

# Higgs Summary

*Sven Heinemeyer, IFCA (CSIC, Santander)*

Granada, 09/2011

9 minutes ⇒ the usual apologies

- Status of the field
- Contributions in Granada
- Outlook / what is needed for the future

## Status of the field

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- Higgs
- Top/QCD
- LoopVerein
- SUSY
- New Physics at TeV, precision electroweak
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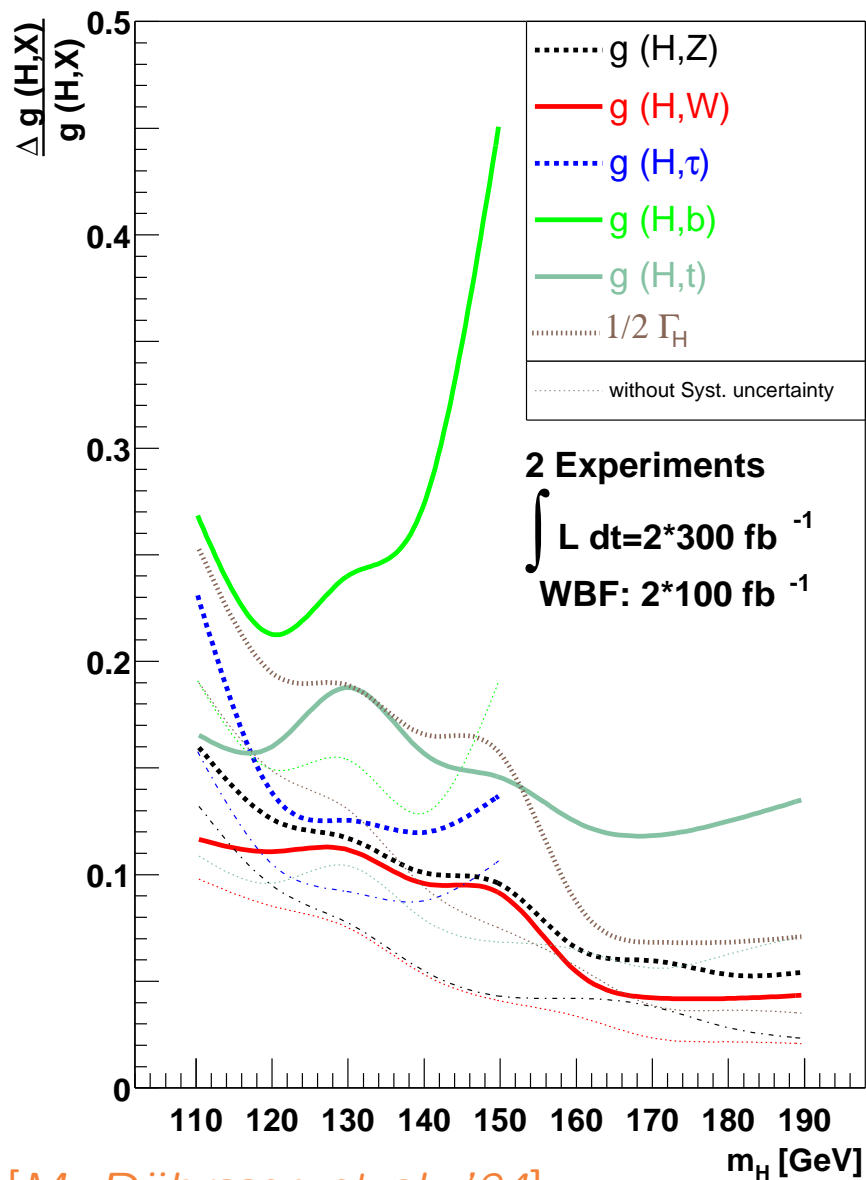
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Keep in mind: two proposals: **ILC** and **CLIC**  
answers depend on the proposal!

## The LHC will find a Higgs and measure its characteristics:



[M. Dürrssen et al. '04]

- mass:  $\delta M_h \approx 200 \text{ MeV}$
- couplings:  $(2 * 300 + 2 * 100) \text{ fb}^{-1}$  :  
 typical accuracies of 20-30%  
 for  $m_H \leq 150 \text{ GeV}$   
 10% accuracies for  $HVV$  couplings  
 above  $WW$  threshold

### Assumption:

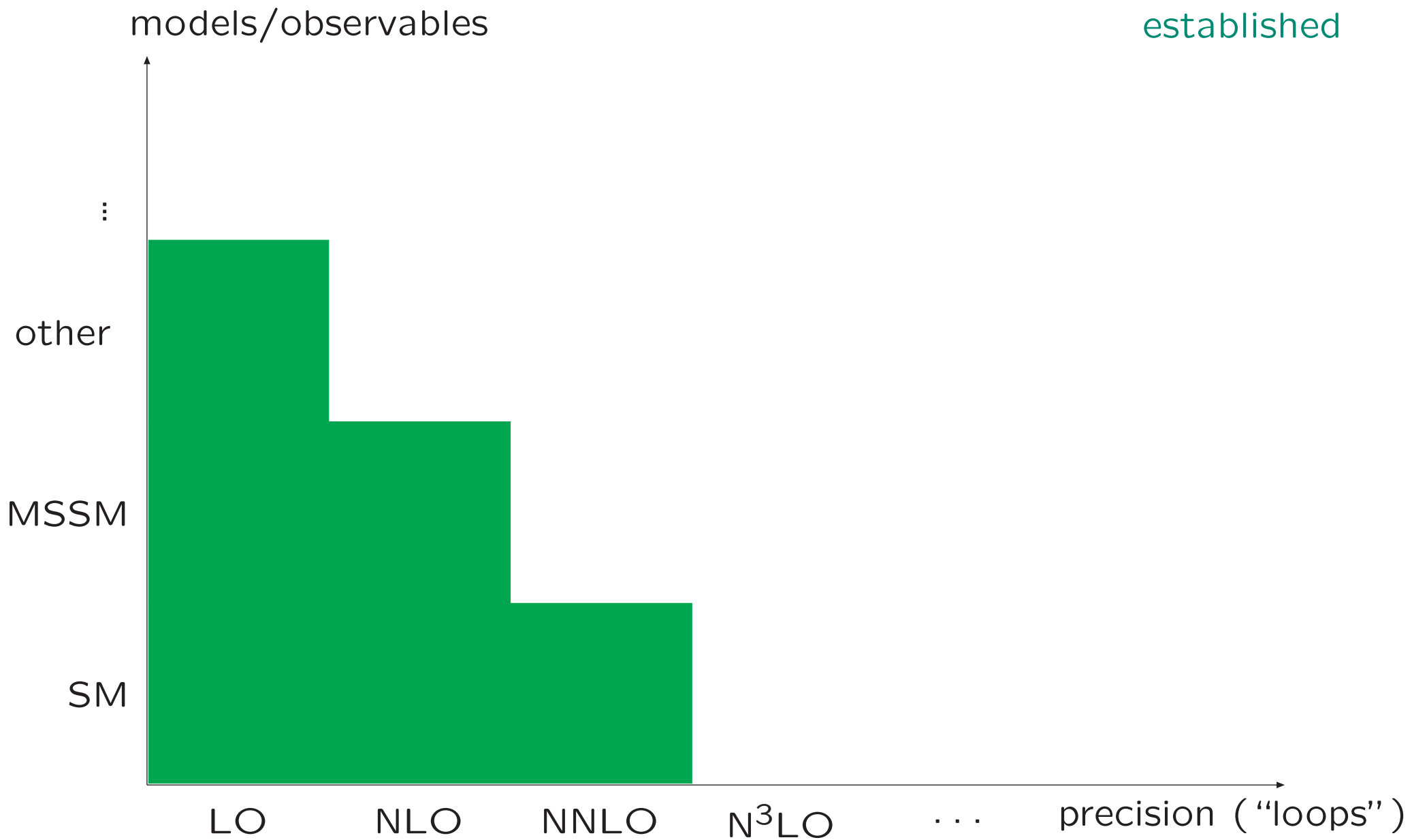
- $g_{HVV}^2 \leq g_{HVV,SM}^2 \times 1.05$
- SM rates for the Higgs

### Problems:

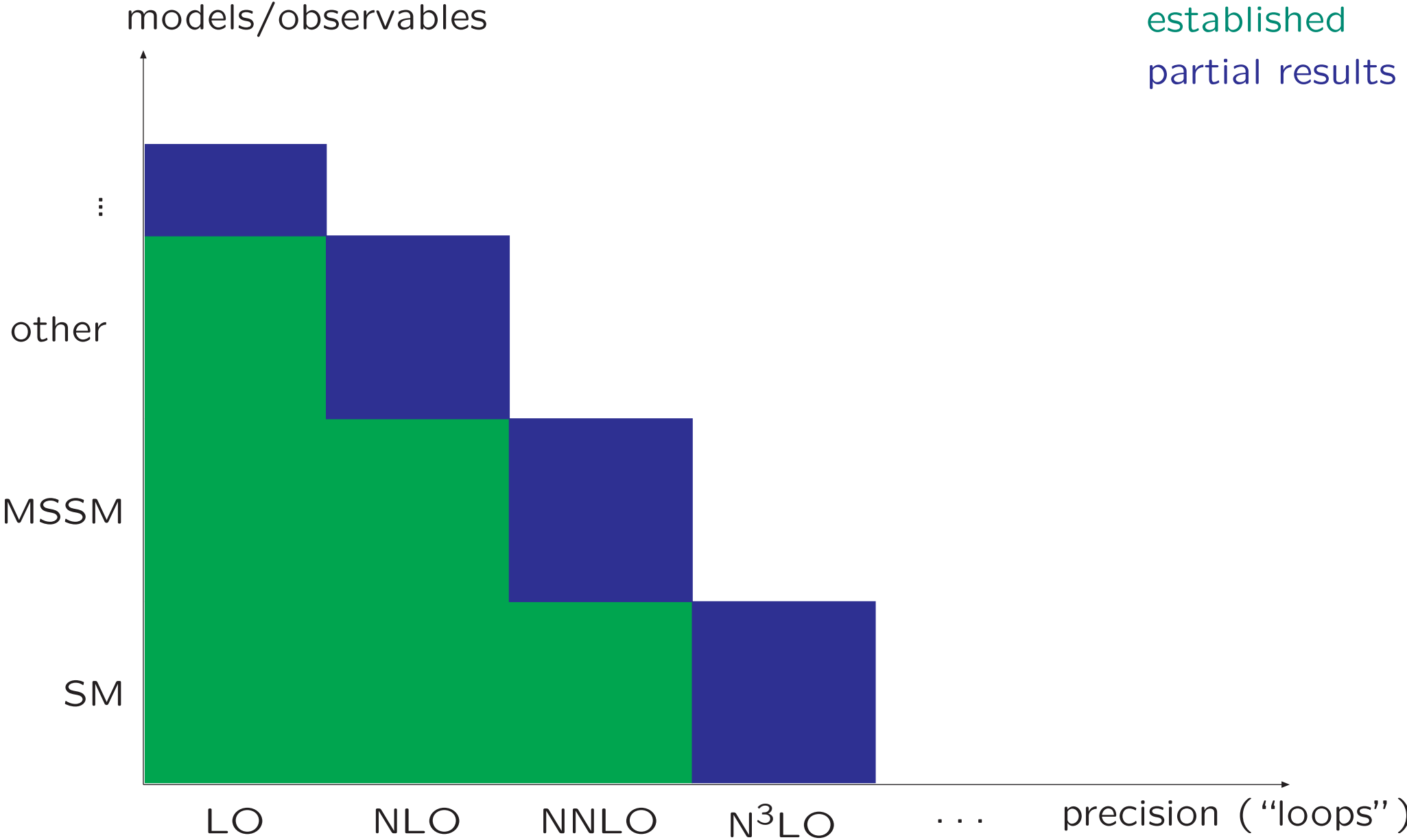
- valid in weakly interacting models
- rates much lower than in SM ??
- physics can/will hide in 5% margin
- self-couplings out of reach

