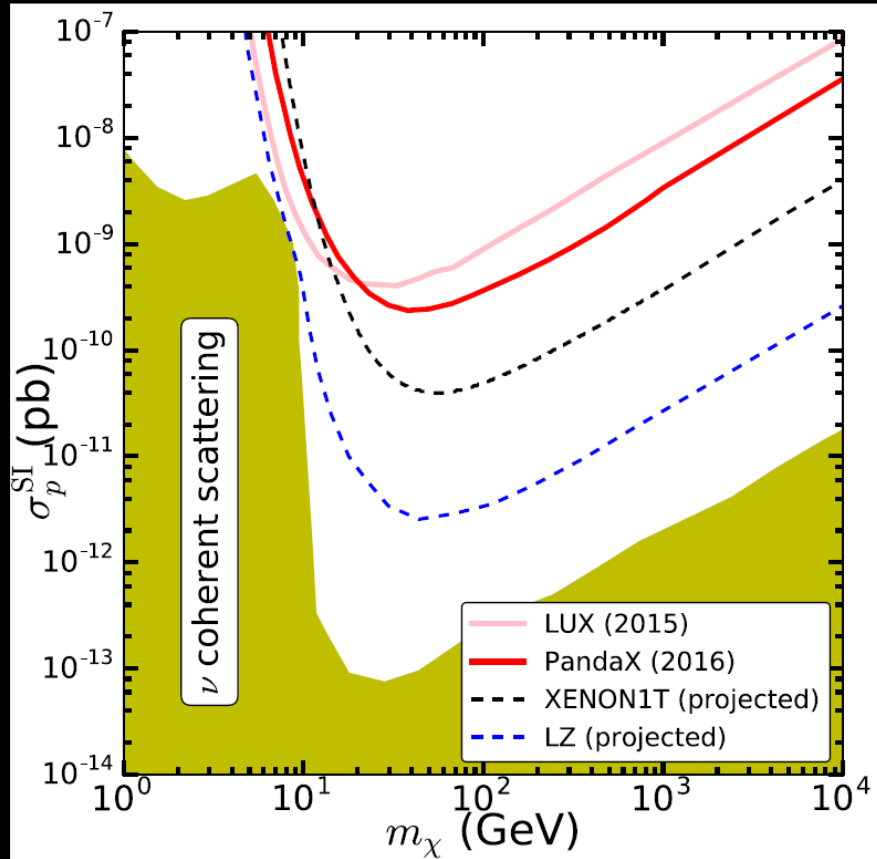


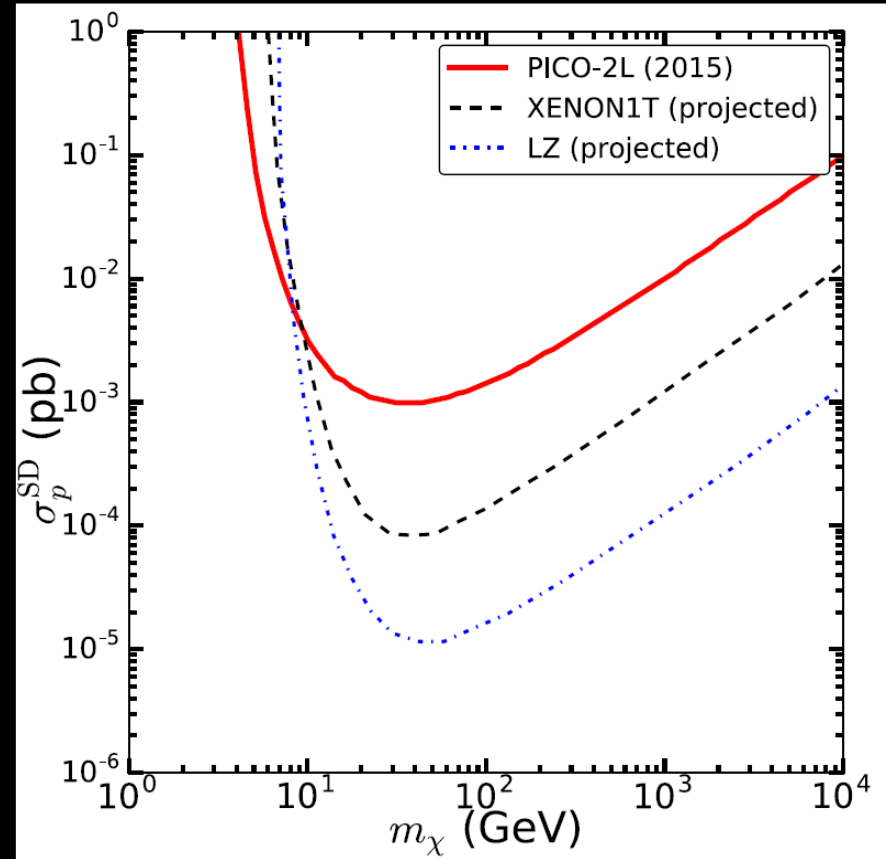
Theoretical aspects of DM

Shigeki Matsumoto (Kavli IPMU)

