Precision vs Discovery: a simple benchmark

(A Hill, J van der Bij 1987, …..)

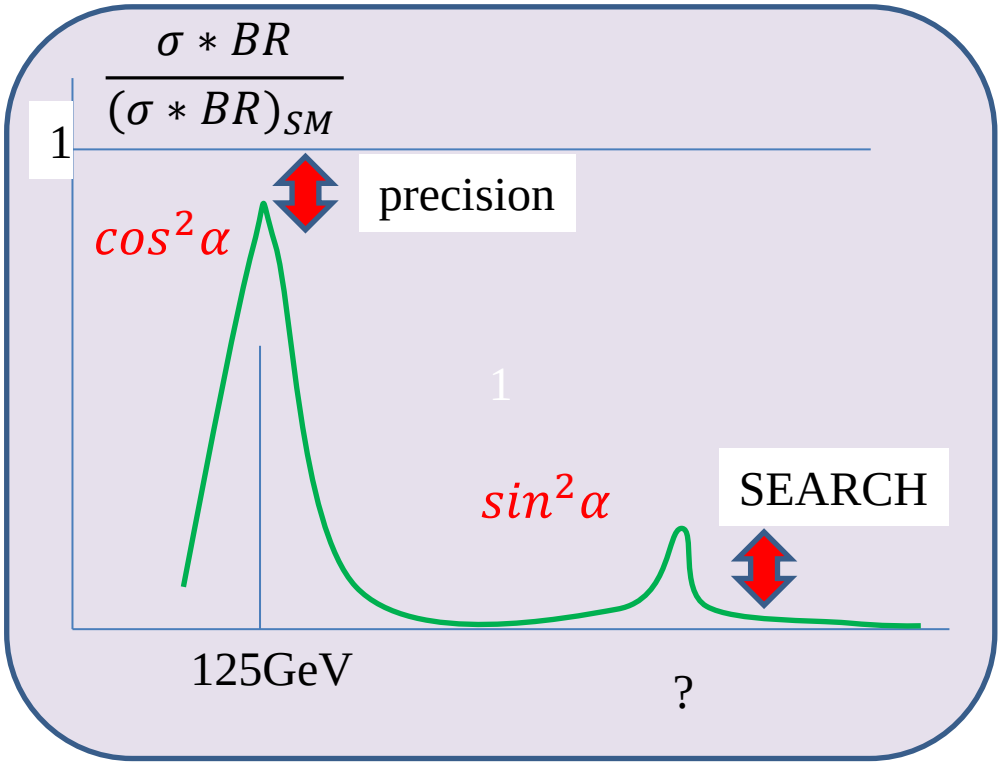
SM doublet H + singlet S

↓ sym breaking ↓

SM scalar h S

2 «peaks»

