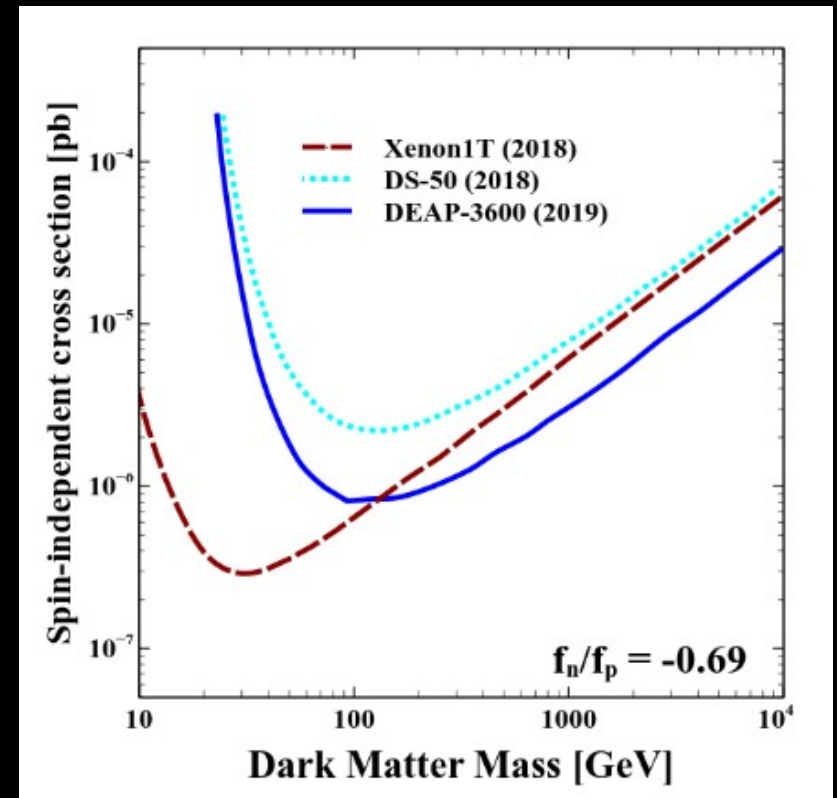
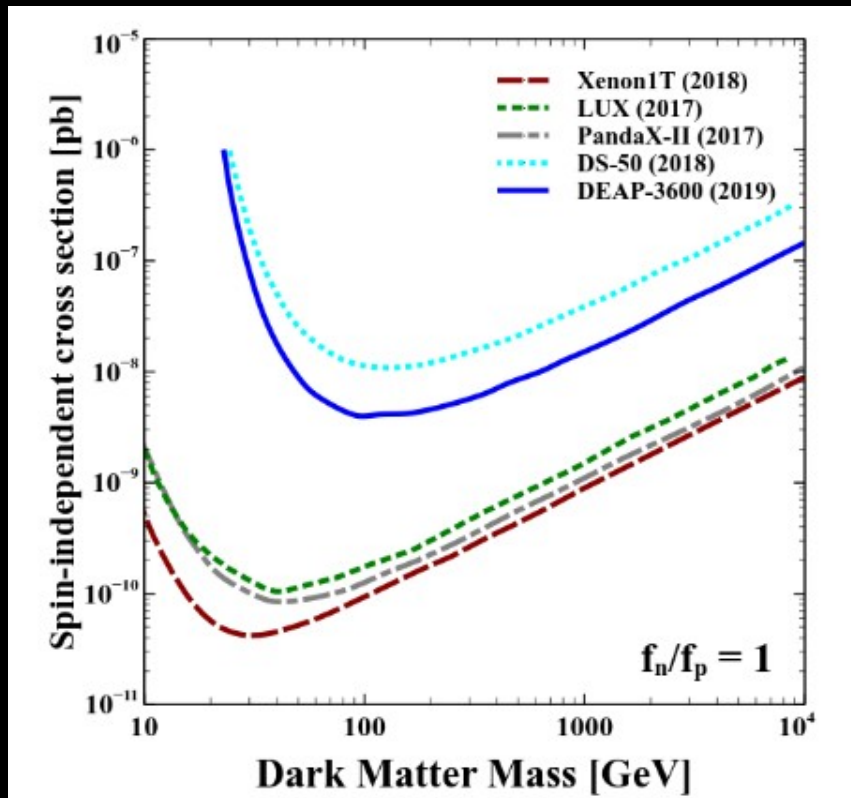