Fig.1 Direct WIMP detection

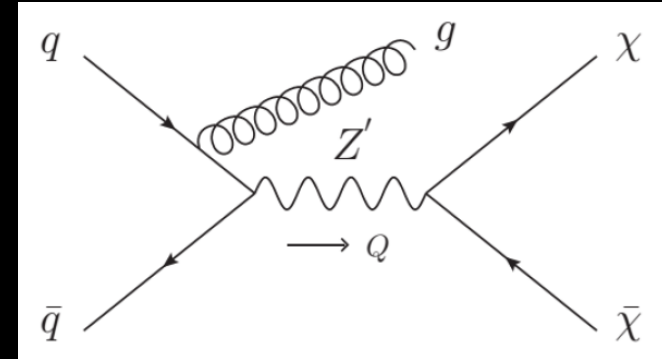
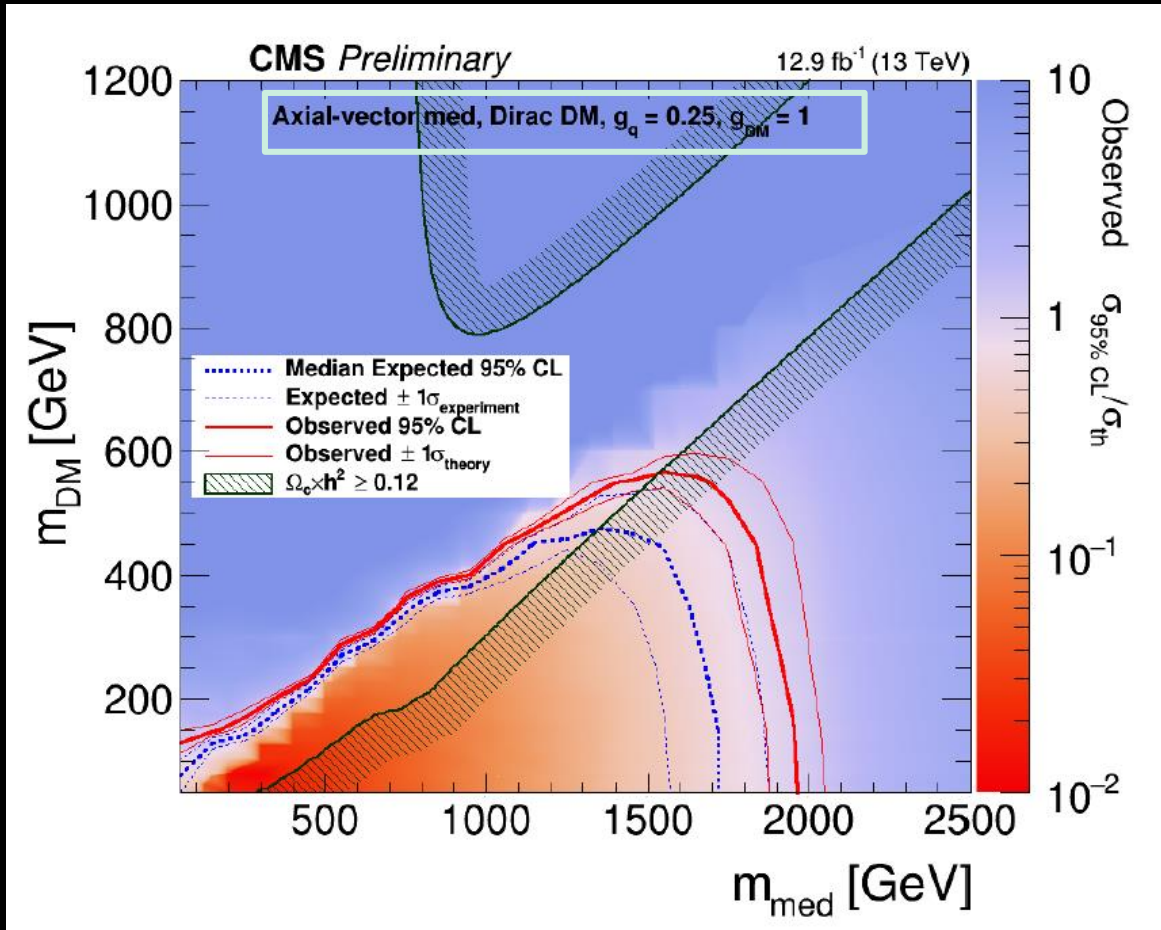


