

Past Pheno Research @ UdeA

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Research topic

- My main research topic:
 - Study of Dark Matter (DM) observables for some (ad hoc) models BSM.
- Second research topics:
 - Neutrino masses and mixings
 - Calculation of Higgs Branching ratios

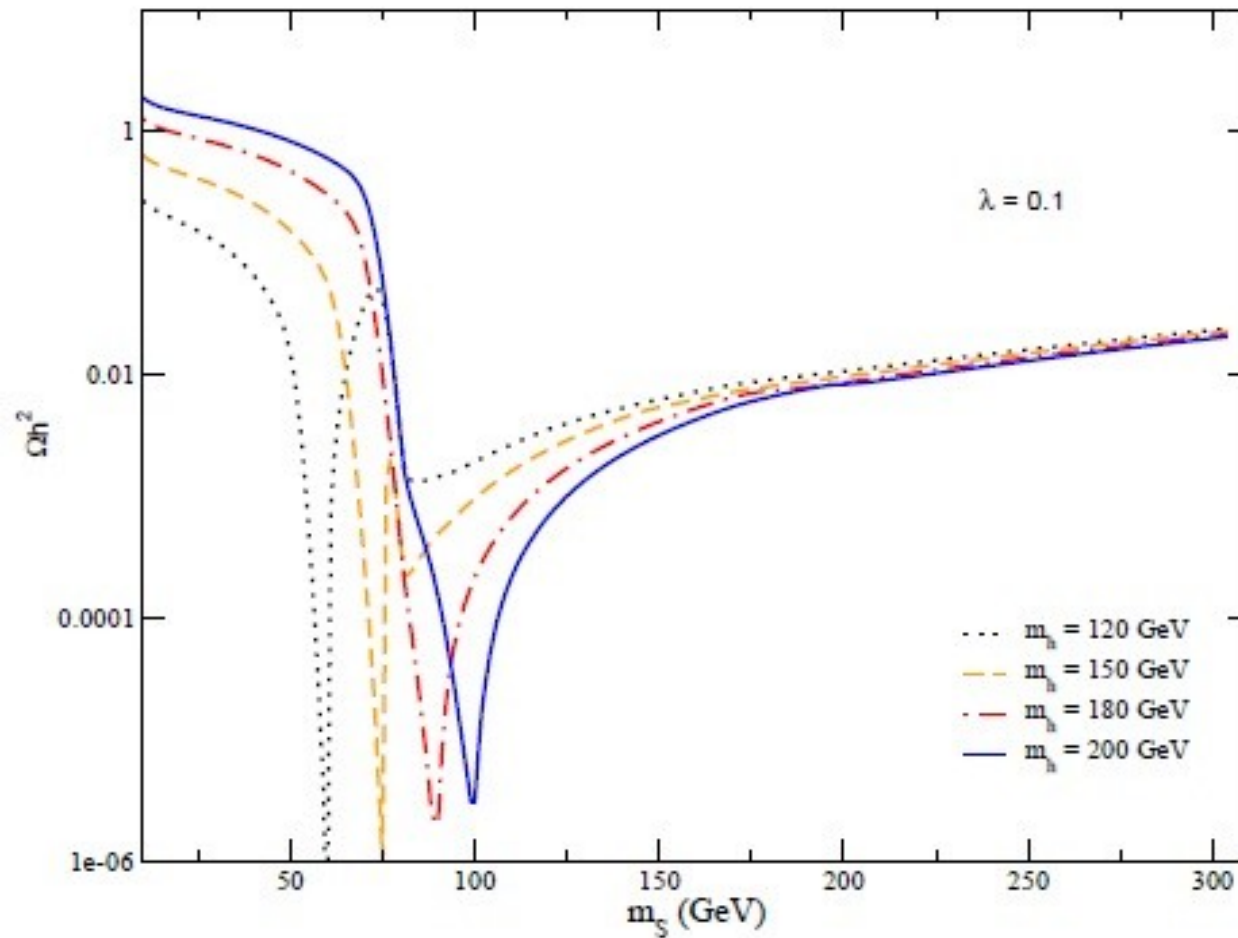
About models BSM for DM

- Ad hoc:
 - Singlet: SM + Scalar Singlet
 - IDM (Inert Doublet Model): SM + Additional Higgs doublet coupled only to SM Higgs.
 - Radiative Seesaw: IDM + 3*(Right Neutrino)
- Theory motivated:
 - 331

Singlet Model

- We studied DM physics with this model
- DM candidate: New scalar singlet
- Scalar singlet only couples to the Higgs
- Two new free parameters: Higgs-Singlet coupling and Singlet mass
- In this model the Invisible Branching ratio of Higgs can be enhanced.