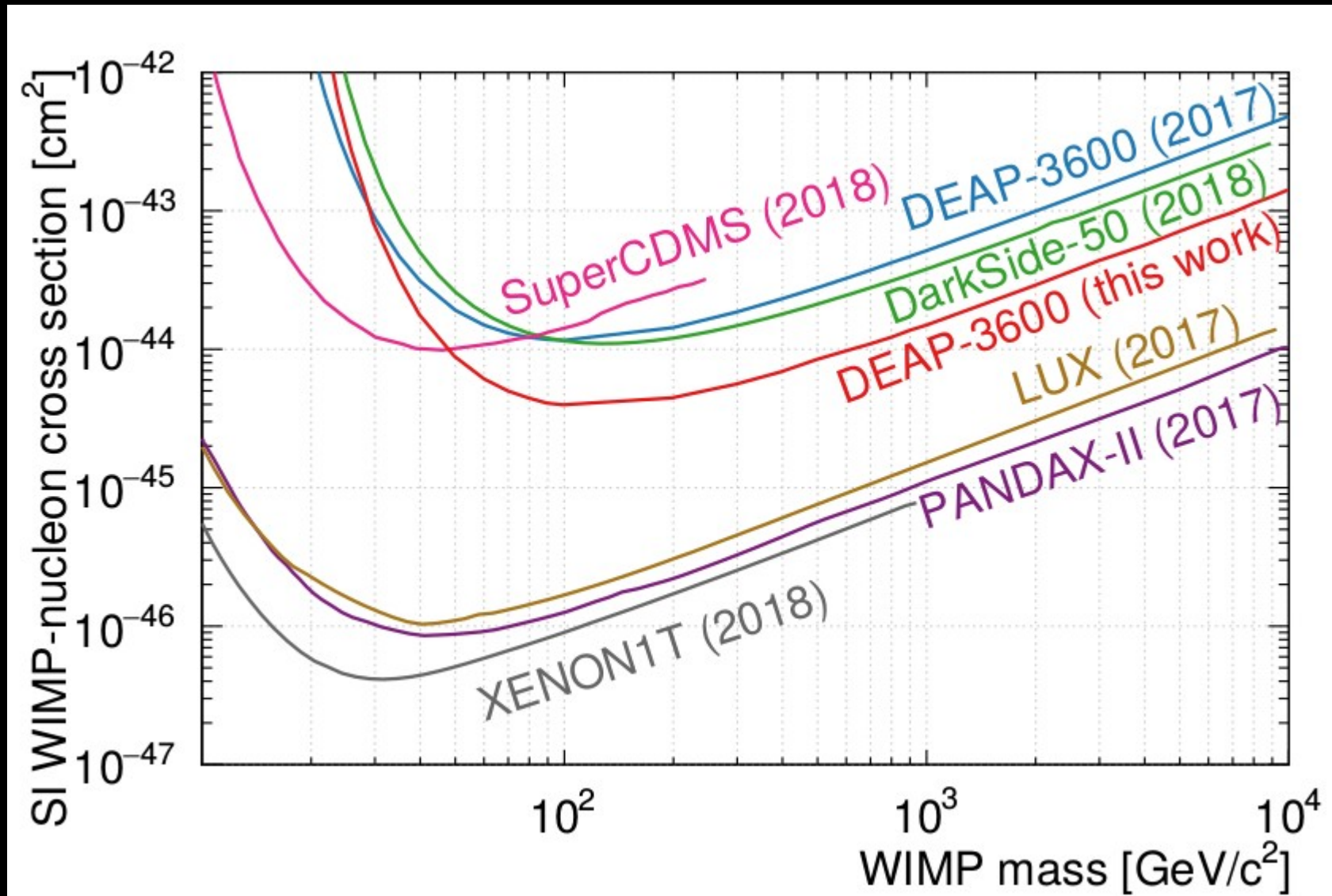
New bounds on isospin-violating dark matter from DEAP-3600