Spin-independent scattering

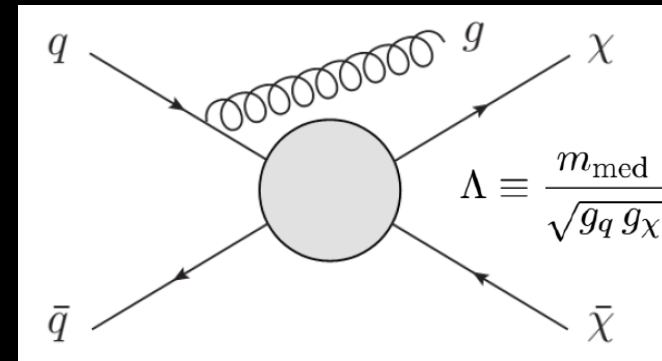


Spin-dependent scattering

Fig.2 WIMP production @ LHC

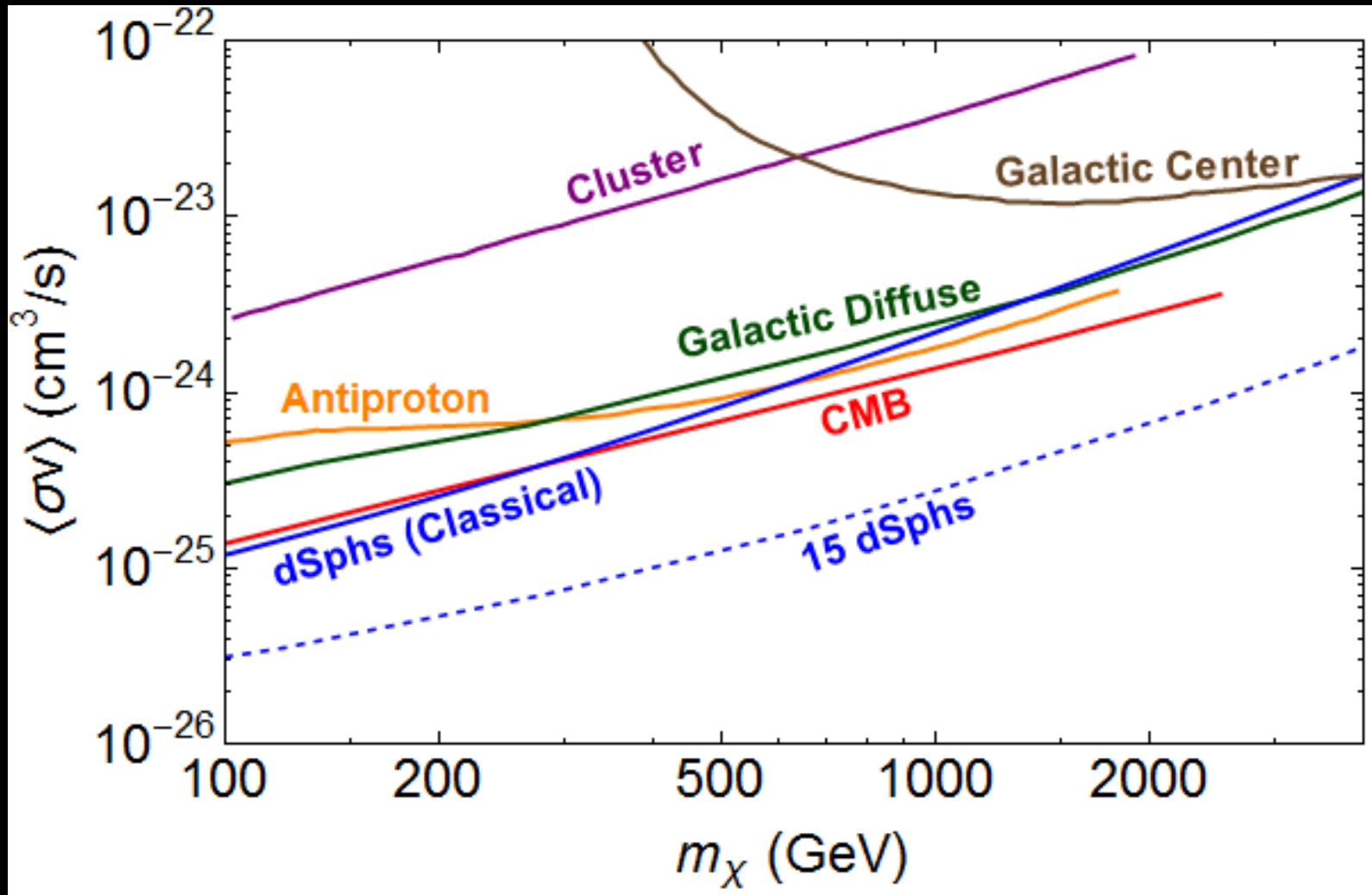


$\Downarrow Q \rightarrow 0$



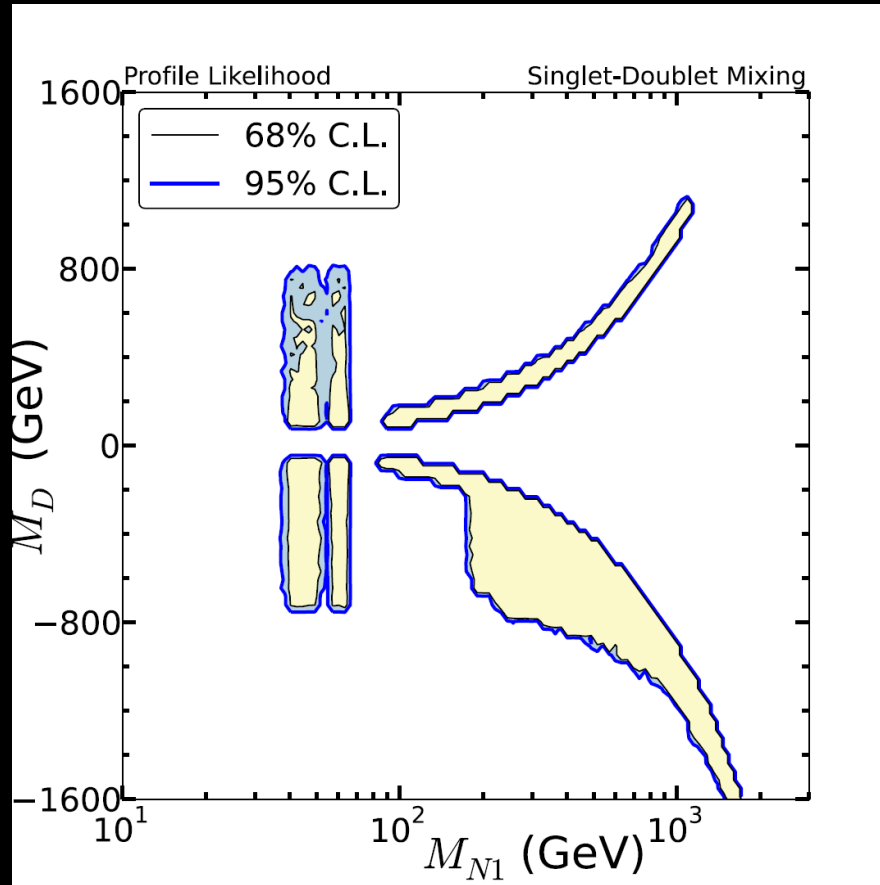
$$4\text{Fermi}(\chi\chi qq/\Lambda^2)$$

Fig.3 Indirect WIMP detection



The case that WIMP annihilates into WW with 100% branching fraction.

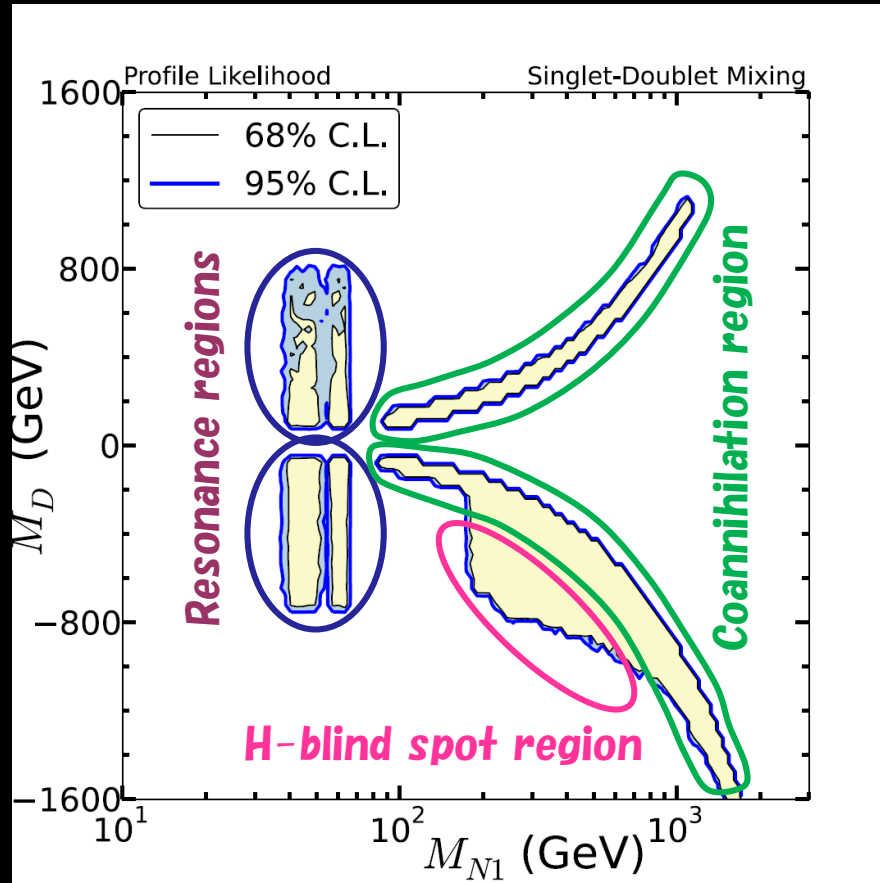
Fig.4 Constraints on S-D WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, M_D) -plane.)