$\Rightarrow$  LC comes in

# Higgs: theory situation

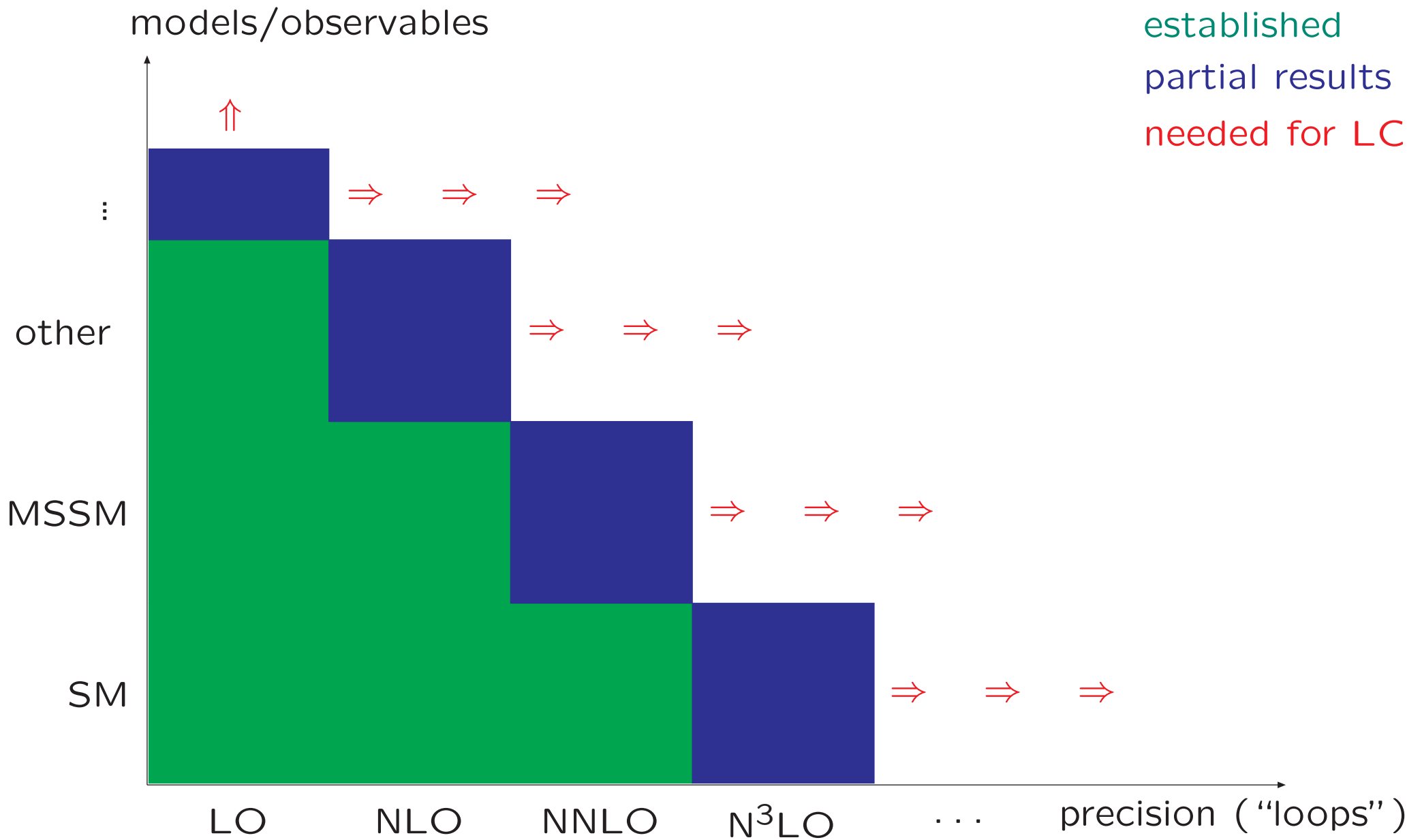


Higgs: theory situation

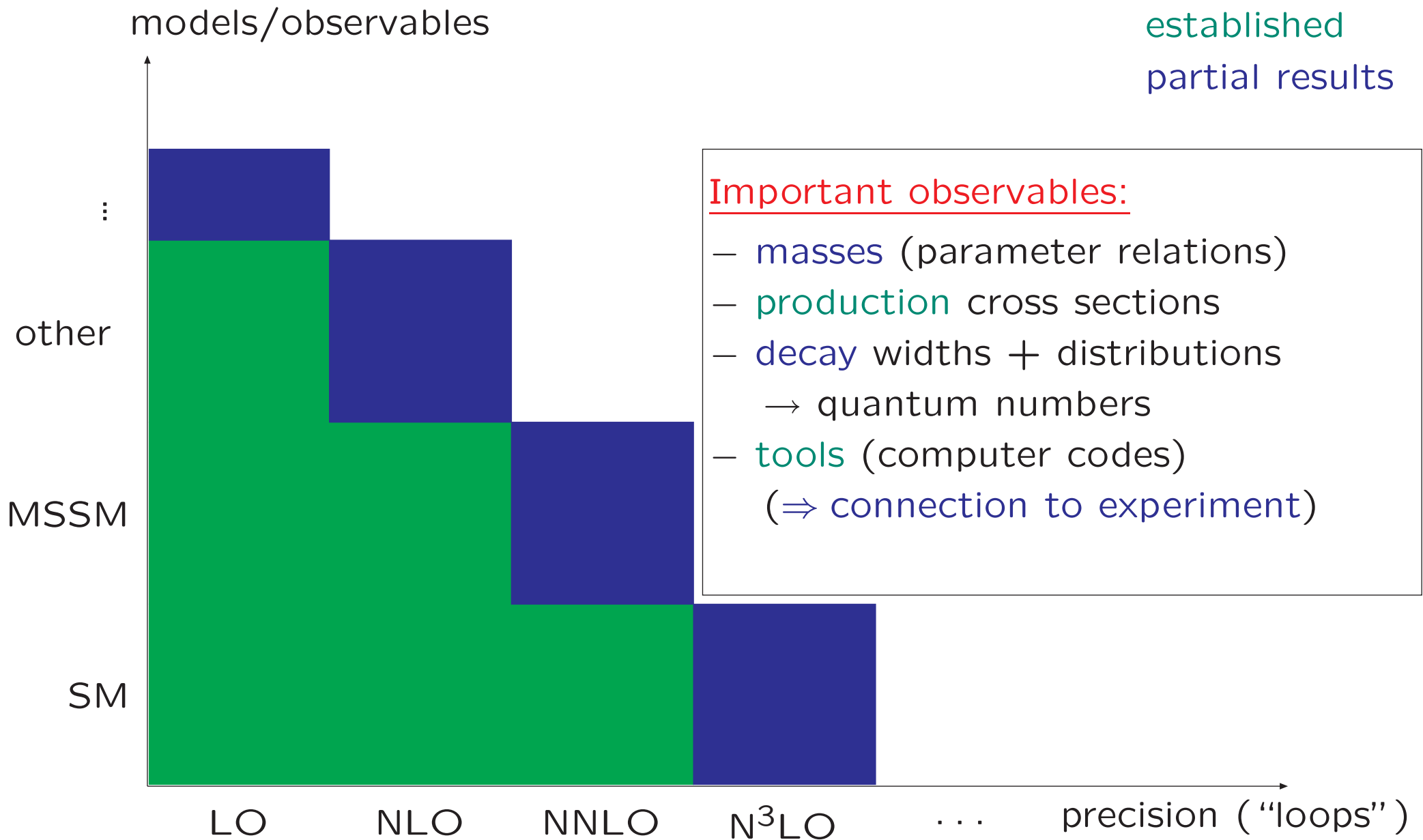




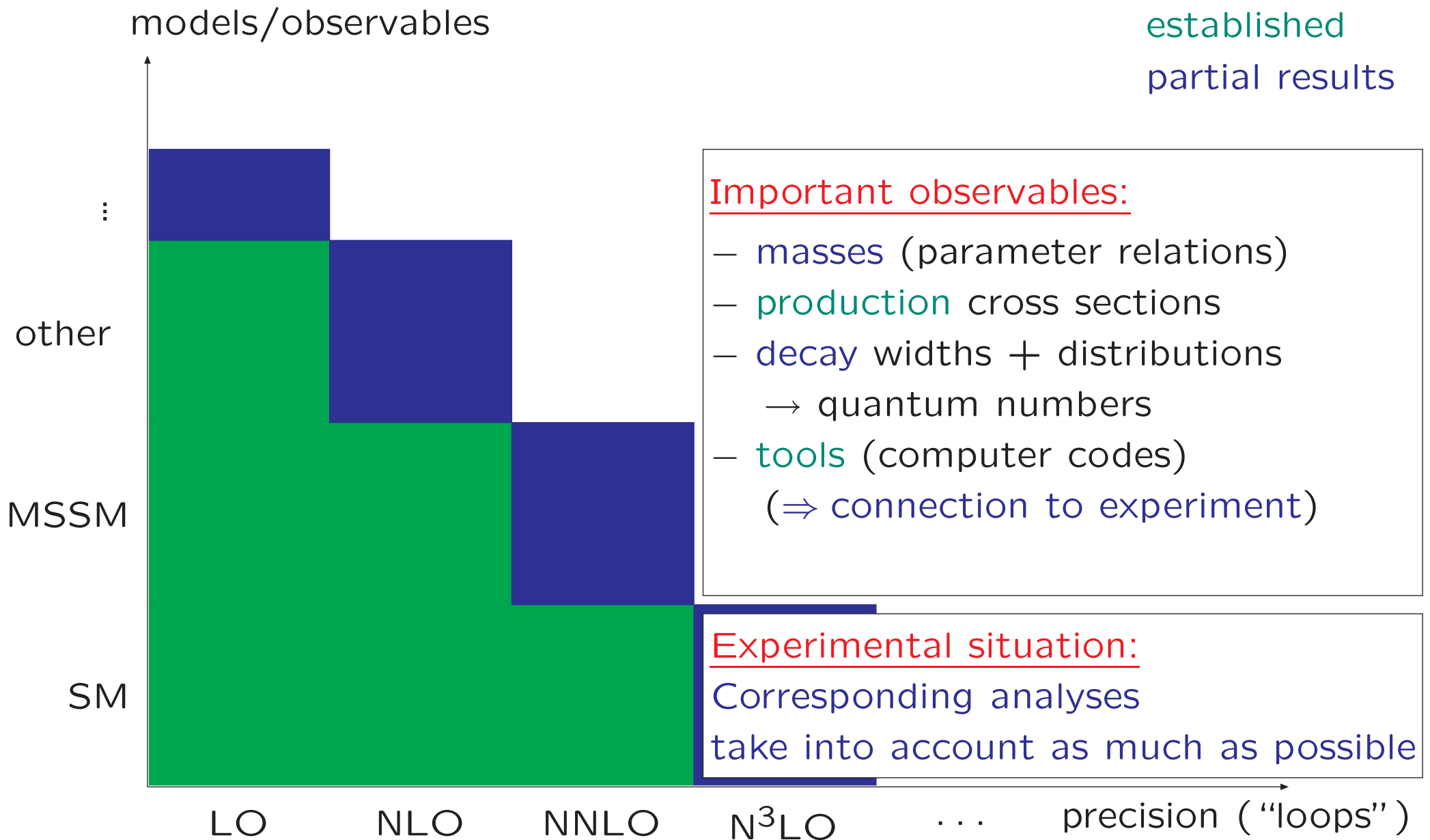
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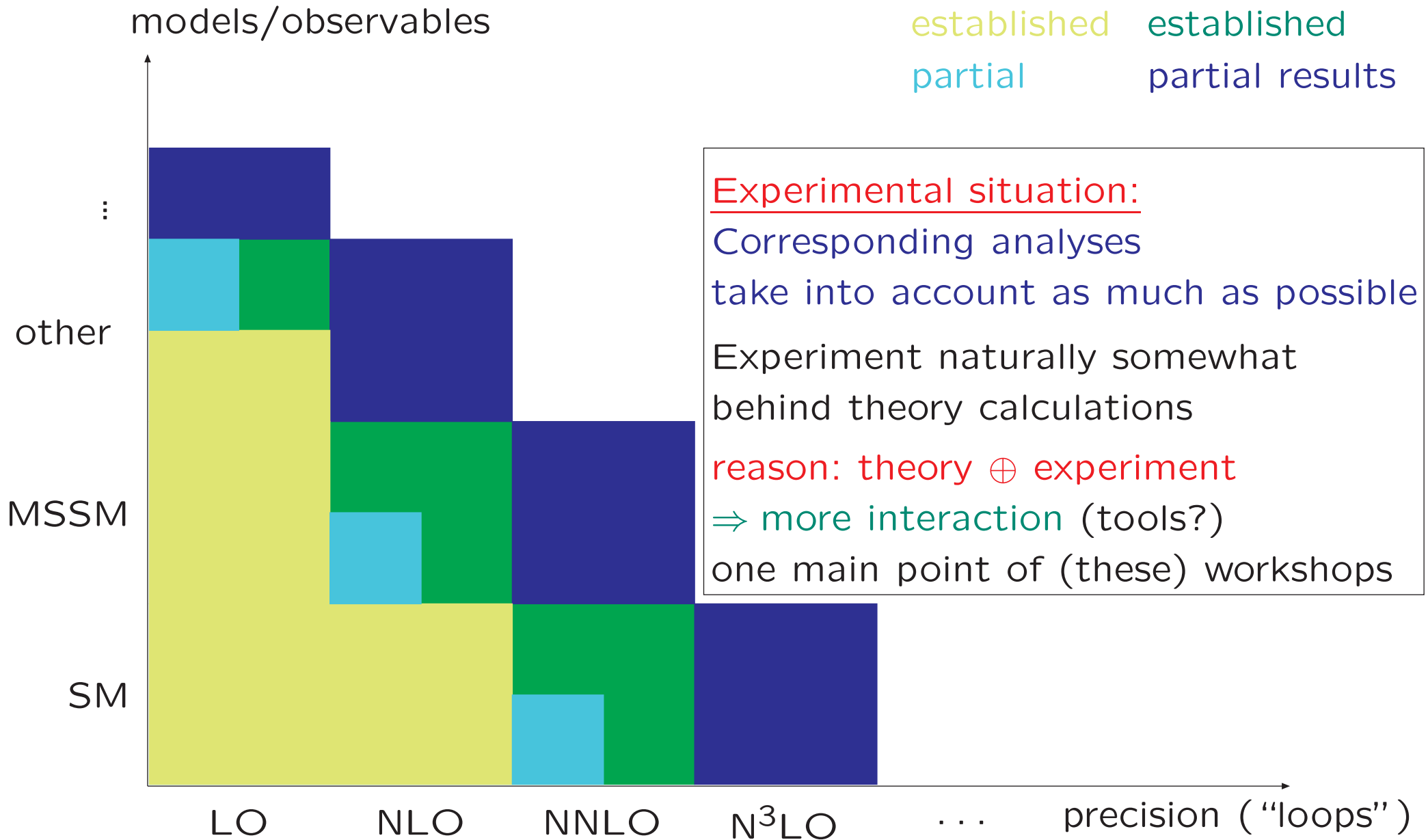


## Higgs: experimental situation



# Higgs: experimental situation

<u>experiment</u>	<u>theory</u>
established	established
partial	partial results



Experimental situation:  
 Corresponding analyses take into account as much as possible  
 Experiment naturally somewhat behind theory calculations  
 reason: theory  $\oplus$  experiment  
 $\Rightarrow$  more interaction (tools?)  
 one main point of (these) workshops

