Constraints on
the EWSB sector
Results from "MasterCode"

Frédéric Ronga (ETH Zurich)
for the MasterCode collaboration
O. Buchmueller, R. Cavanaugh, D. Colling, A. de Roeck, M.J. Dolan, J.R. Ellis,
H. Flaecher, S. Heinemeyer, 0G. Is1idori, D. Martinez Santos, K.A. Olive, S. Rogerson,
F.J. Ronga, G. Weiglein

Implications of LHC results for TeV-scale physics, Sept. 1st 2011
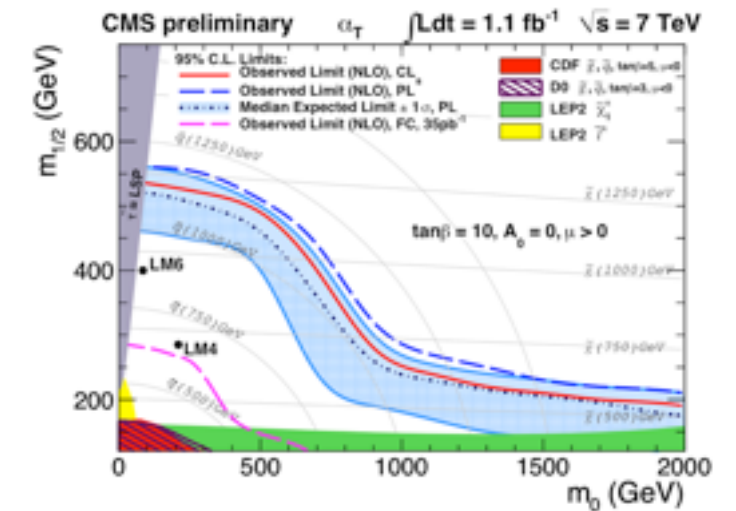
Reminder: MasterCode

- χ2 "fit" of SUSY parameters, with constraints…

  - including EWPO, flavour physics, g–2, dark matter, LHC,…

- Based on Markov Chain Monte Carlo

  - used as a sampling method

  - use classic Minuit fit to confirm best minimum

- Additional constraints added as afterburners

  - initial sampling uses reduced set (inclusive)

  - can easily add or remove constraints from χ2 to see the effect

- Models and samples

  - CMSSM, NUHM1, VCMSSM, mSUGRA

  - at least 60 million (6×10^7) points each
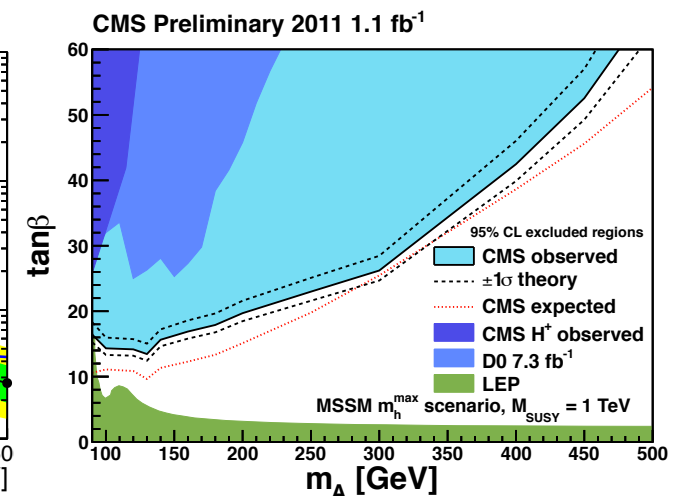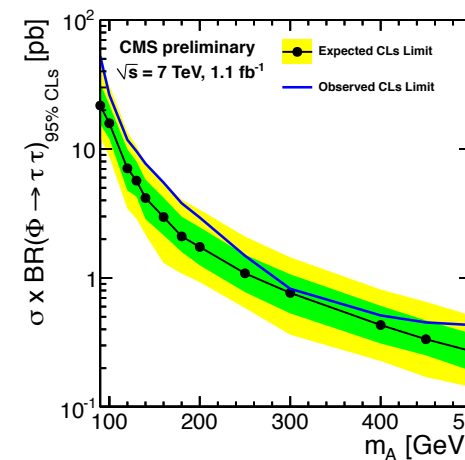
Including recent searches

- ## ATLAS and CMS direct searches

  - model: $N(\text{events}) \propto M^{-4}, M = \sqrt{m_0^2 + m_{1/2}^2}$

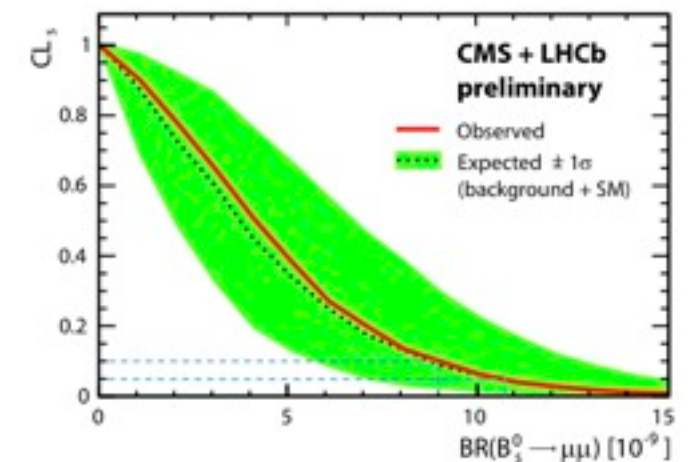 $\chi^2 \sim \chi^2_{95\%} \left(\dfrac{M}{M_{95\%}}\right)^4$