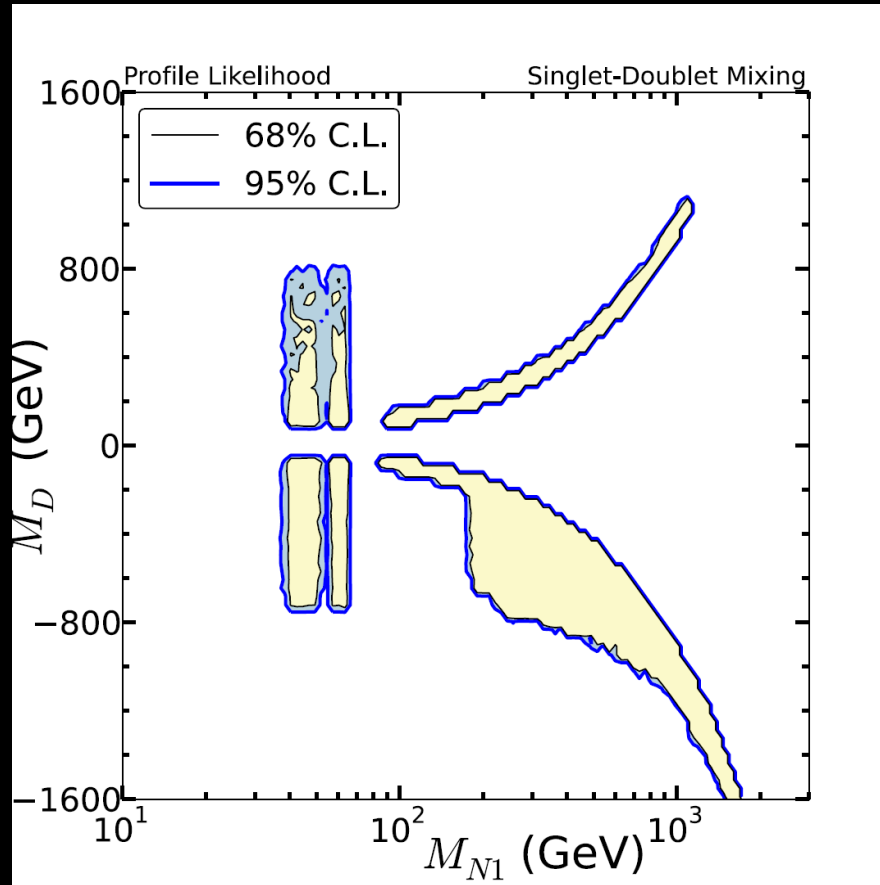
Fig.4 Constraints on S-D WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, M_D) -plane.)

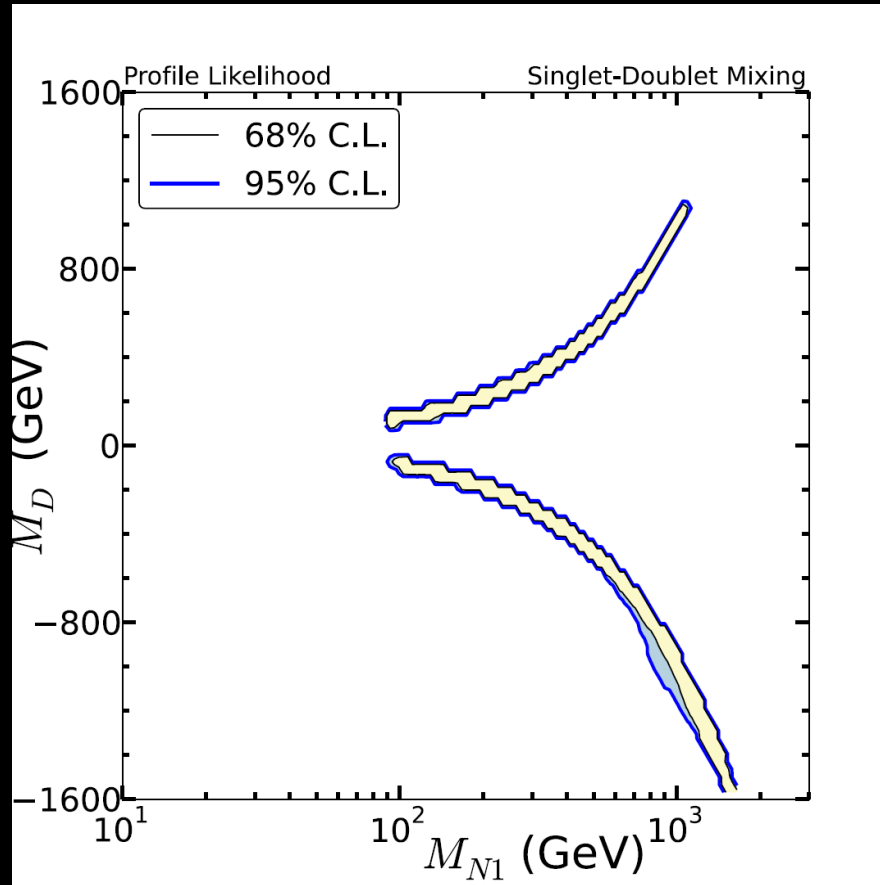
Fig.4 Constraints on S-D WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, M_D) -plane.)

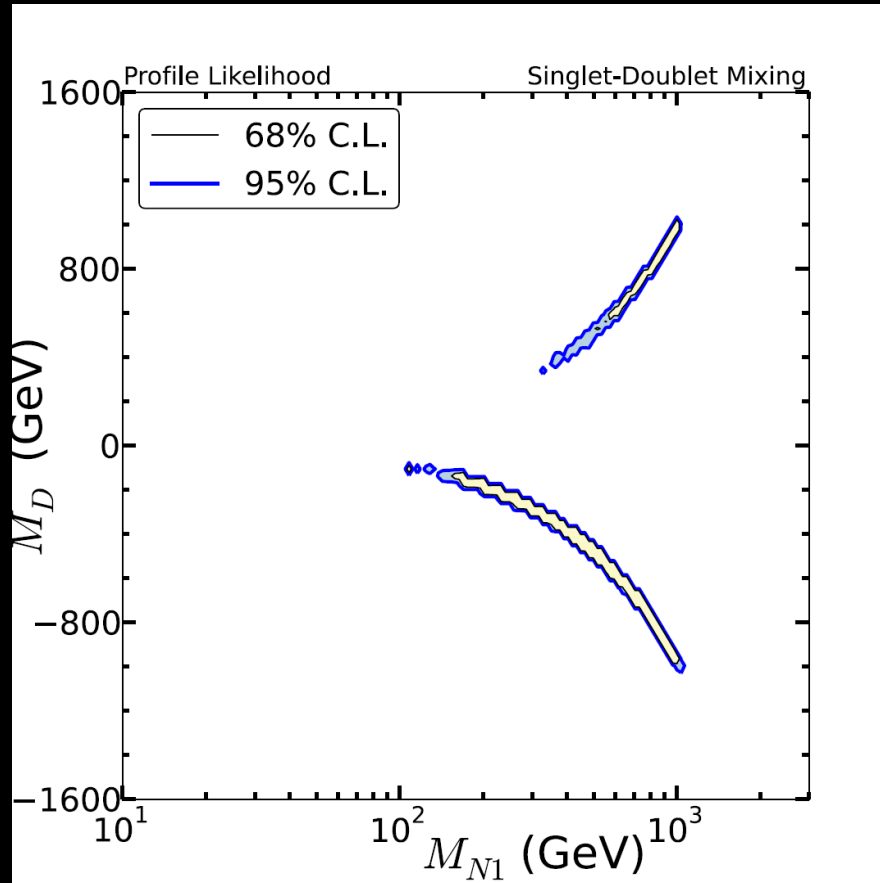
Fig.4 Constraints on S-D WIMP



After XENON1T

(The likelihood function is now projected onto the (M_{DM}, M_D) -plane.)

