Inelastic Boosted Dark Matter

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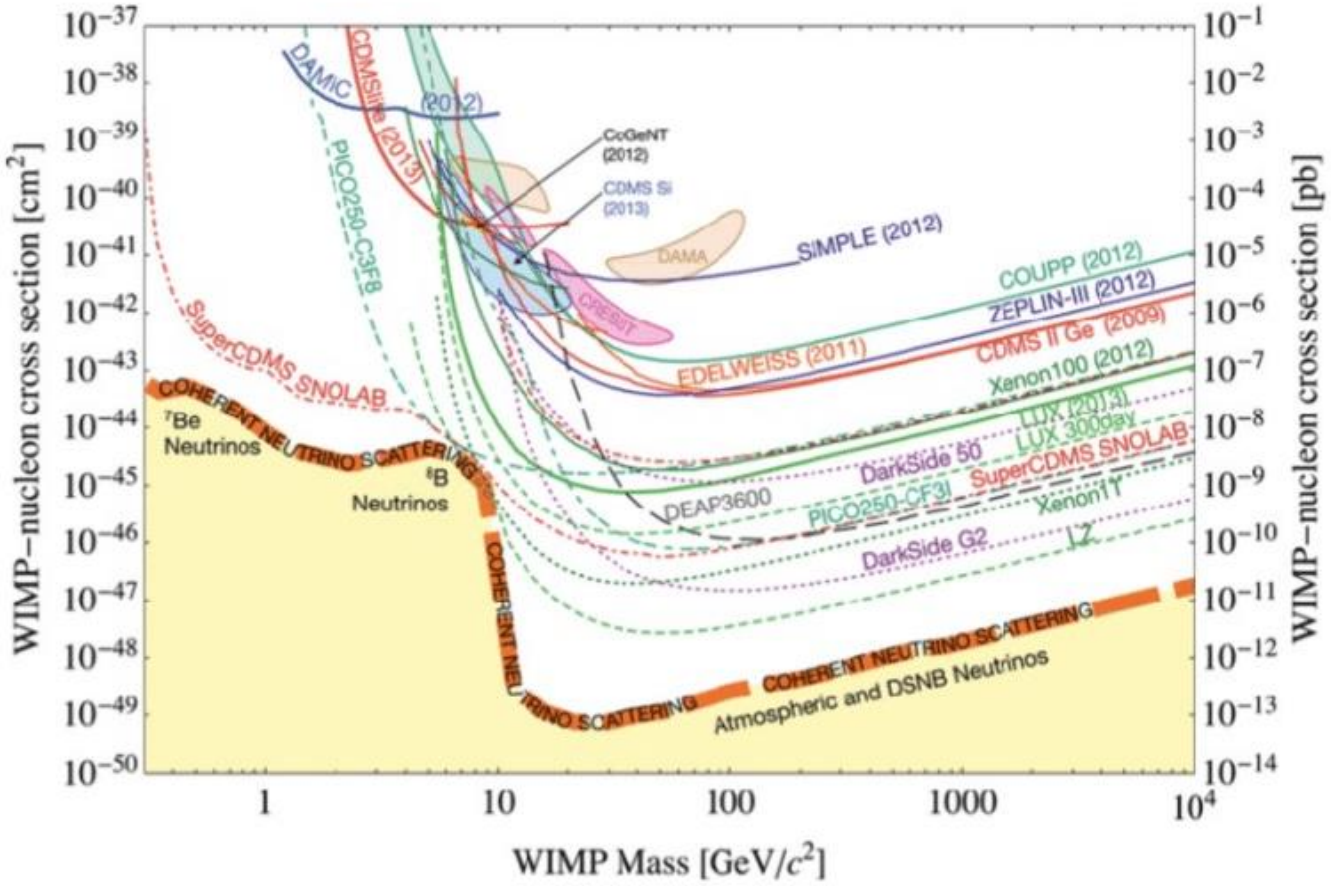
Inelastic Boosted Dark Matter



WIMP search is direct detection experiment by observing a recoiling of target material which is induced by elastic scattering off of non-relativistic DM

We didn't detect WIMP signal

→ Need other dark sector(iBDM)