- ## Search for heavy MSSM Higgs

  - model: $\chi^2 \propto (\sigma \times BR)^{p(M_A)}$

    $(\sigma \times BR) \propto \tan^2 \beta$

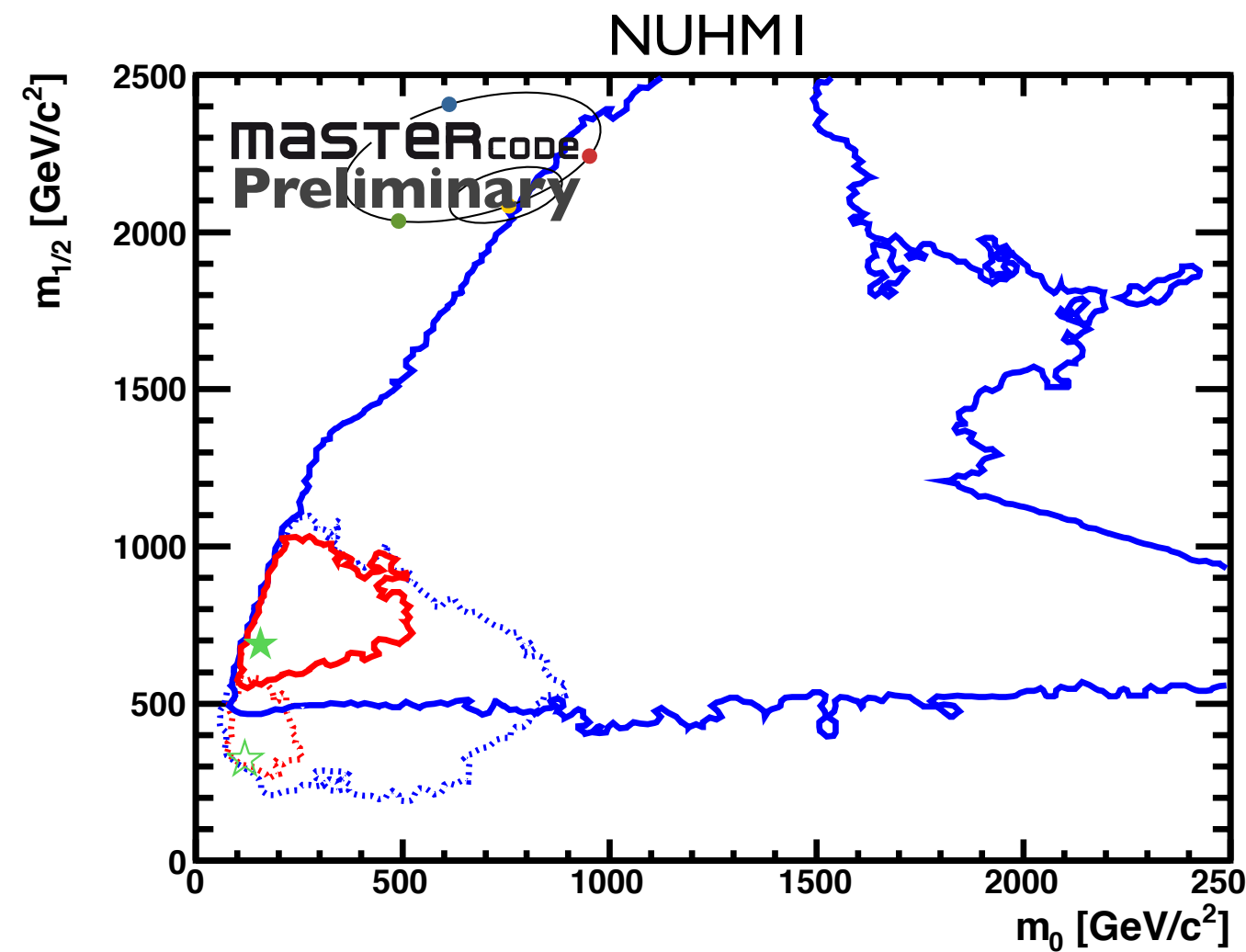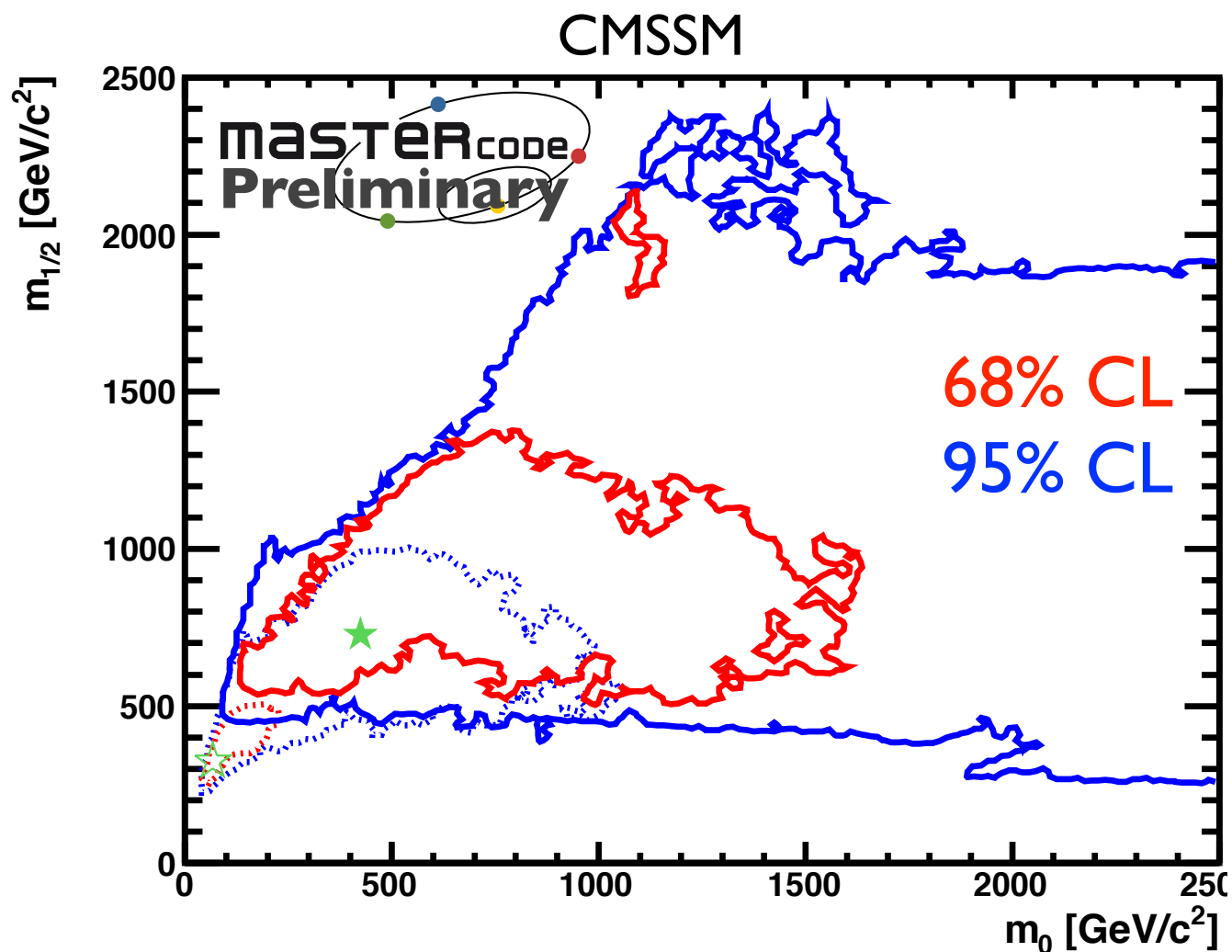 $\chi^2 \sim \left(\dfrac{\tan^2 \beta}{\tan^2 \beta_{95\%}}\right)^{p(M_A)}$

