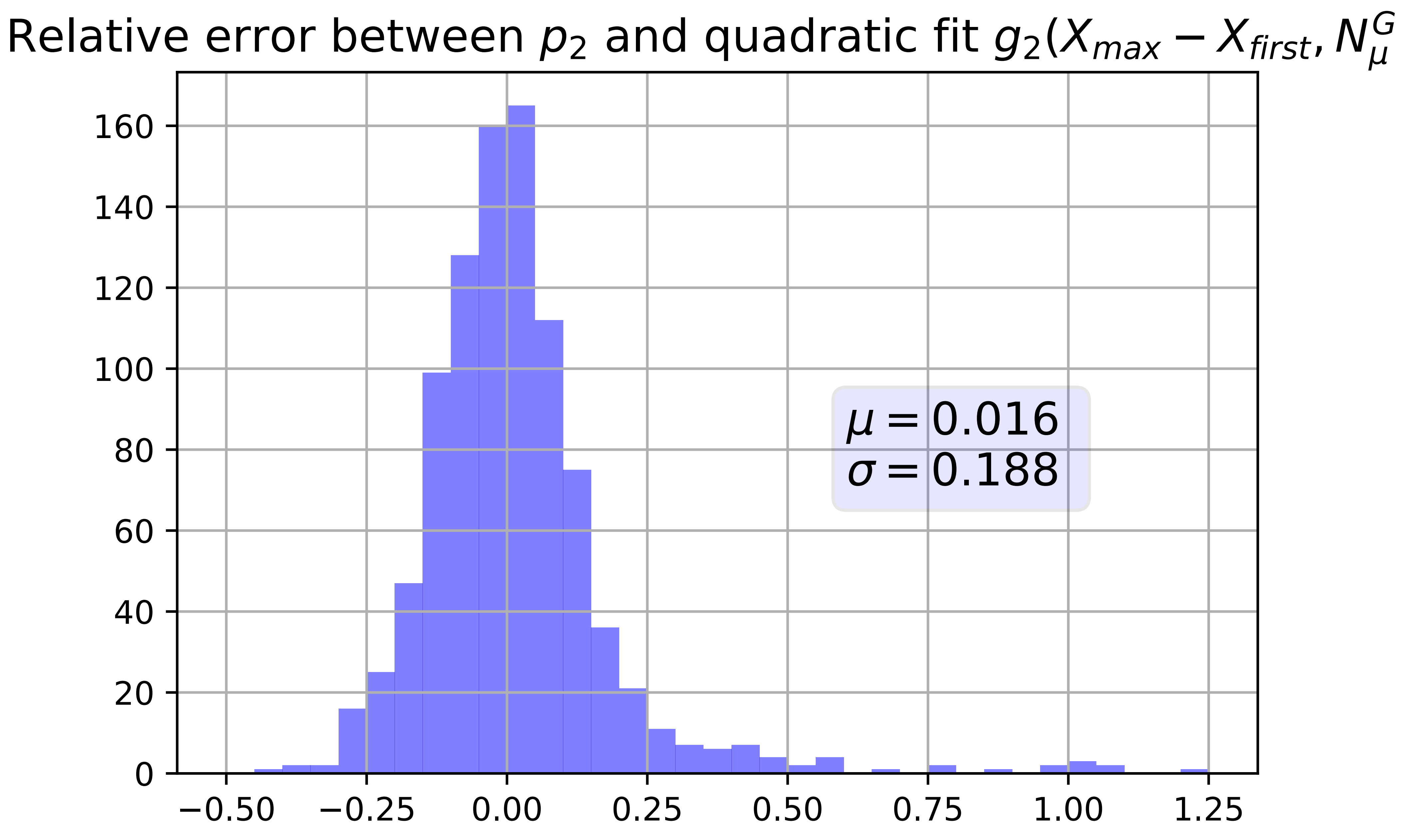
$p_4 = E^1_{had}$

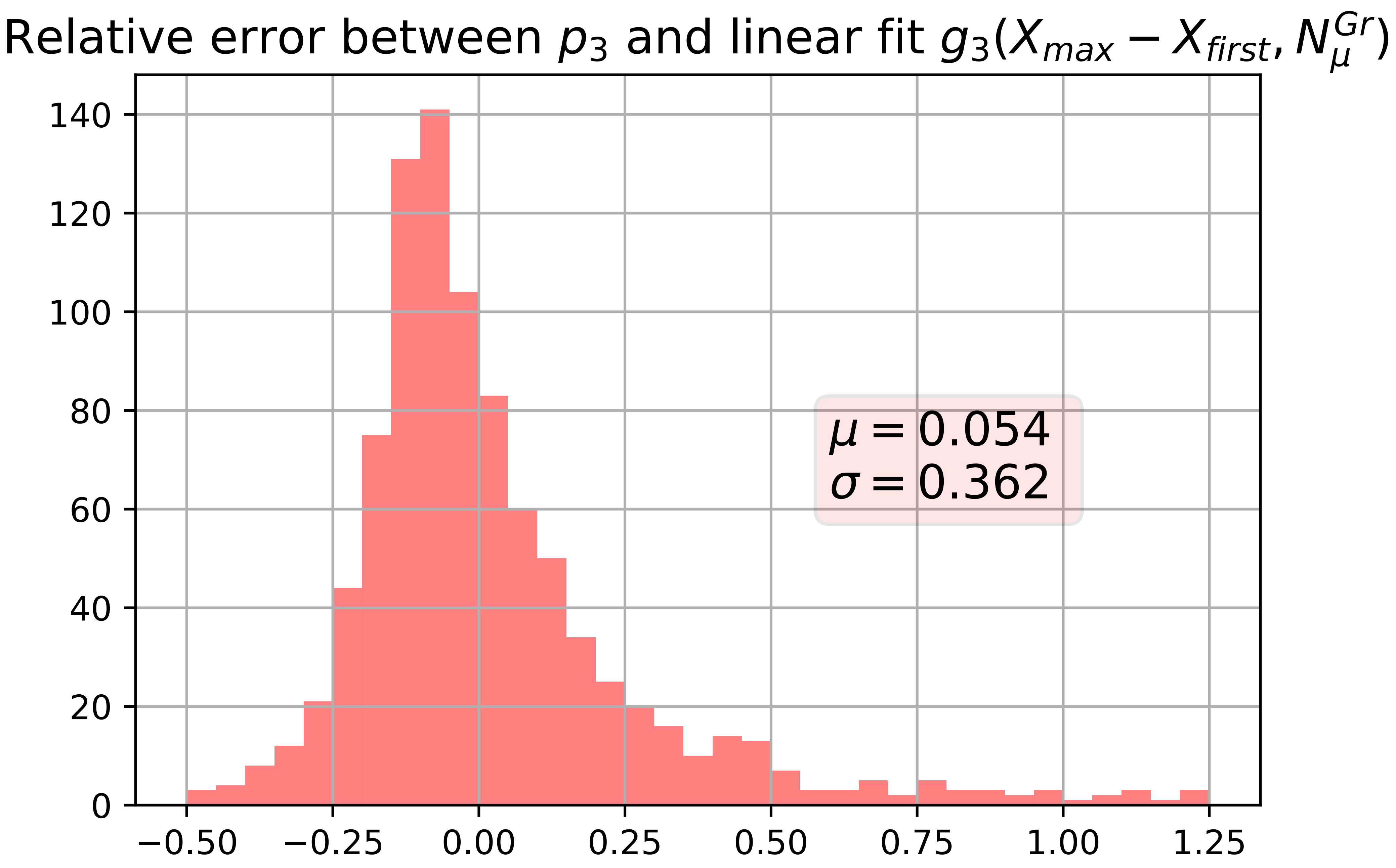


$p_5 = n_{LP}$

$had \longrightarrow$ charged pions and kaons, nucleons, lambdas, sigmas, ...

