

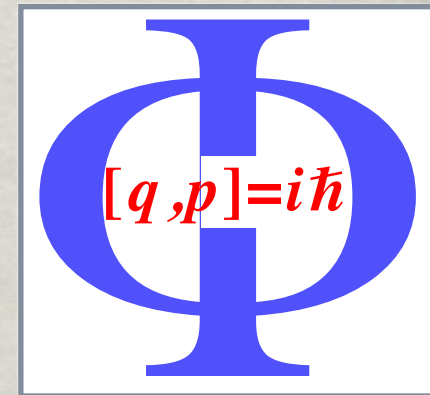
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DARK MATTER: DISCUSSION



Laura Covi

Institute for Theoretical Physics
Georg-August-University Göttingen



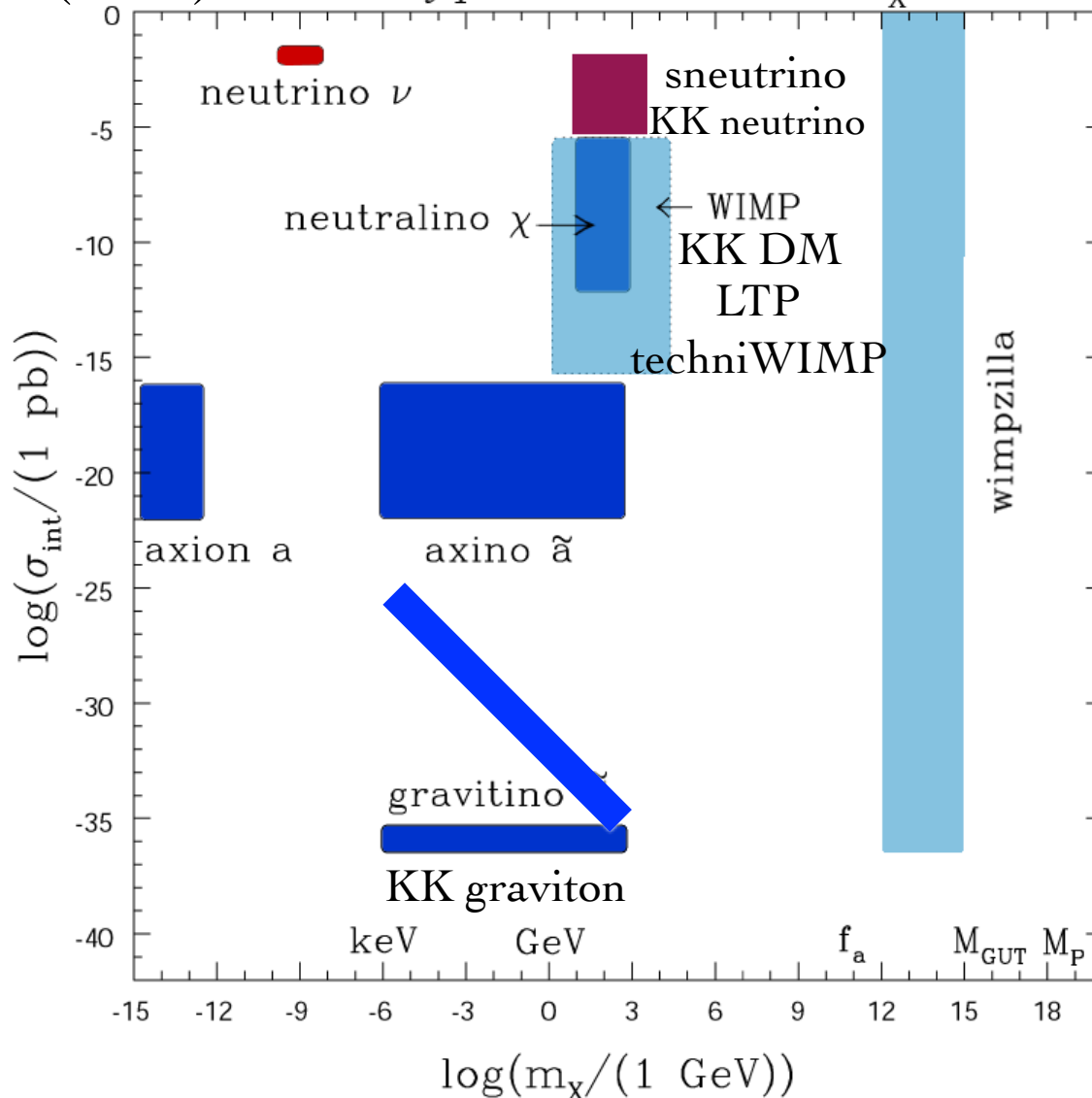
elusives-invisiblesPlus
neutrinos, dark matter & dark energy physics



DARK MATTER CANDIDATES

[Roszkowski 04]

(non) WIMP-type Candidates $\Omega_{\chi} \sim 1$



Too many different candidates...

