

# Light Dark Matter with a Scalar Mediator

Martin W. Winkler

based on Phys.Rev. D99 (2019)



*COSMO 2019*

*Aachen,*

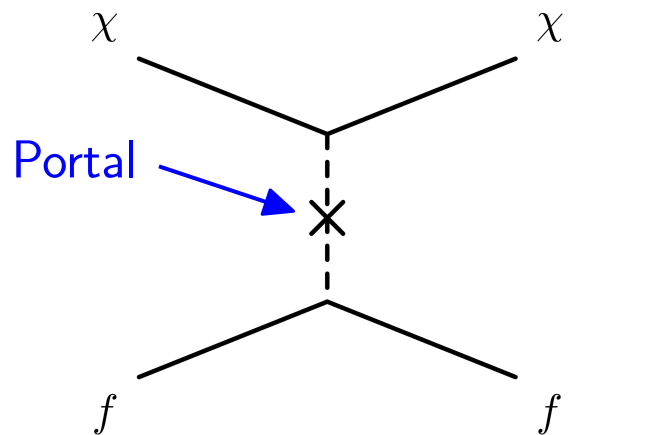
*September 2, 2019*



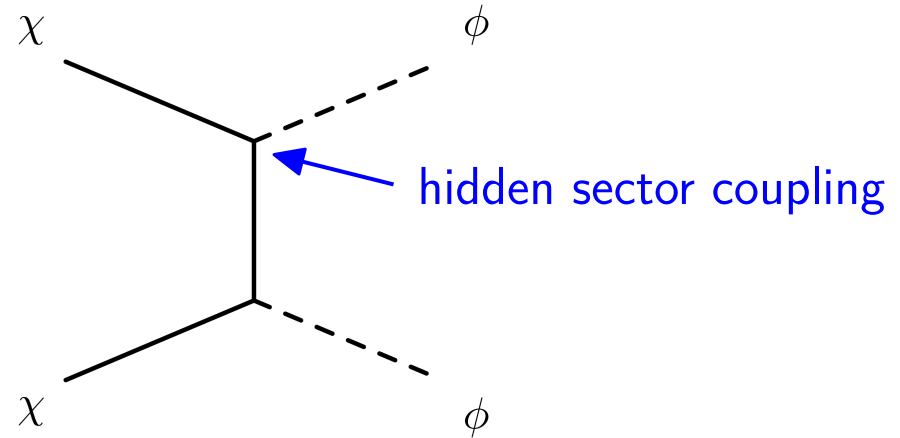
**Stockholm  
University**

# "Secluded" WIMPs

Pospelov, Ritz, Voloshin, Phys. Lett. B662 (2008)



suppressed direct detection



thermal freeze-out

$H^\dagger H \phi^\dagger \phi$       Higgs Portal

$F^{\mu\nu} F'_{\mu\nu}$       Vector Portal

$HLN_R$       Neutrino Portal

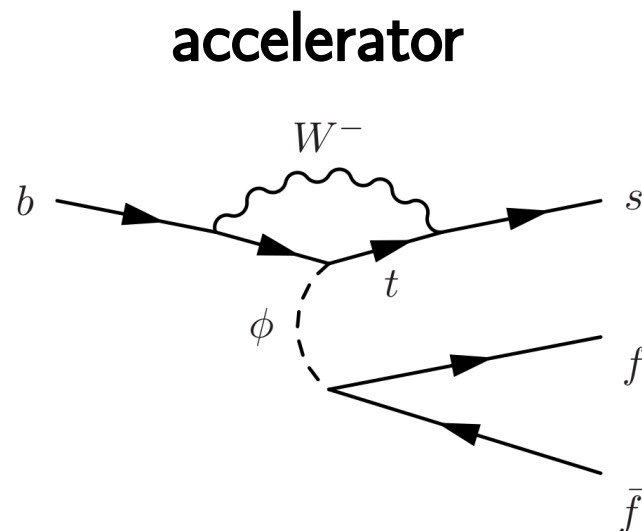
# Scalar Mediator

- mixing with the Higgs induces coupling to SM fields

$$\mathcal{L} \supset s_\theta y_f \phi \bar{f} f$$

universal  
suppression

- constraints:

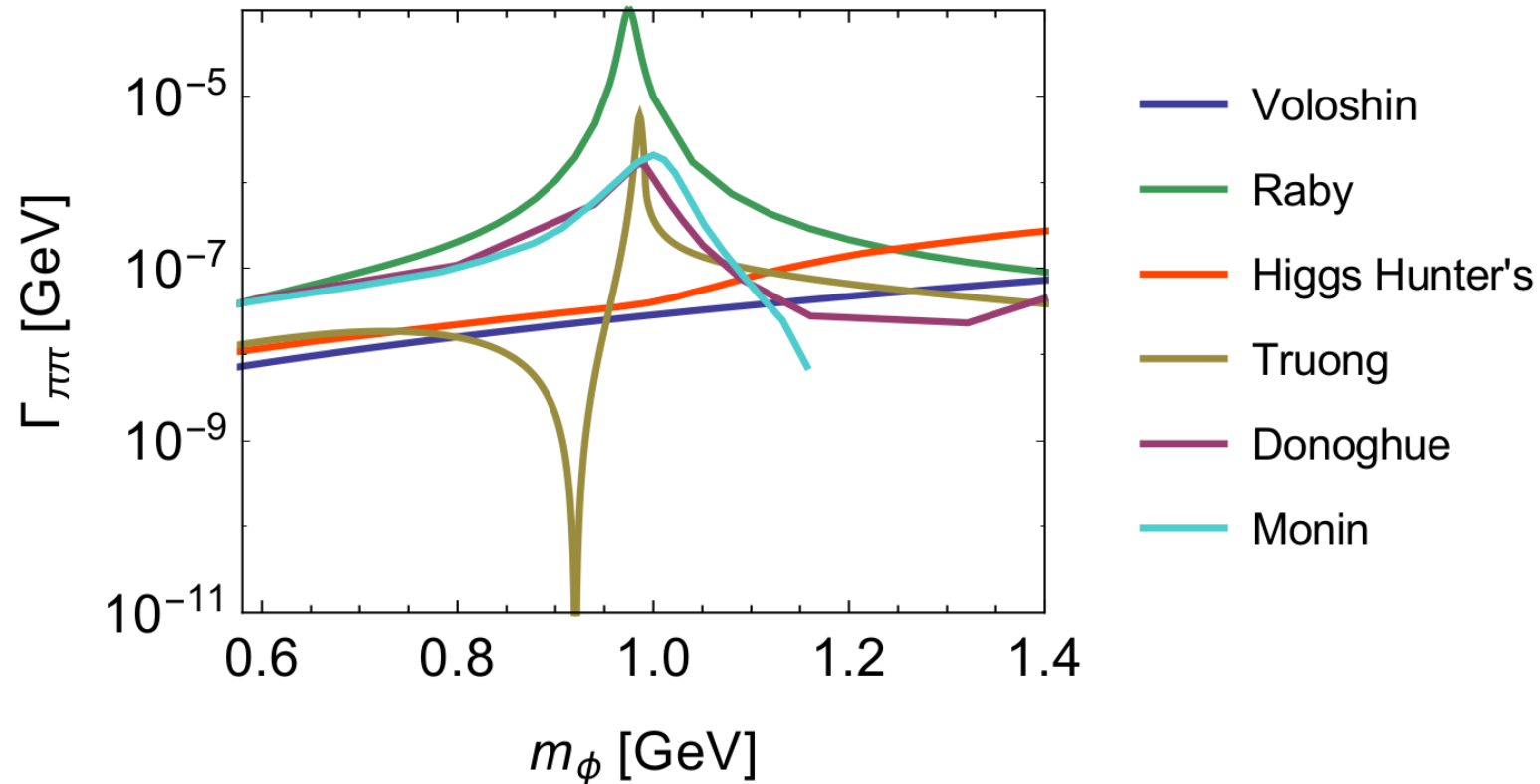


- BBN
  - Supernova
  - Direct DM detection
  - DM thermalization
- } in DM model