ANALYSIS OF p_2 AND p_3

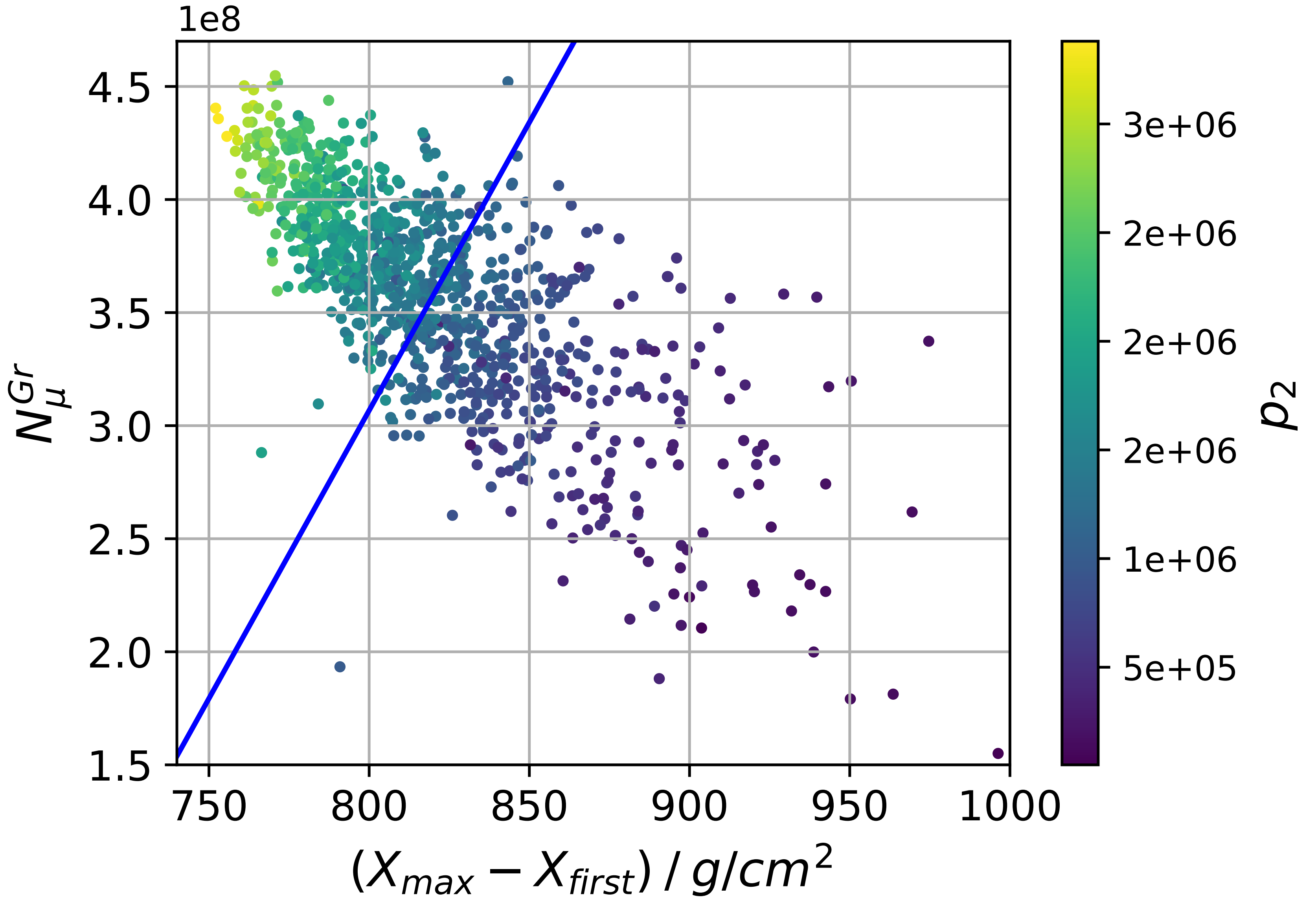


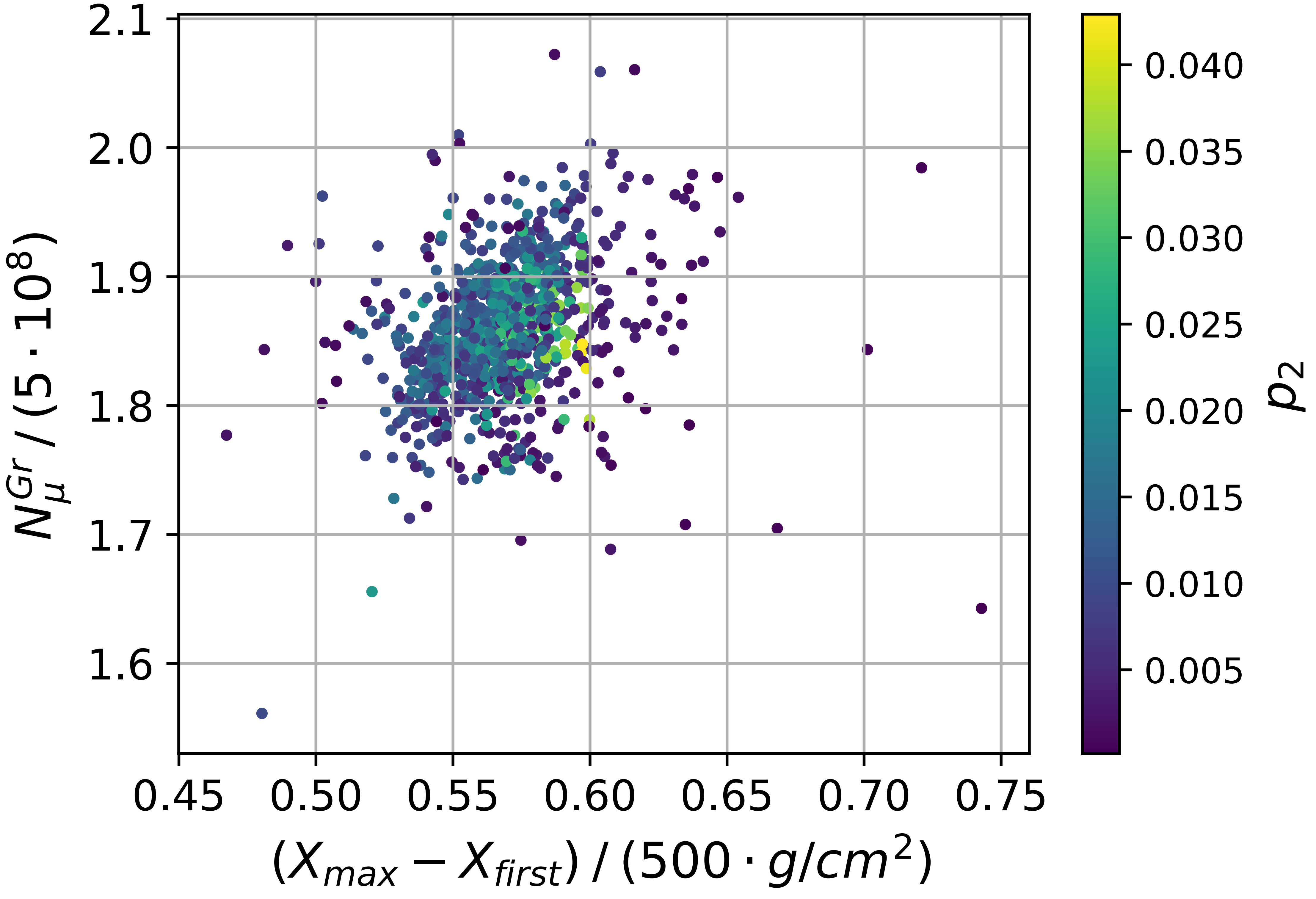


$$p_2 = E_0 \cdot f^1_{Ehad}(with\ LP) \cdot (f^{HM}_{Ehad})^{n_{(X_{max}-X_{first})}-1}$$