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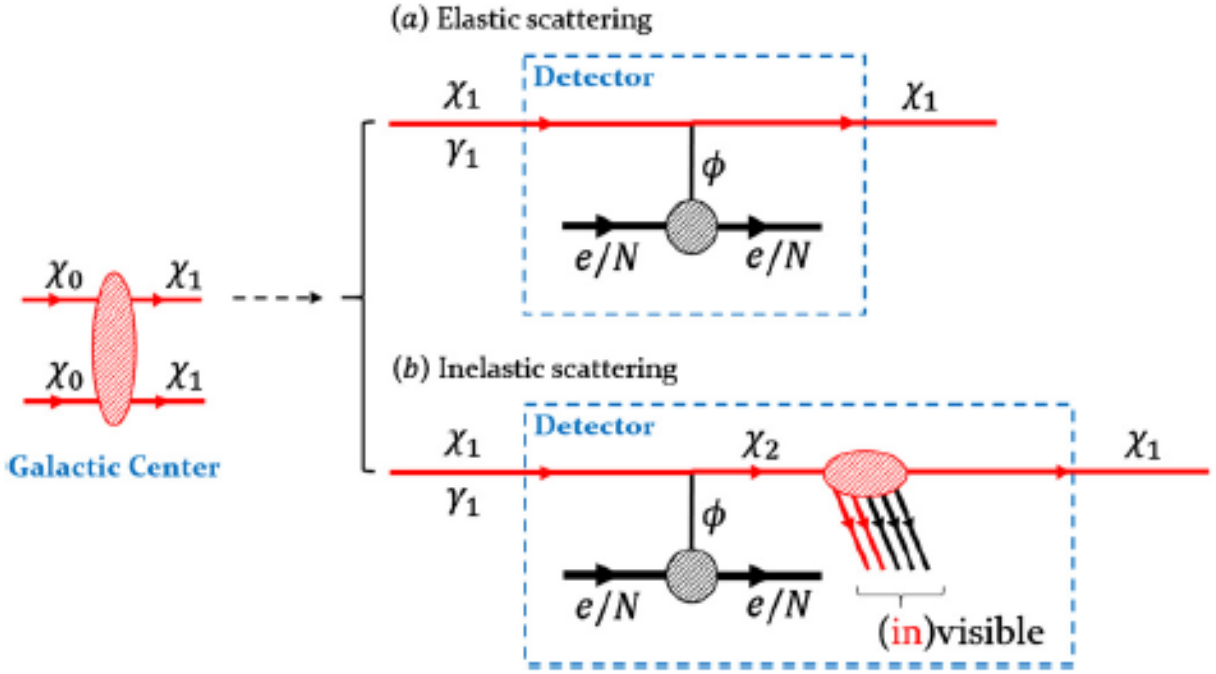

The boosted x_1 can be produced via pair-annihilation of x_0 in the galactic halo, leading to al total flux

$$\mathcal{F} = 1.6 \times 10^{-4}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1} \left(\frac{\langle\sigma v\rangle_{0\to 1}}{5 \times 10^{-26}\,\mathrm{cm}^3\,\mathrm{s}^{-1}}\right)\left(\frac{\mathrm{GeV}}{m_0}\right)^2, \qquad (2.1)$$

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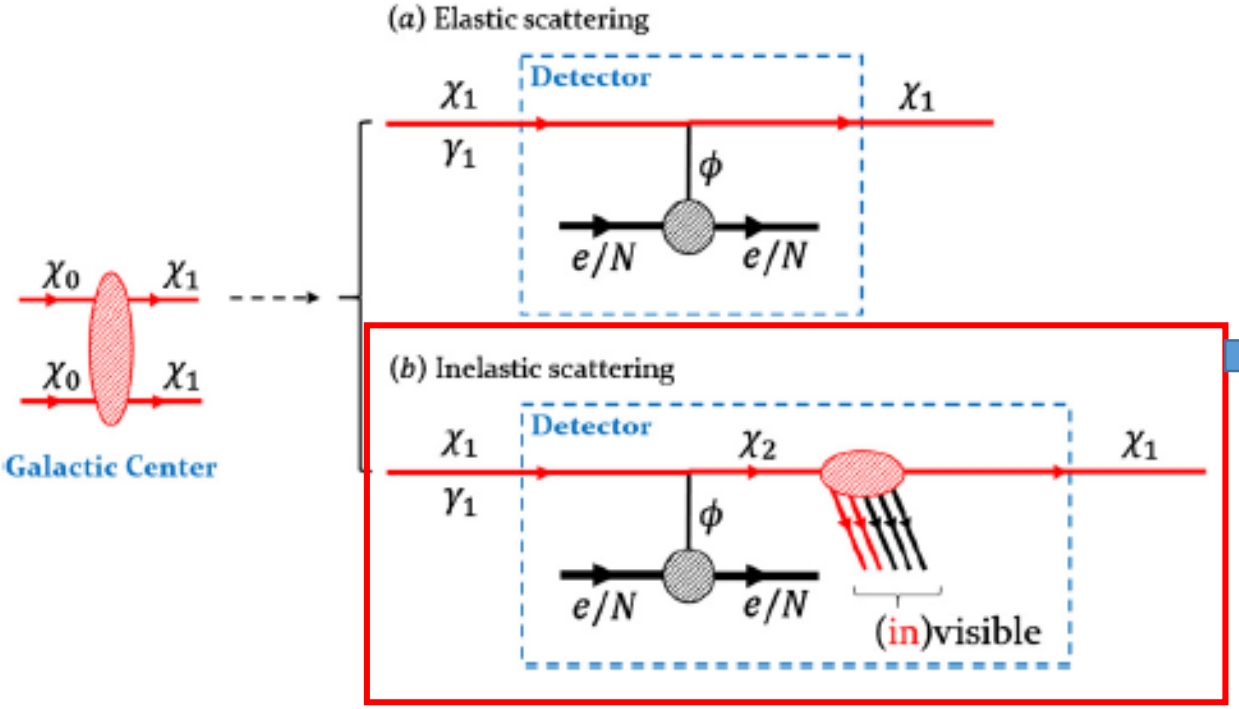