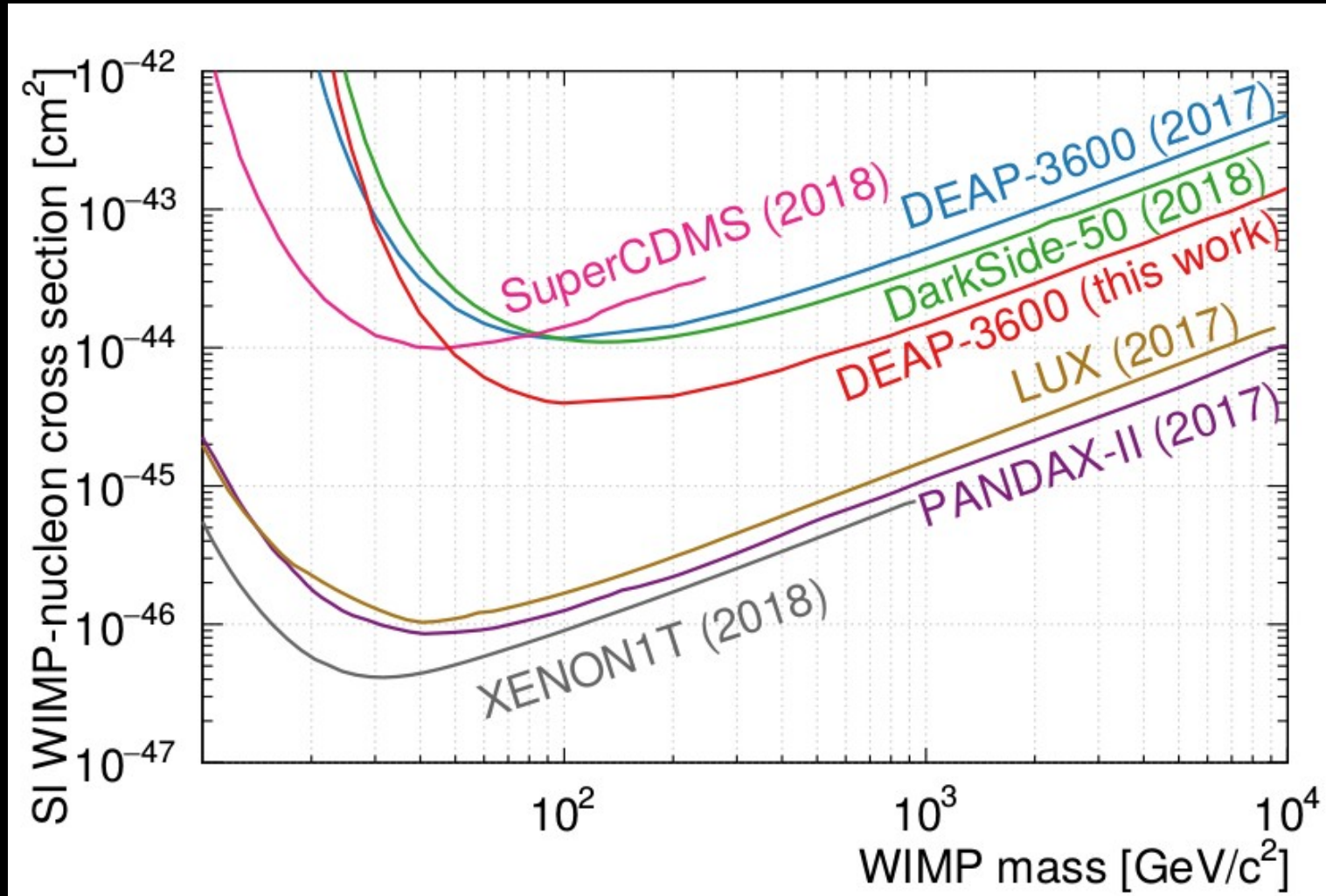
Based on 1902.10256,
JCAP 1904, 041

Carlos E. Yaguna
Escuela de Física
UPTC, 2019

New direct detection limits were recently reported by the DEAP-3600 experiment

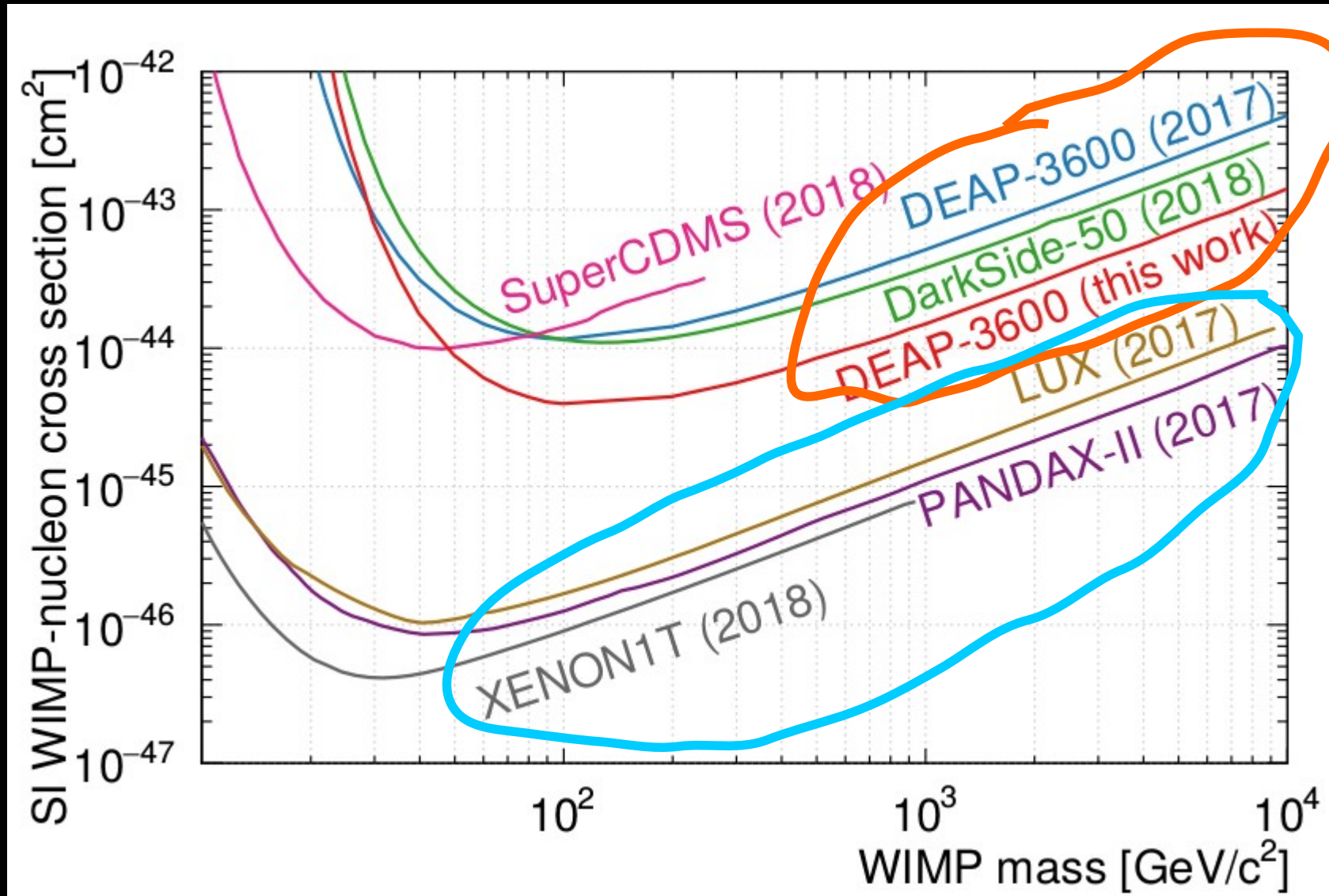


These new limits look irrelevant but I claim that they are not



The region above the lines is excluded

The crucial point is that these experiments use different targets



Argon

Xenon

The experimental signal depends on 3 particle physics parameters

$$\frac{dR}{dE}(E, t) = \frac{\rho_0}{m_\chi \cdot m_A} \cdot \int v \cdot f(\mathbf{v}, t) \cdot \frac{d\sigma}{dE}(E, v) d^3v$$

$$\frac{d\sigma}{dE} = \frac{m_A}{2\mu_A^2 v^2} \cdot (\sigma_0^{\text{SI}} \cdot F_{\text{SI}}^2(E) + \sigma_0^{\text{SD}} \cdot F_{\text{SD}}^2(E)).$$

$$\sigma_0^{\text{SI}} = \sigma_p \cdot \frac{\mu_A^2}{\mu_p^2} \cdot [Z \cdot f^p + (A - Z) \cdot f^n]^2$$

In the previous figure it was assumed that $f^p = f^n$ (isospin-conservation)

$$\sigma_0^{\text{SI}} = \sigma_p \cdot \frac{\mu_A^2}{\mu_p^2} \cdot [Z \cdot f^p + (A - Z) \cdot f^n]^2$$

There is no support whatsoever for this assumption. The default dark matter scenario should be $f^p \neq f^n$ (isospin-violating DM)