- ## $B_s \to \mu\mu$ (LHCb, CMS)

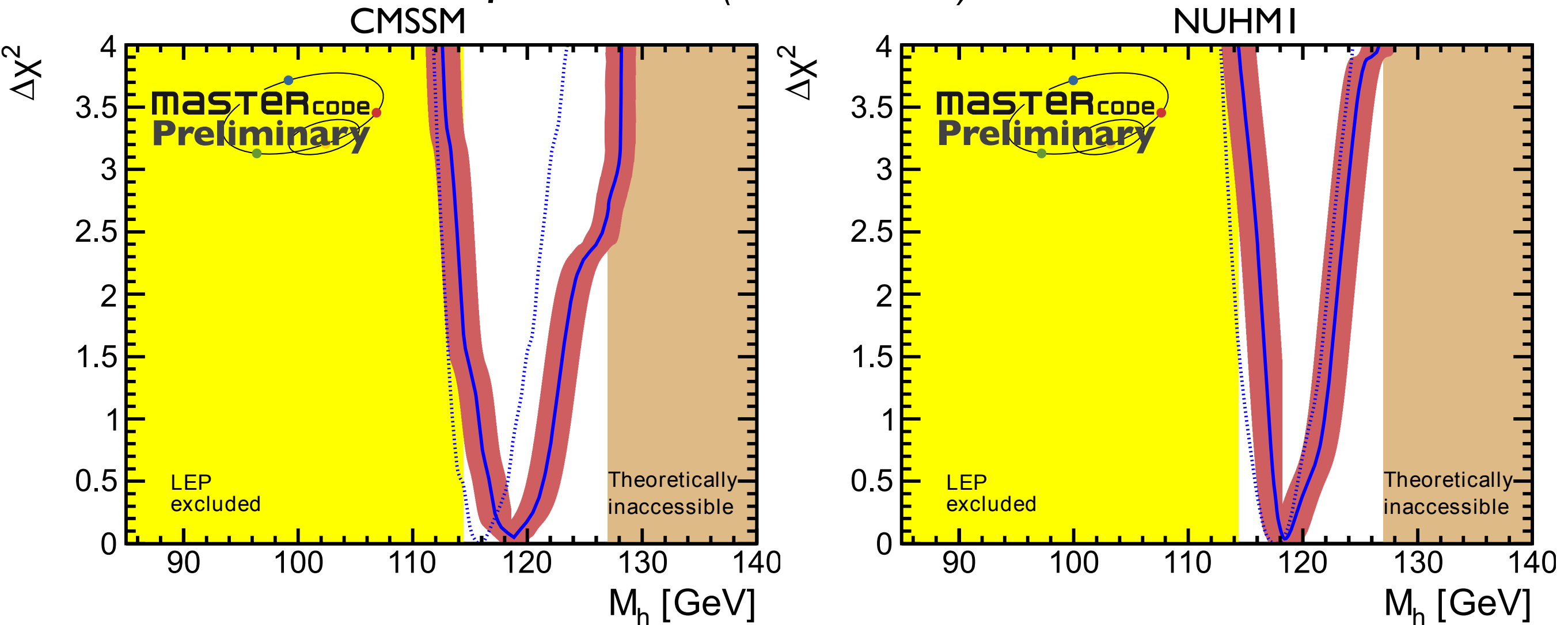 - use full likelihood from official combination

Global picture (reminder)

- Situation after including 1/fb results

CMSSM

NUHM1

68% CL
95% CL

- Wider "preferred" region, but lower probability
  - overall minimum significantly higher in mass