$$H_1 = h\cos\alpha + S\sin\alpha$$
$$H_2 = -h\sin\alpha + S\cos\alpha$$

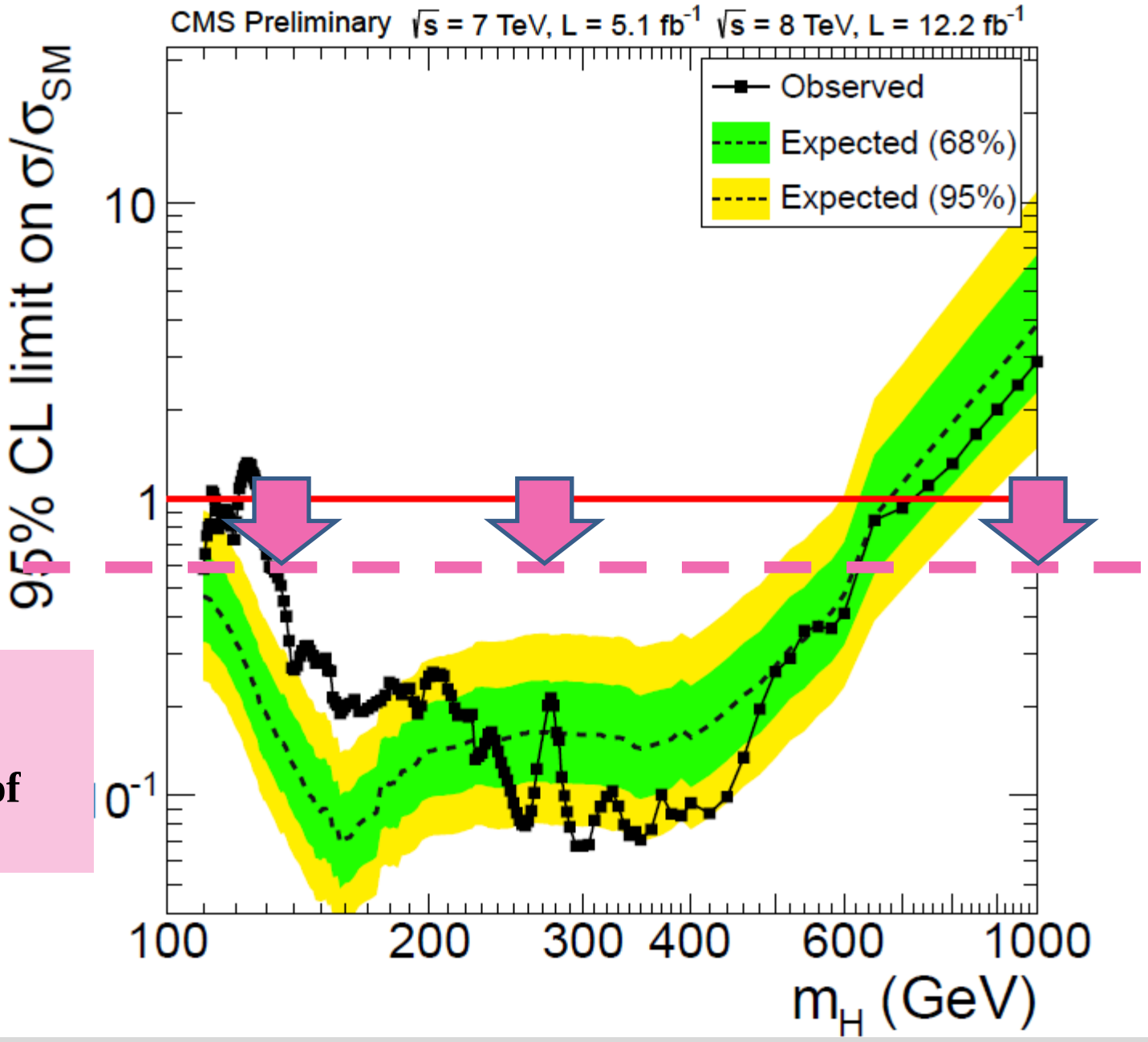


H_1 m_1= 125 GeV $\quad \sigma * BR_1 = cos^2\alpha \ (\sigma * BR)_{SM,m1}$

H_2 m_2= ?, $\quad \sigma * BR_2 = sin^2\alpha \ (\sigma * BR)_{SM,m2}$

Based on arXiv:1304.0386 with C. Caillol, B. Clerbaux, S. Mollet

search for 2nd peak of Extra Singlet Model



Current limit (approx 2σ) from precision of 125 GeV peak