iBDM scenarios :

Primary process : scatters off to a heavier, unstable dark sector particle x_2 together with a target recoil (e or p) via a mediator Ø exchange

Secondary process : x_2 disintegrates back into x_1 and some other decay products which may include SM particles

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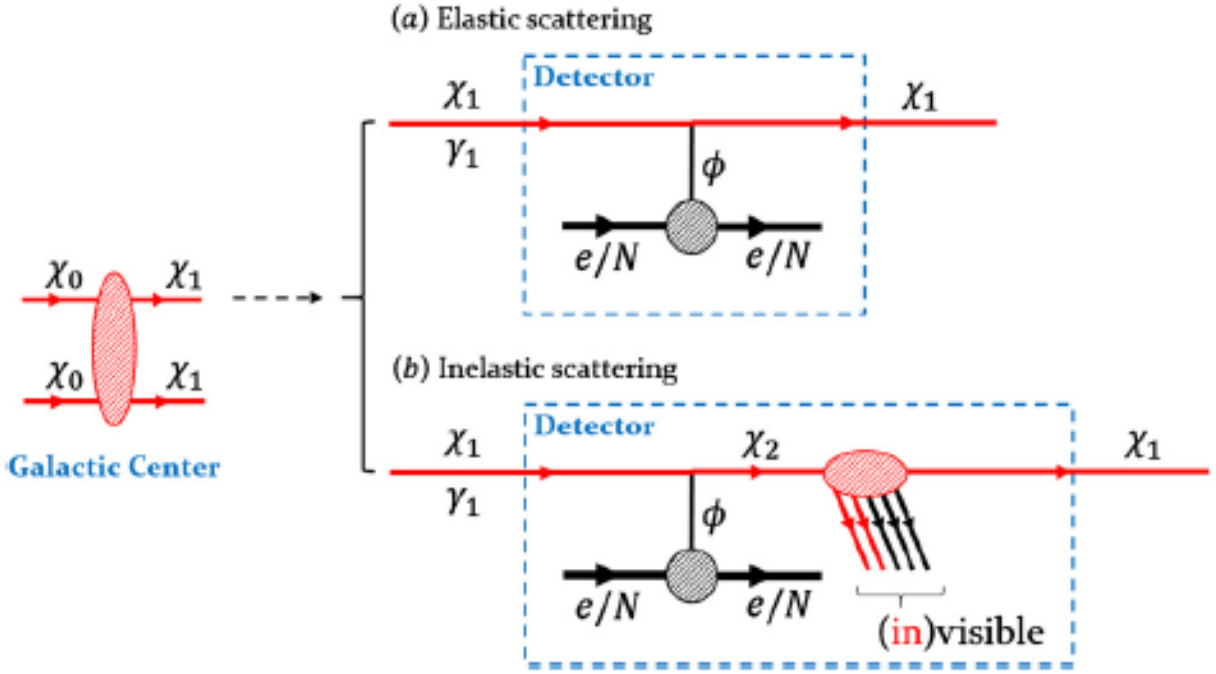

For WIMP search, electron recoil(ER) is usually rejected due to a large rate of expected backgrounds(only consider nuclear recoil as signal)