# Higgs: contributions in Granada

experiment

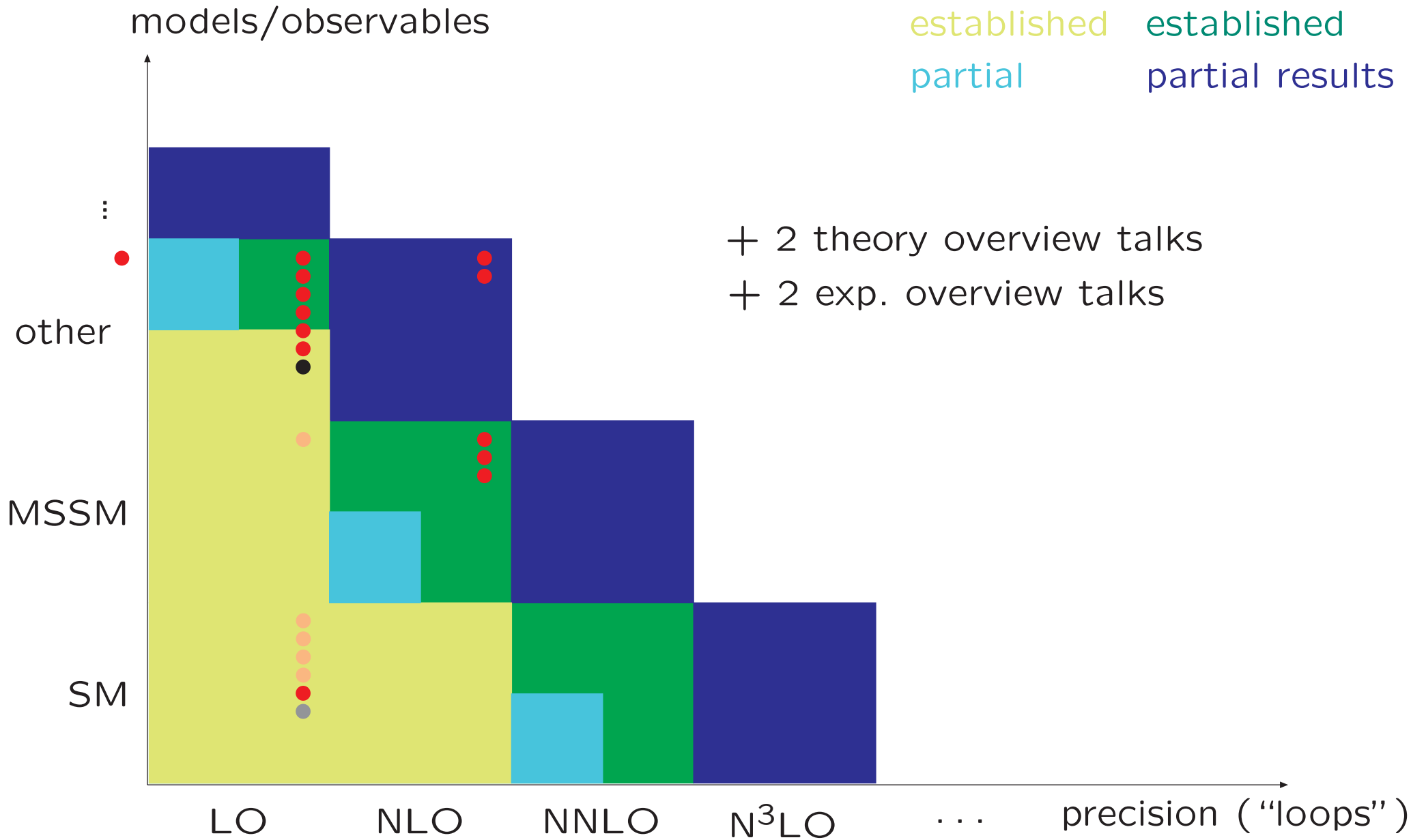
theory

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partial results



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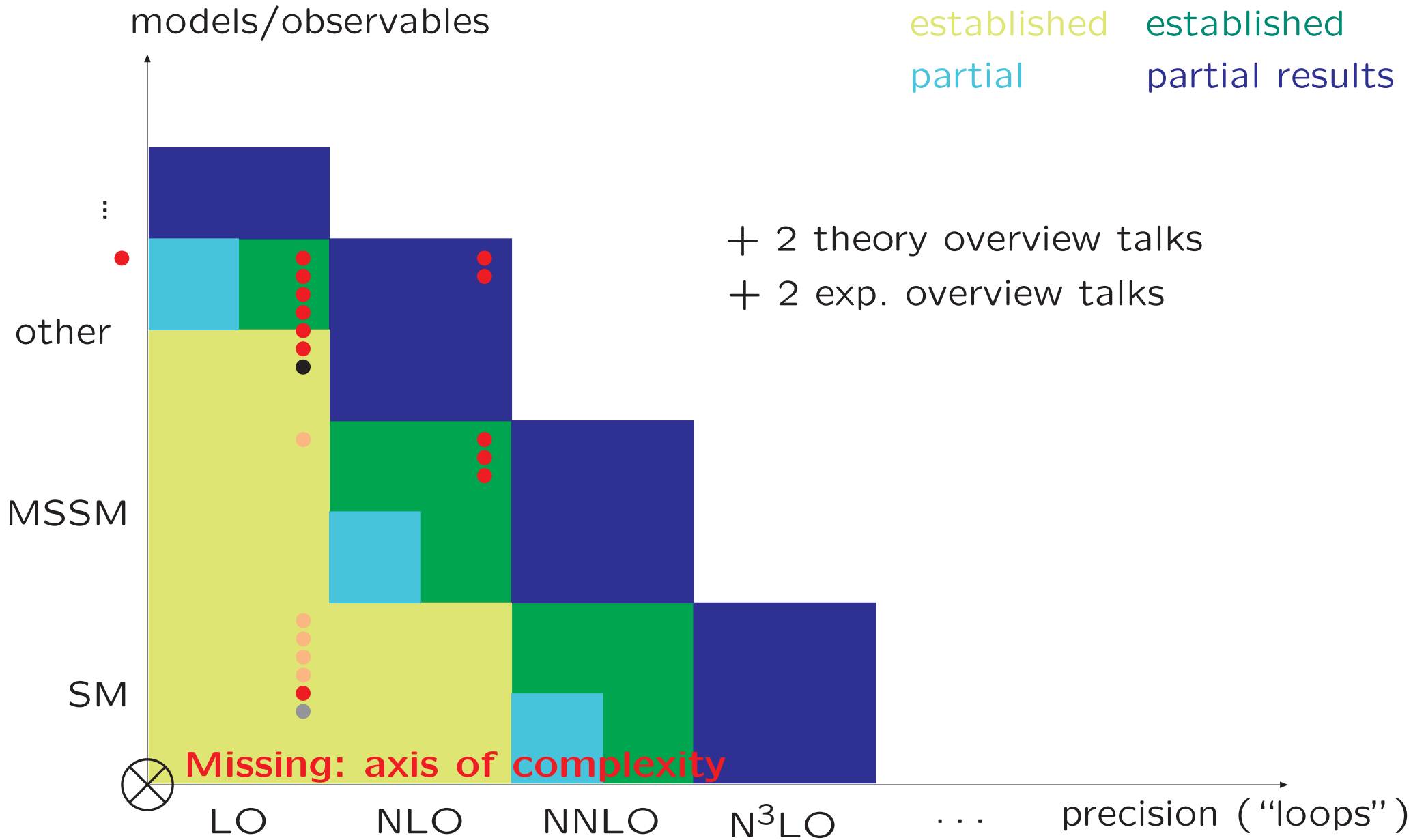
theory

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## General observations:

1. Active participation: 24 talks
2. Theory: moves more into theory space  
**Q:** Have we reached the required precision in the SM/MSSM yet?  
**A:** Certainly not everywhere!
3. CLIC often somewhat less advanced than ILC  
statistical uncertainties: ok for both  
systematical uncertainties: (sometimes) missing for CLIC
4. Experiment: much more in full simulation
5. ILC: much more for  $\sqrt{s} = 500$  GeV

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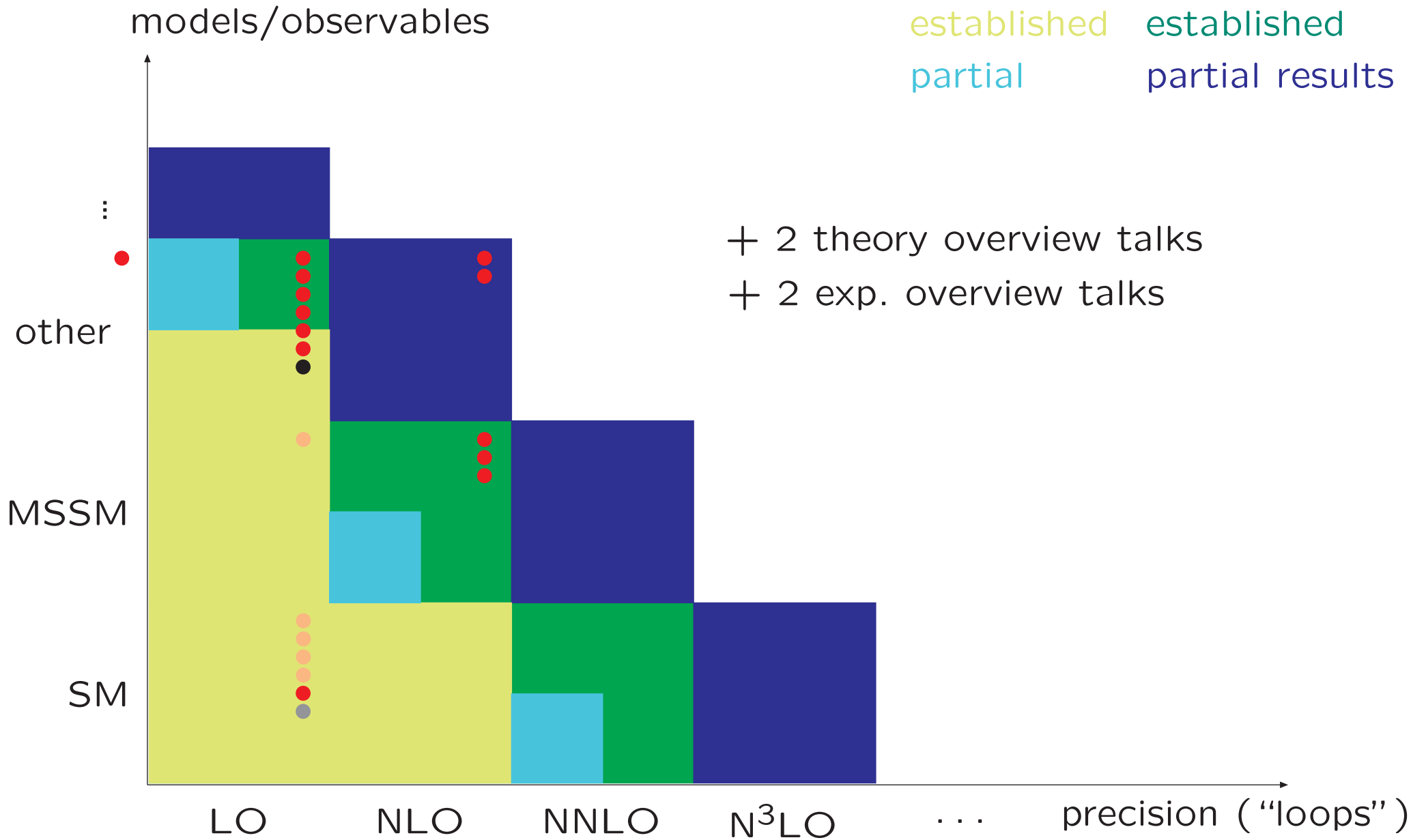
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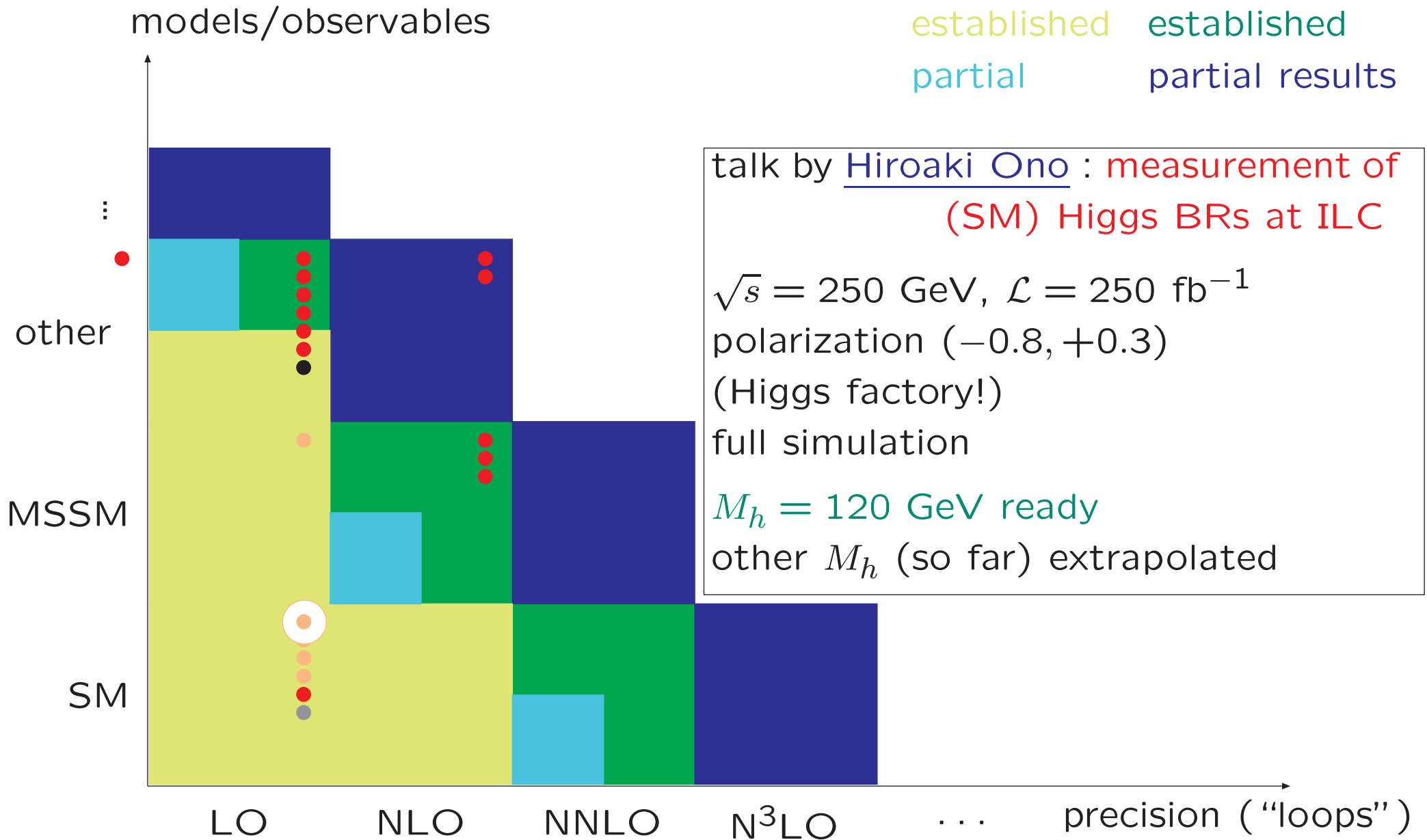
partial results