“Standard” DM production paradigms:

WIMPs
(i.e. neutralino)

&

“FIMP/SuperWIMPs”

(i.e. gravitino)

&

Misalignment

(i.e. axion/condensate)

10+BILLION\$ QUESTION: HOW DOES DARK MATTER INTERACT ?

We detected DM so far only through its gravitational interaction... Unfortunately gravity is democratic, it does not tell us what DM is !

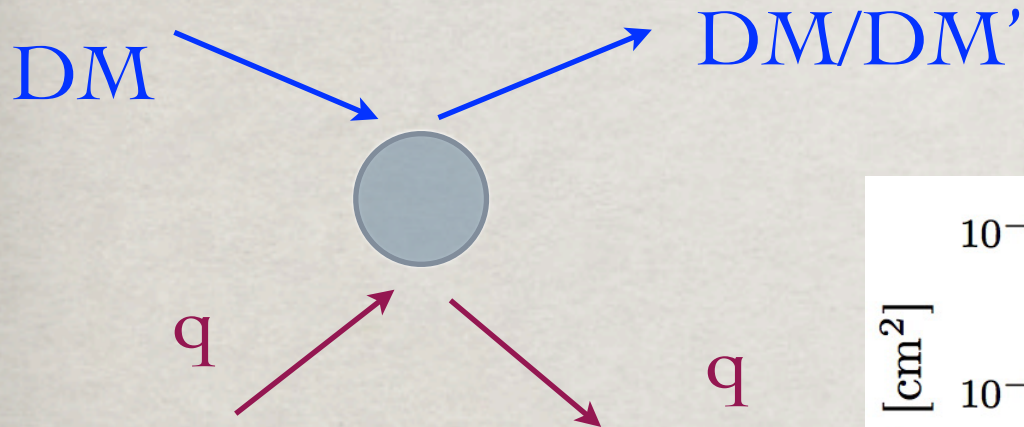
BUT probably we some other interaction is needed to produce DM since gravity is not very effective.

How can we explore DM (non-gravitational) interactions ???

Going beyond the CDM/(SUSY) WIMP paradigms !