interesting:  $m_\phi \lesssim 10 \text{ GeV}$

# Mediator Decay

- large theoretical uncertainties on scalar decay

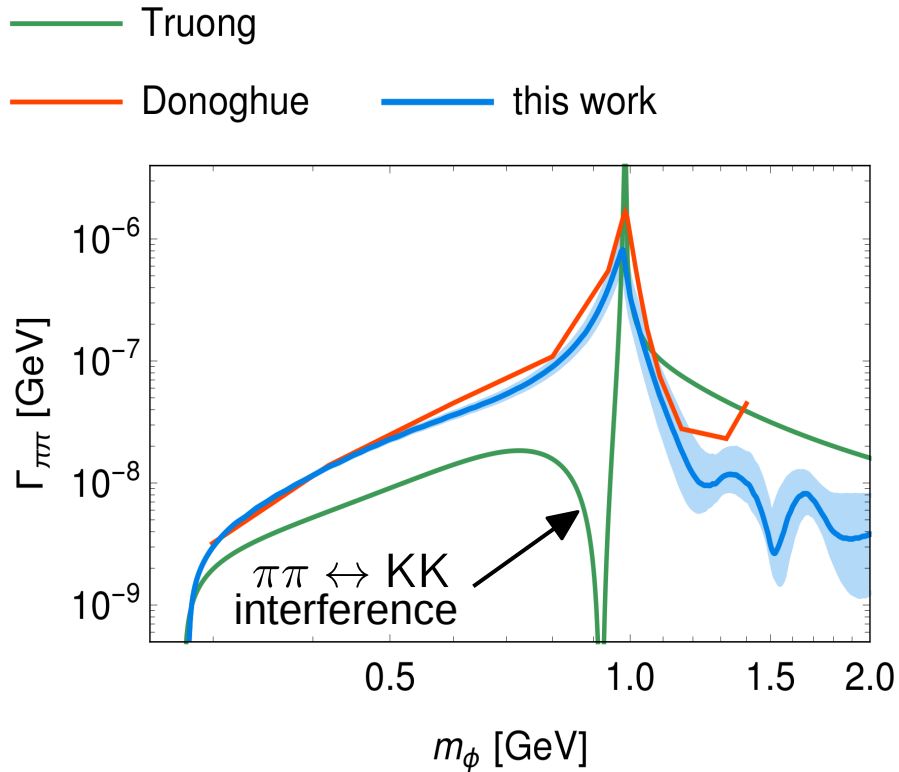


Voloshin, Sov.J.Nucl.Phys. 44 (1986), Raby, West, Phys.Rev. D38 (1988), Gunion et al., Front. Phys. 80 (2000), Truong, Willey Phys.Rev. D40 (1989), Donoghue, Gasser, Leutwyler, Nucl.Phys. B343 (1990), Monin et al., Phys.Rev. D99 (2019)

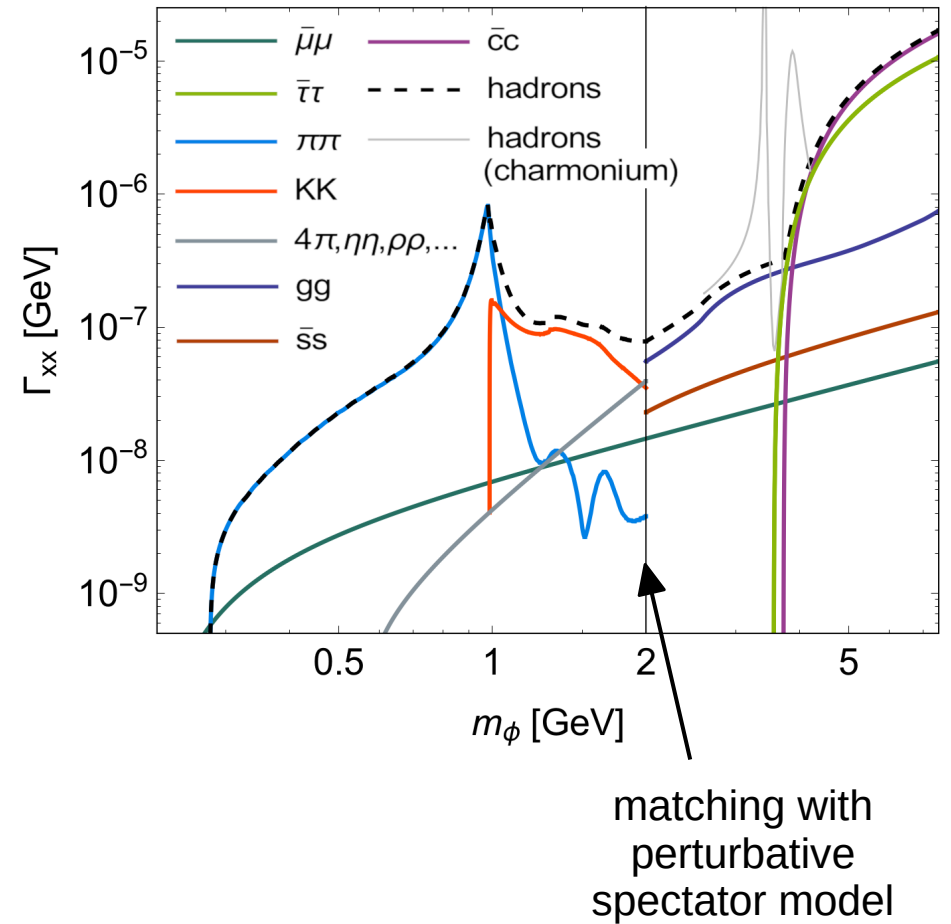
**disagreement by 5 orders of magnitude for  $m_\phi \sim \text{GeV}$**