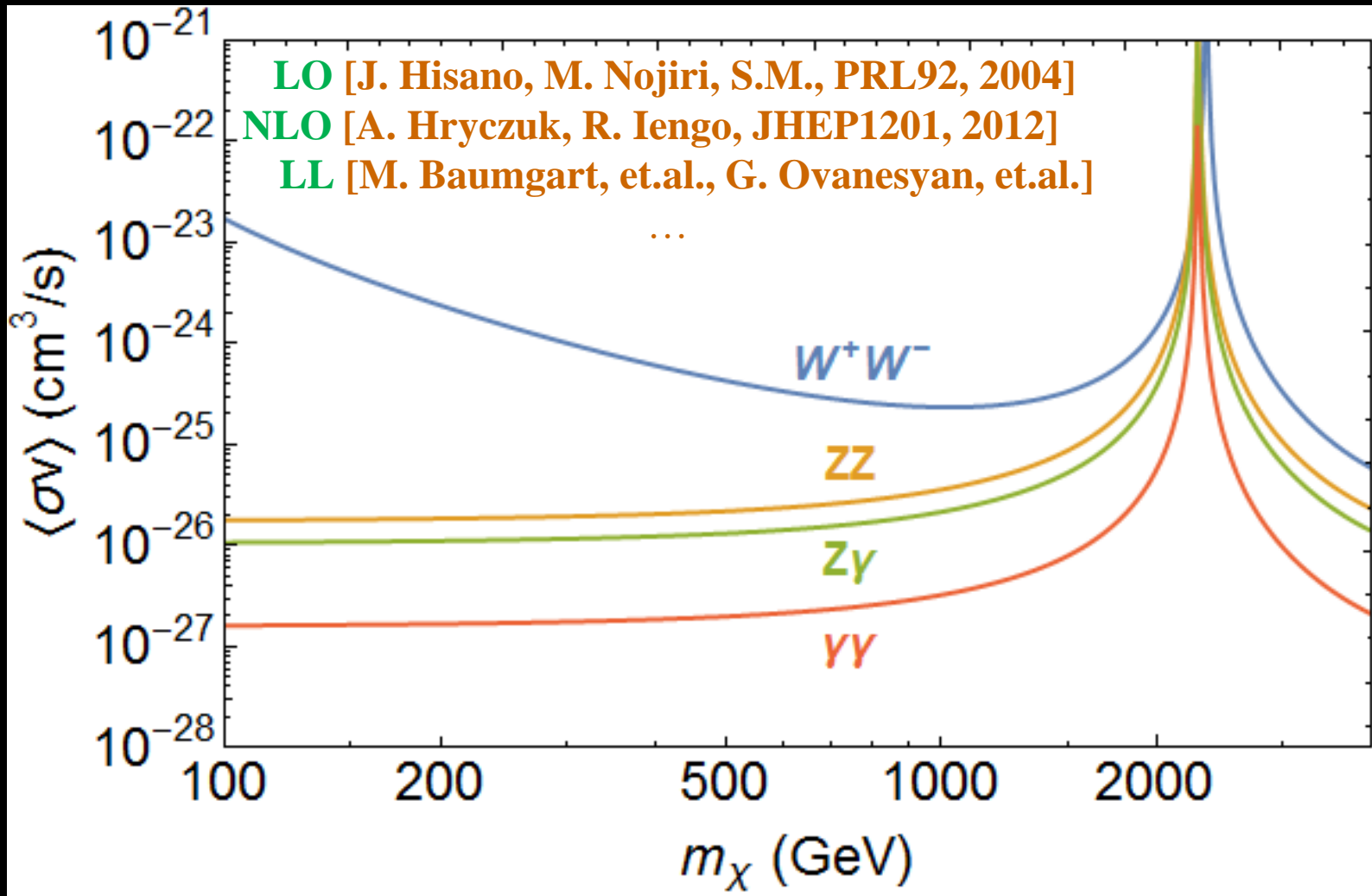
Fig.4 Constraints on S-D WIMP



After LZ / PIC0250

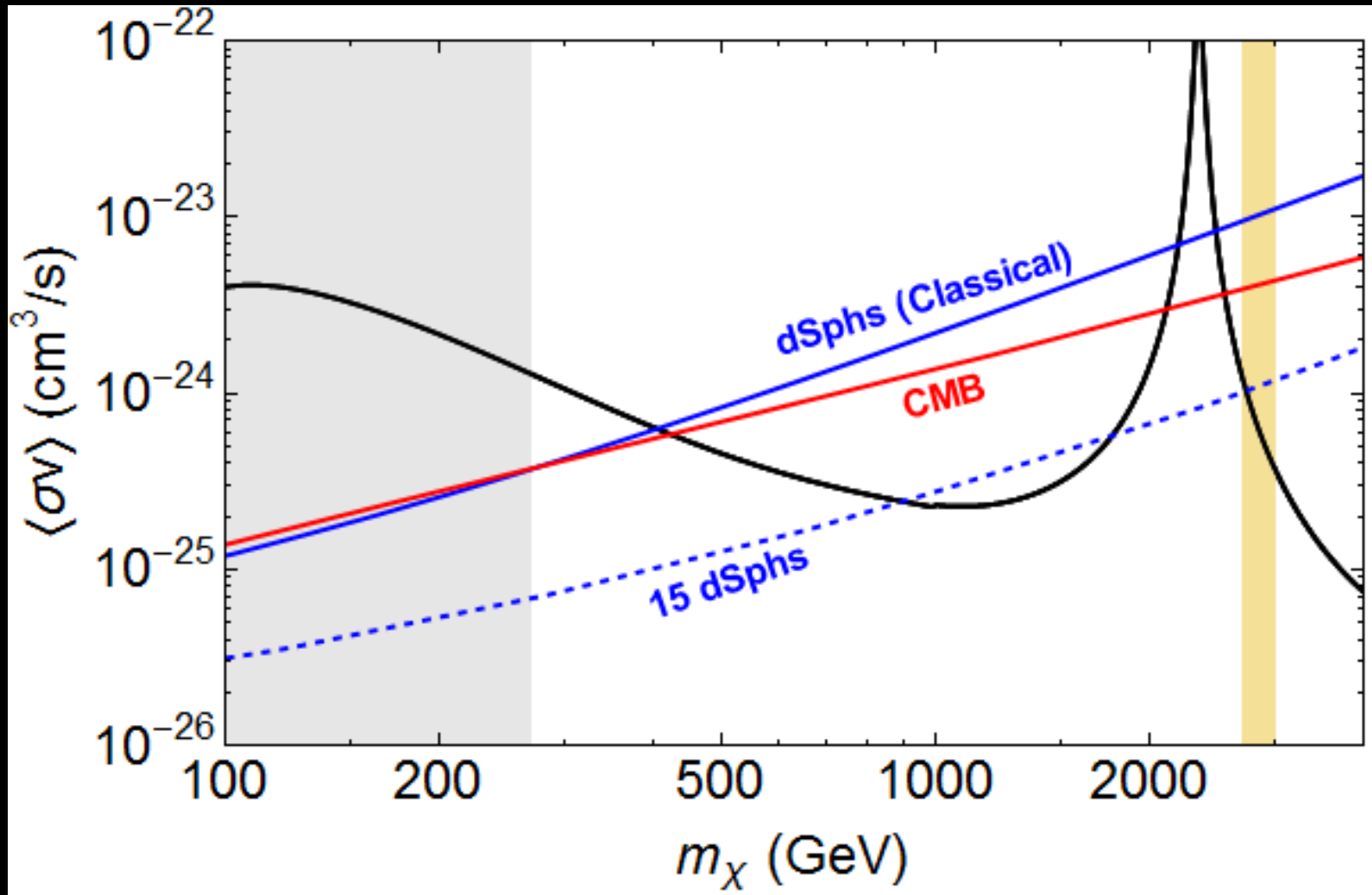
(The likelihood function is now projected onto the (M_{DM}, M_D) - plane.)

Fig.5 Sommerfeld effect



Constraints on Triplet WIMP from various indirect detections and LHC.