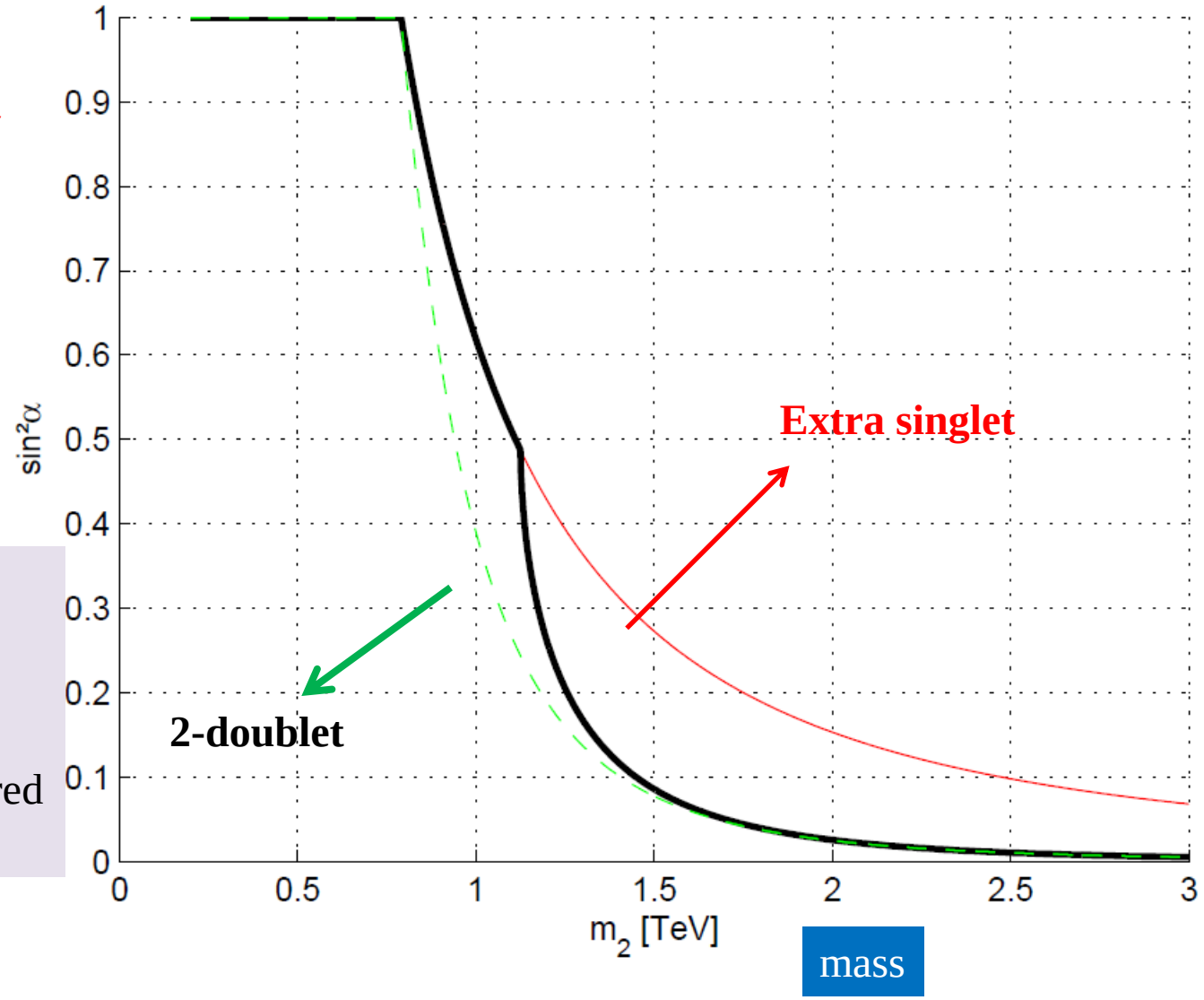
Small caveat: BR o'sf 2nd peak are the same as SM , but width would be reduced by $sin^2\alpha$

Which mass range for which mixing?

Decoupling implies that mixing disappears when the mass of the new particles → ∞

Accuracy ….. $sin^2\alpha$ →

mixing



mass

The extra singlet seems a bit unusual, as the limits on mixing fall off very slowly for instance when compared to 2 DM