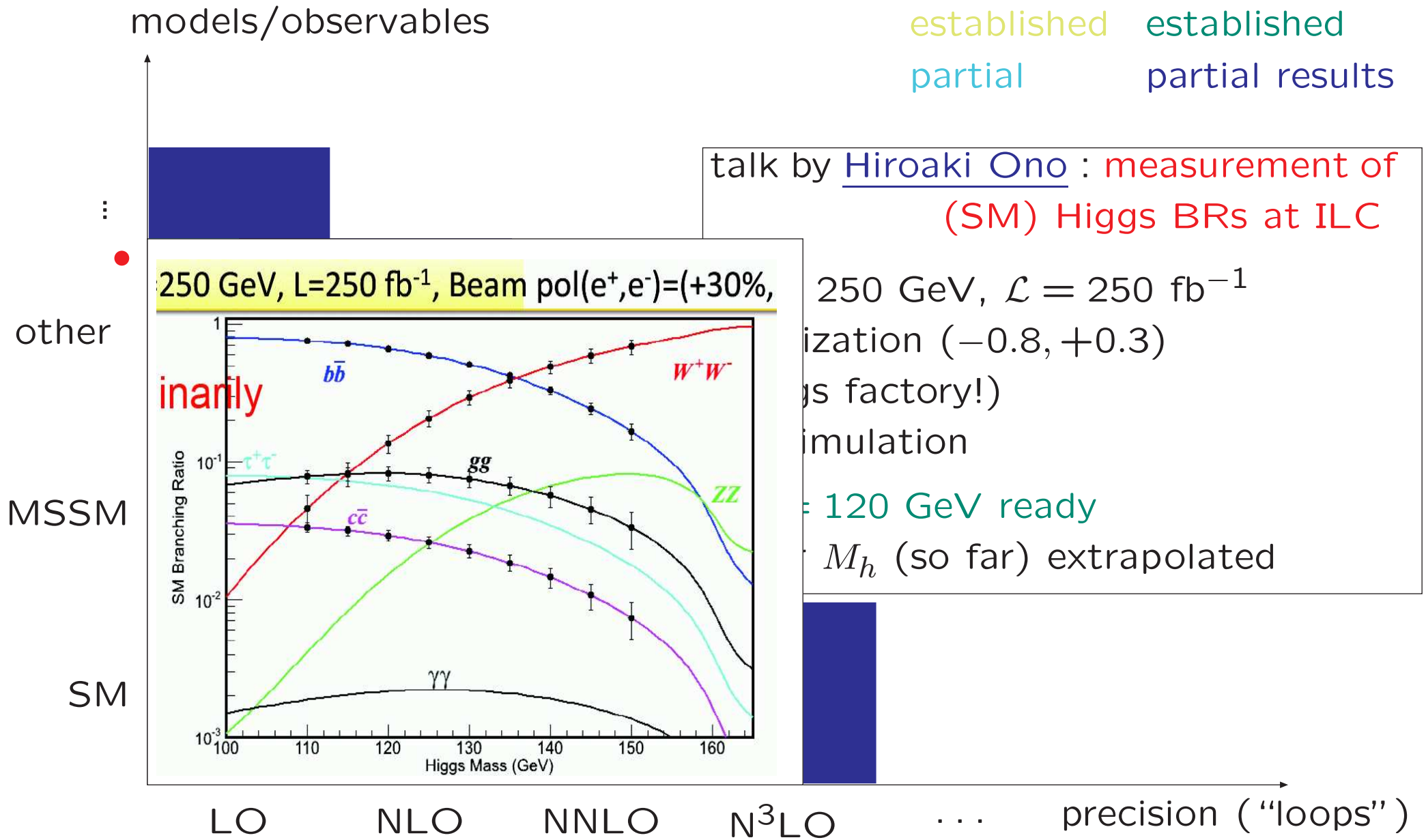
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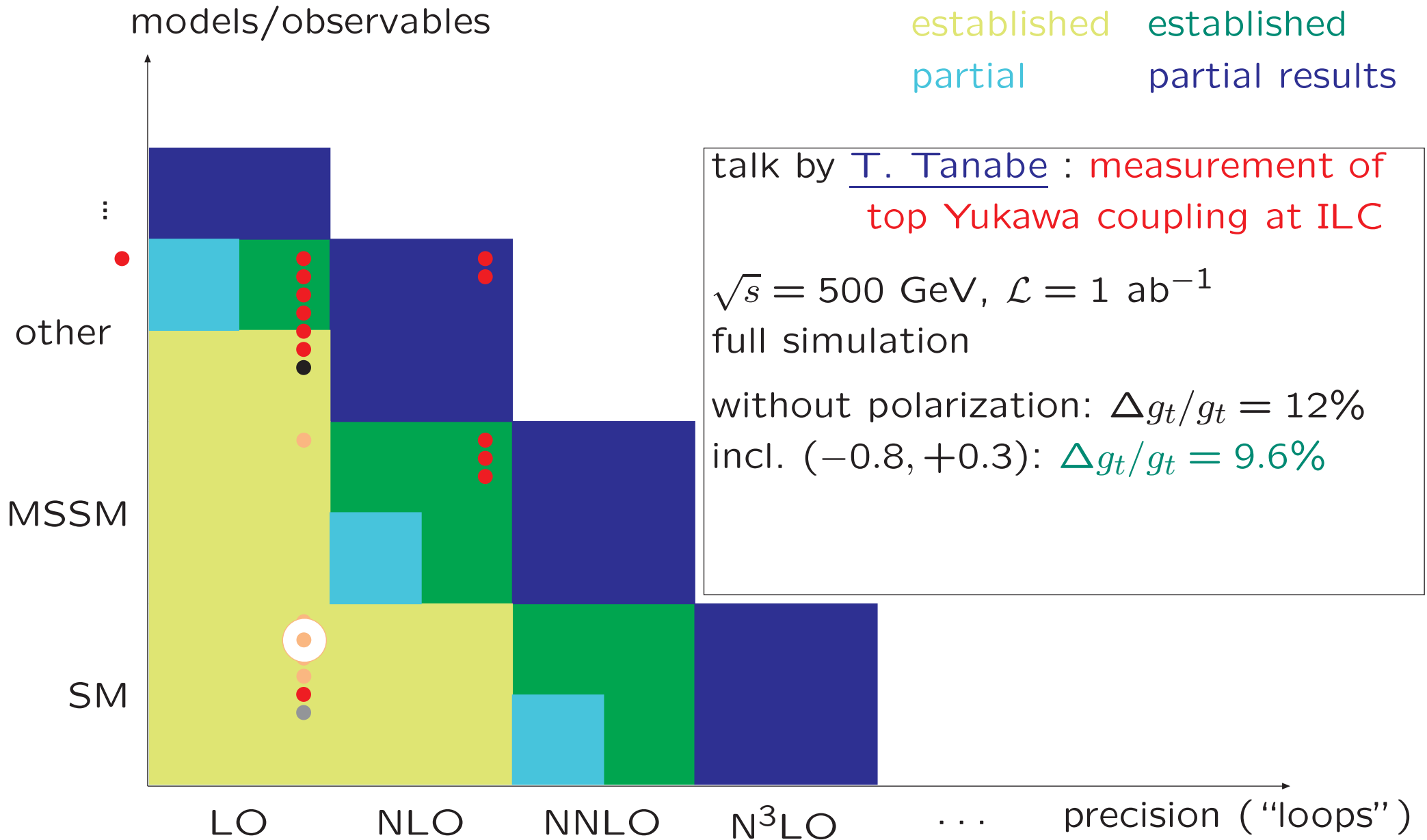
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models/observables

talk by T. Tanabe : measurement of top Yukawa coupling at ILC

6-jet + lepton analysis

500 GeV,  $\mathcal{L} = 1 \text{ ab}^{-1}$

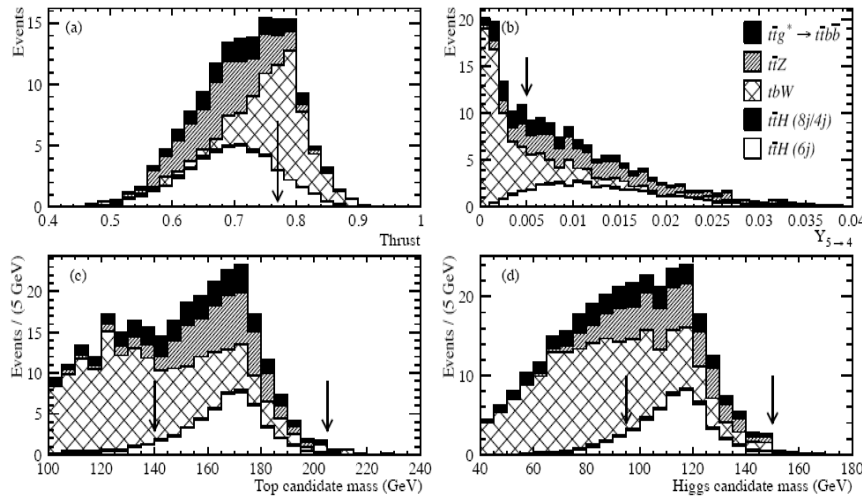
simulation

without polarization:  $\Delta g_t/g_t = 12\%$   
 (-0.8, +0.3):  $\Delta g_t/g_t = 9.6\%$

other

MSSM

SM



Scaled to  $1 \text{ ab}^{-1}$   
 Beam polarization ( Pol(e-), Pol(e+) ) = (-0.8, +0.3)  
 All other cuts applied.

LO    NLO    NNLO    N<sup>3</sup>LO    ...    precision ("loops")