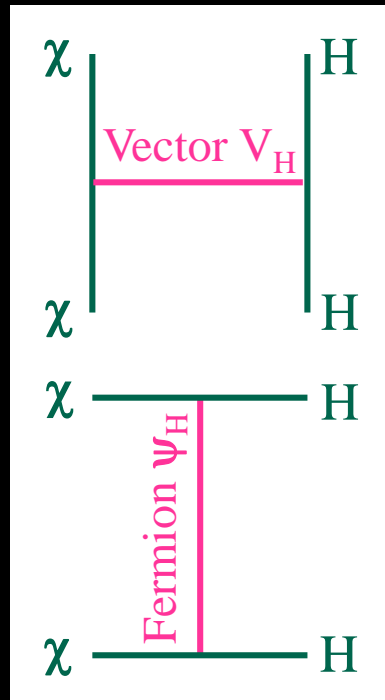
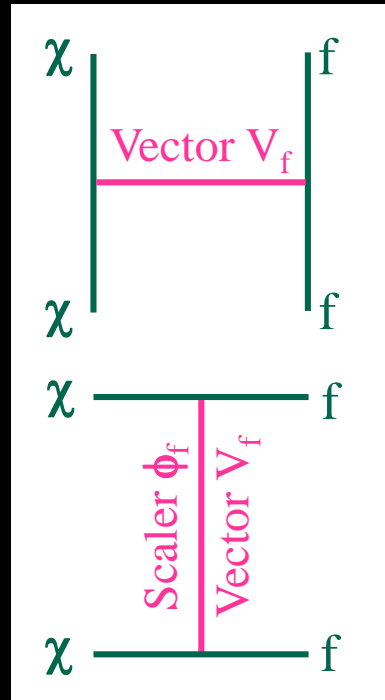
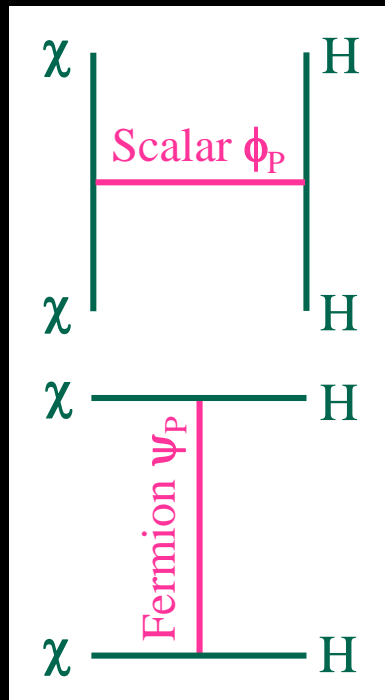
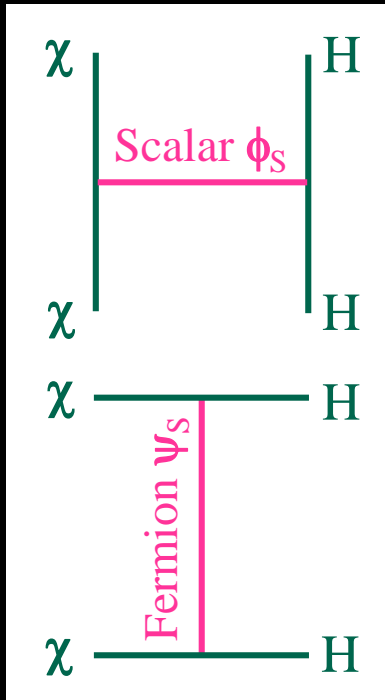
Fig.6 Constraints on Wino



Constraints on Triplet WIMP from various indirect detections and LHC.