$$p_3 = N^1_{had}$$

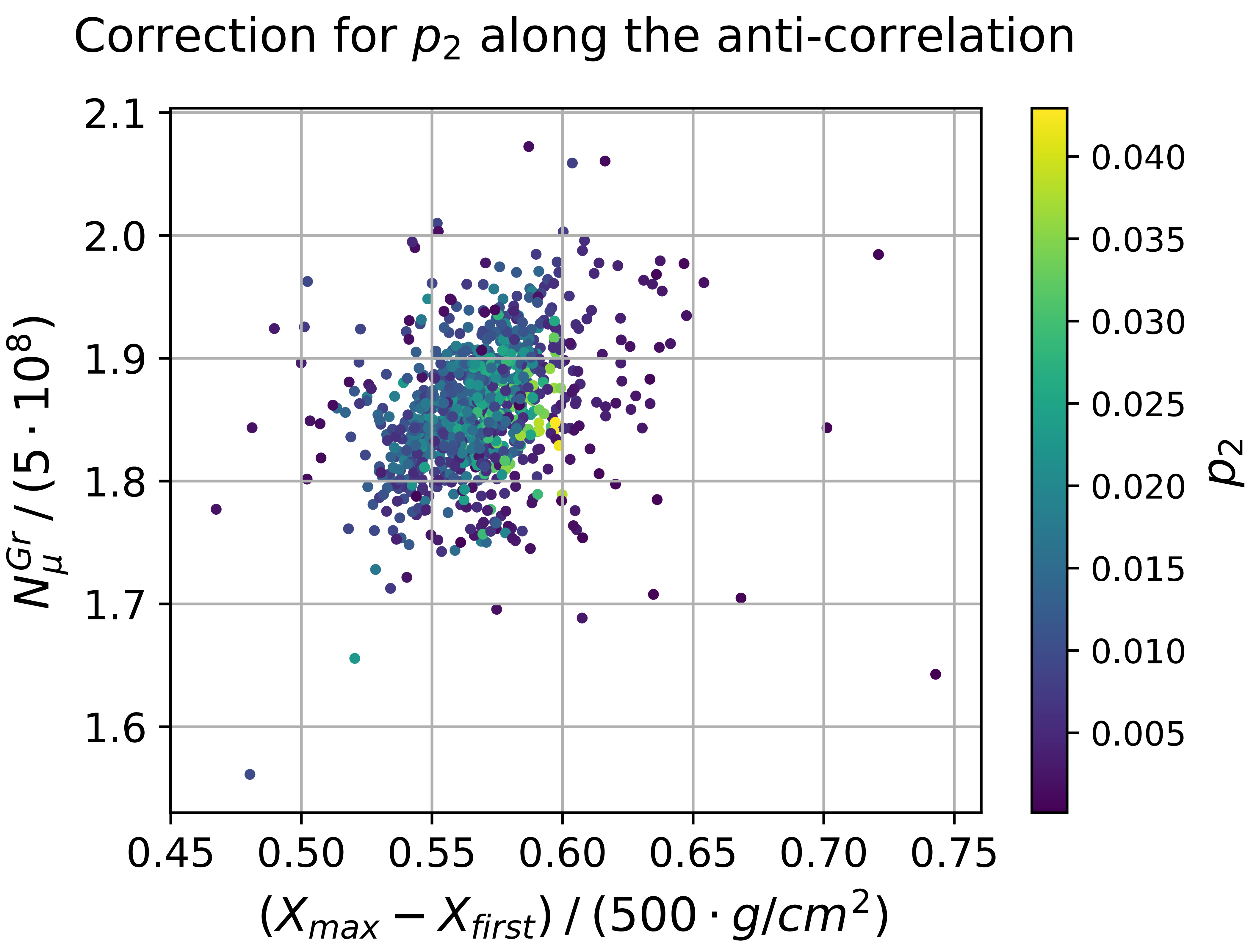
CORRECTING FOR p_2

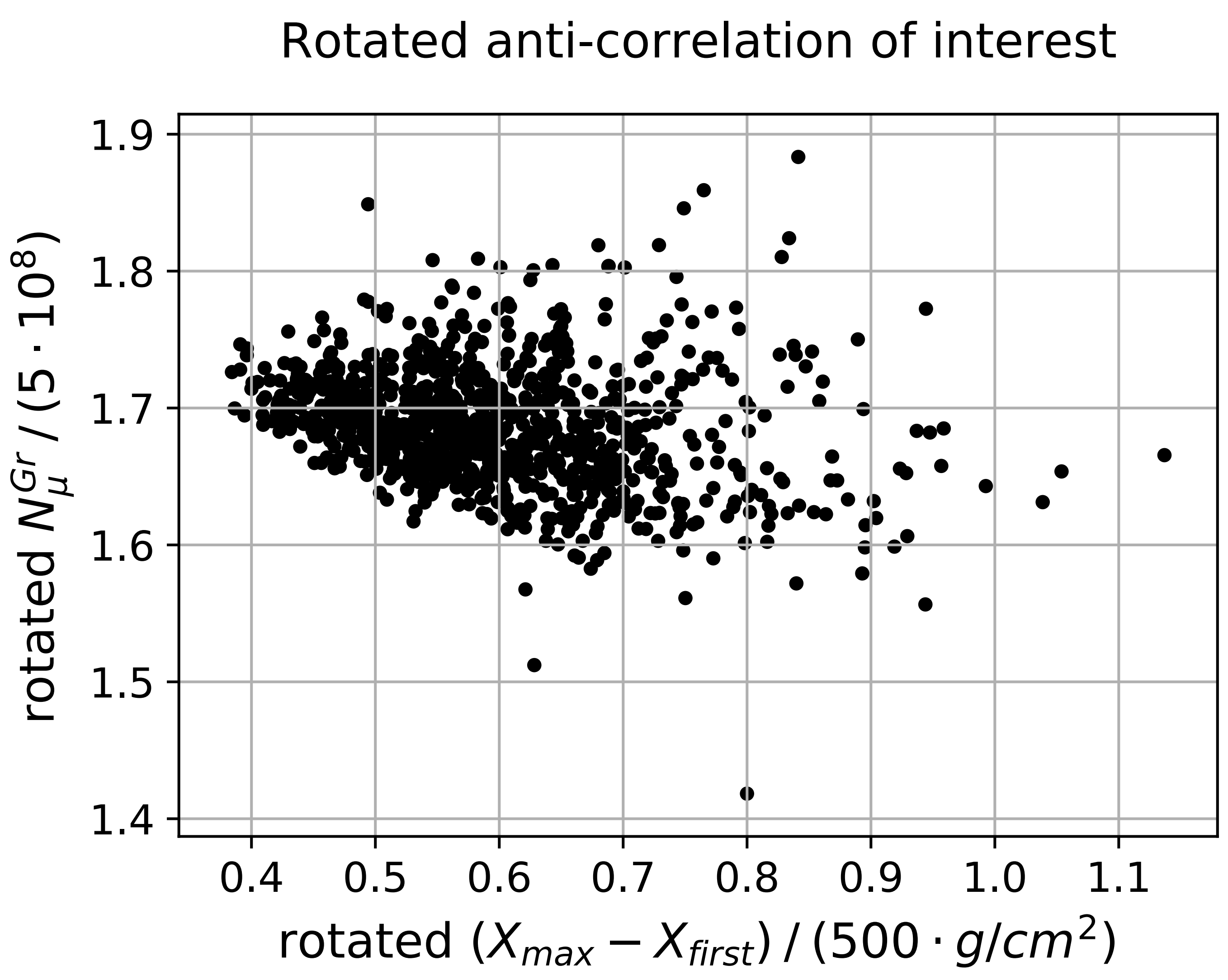




$$p_2 = E_0 \cdot f^1_{Ehad}(with\ LP) \cdot (f^{HM}_{Ehad})^{n_{(X_{max}-X_{first})}-1}$$

CORRECTING FOR p_2





Comparison:

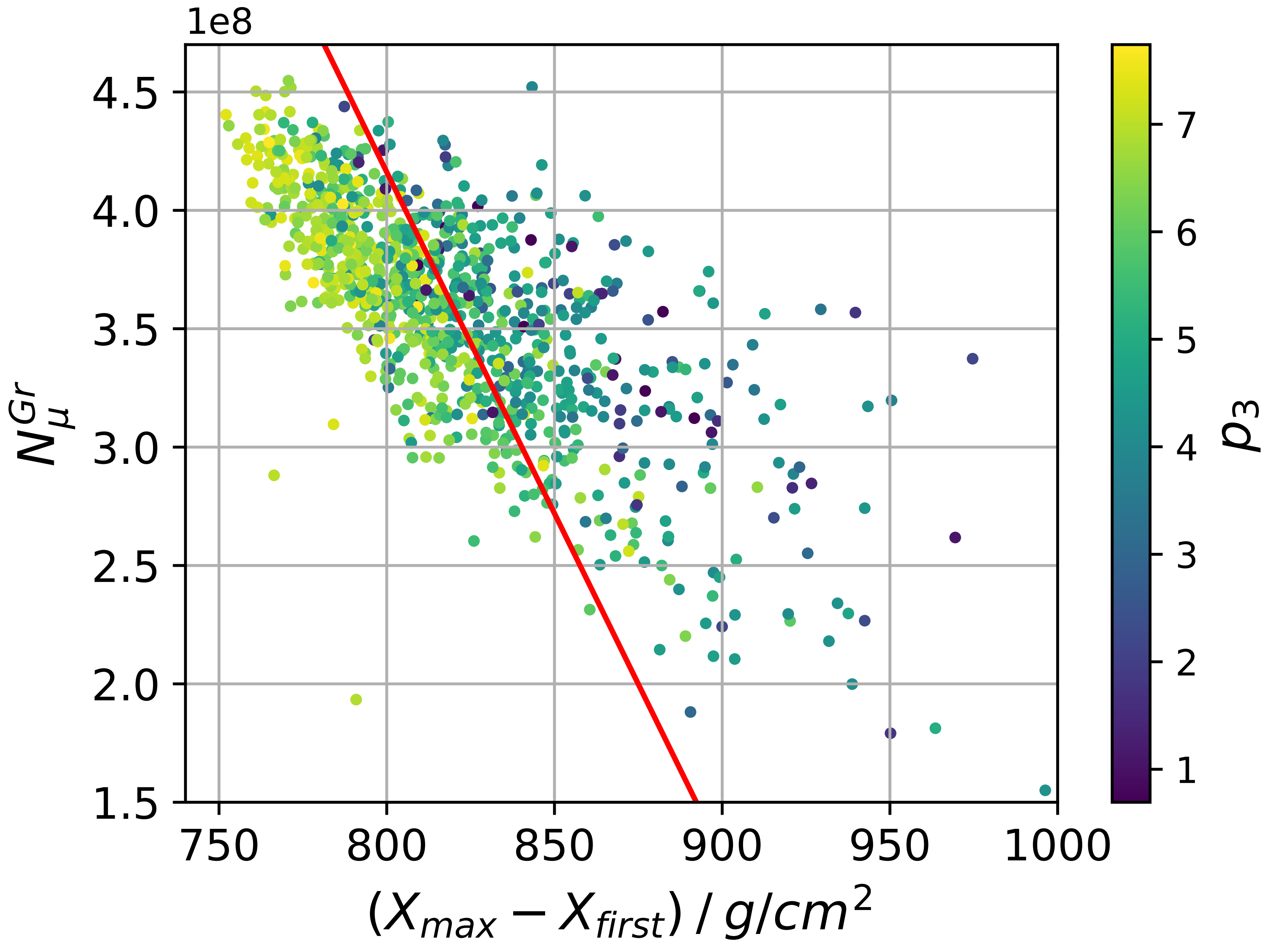
$$\sigma(\bar{x}) = 0.113 \rightarrow \sigma(\bar{x}) = 0.024$$

$$\bar{x}_{max} - \bar{x}_{min} = 0.753 \rightarrow \bar{x}_{max} - \bar{x}_{min} = 0.324$$

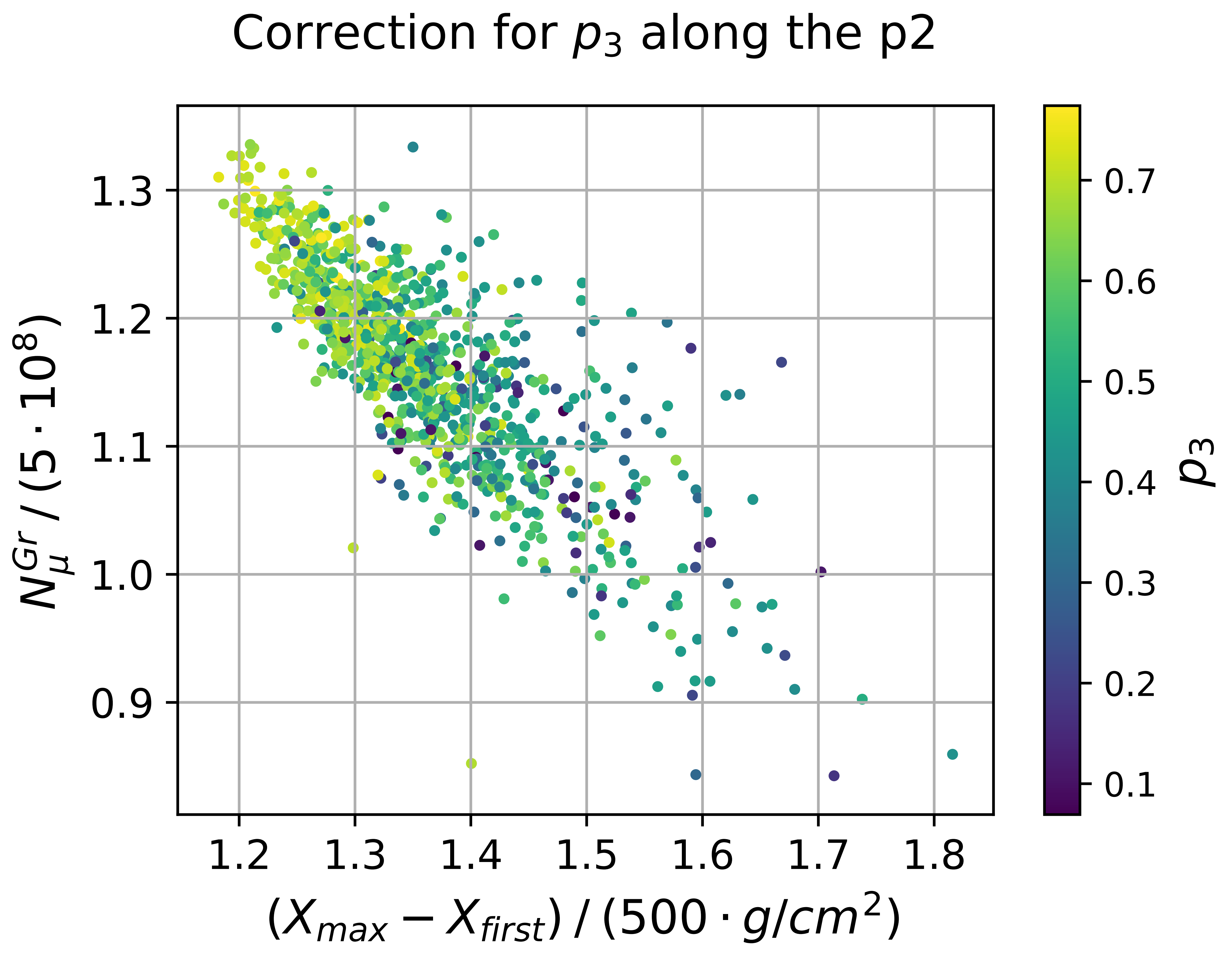
$$\sigma(\bar{y}) = 0.045 \rightarrow \sigma(\bar{y}) = 0.053$$