Constraints on σ*BR(Extra Singlet Model) / SM

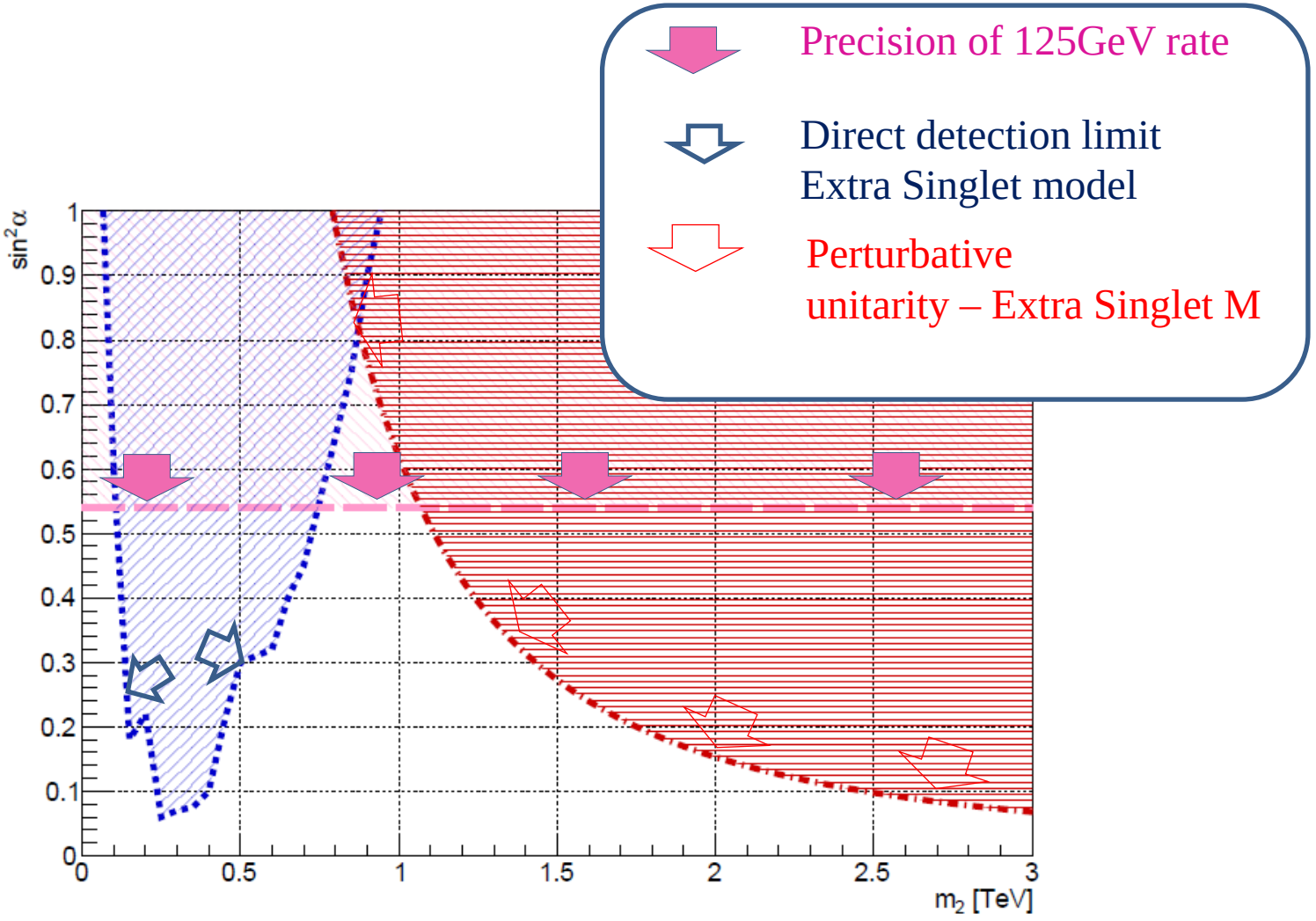


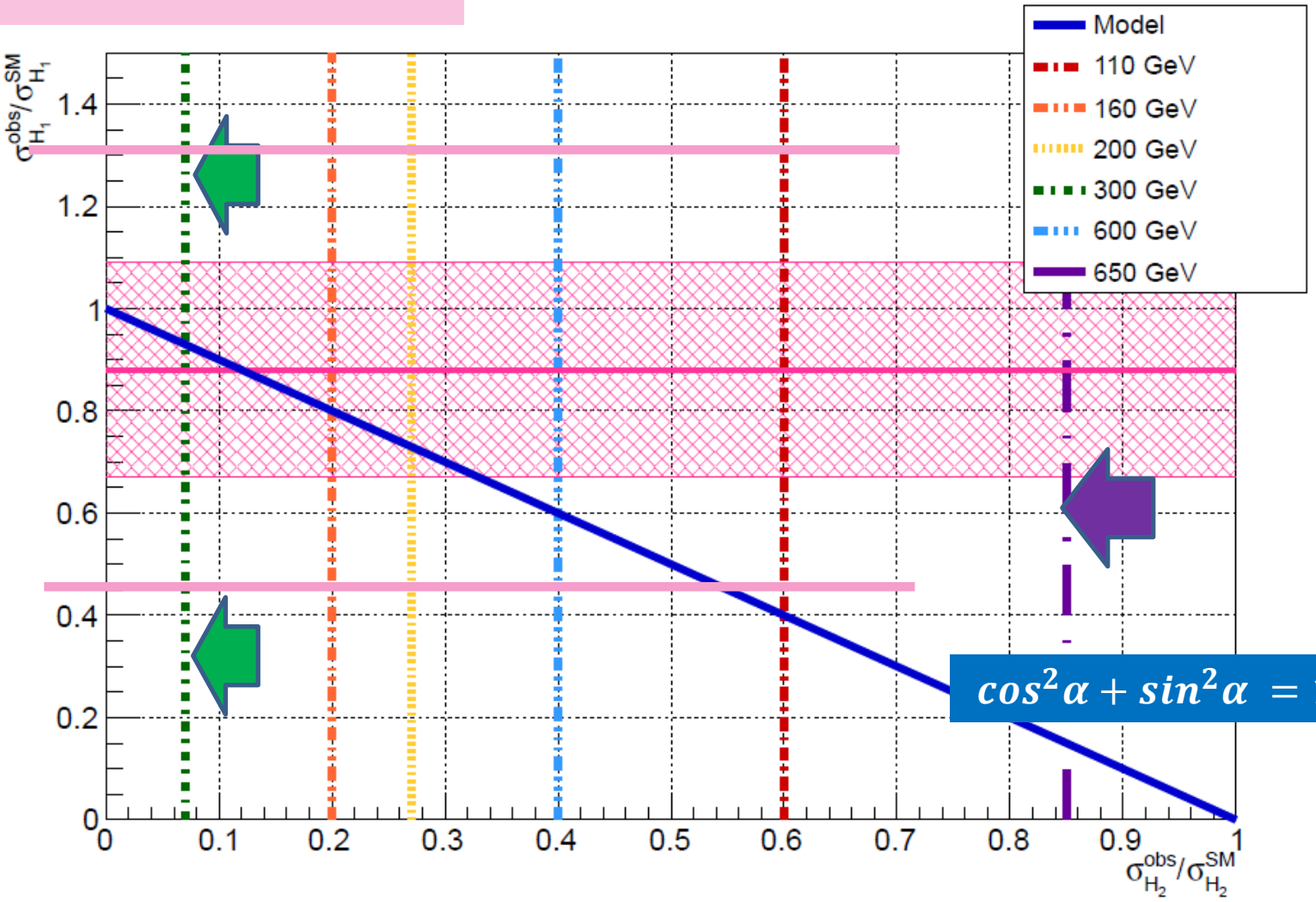
Figure 4: Comparison of the constraints on the mixing $\sin^2\alpha$ as a function of m_2 in the ESM case. The graph shows the constraints from "perturbative unitarity" as discussed above, combined with "precision" constraints stemming from the 125GeV peak and "direct search" constraints, both inferred at "2 σ".

Based on public CMS data

j-m frere, Hellenic School Discussion, 2013

Constraining the simplest model

Precision (measure of 125 GeV peak)
$cos^2\alpha$



CMS data;
125 GeV 1 σ,
limits at 2σ

For the moment, direct search wins,
Except < 110 GeV and > 600 GeV

Search for 2nd peak $sin^2\alpha$