However, the signal induced by boosted DM can be quite energetic and usually leaving an appreciable track in the detector system

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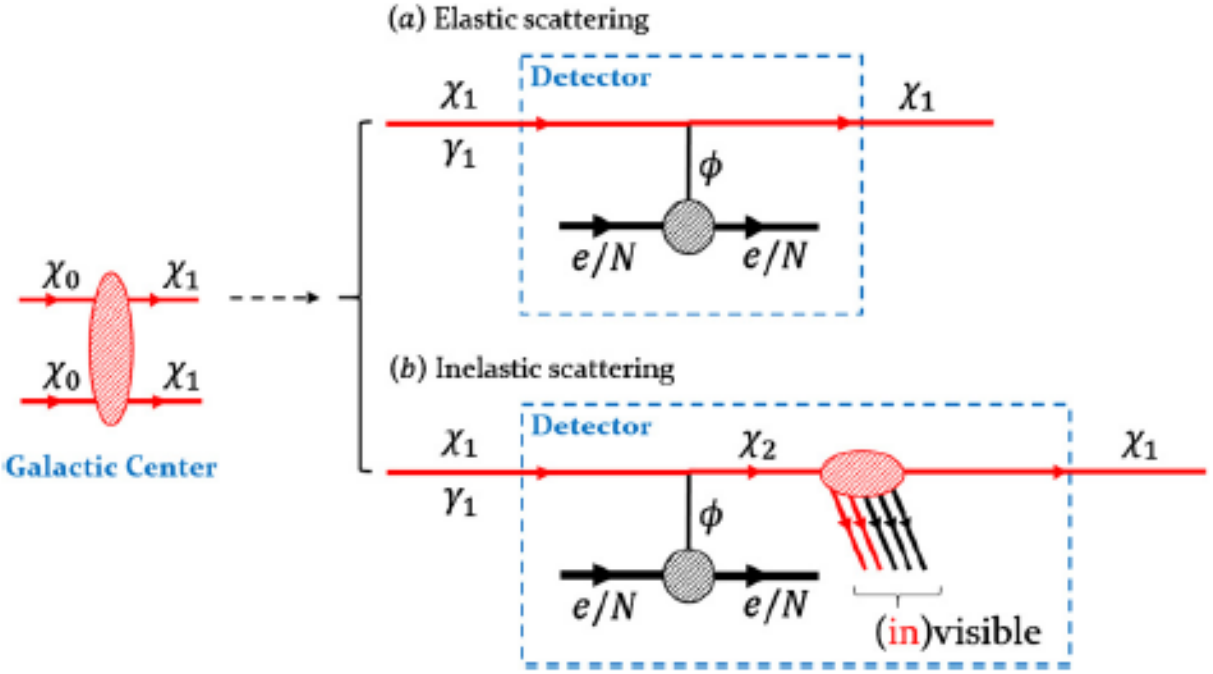

DM direct detection experiments such as XENON1T, DEEP-3600 and LUX-ZEPLIN may possess sufficient sensitivity to signals caused by boosted DM of MeV-range mass(because of low threshold energy)

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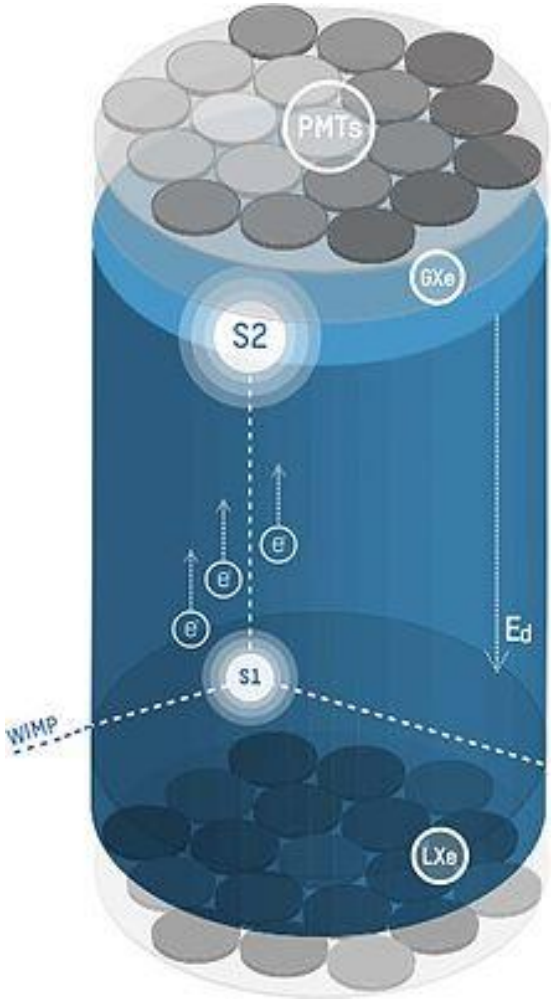