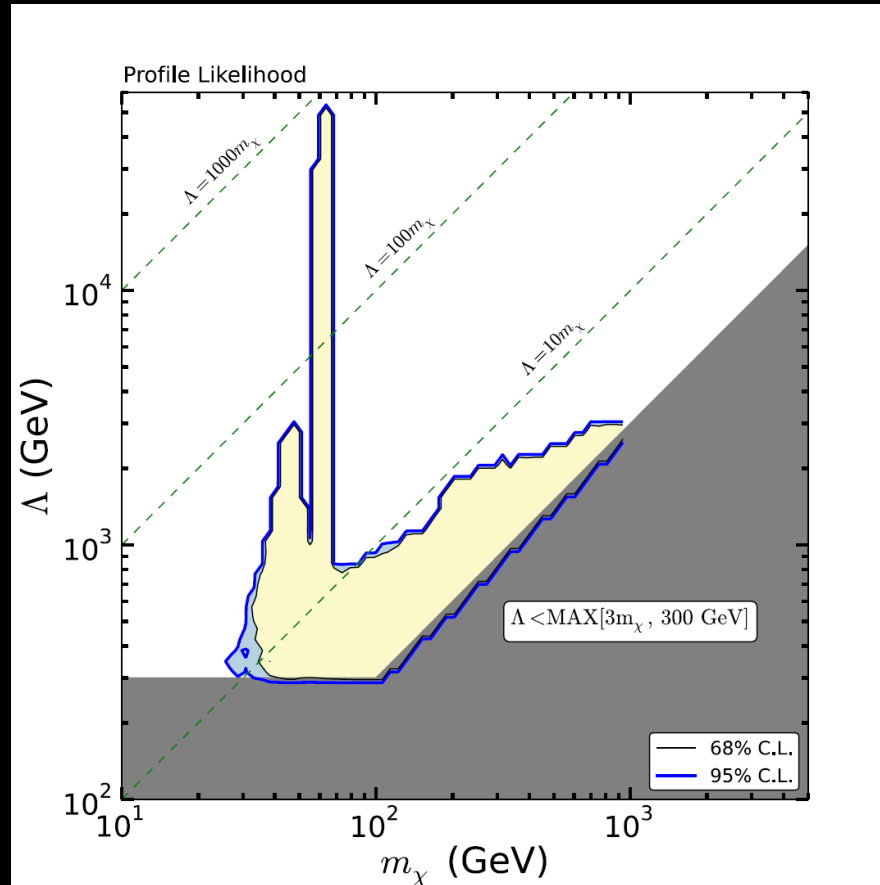
Fig.7 EFT and Simplified Models

$$\mathcal{L}_{\text{EFT}} \supset \frac{c_S}{2\Lambda_S} (\bar{\chi}\chi)|H|^2 + \frac{c_P}{2\Lambda_P} (\bar{\chi}i\gamma_5\chi)|H|^2 + \sum_f \frac{c_f}{2\Lambda_f^2} (\bar{\chi}\gamma^\mu\gamma_5\chi)(\bar{f}\gamma_\mu f) + \frac{c_H}{2\Lambda_H^2} (\bar{\chi}\gamma^\mu\gamma_5\chi)(H^\dagger i\overleftrightarrow{D}_\mu H)$$



Simplified model (renormalizable) interactions providing the EFT Lagrangian.

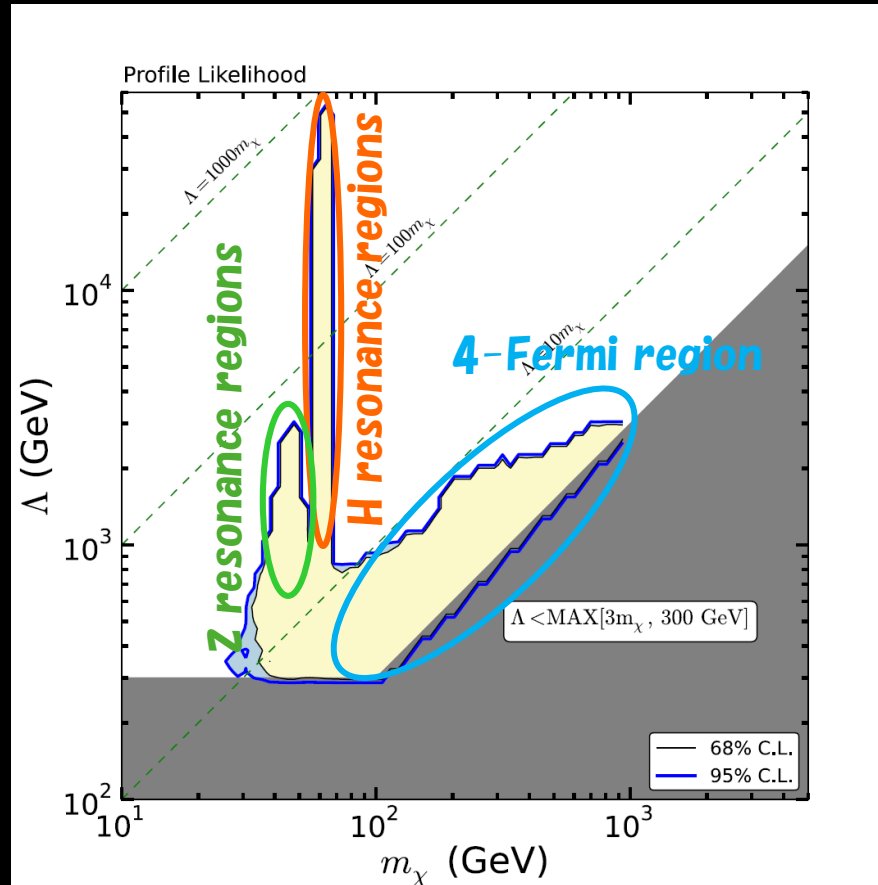
Fig.8 Constraints on Singlet-like WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, Λ) -plane.)

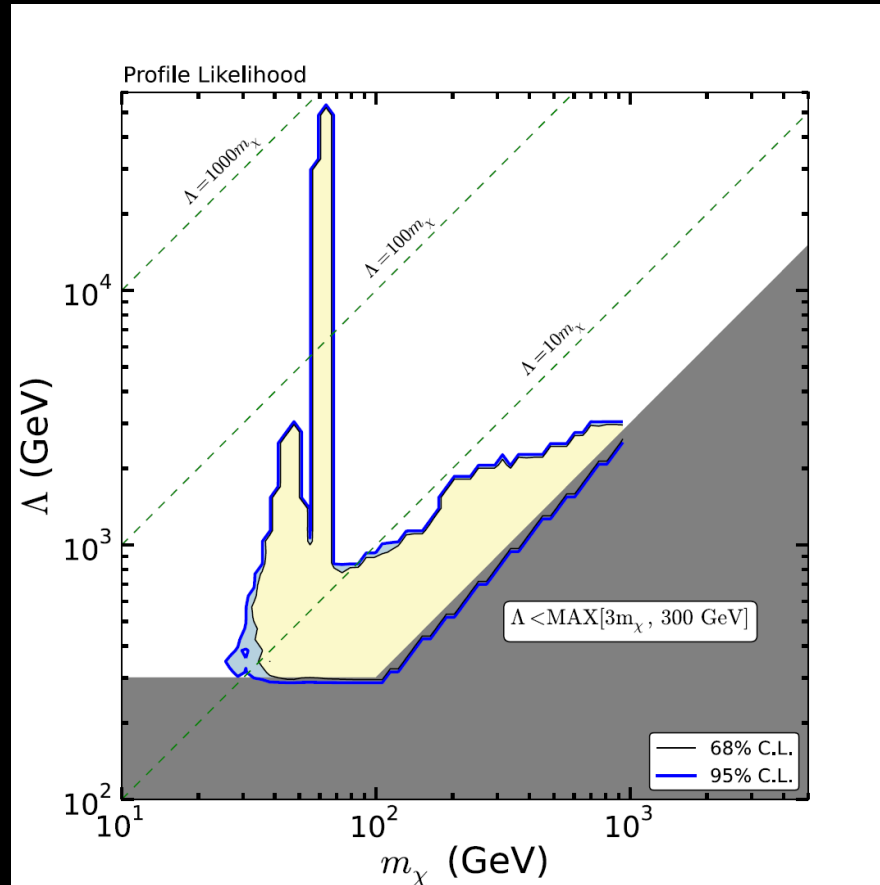
Fig.8 Constraints on Singlet-like WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, Λ) -plane.)