# New Phase Shift Analysis

## pion channel

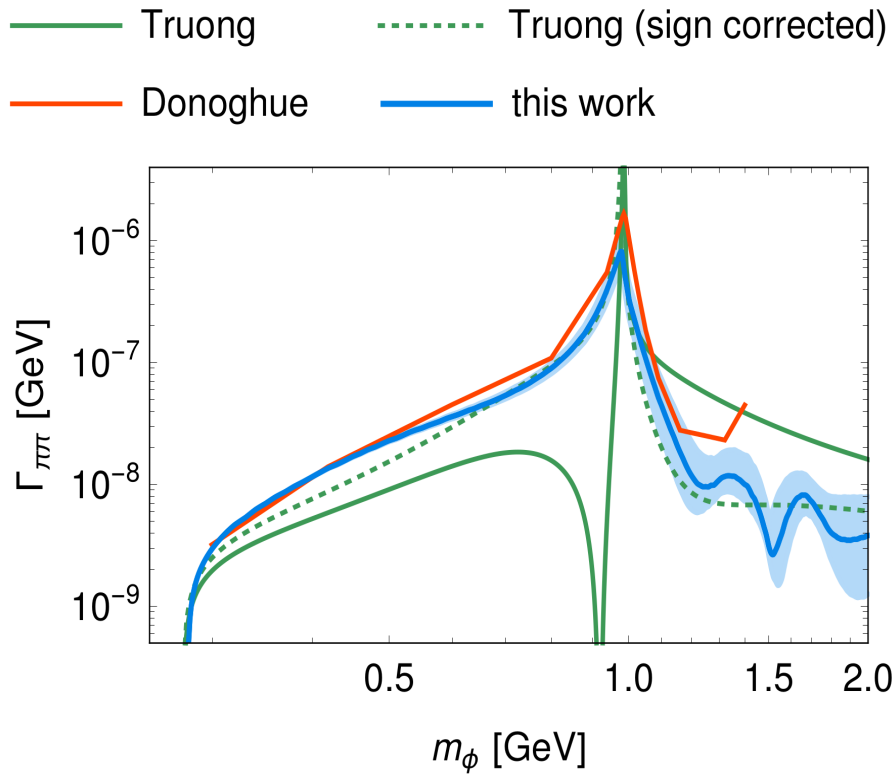


## all channels

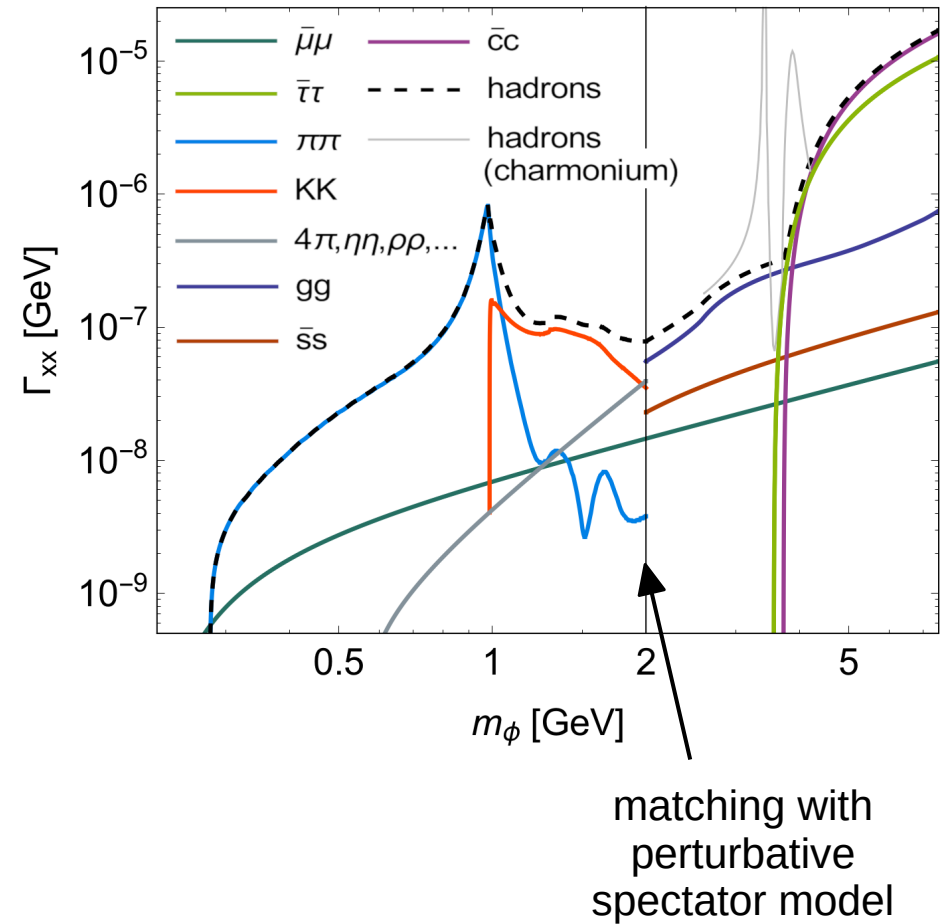


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## pion channel