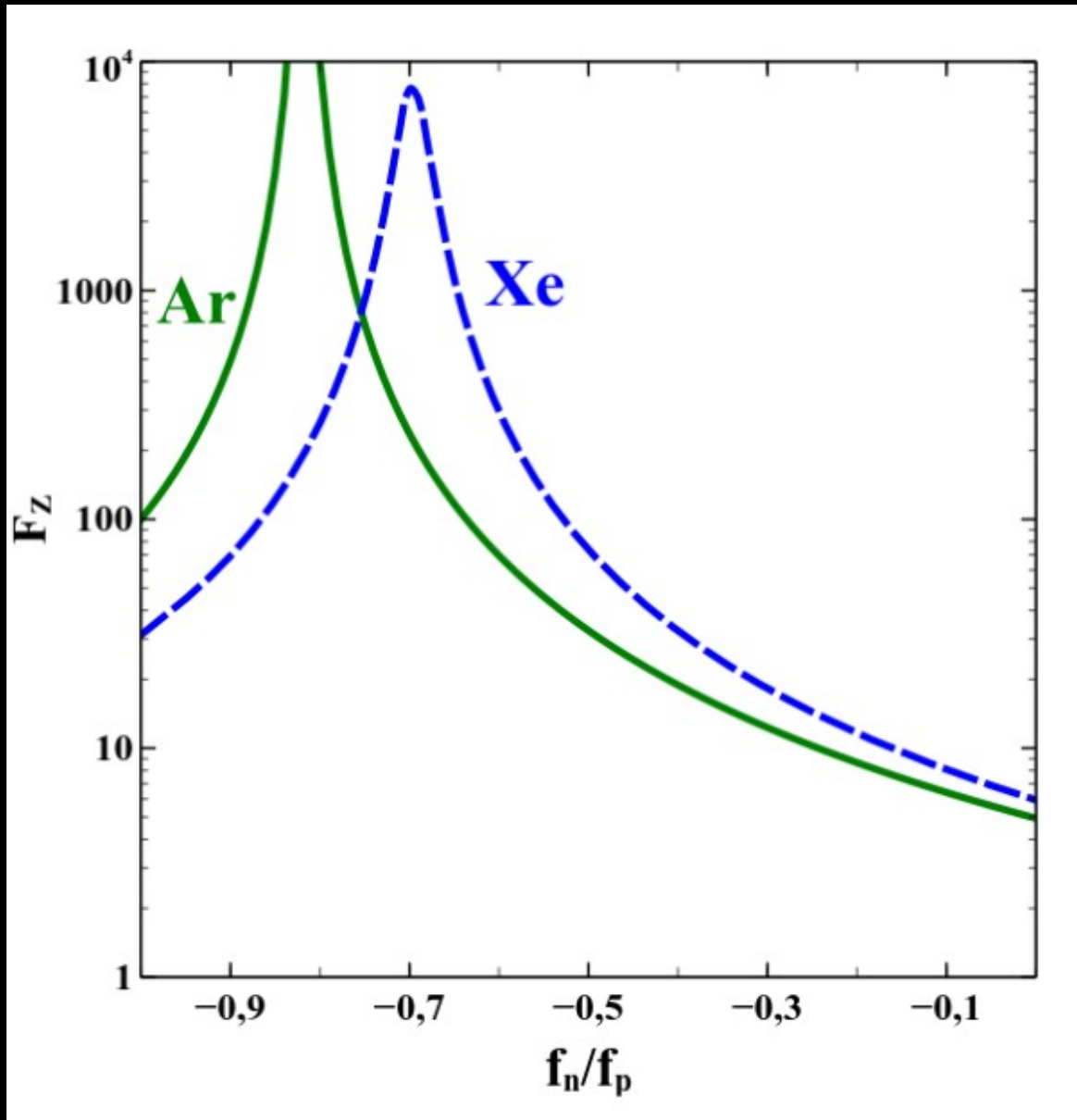
Several simple dark matter models give rise to isospin-violating DM