$$\bar{y}_{max} - \bar{y}_{min} = 0.465 \rightarrow \bar{y}_{max} - \bar{y}_{min} = 0.52$$

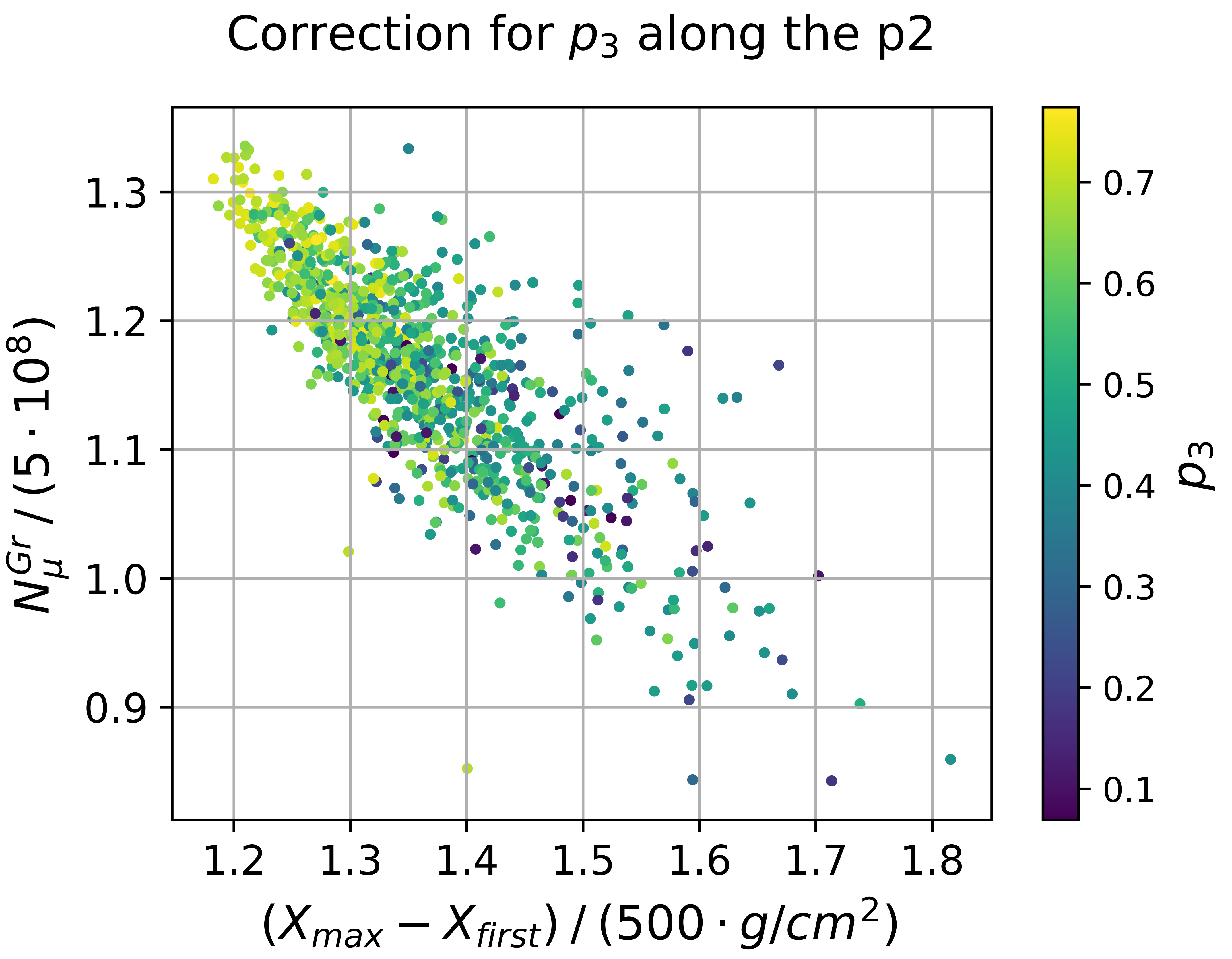
CORRECTING FOR p_3

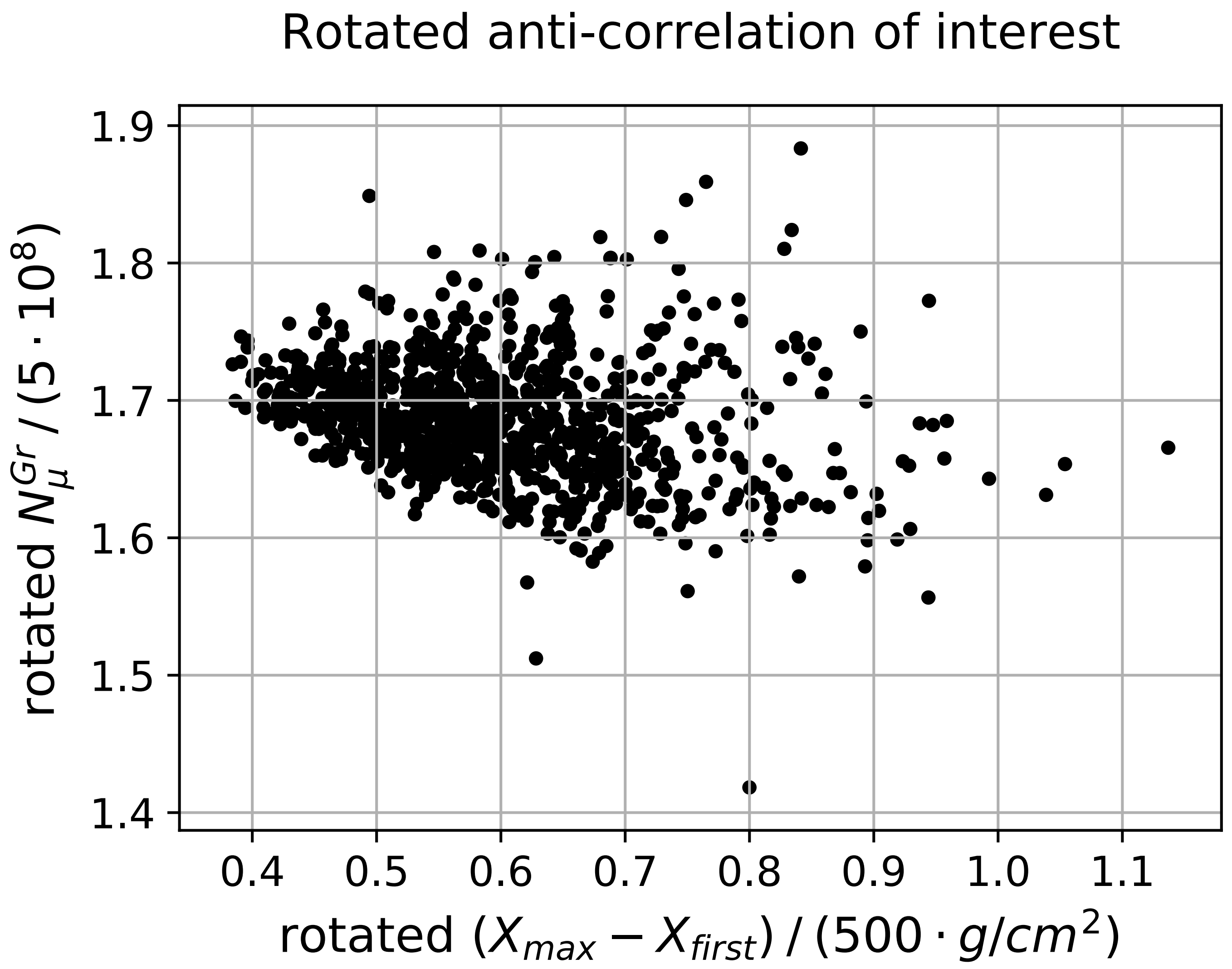