For example

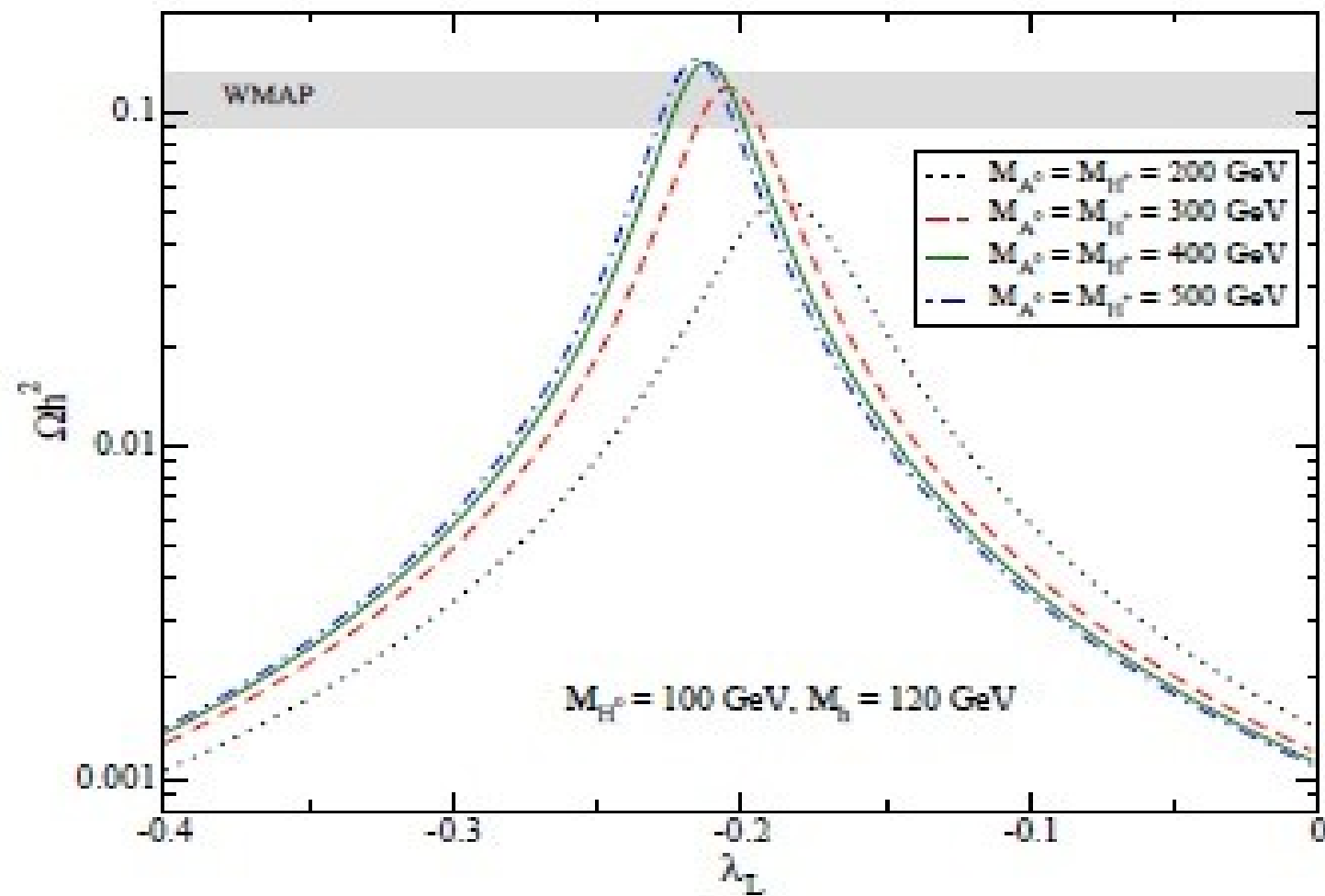


arXiv:0810.4267

IDM

- DM Candidate: Neutral component of the new scalar doublet
- Free parameters: 3 masses (charged, odd and even Higgses), self-interaction of new doublet, and Higgs-New doublet coupling.
- Properties:
 - Enhanced Higgs Invisible Branching ratio
 - Decay of Charged Higgs into SM Higgs