Dark-Photon Mediation: $f_n/f_p = 0$

Z Mediation: $f_n/f_p = -12.5$

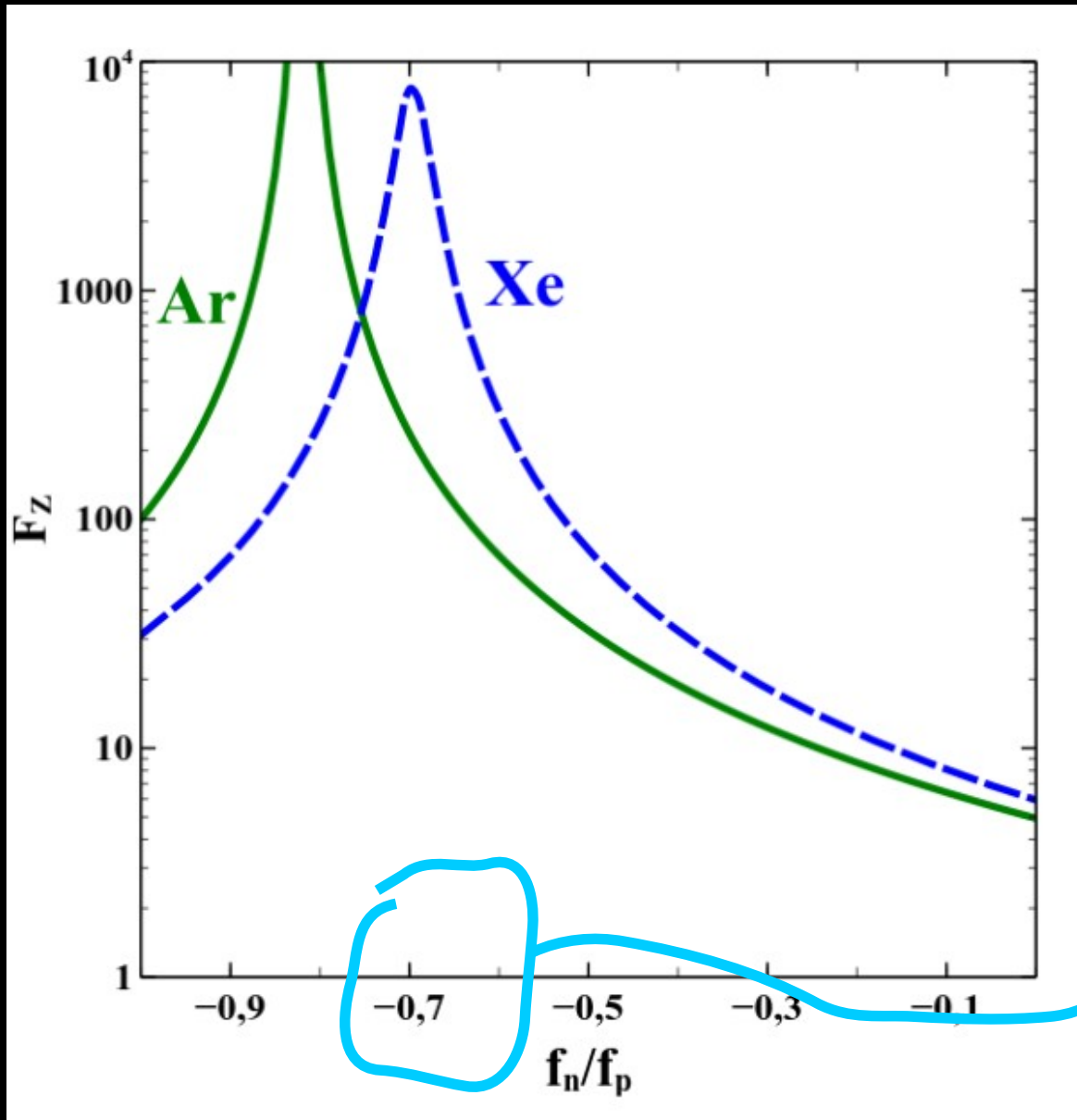
Light Squark-Mediation: $f_n/f_p = 0.7 (\tilde{u})$ or $1.5 (\tilde{d})$

