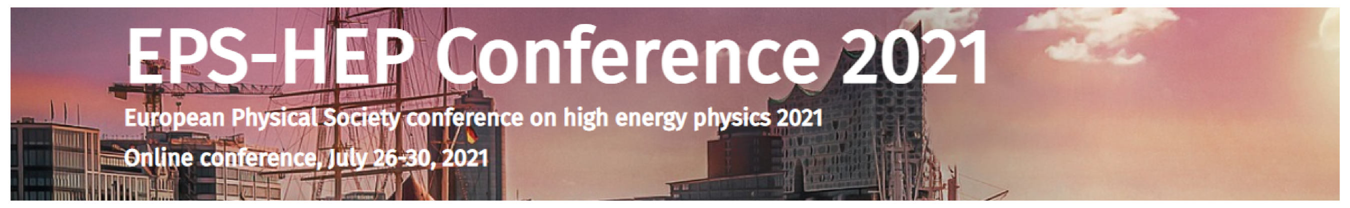

ANALYSING HIGGS BOSON IN A FLAVOR VIOLATING CMSSM THROUGH INFORMATION THEORY

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ABSTRACT

Flavor violation in the top sector allows an extra few GeV contribution to the Higgs mass and thereby could reduce the SUSY breaking scale to remain within a few TeV. In this talk we discuss our findings of a detailed investigation on the CMSSM parameter scan particularly in the context of the LHC Higgs observation using the information-theoretic approach and will demonstrate its impact on sparticle masses.

FORMALISM

The information theory deals with a quantitative measurement of uncertainty of the state of the certained system using the Gibbs-Shannon entropy or information entropy [1]. The entropy of the system could therefore be written as

$$S = -k_B \langle \ln p \rangle = -k_B \sum_{i \in \{micro\}} p_i \ln p_i. \quad (1)$$

where, the i^{th} microstate contains probability p_i while k_B is the Boltzmann's constant.

This theory is applied to our study by considering an ensemble of $\mathcal{N}$–number of independent Higgs-boson where each one is decaying to its various allowed decay modes with probabilities $p_d(m_h)$ of its d^{th} decay mode, n_d consider as number of allowed decay modes of the Higgs-boson.

The mass of the CP-even lightest Higgs of the MSSM at the tree-level [2],

$$m_h^2 = \frac{1}{2}(m_{A^0}^2 + m_Z^2 - \sqrt{(m_{A^0}^2 - m_Z^2)^2 + 4 m_Z^2 m_{A^0}^2 sin^2(2\beta)}), \quad (2)$$

Thus the term of leading contribution to CP-even lightest Higgs is of the order,

$$\triangle m_h^2 = \frac{3 g^2 m_t^4}{8 \pi^2 m_W^2}[ln(\frac{M_S^2}{m_t^2}) + \frac{X_t^2}{M_S^2}(1 - \frac{X_t^2}{12 M_S^2})]. \quad (3)$$

SCANNED PARAMETERS

We have scanned the parameter space within the following limits

- $m_0 \in [0.1, 10]$ TeV,
- $m_{1/2} \in [0.1, 6]$ TeV,
- $tan\beta \in [2, 60]$,
- $A_0 \in [-10, 10]$ TeV,
- sign$(\mu) = +1$,
- $\delta_{ij}^{XY} \in [-0.07, 0.07]$.

DISCUSSIONS

Constraints	Observables	Experimental Value
LEP	m_h	> 114.4 GeV
	$m_{\tilde{\chi}^0_{1,2,3,4}}$	$> m_Z/2$
	$m_{\tilde{\chi}^\pm_{1,2}}$	> 103.5 GeV
PO	$\triangle\rho$	0.00038 ± 0.0002
	$BR(b \to s\gamma)$	$(3.32 \pm 0.15) \times 10^{-4}$
	$\triangle a_\mu$	$(2.51 \pm 0.59) \times 10^{-9}$
DM	$\Omega_\chi h^2$	0.1200 ± 0.0012

Table 1: *List of experimental observables used as constraints [2].*

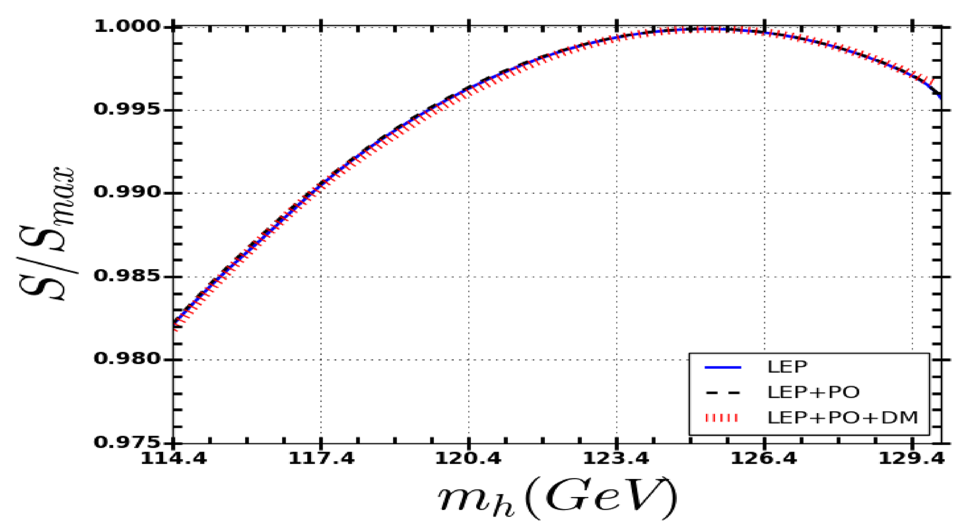

Fig.1: *Marginalized entropy vs lightest CP-even Higgs-boson.*

Conclusions: We have studied the parameter space involving the different constraints from LEP data on sparticles and Higgs-boson search limits, precision observables and dark matter. The lightest CP-even Higgs mass of the MSSM model is in well agreement with the LHC observations. Through the Higgs's entropy, we evaluate the sfermions and gauginos masses of the order of the TeV scale. After inclusion of flavor violation in the LR of the top sector, there is a reduction of SUSY breaking scale as seen in Fig.2.