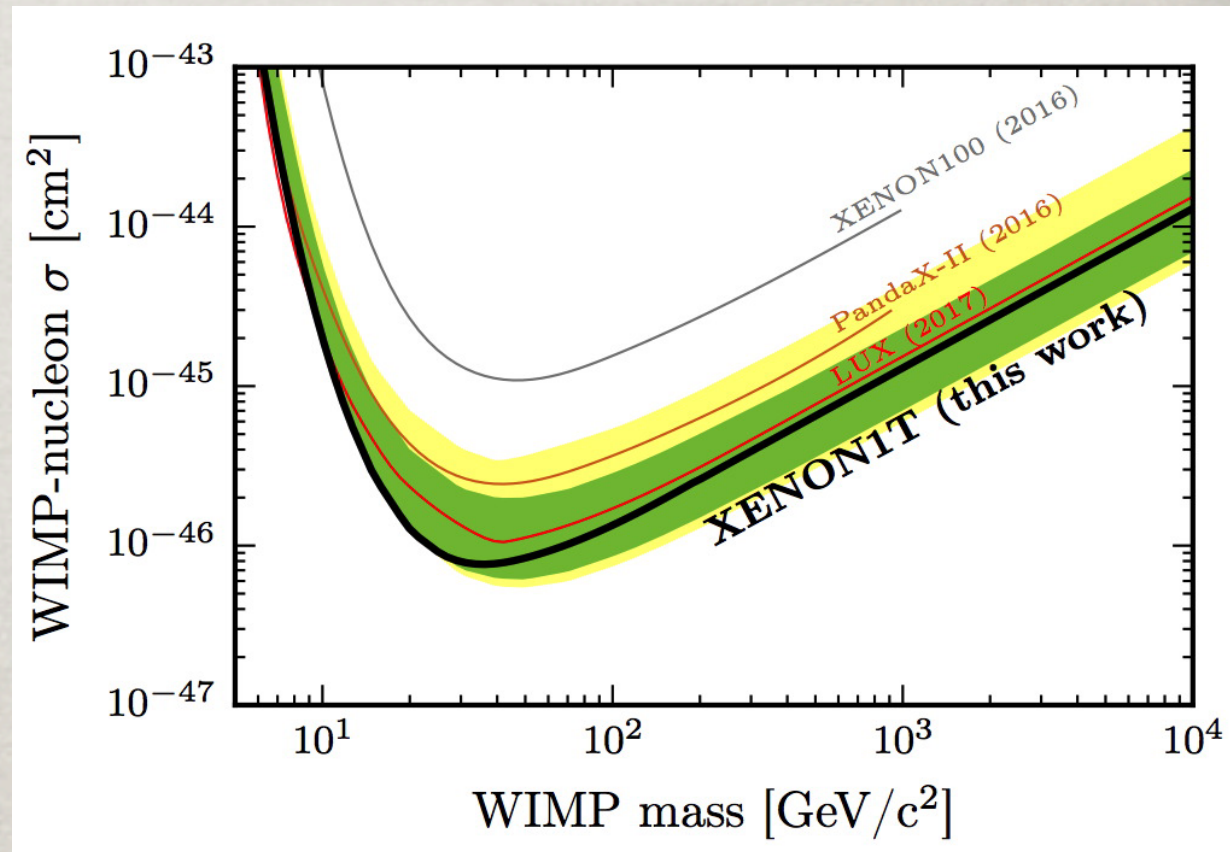
DM-MATTER INTERACTION

Elastic/inelastic scattering



[Talk by Elena Aprile]

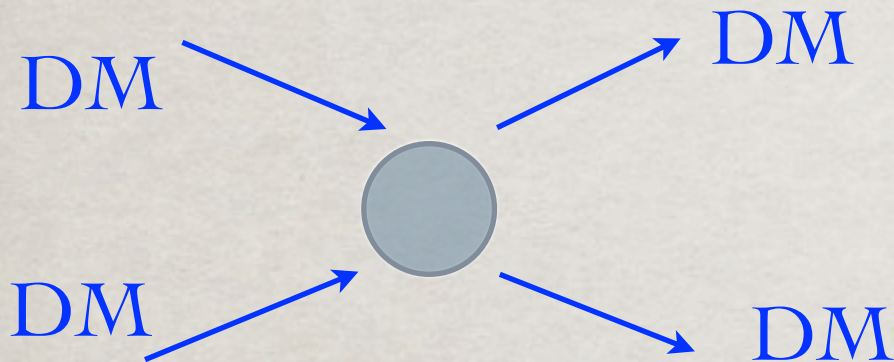
Direct detection:
elastic spin independent
cross-section



As we heard today also other interactions can be tested,
e.g. with SM neutrinos [Talk by Aaron Vincent]

DM-DM INTERACTION

Self-interaction:



Bullett cluster bound on self-interaction:

$$\sigma \leq 1.7 \times 10^{-24} \text{ cm}^2 \sim 10^9 \text{ pb} \quad (m = 1 \text{ GeV})$$

[Markevitch et al 03]

Slightly stronger constraint by requiring a sufficiently large core & from sphericity of halos... [Yoshida, Springer & White 00]

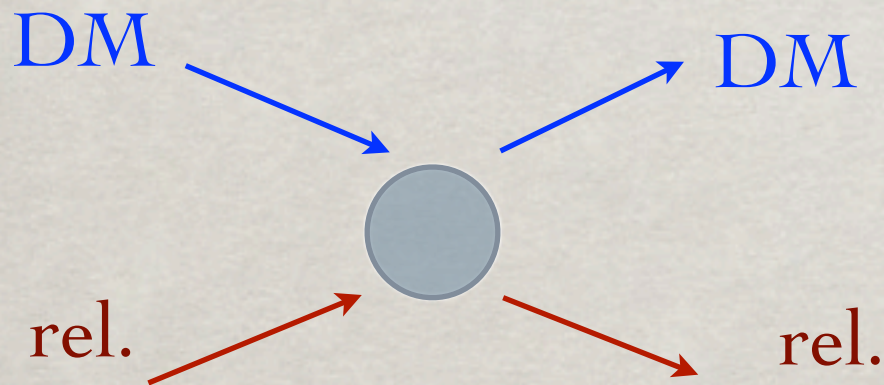
But at the boundary maybe some effect on small scales: SIMP

[Talks by Mathias Pierre, Ivonne Albuquerque, ...]