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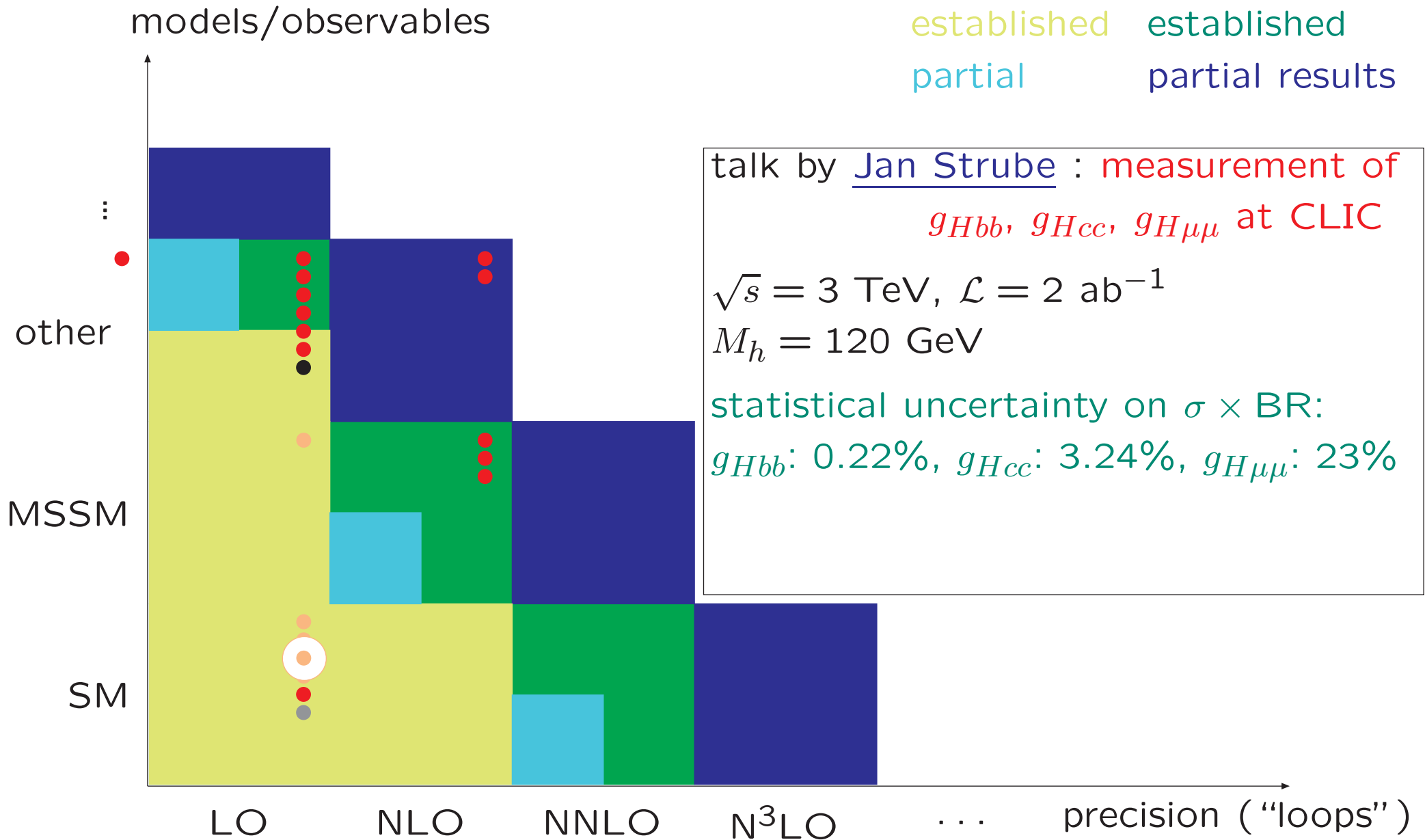
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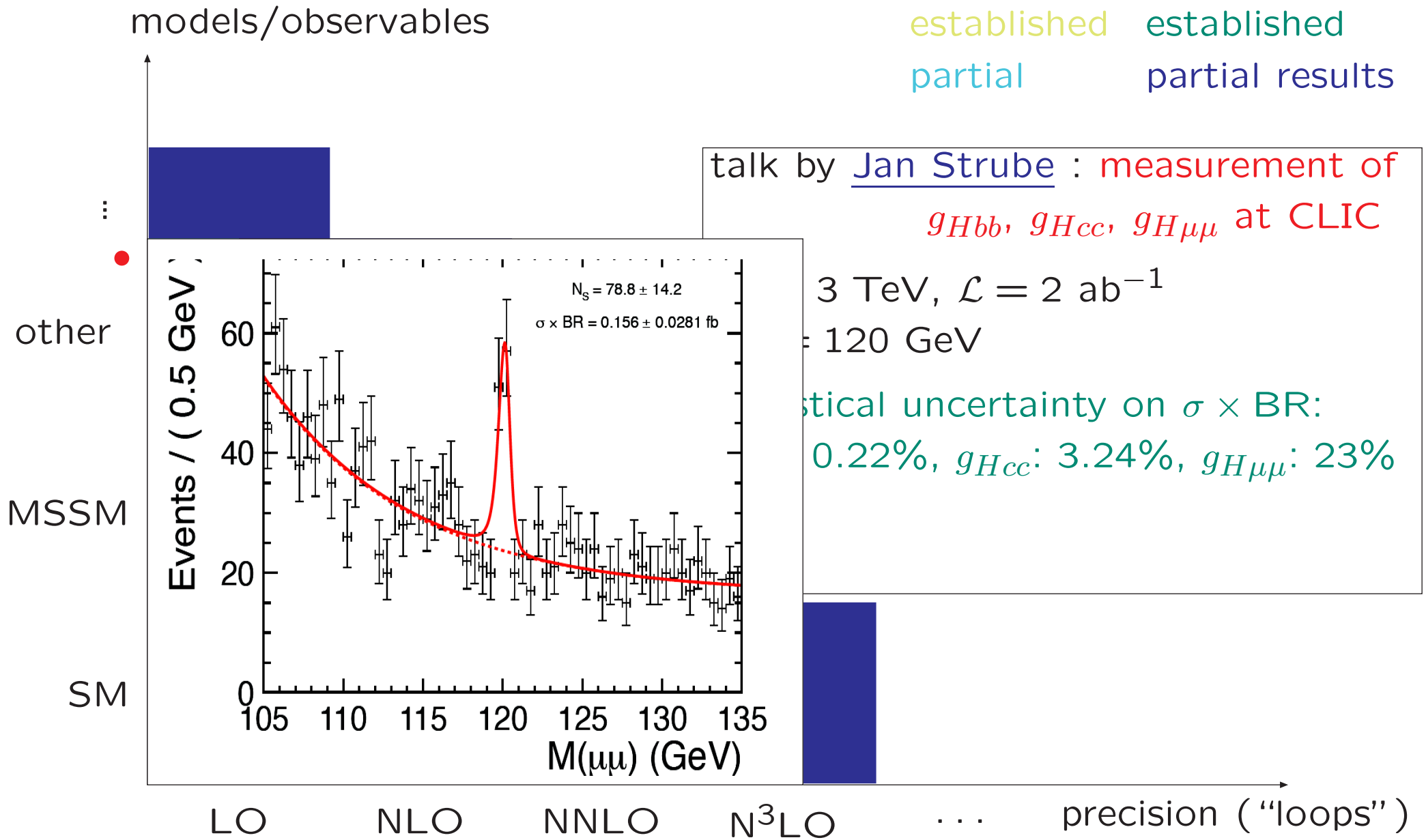
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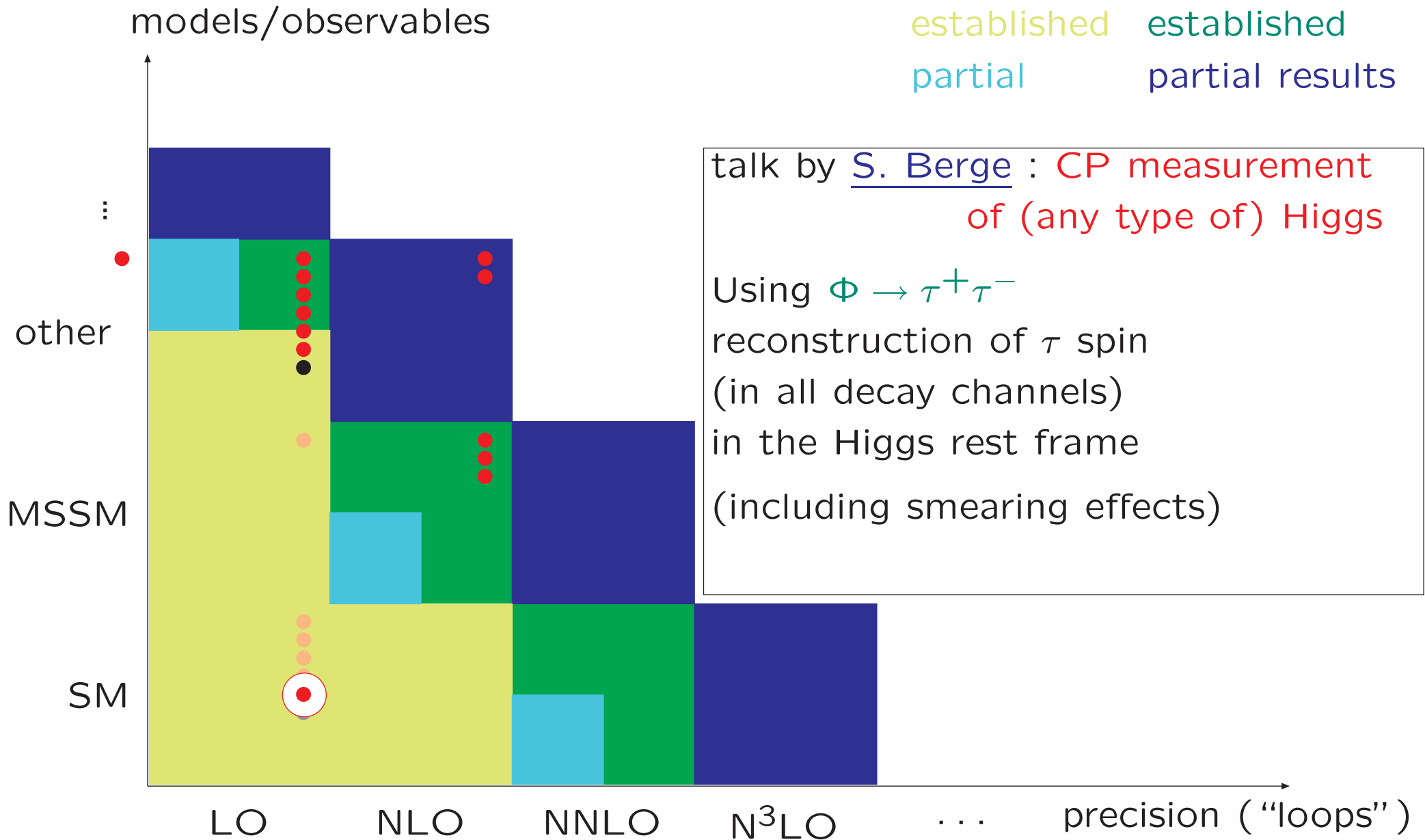
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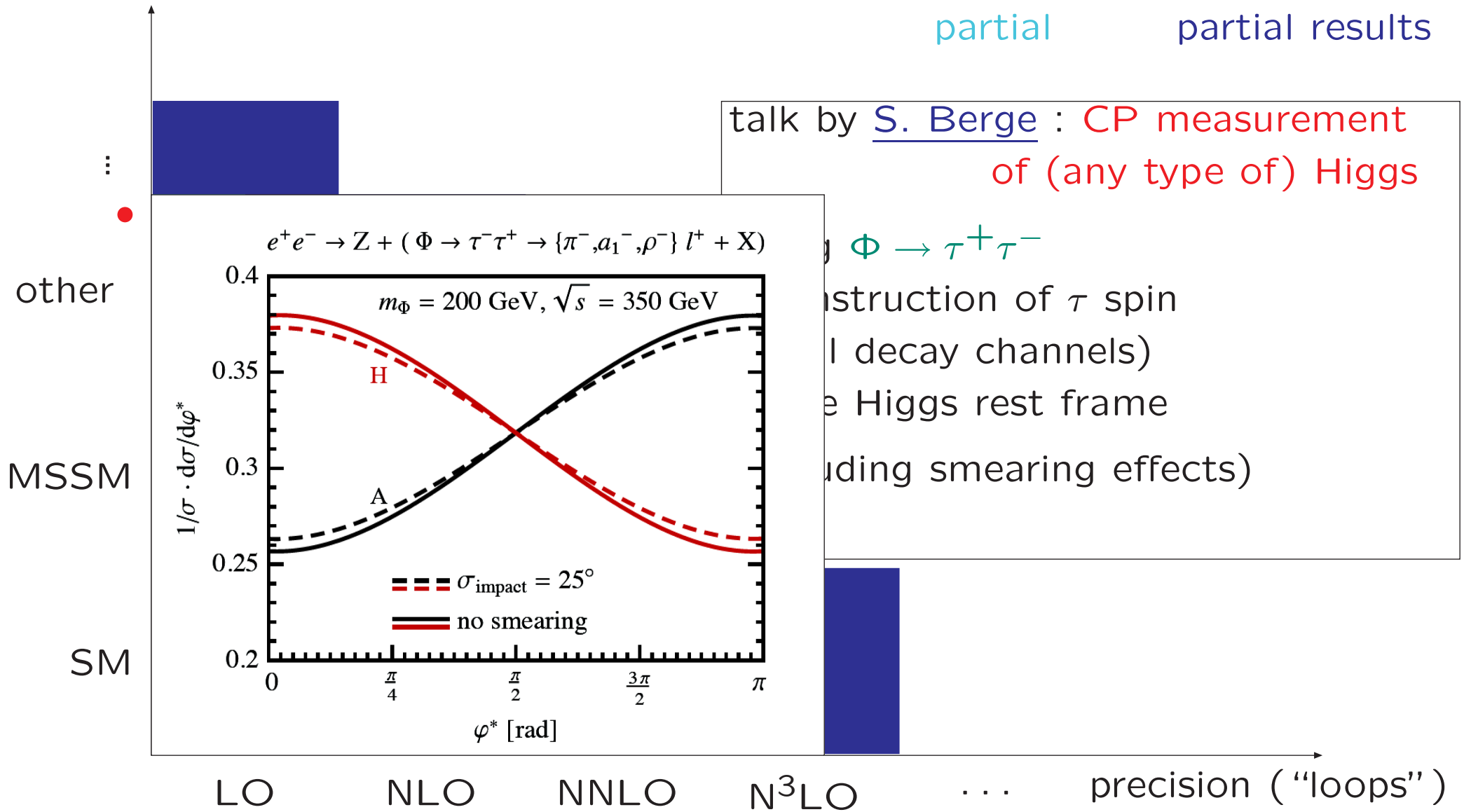
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models/observables