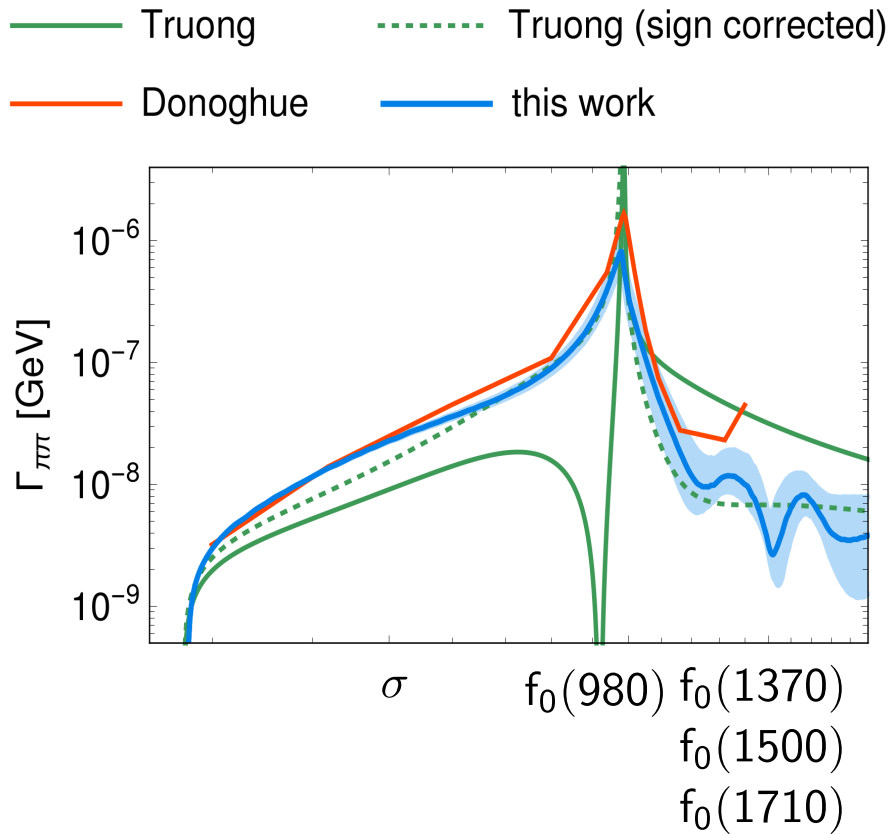


## all channels

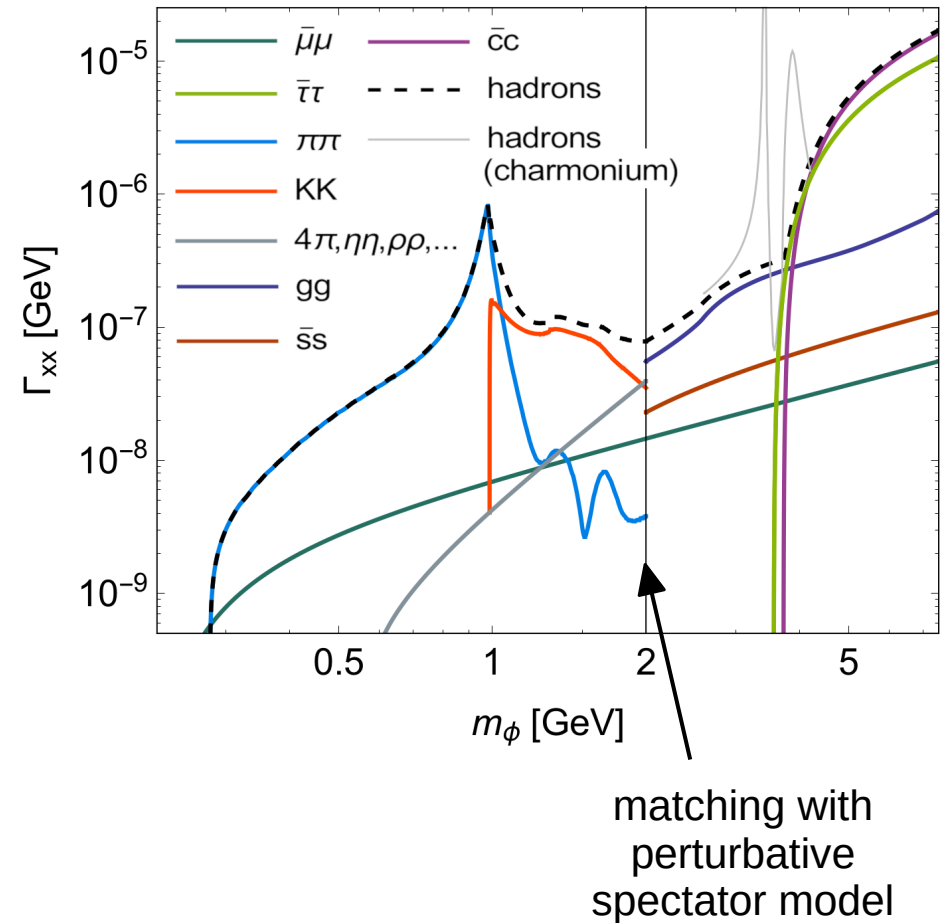


# New Phase Shift Analysis

## pion channel

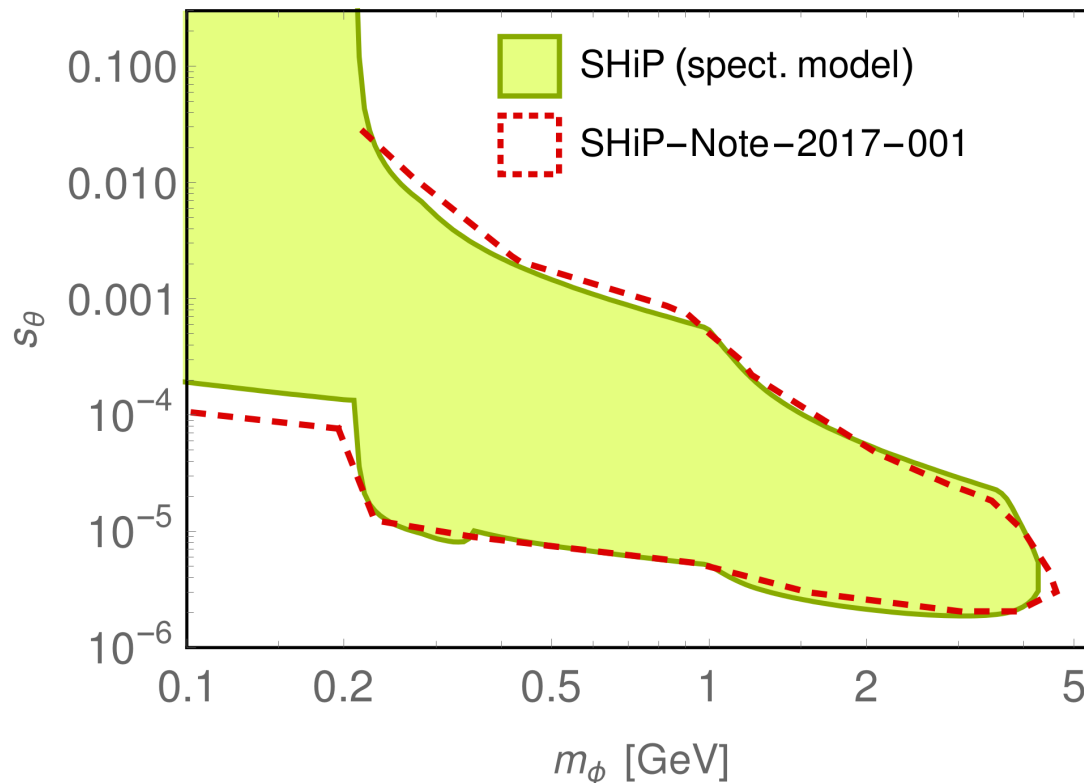
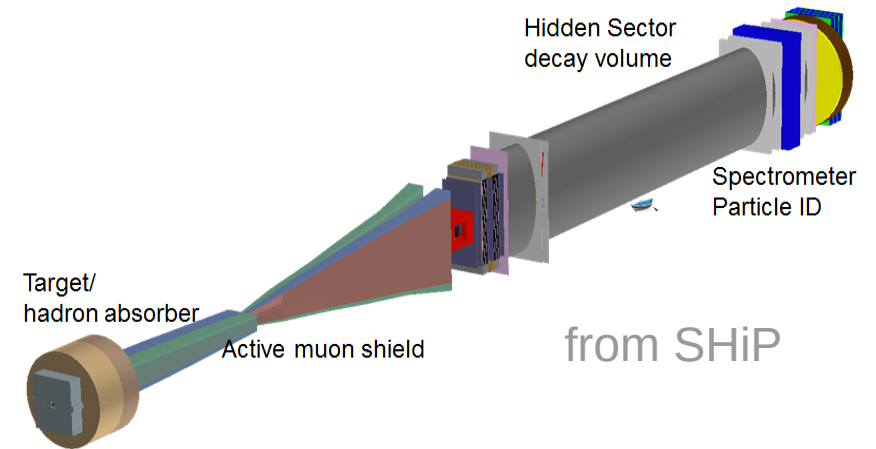


## all channels



# Beam Dumps

- search for long-lived particles  
with far detector:  $K, B \rightarrow \phi \rightarrow \text{SM}$
- e.g. CHARM, SHiP (planned)  
Phys.Lett. 157B (1985), Rept. Prog. Phys. 79 (2016)