Light Higgs mass prediction

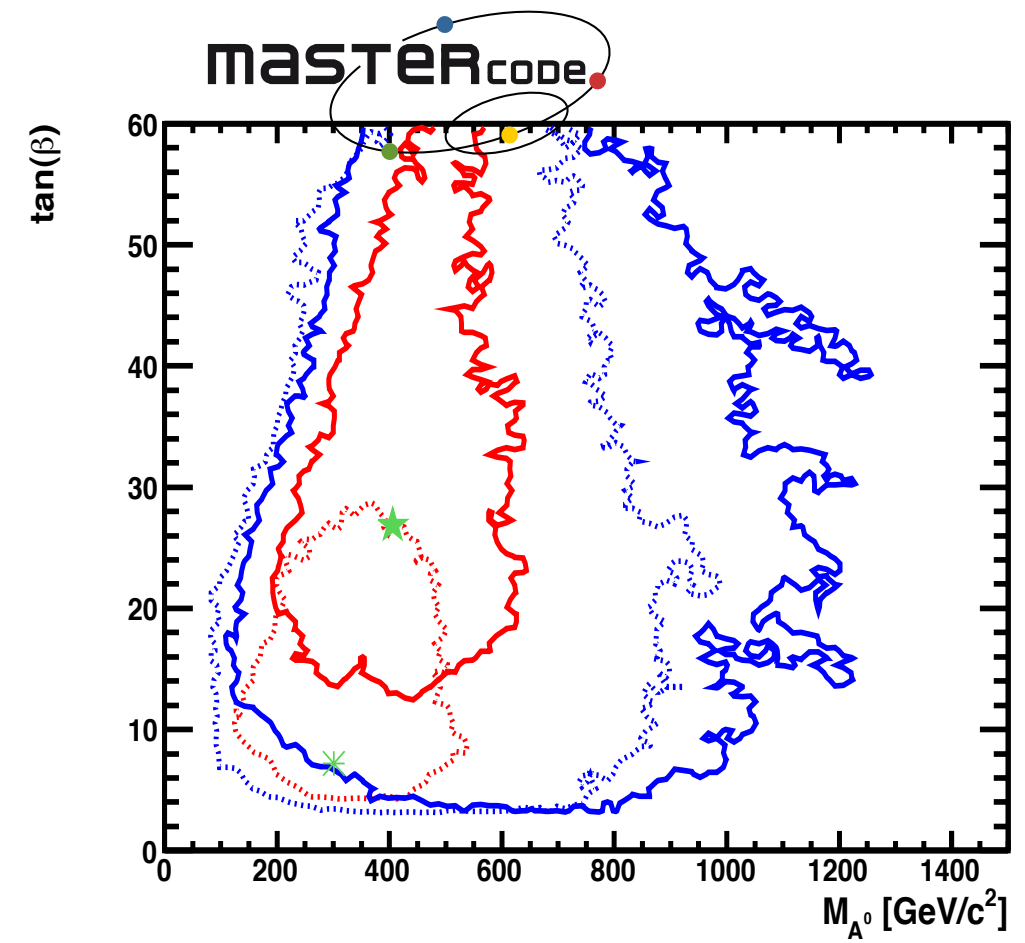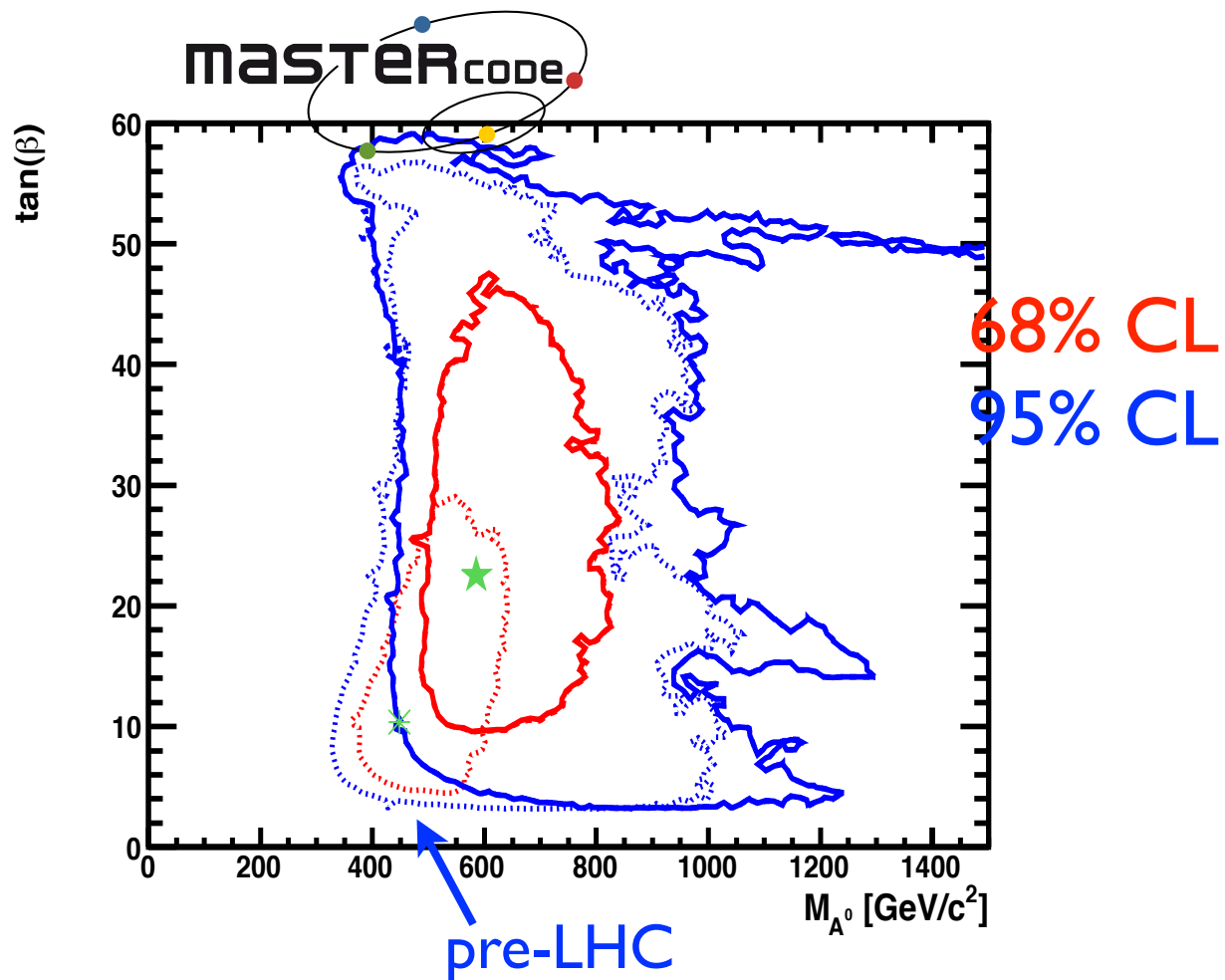- *N.B. constraint from LEP2 (or Tevatron) is **not** included*

- Now consistent prediction in both models

  - CMSSM is out of LEP exclusion!