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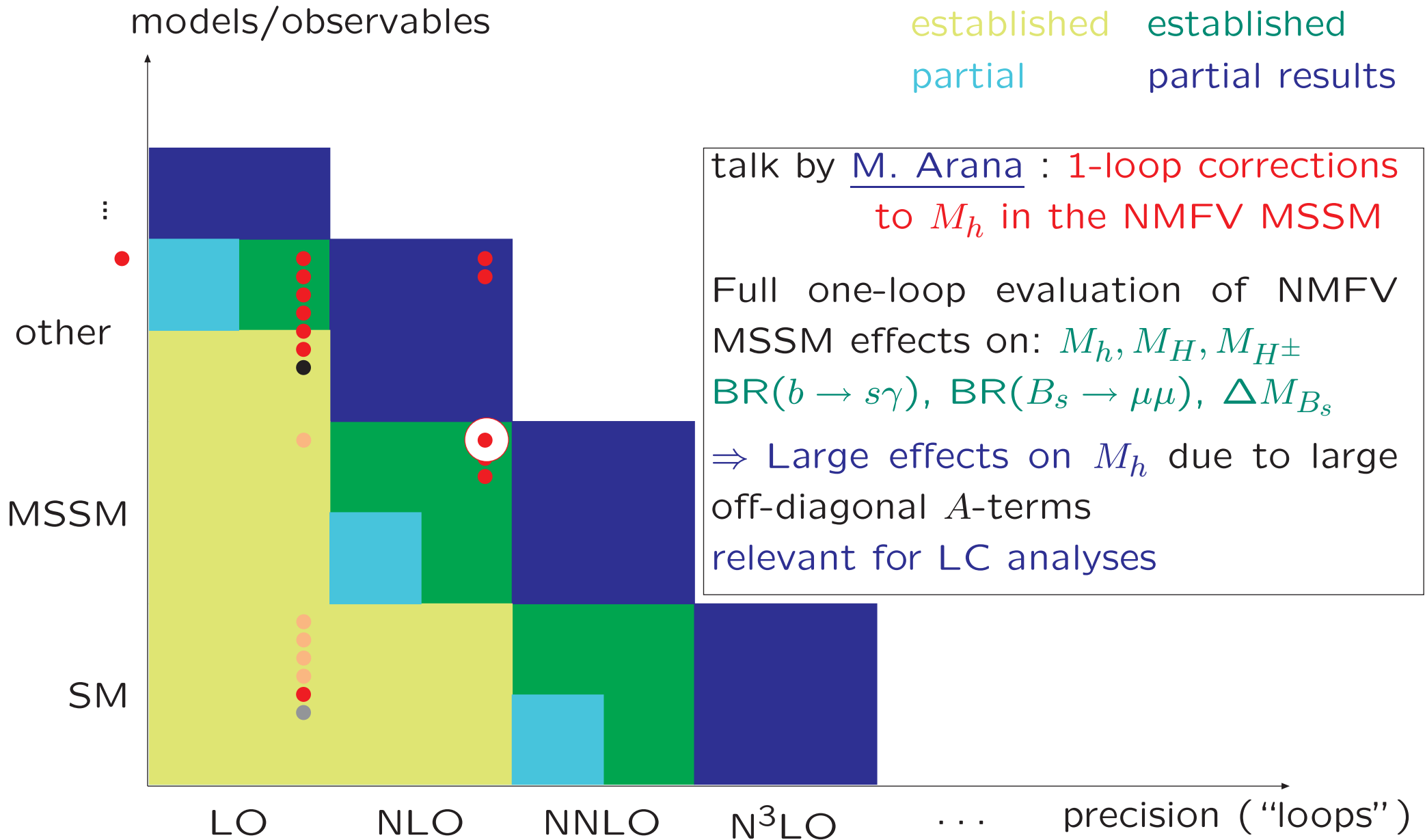
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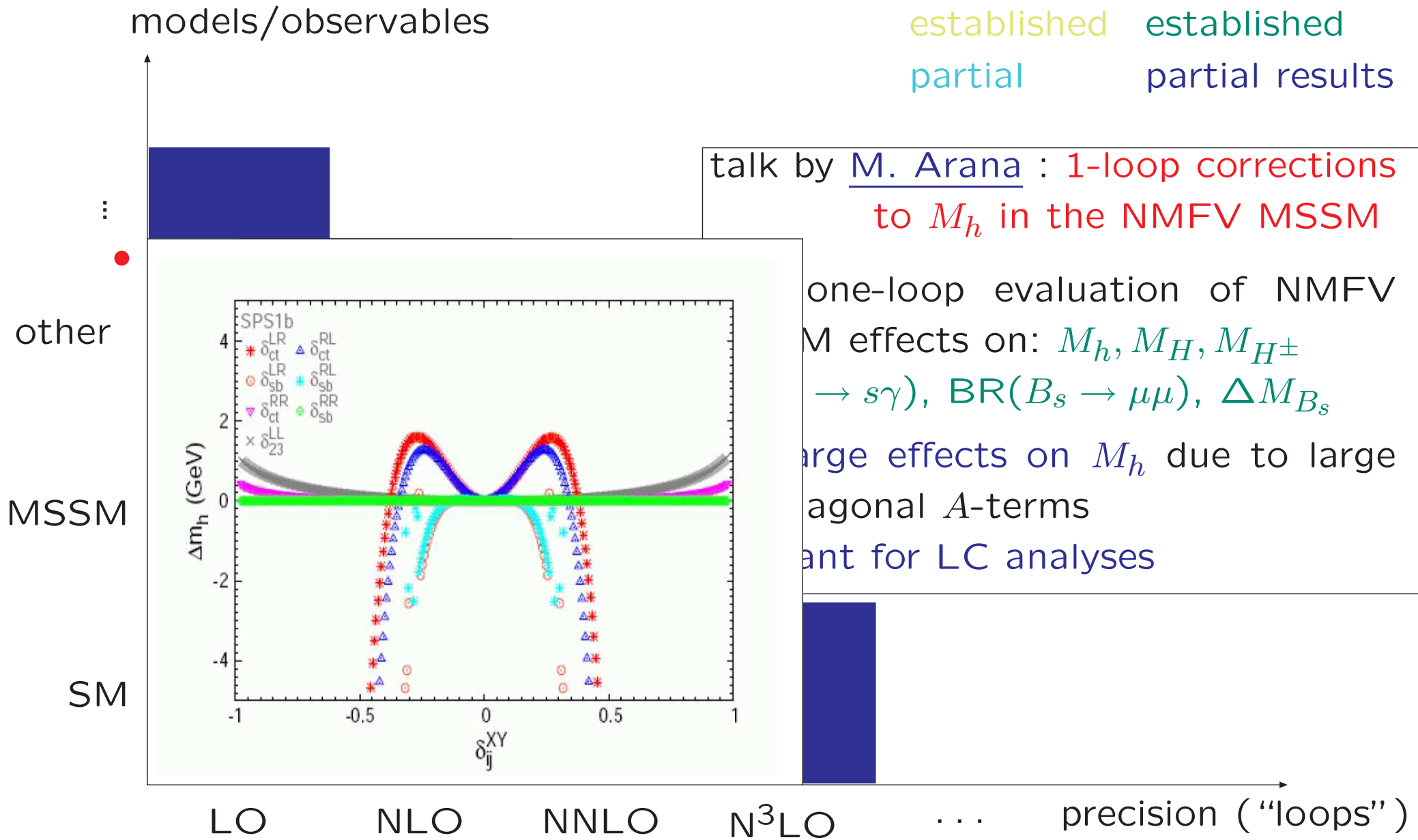
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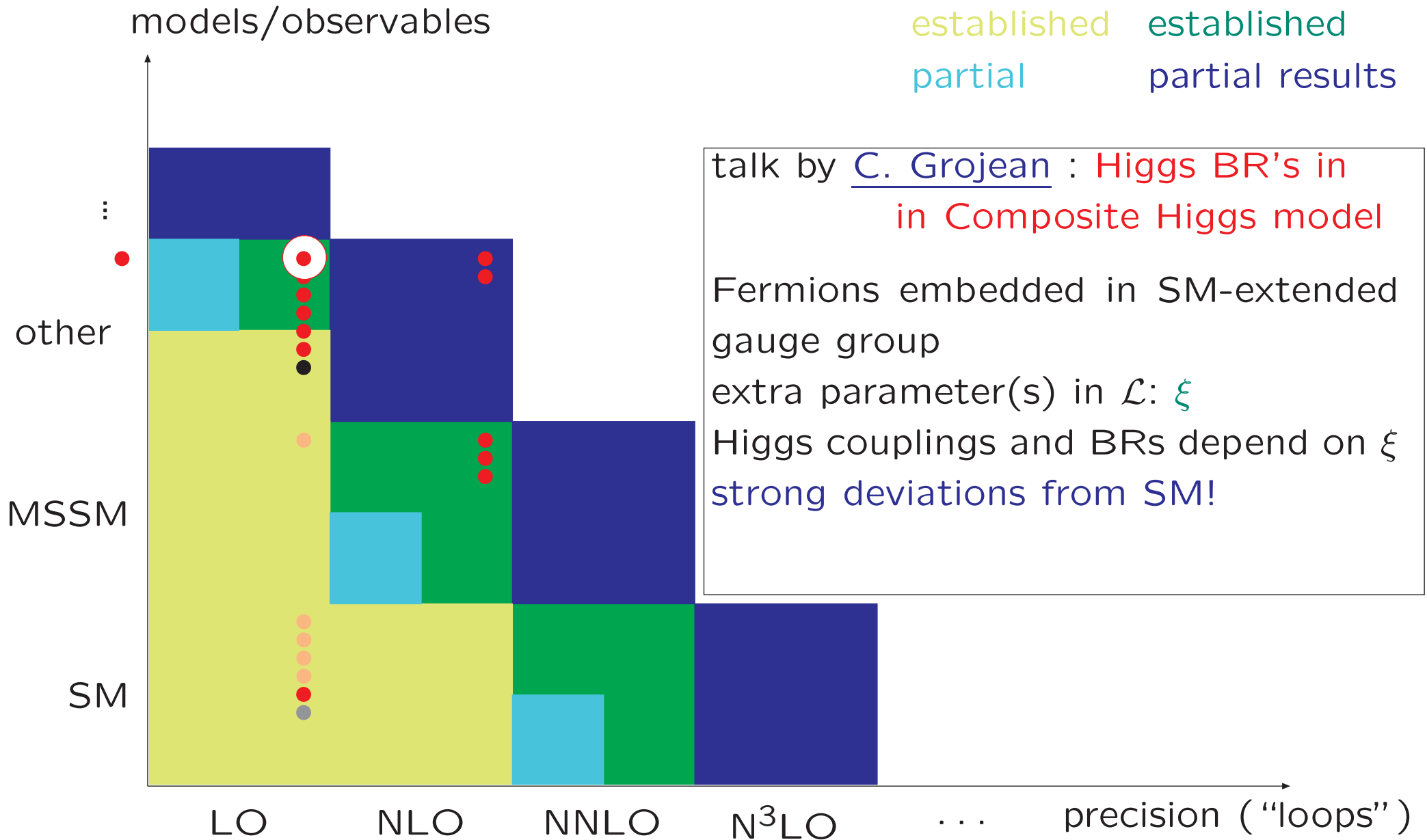
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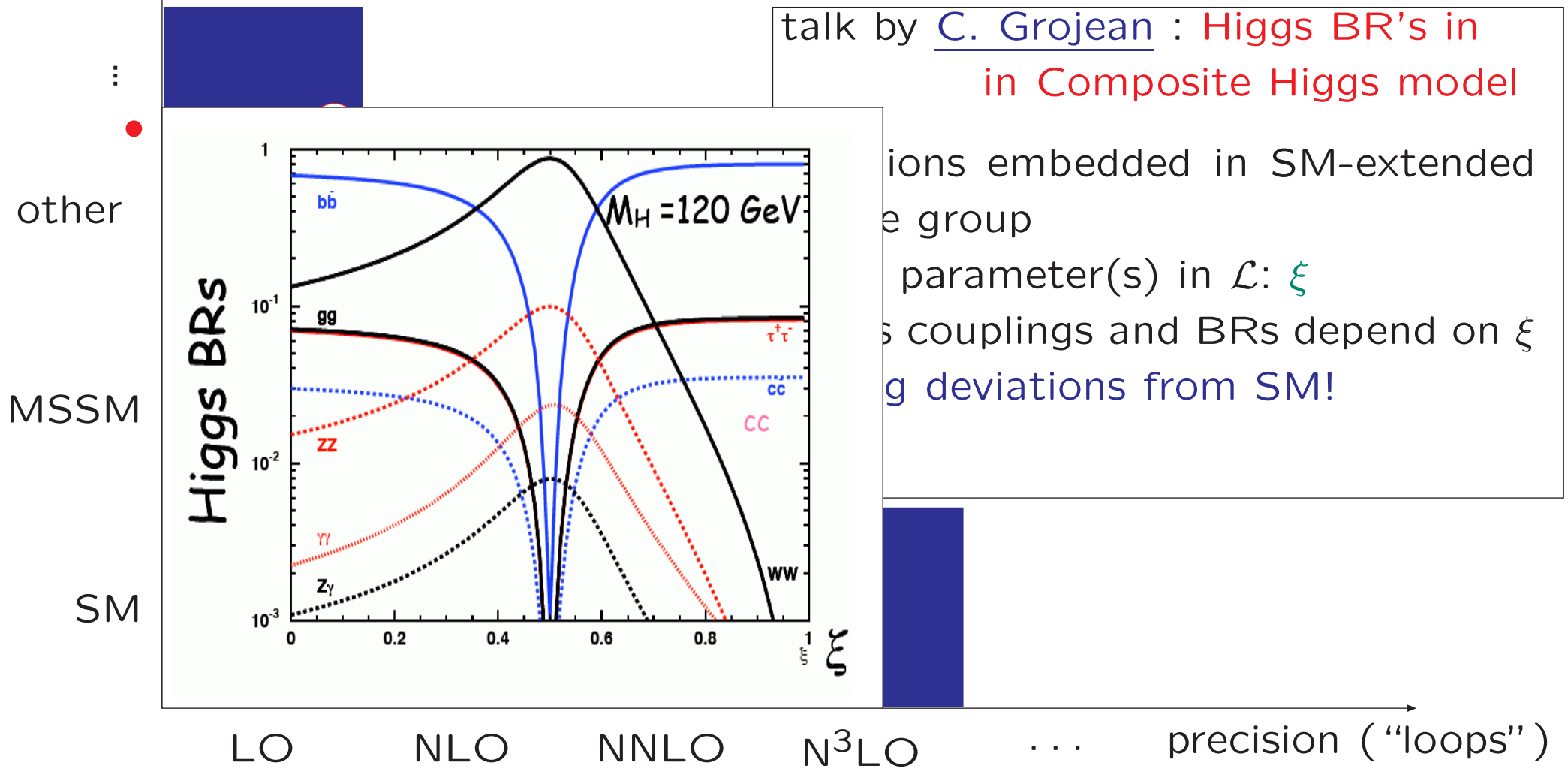
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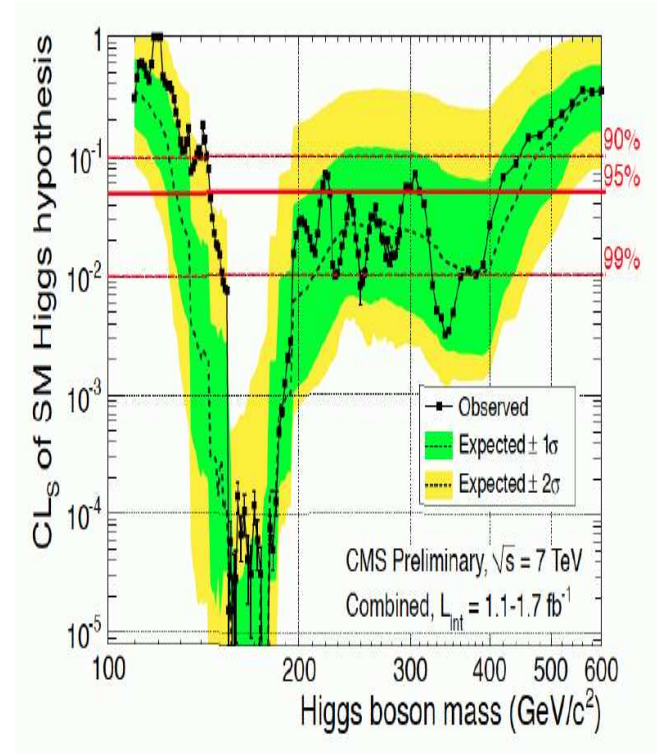