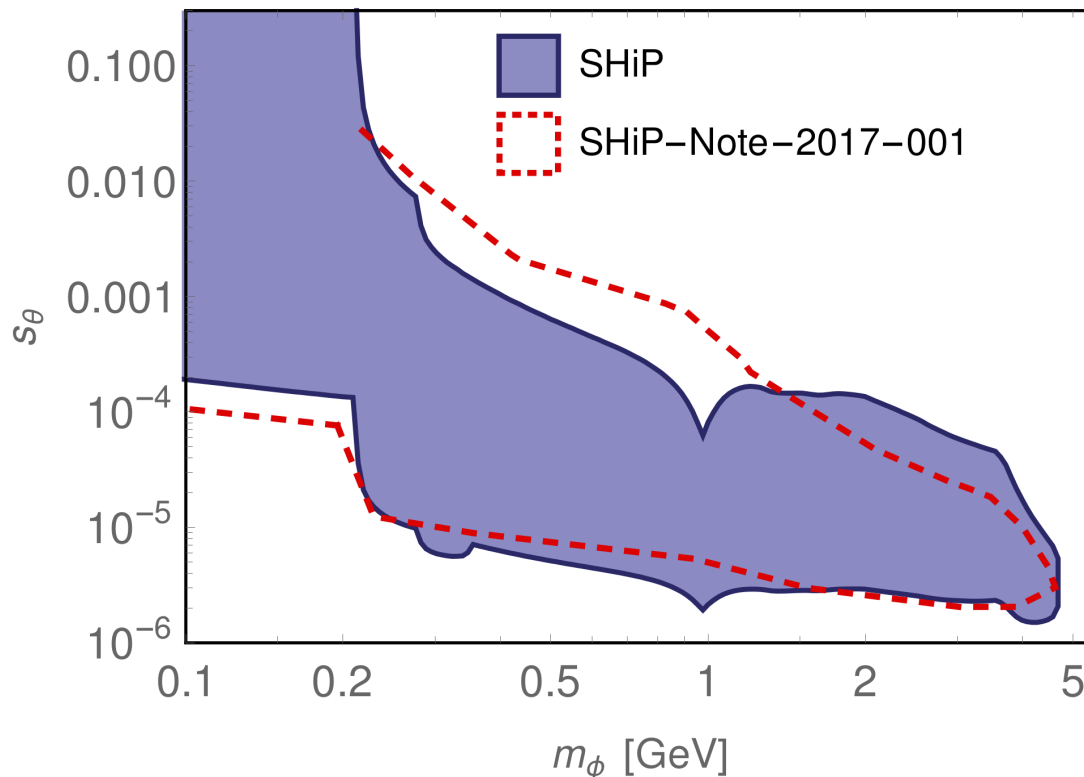
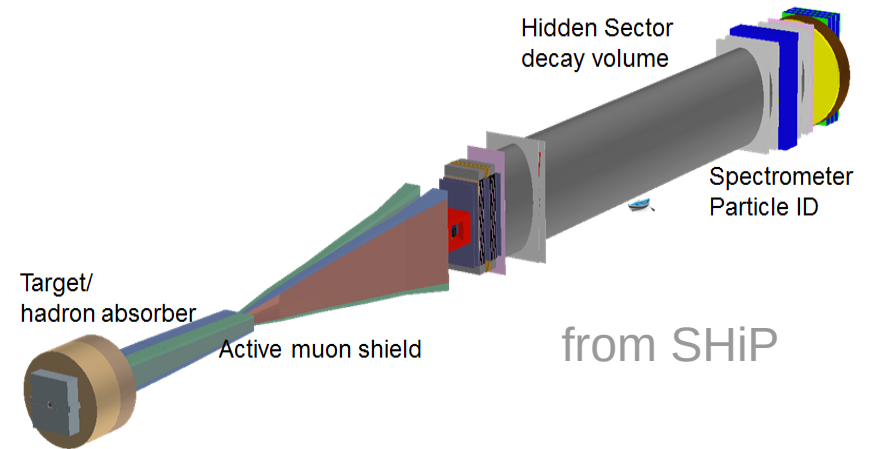