For isospin-violating DM, cancellations may occur for certain values of f^p/f^n



And they strongly depend on the target nucleus

For isospin-violating DM, the experimental limits need to be reevaluated

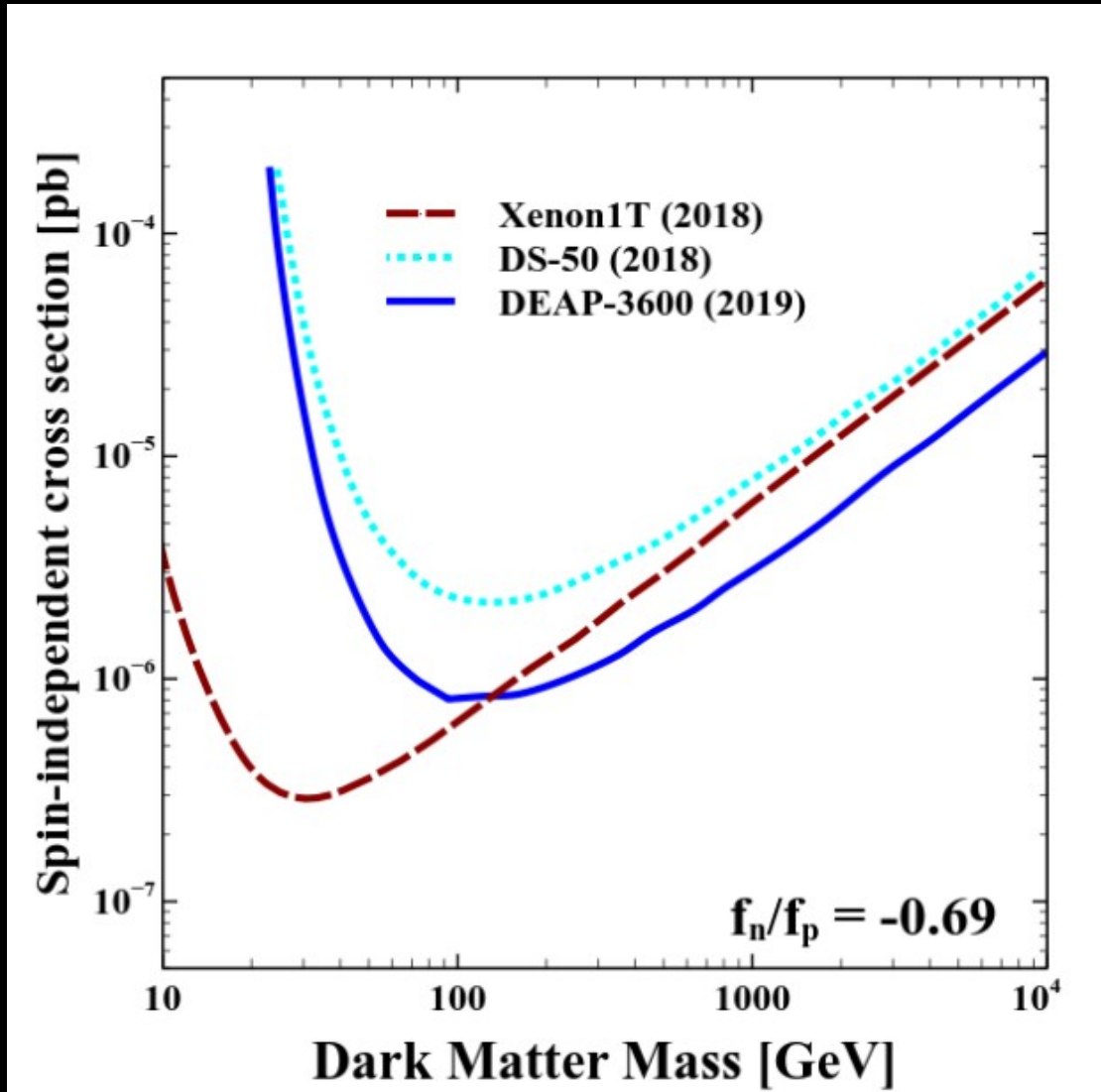


The limits will depend on f_n/f_p

Only for $f_n/f_p \approx -0.7$ are changes important

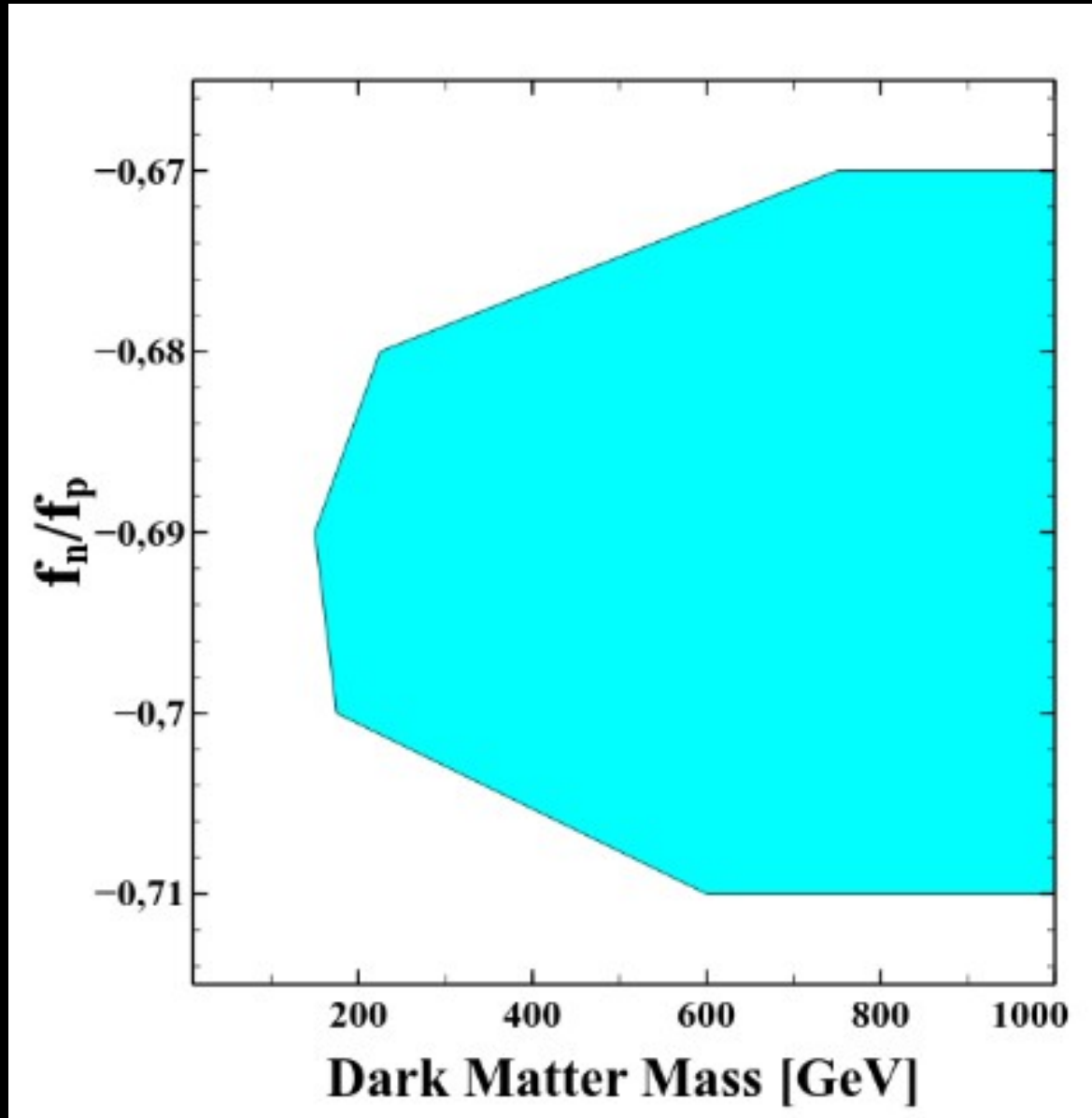
Xenophobic dark matter