Heavy Higgs

- (MA,tanβ) with 2010 LHC results

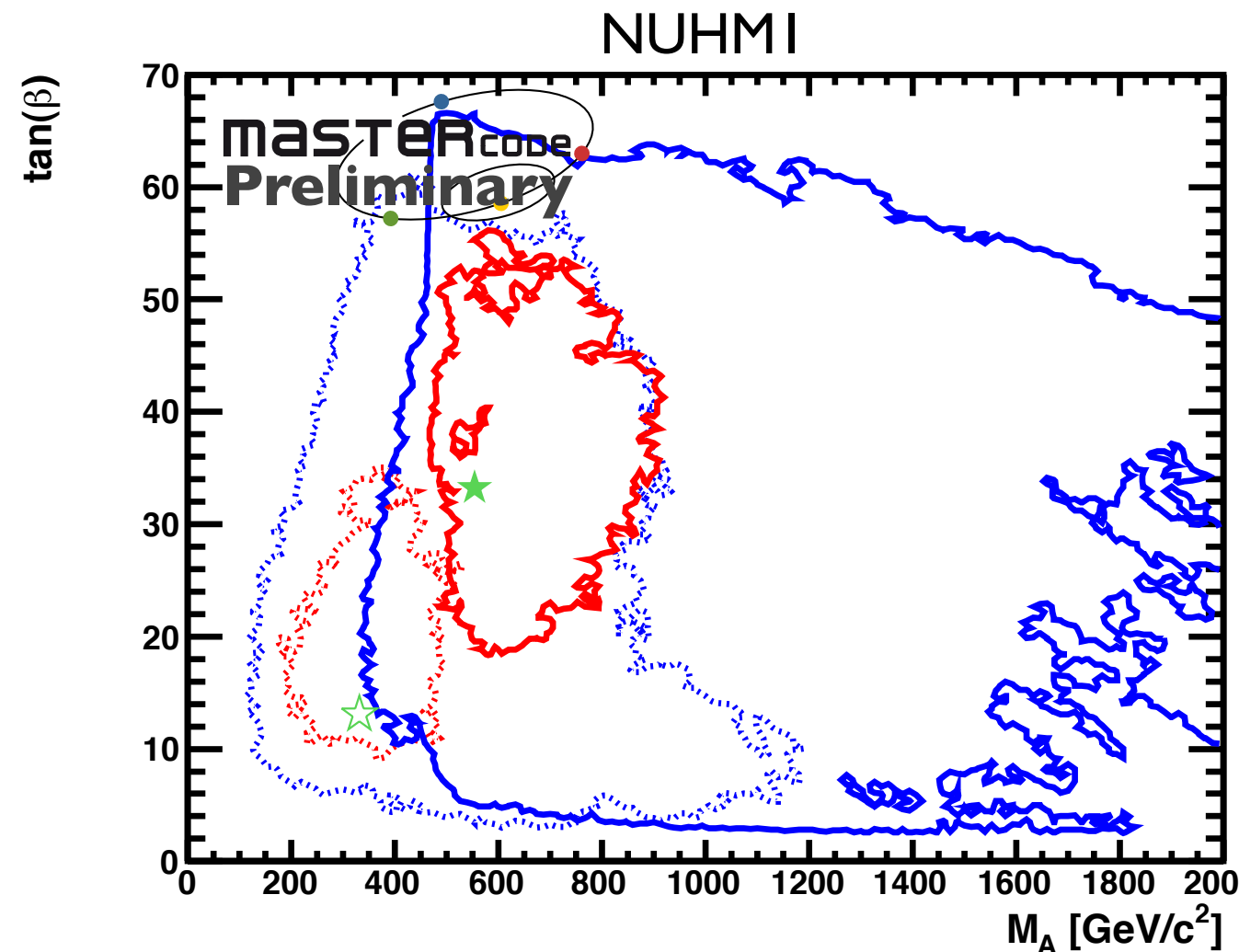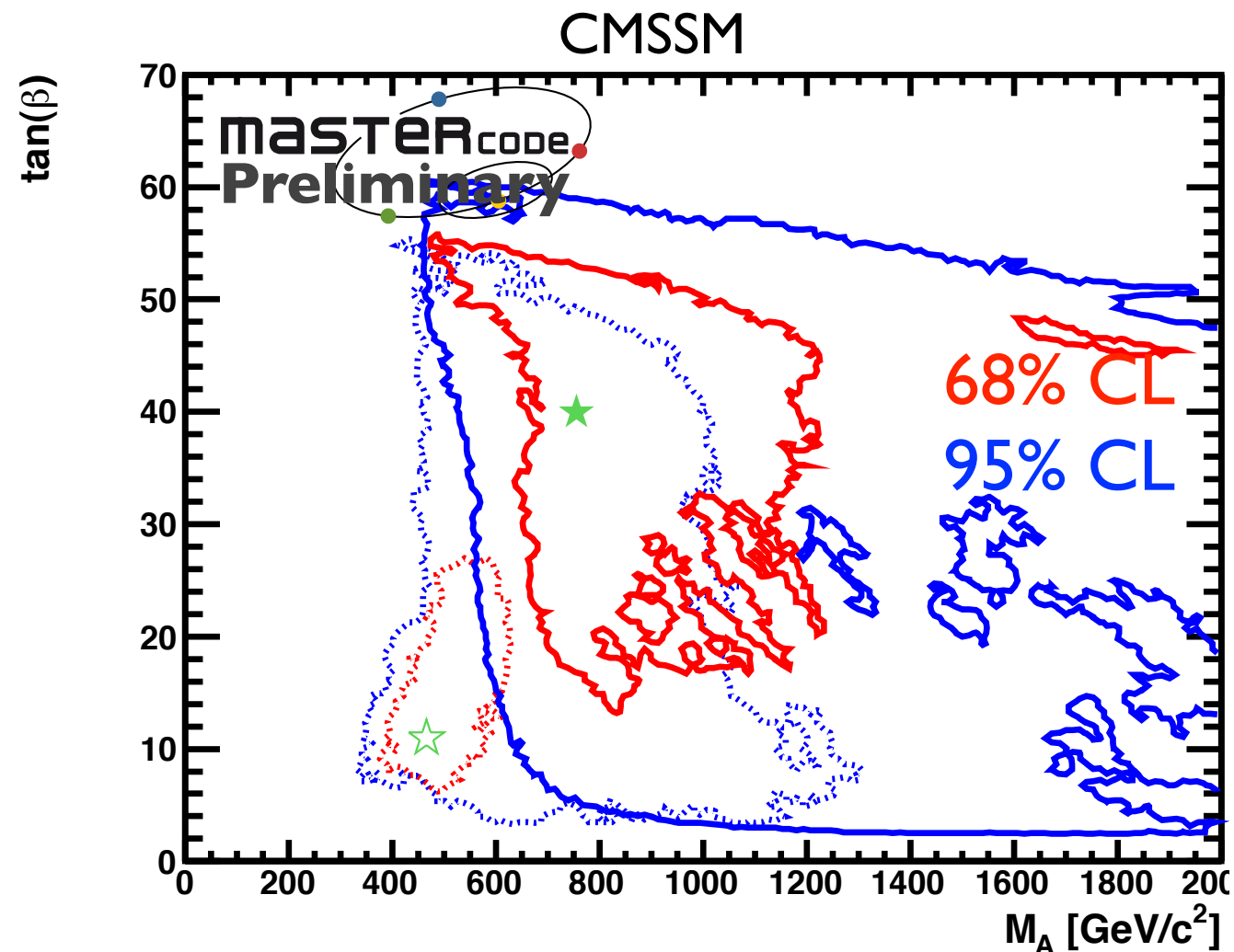CMSSM