**SHiP sensitivity**  
impact of new  
decay rates



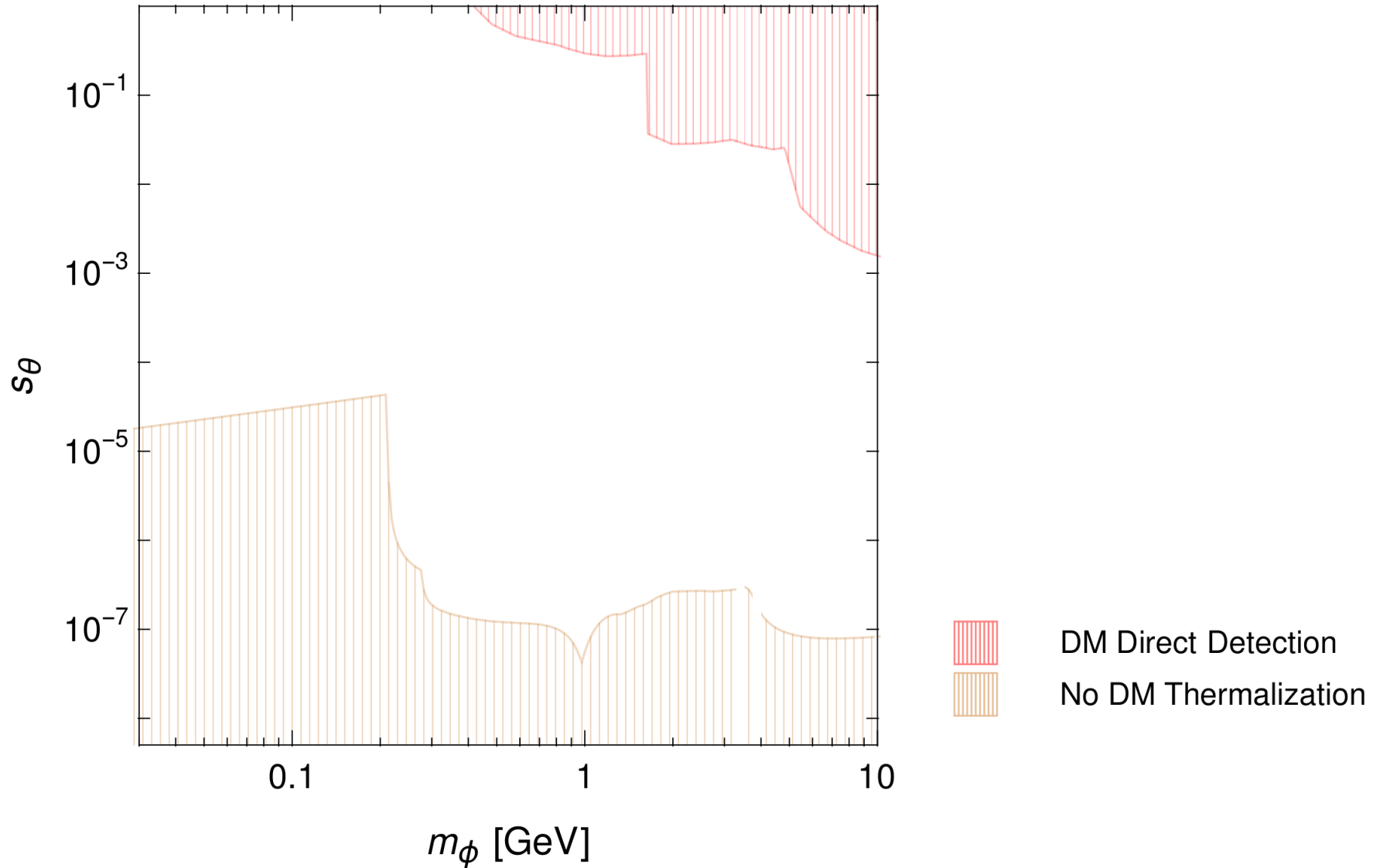
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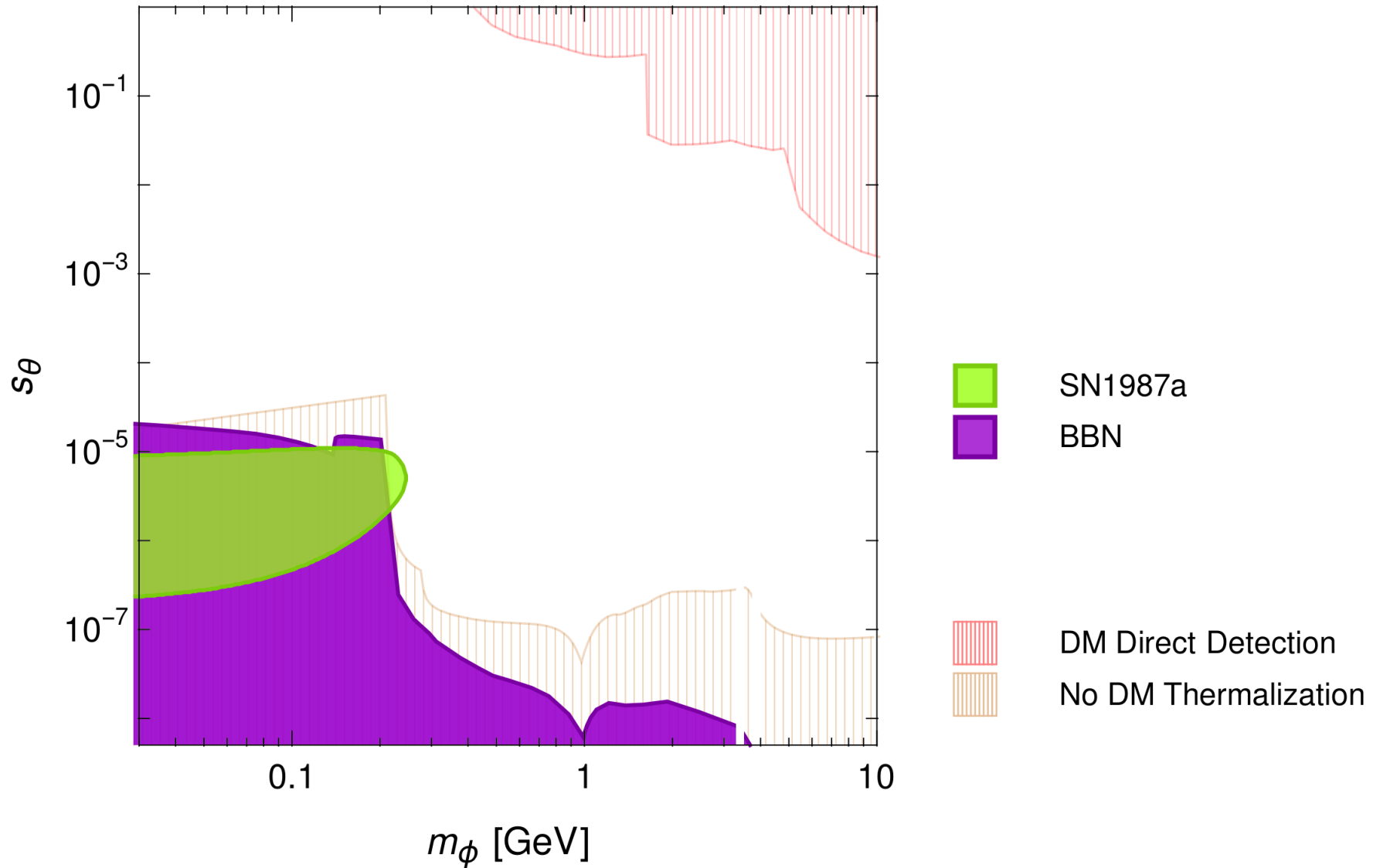


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# Summary Plot



# Summary Plot



# Summary Plot