DM signals are quite energetic(boosted)
And signal via DM-electron scattering could be featured by appreciable track(using S1 ,S2 signal) due to great resolution in the z direction and the 511 keV peak

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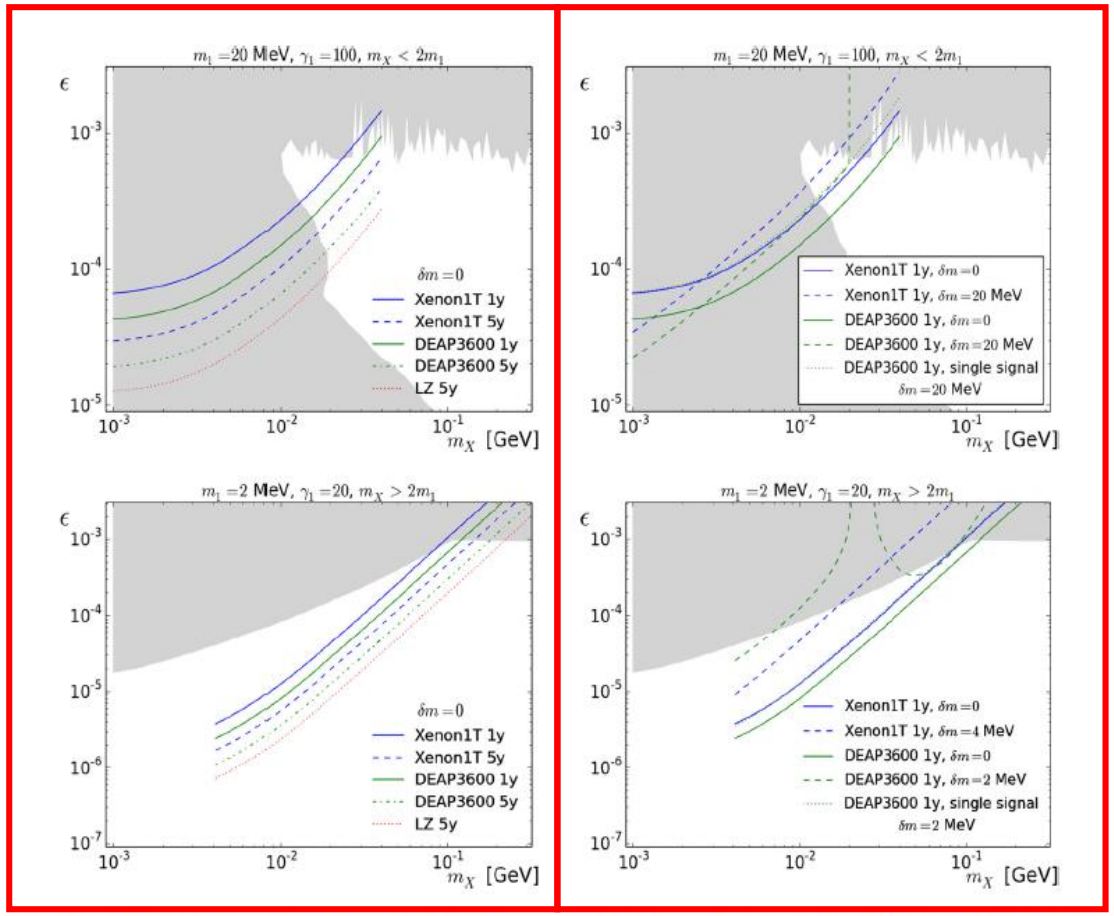

Fig. 6. Experimental reach at various experiments in the m_X–ϵ plane for the case in which the dark photon X decays visibly (top panels) or invisibly (bottom panels). The grey regions show the currently excluded parameter space, as reported in Refs. [43] (top panels) and [44] (bottom panels). The left panels show the results of elastic scattering at different experiments, while in the right panels we compare cases of elastic ($\delta m = 0$) and inelastic ($\delta m \neq 0$) scattering.

Grey regions : currently excluded parameter space