$$p_3 = N^1_{had}$$



CORRECTING FOR p_2





Comparison:

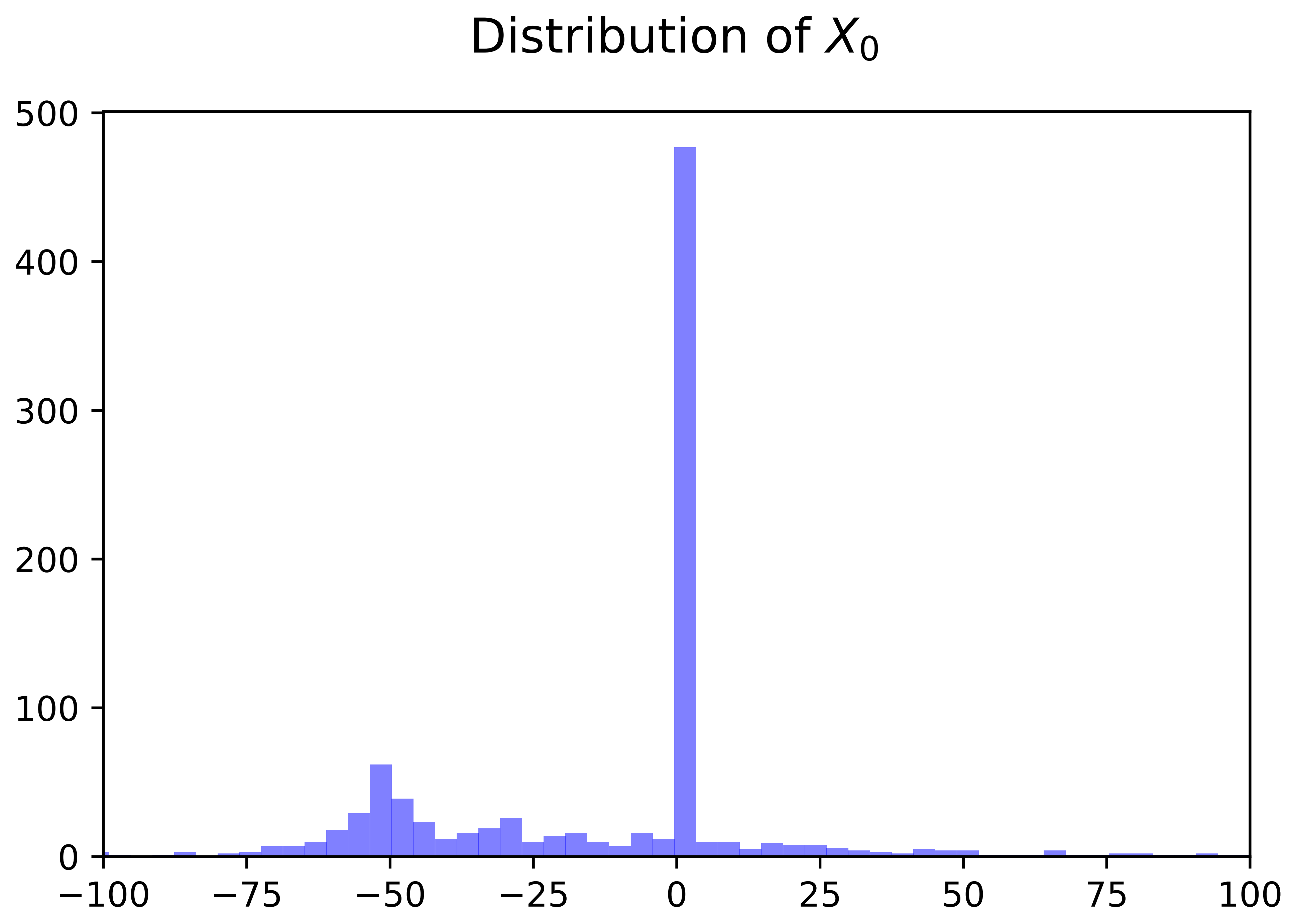
$$\sigma(\bar{x}) = 0.113 \rightarrow \sigma(\bar{x}) = 0.119$$