NUHM1

68% CL

95% CL

pre-LHC

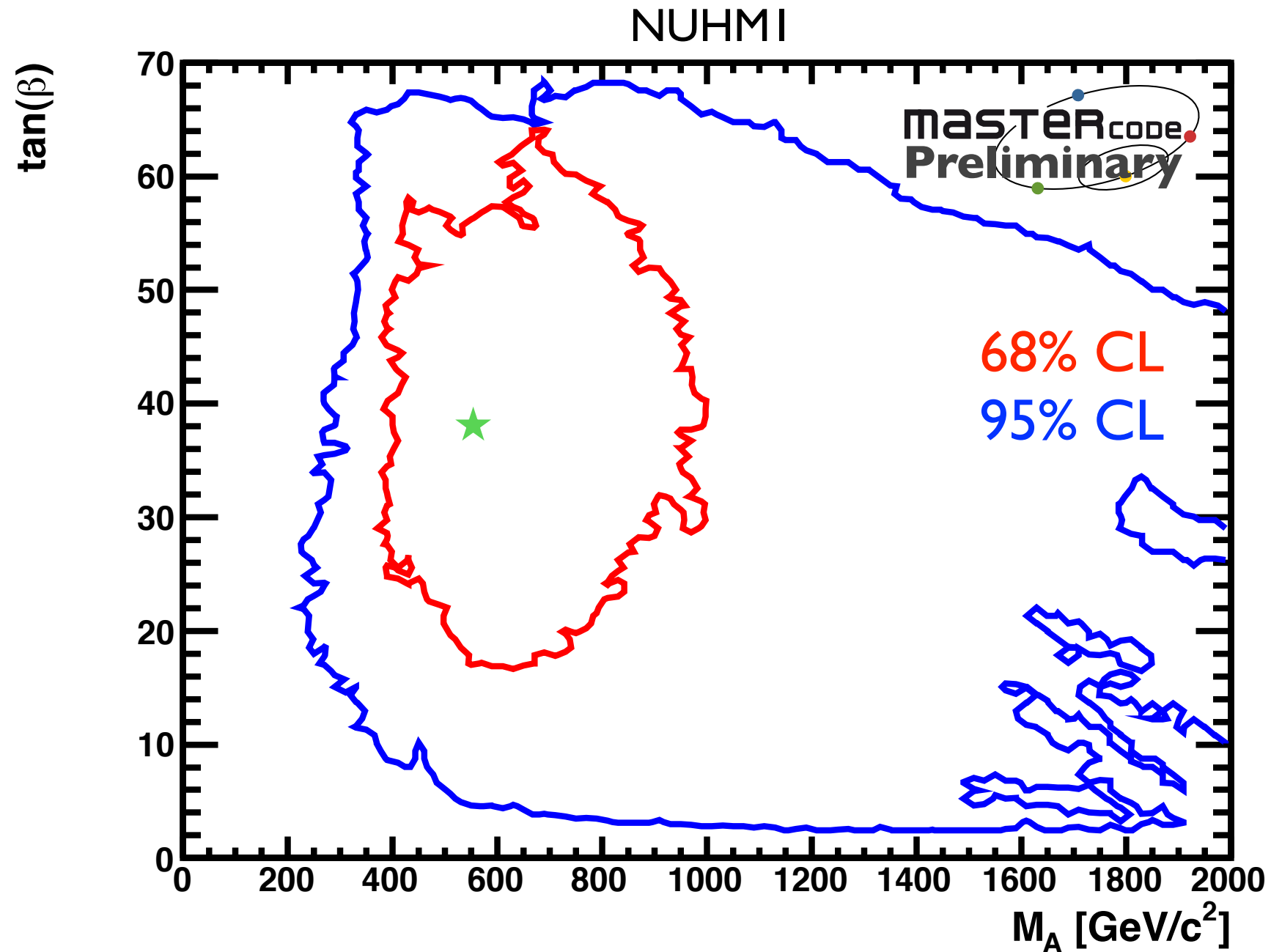- Additional degree of freedom in NUHM1 allows for low M_A values

Heavy Higgs

- ## (MA,tanβ) after 2011 LHC results

- ## Higher M_A now favoured in both models

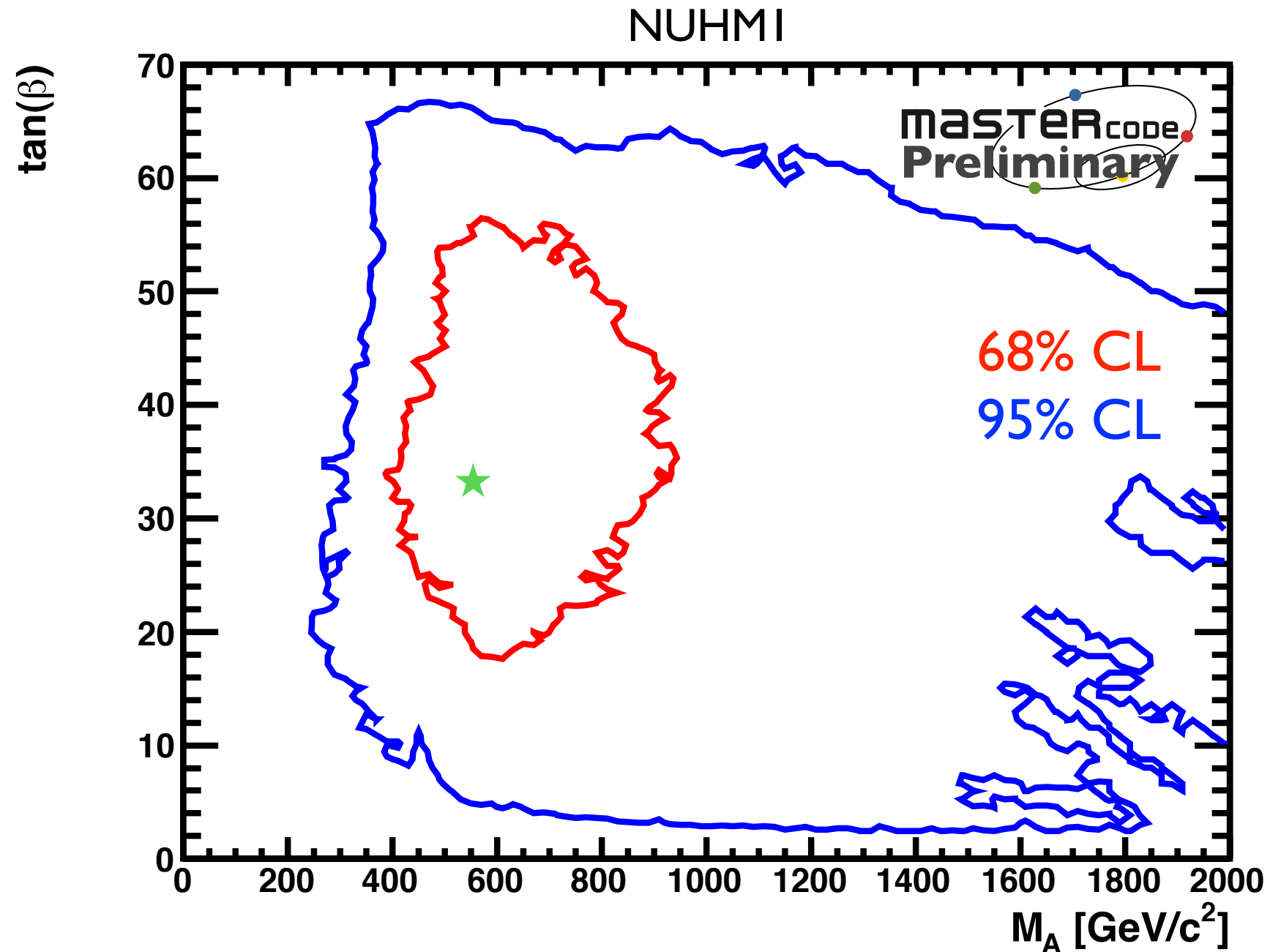 - ### Also, low tanβ now disfavoured!