For Example

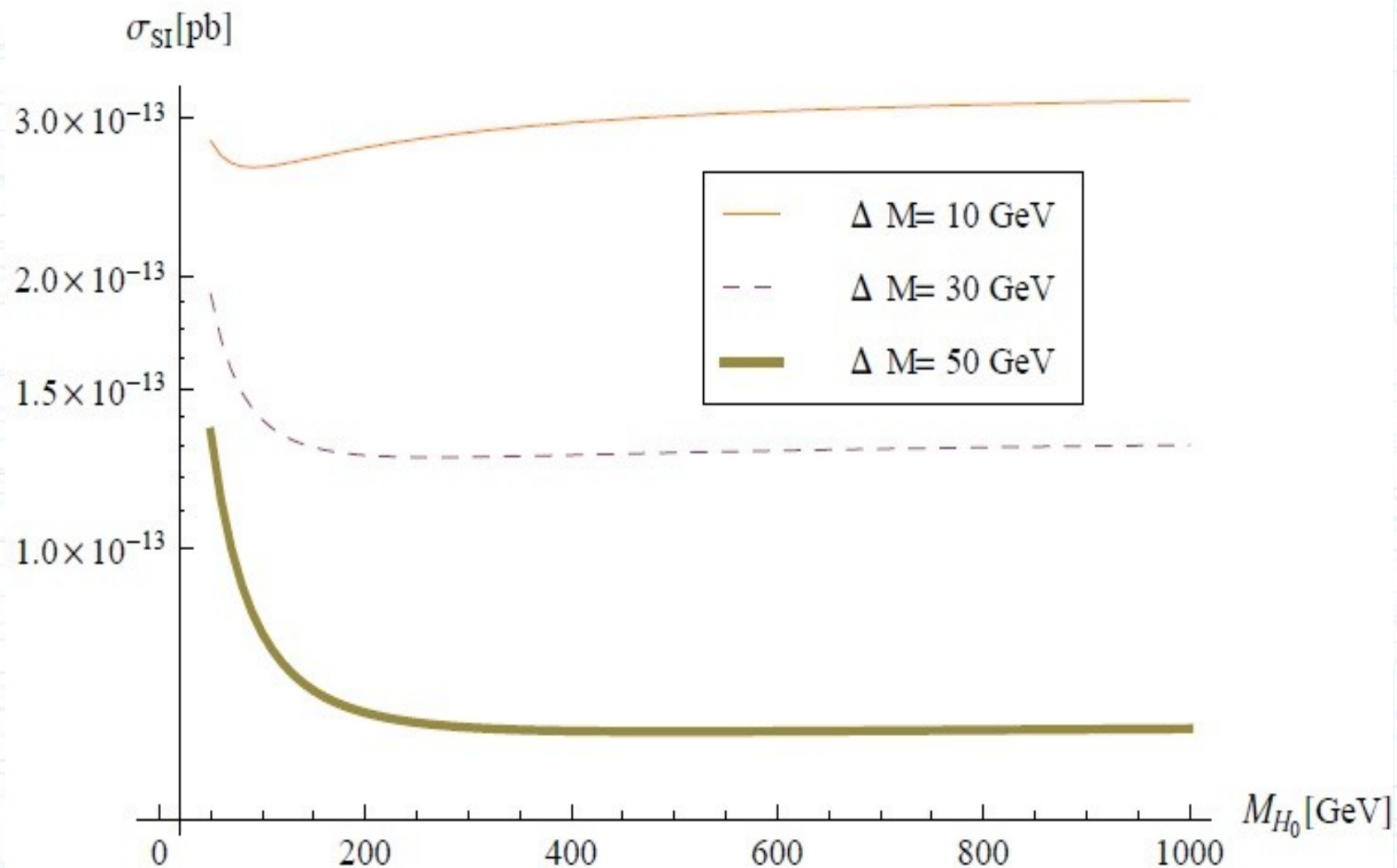


arXiv: 1011.1411

Research

- We (Carlos Yaguna, Diego Restrepo and myself) have studied the consequences of taking into account the one loop contributions to direct detection cross section.
- Interesting:
 - When there is no interaction between the two doublets there is still a little direct detection cross section, due to electroweak one loop contributions
- Some checks in progress in order to finish the work.