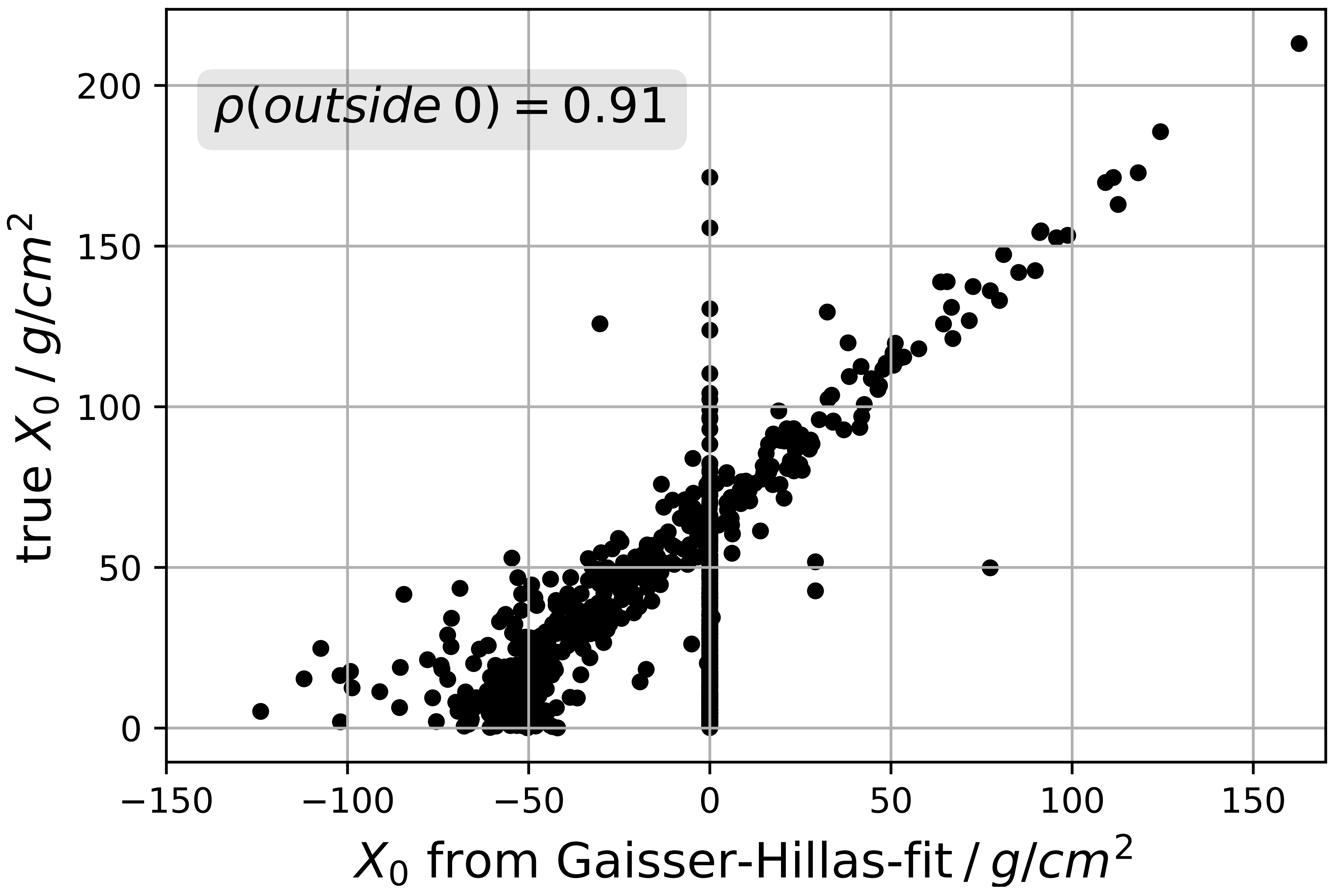
$$\bar{x}_{max} - \bar{x}_{min} = 0.753 \rightarrow \bar{x}_{max} - \bar{x}_{min} = 0.776$$

$$\sigma(\bar{y}) = 0.045 \rightarrow \sigma(\bar{y}) = 0.038$$

$$\bar{y}_{max} - \bar{y}_{min} = 0.465 \rightarrow \bar{y}_{max} - \bar{y}_{min} = 0.412$$

WORKING TOWARDS REPLACING X_{first}





Can the Gaisser-Hillas fit be done in such a way that not every second shower has $X_0 \approx 0$?

CONCLUSIONS

- Theoretical part: advanced, practical part: to be done
- $p_2 = E_0 \cdot f^1_{Ehad}(with\ LP) \cdot (f^{HM}_{Ehad})^{n_{(X_{max}-X_{first})}-1}$ and $p_3 = N^1_{had}$ explain a good part of the anti-correlation and the spread
- There are good chances to replace X_{first} by X_0

THANK YOU FOR YOUR ATTENTION!

BACKUP - DOING CORRECTIONS