INTERACTING DARK MATTER

Apart for chemical decoupling of DM, also the kinetic decoupling is important as it sets the cut-off in the power spectrum at small scales. ANY interaction of the DM, even with a hidden (relativistic) Dark Sector can influence the DM kinetic decoupling and structure formation at small scales.

[Hofmann, Schwarz & Stecker 2001, Green, Hofmann & Schwarz 2005, Bringmann & Hofmann 2007, ...]



Probes ANY interaction with a relativistic species !

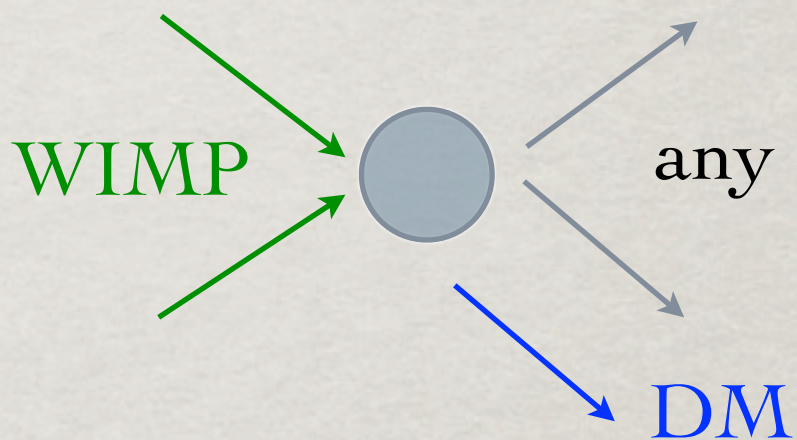
A lot of activity for different interactions/mediators !
Not clear if it can always resolve the small scale crises, though...

WHAT IF COUPLING IS TOO WEAK ?

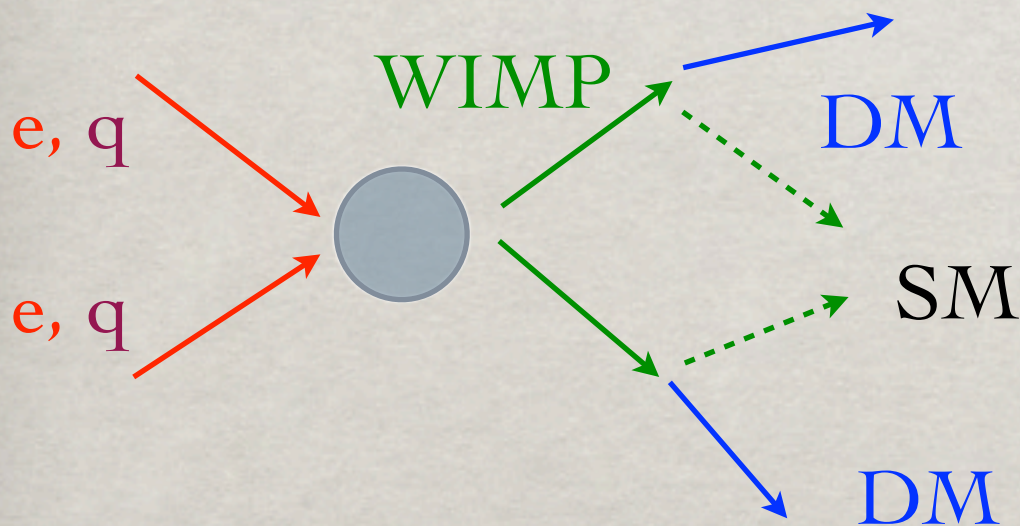
Decaying Dark Matter

is also a viable option and can give signals even for tiny couplings to SM !