Heavy Higgs

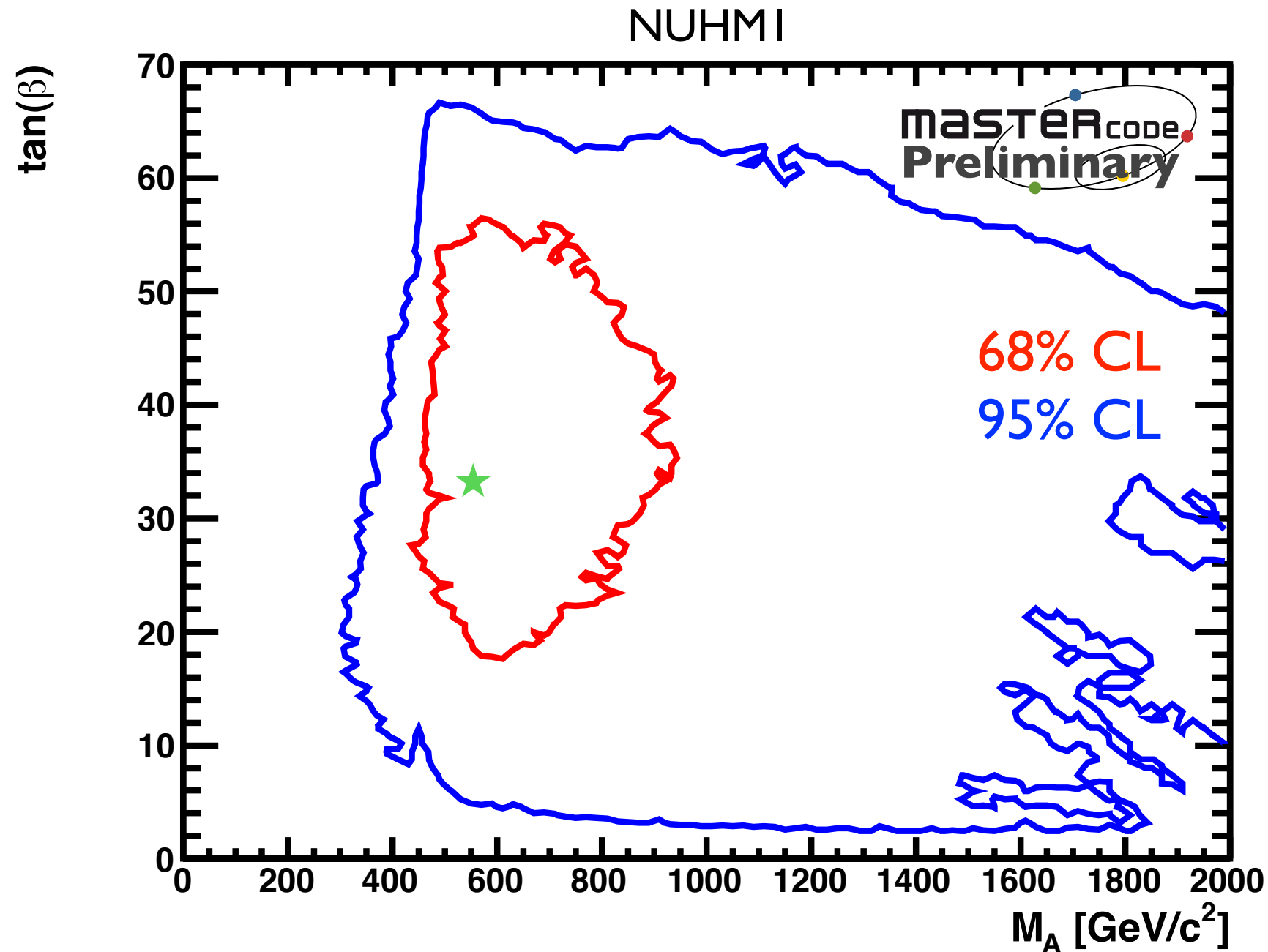- LHC 2011 MET searches only

NUHM1

68% CL
95% CL

M_A [GeV/c²]

tan(β)

Heavy Higgs

- LHC 2011 MET searches and $B_s \rightarrow \mu\mu$

Heavy Higgs

- LHC 2011 MET searches, $B_s \to \mu\mu$, $H \to \tau\tau$

NUHM1

68% CL
95% CL

$\tan(\beta)$

M_A [GeV/c^2]