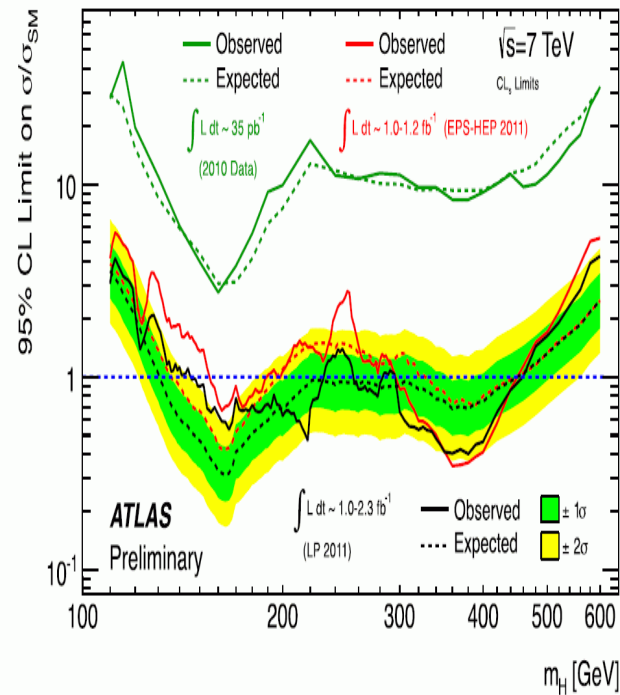
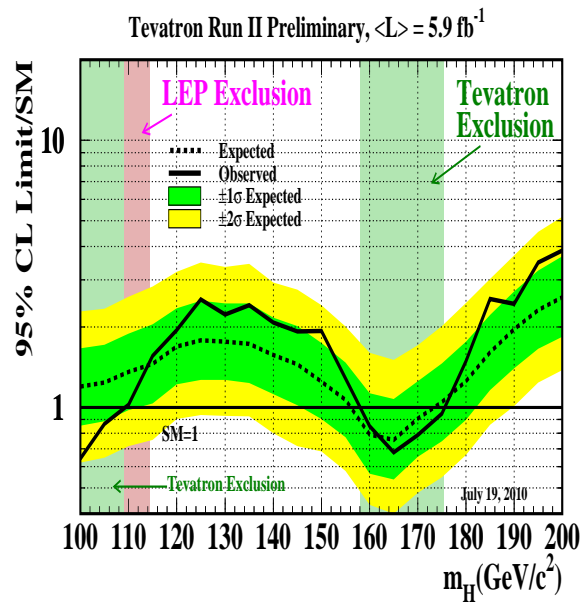
models/observables



Outlook . . . no time left . . .

# Outlook ... no time left ...

## Direct Higgs searches at Tevatron and LHC:



⇒ everything points towards a low mass Higgs

⇒ low energy  $e^+e^+$  collider IDEAL to study this scenario

**If we continue with the hard work, physics will be ready  
for the LC start**