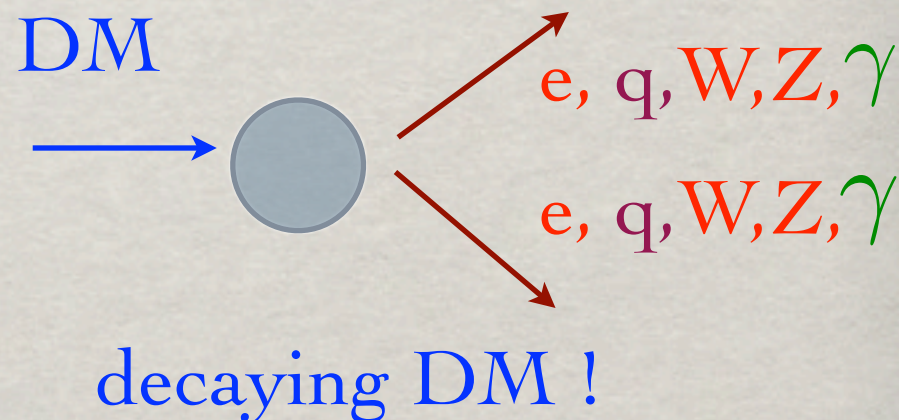
Early Universe: $\Omega_{CDM} h^2$



Colliders: LHC/ILC

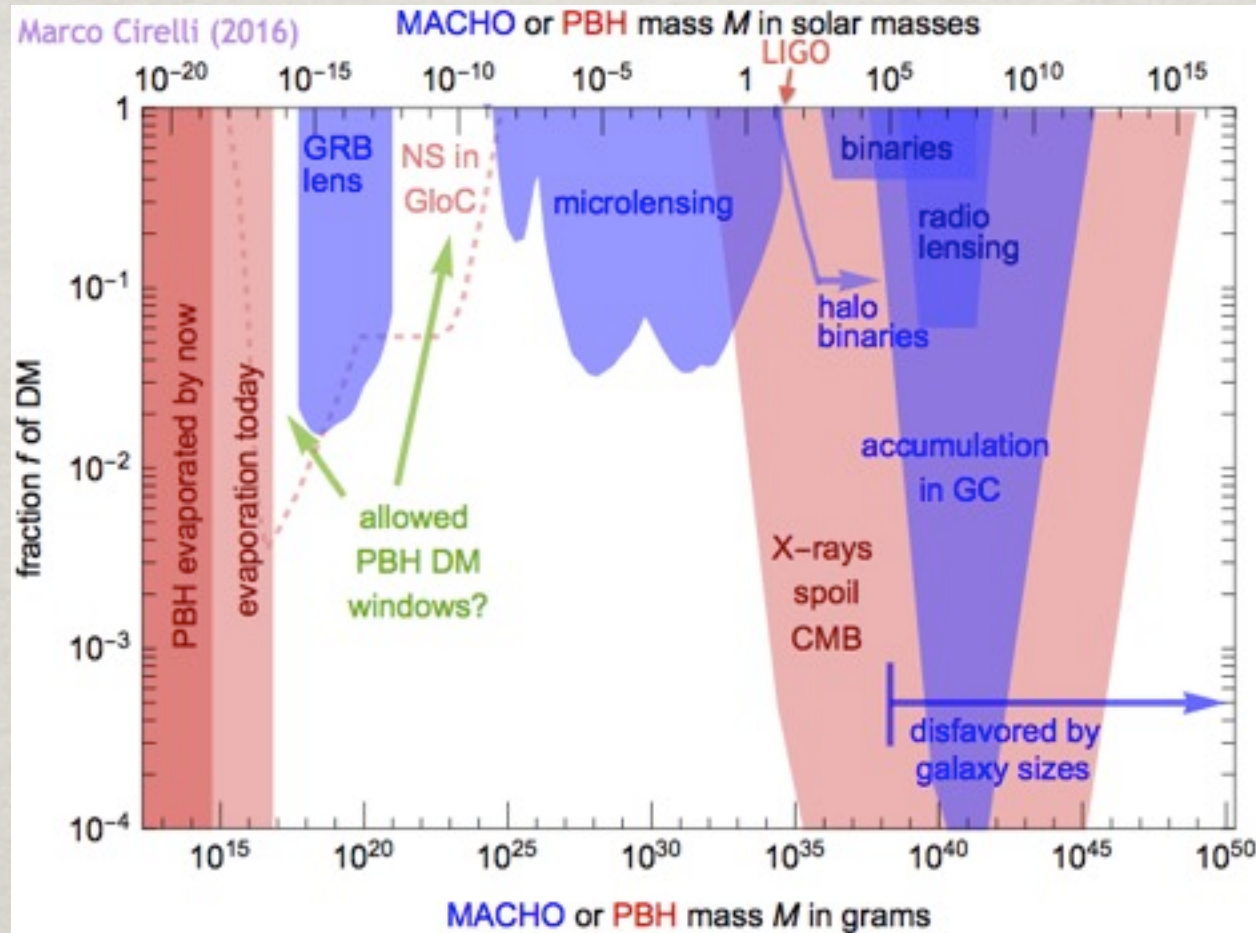


Indirect Detection:



3 different ways to check this hypothesis !!!

BLACK HOLE DM



Not easy to produce them in the Early Universe..., e.g. need funny power spectra from inflation for primordial Black Holes