The DEAP-3600 limit can actually be more constraining

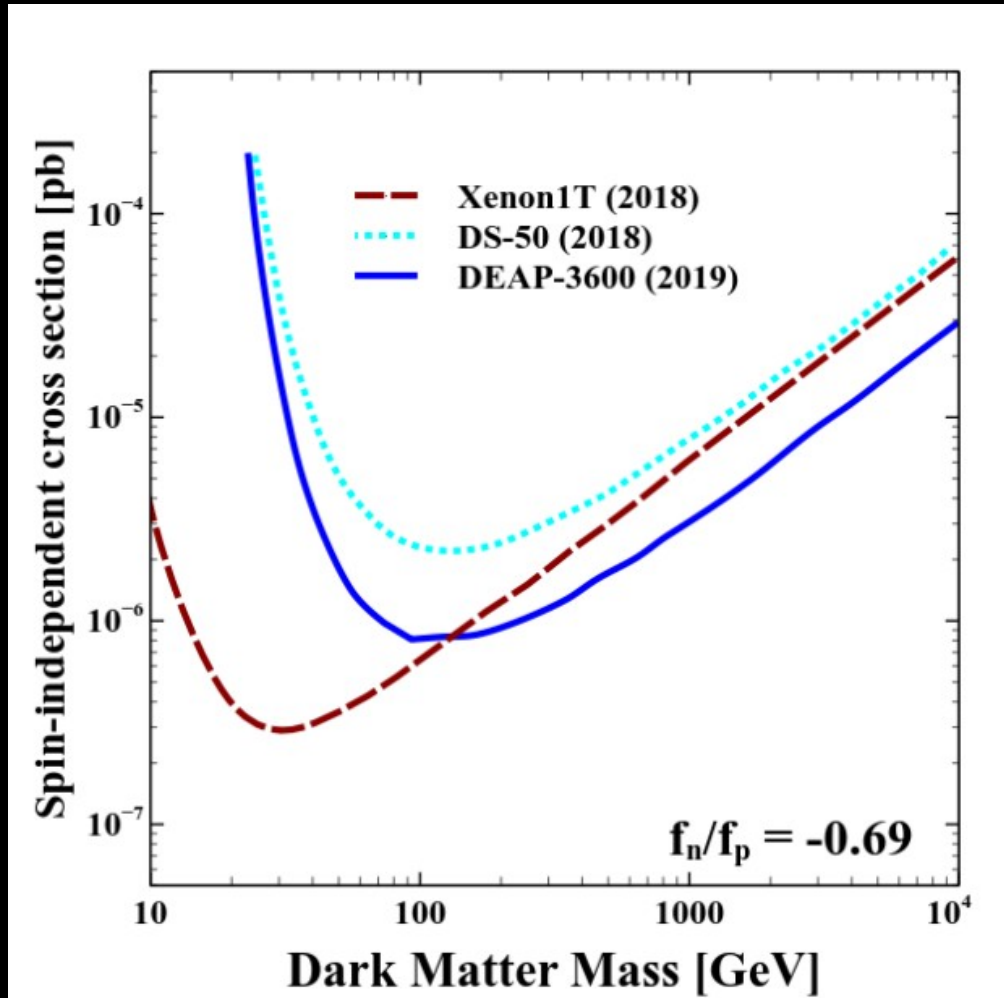


It is really probing new regions of parameter space!

There is a region of parameter space where DEAP-3600 is most constraining



This is a new example of complementarity among different direct detection targets



The end of the Xenon dominated epoch

The beginning of a new era:

- Testing isospin conservation
- Majorana or Dirac DM