More on tanβ

- (m$_{1/2}$,tanβ) after 2011 LHC results

CMSSM

NUHM1

- Interplay between LHC and g–2
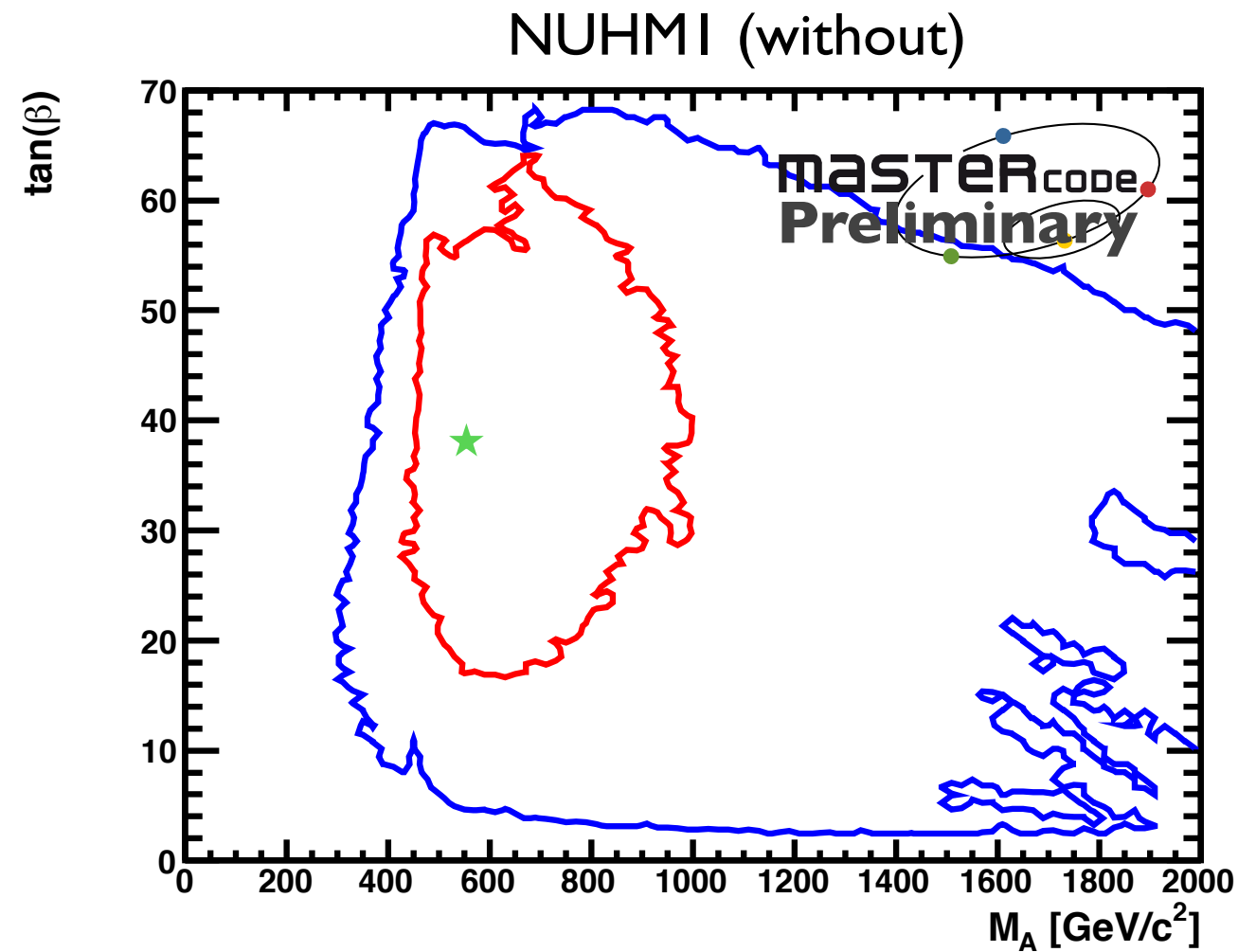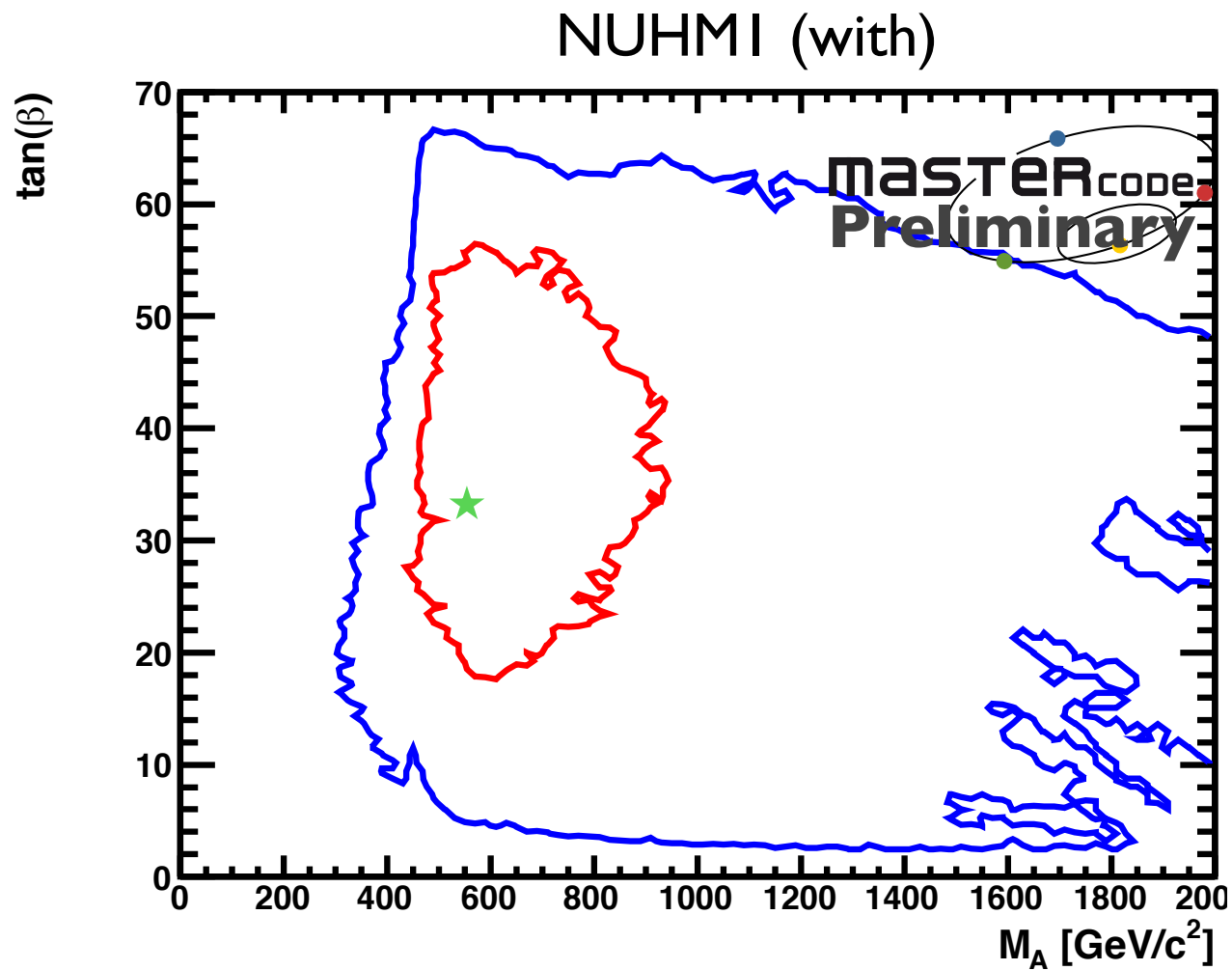
  - higher masses are compensated by larger tanβ

Conclusions

- CMSSM and NUHM1 still on the safe(ish) side

  - new 1/fb LHC data significantly pushes the allowed mass scale up

  - effect visible on M_A and $\tan\beta$ as well

  - low $\tan\beta$ no longer favoured!

- Very constraint models essentially excluded at 95% CL

- Lightest Higgs mass prediction now above LEP constraint

- Unfortunately still no discovery to play with…

Backup

Heavy Higgs

- 2011 results, with & without $B_s \rightarrow \mu\mu$

$B_s \rightarrow \mu\mu$ likelihoods