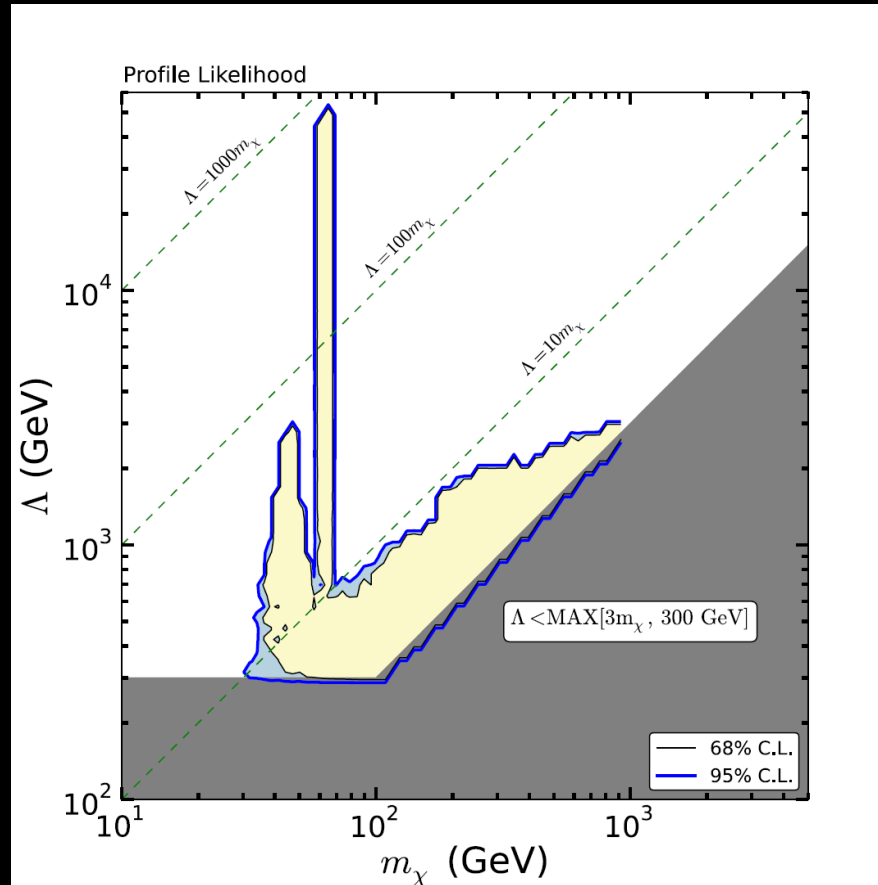
Fig.8 Constraints on Singlet-like WIMP



Present status

(The likelihood function is now projected onto the (M_{DM}, Λ) -plane.)

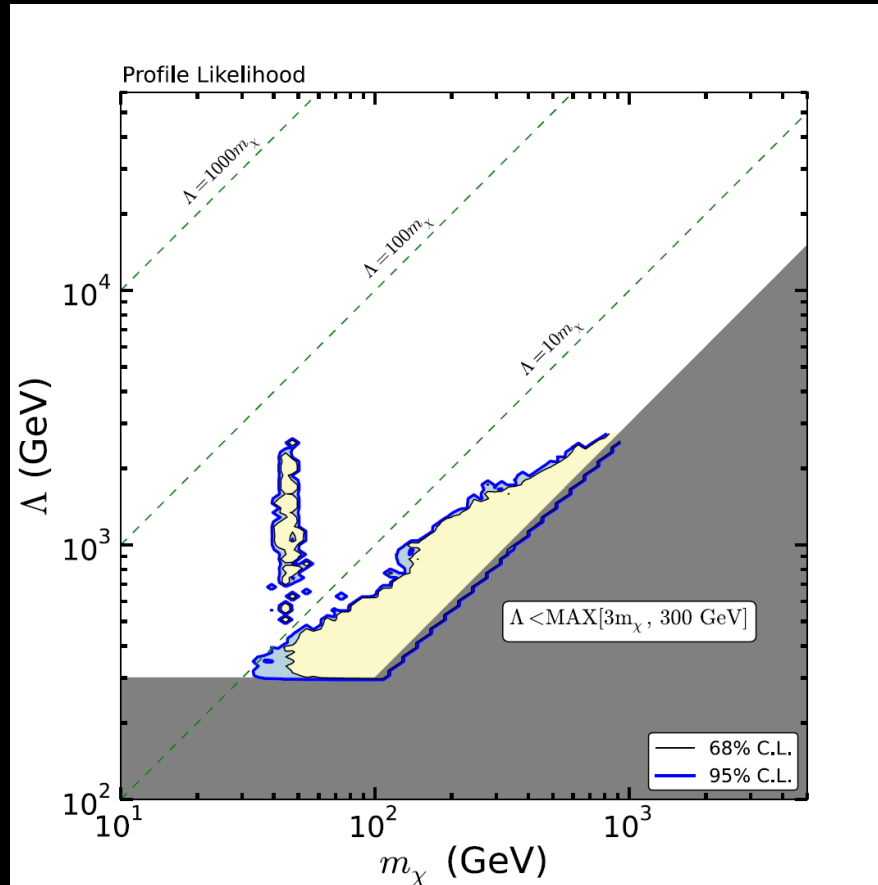
Fig.8 Constraints on Singlet-like WIMP



After XENON1T

(The likelihood function is now projected onto the (M_{DM}, Λ) -plane.)

Fig.8 Constraints on Singlet-like WIMP



After LZ / PIC0250

(The likelihood function is now projected onto the (M_{DM}, Λ) -plane.)