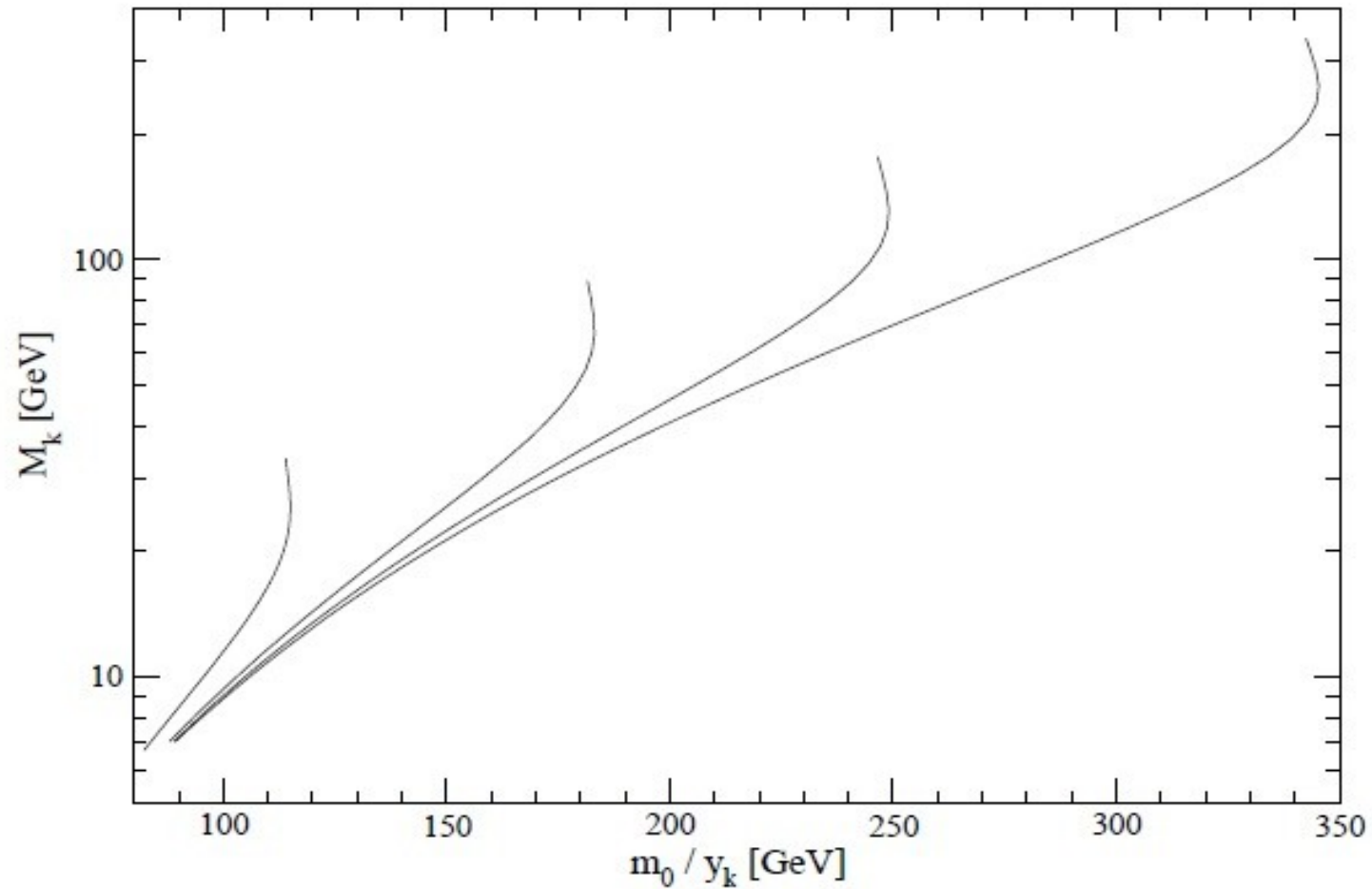
For example



Radiative Seesaw

- The DM candidate is the lightest right neutrino
- Dirac Right neutrino that gives mass to left neutrino at loop level, “radiatively”.
- A main issue of this model is that is able to explain left neutrino masses, mixings and DM relic density and direct detection.
- Has only been studied for DM physics in highly degenerate regime for the additional neutral scalars.

For example



ArXiv: hep-ph/0604114

Research

- We (Oscar Zapata, Diego Restrepo and myself) are finishing a study where a full scan over the neutral scalar degeneracy is done, and cross-checked with neutrino oscillations parameters.

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- $SU(2) \rightarrow SU(3) \text{-----} >$ New electroweak bosons.
- New scalar doublet plus right neutrinos plus exotic quarks
- Advantages: Lot of problems explained (neutrino masses, DM, anomalies, ...)
- Disadvantages: Lot of new free parameters, quite disfavoured.

Research

- With Farinaldo Queiroz we have published on PRD an article analyzing how the model behaviour for DM physics, taking into account the recent Higgs discovery and his brnaching ratios.

Computational tools

- LanHep: Model implementation for several packages.
- MicrOMEGAs: Calculation of DM observables and Higgs branchign ratios
- CalcHep: Calculation of tree level decay rates and cross sections
- FeynArts+FormCalc+LoopTools: One loop calculations

Additional activities

- Several seminars on the usage of the computational tools listed below.
- Several seminars on DM physics.
- Several activities on science “Vulgarization”. For example: Quarknet masterclass.

Thanks!