RESULTS

An asymptotic expansion would produce the expression of entropy of the Higgs-bosons [3],

$$S(m_h) \simeq \frac{1}{2} \ln \left((2\pi \mathcal{N} e)^{n_d - 1} \prod_{d=1}^{n_d} p_d(m_h) \right) + \frac{1}{12\mathcal{N}} \left(3n_d - 2 - \sum_{d=1}^{n_d} (p_d(m_h))^{-1} \right) + \mathcal{O}\left(\mathcal{N}^{-2}\right) . (4)$$

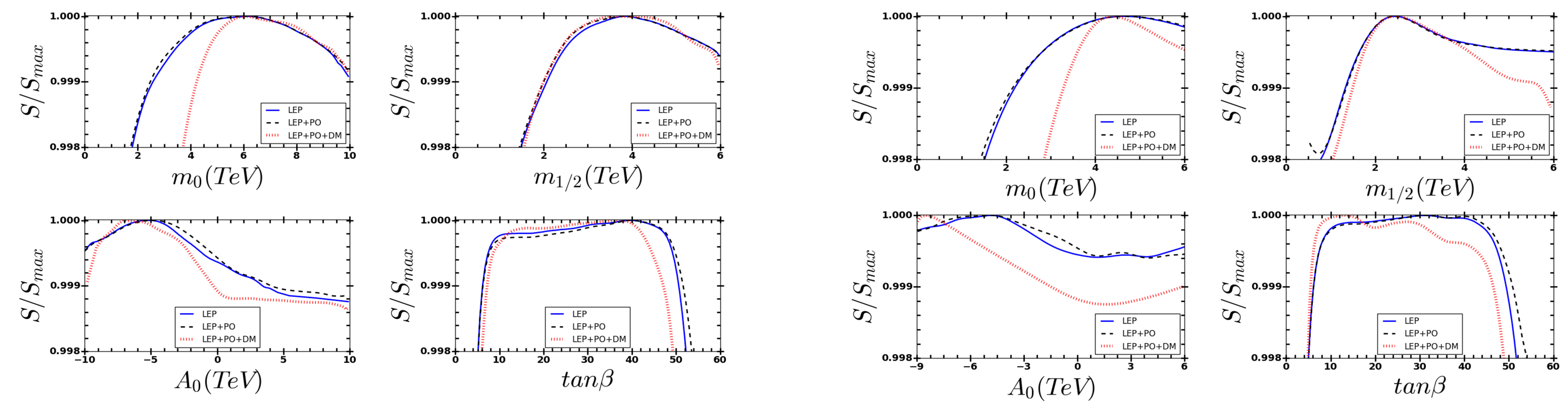

Fig.2: *Marginalized entropy vs CMSSM parameters in the base CMSSM model and in the LR of the top sector of NMFV respectively.*

Parameters	Constraints: LEP	LEP + PO	LEP + PO + DM
m_0	6.16	6.00	5.99
$m_{1/2}$	3.80	3.74	3.58
A_0	−5.40	−4.93	−6.92
$tan\beta$	39.4	39.6	36.8
δ_{ct}^{LR}	0.0	0.0	0.0
m_h	125.16	125.16	125.24
m_H	5.21	5.22	5.61
m_{A^0}	5.20	5.19	5.71
$m_{H^\pm}$	5.27	5.28	6.19
$m_{\tilde{\chi}_1^0}$	1.73	1.71	1.92
$m_{\tilde{\chi}_2^0}$	2.84	2.82	2.32
$m_{\tilde{\chi}_3^0}$	3.31	3.35	2.23
$m_{\tilde{\chi}_4^0}$	3.55	3.50	3.11
$m_{\tilde{\chi}_1^\pm}$	2.68	2.71	2.10
$m_{\tilde{\chi}_2^\pm}$	3.45	3.45	2.96
$m_{\tilde{g}}$	7.78	7.73	7.44
$m_{\tilde{q}_L}$	8.17	7.99	8.97
$m_{\tilde{q}_R}$	7.81	7.76	8.71
$m_{\tilde{b}_1}$	7.10	7.09	7.94
$m_{\tilde{b}_2}$	7.50	7.49	8.33
$m_{\tilde{t}_1}$	6.24	6.24	6.75
$m_{\tilde{t}_2}$	7.15	7.12	7.96
$m_{\tilde{l}_L}$	5.73	5.73	6.60
$m_{\tilde{l}_R}$	6.06	5.76	6.18
$m_{\tilde{\tau}_1}$	5.31	5.12	5.17
$m_{\tilde{\tau}_2}$	5.45	5.35	6.09

Parameters	Constraints: LEP	LEP + PO	LEP + PO + DM
m_0	4.54	4.59	4.34
$m_{1/2}$	2.42	2.42	2.42
A_0	−4.83	−4.83	−8.52
$tan\beta$	31.26	31.05	12.96
δ_{ct}^{LR}	-0.033/0.032	-0.033/0.033	0.0011
m_h	125.27	125.26	125.40
m_H	3.93	4.02	3.81
m_{A^0}	3.88	4.07	3.77
$m_{H^\pm}$	3.93	4.02	3.36
$m_{\tilde{\chi}_1^0}$	1.12	1.05	1.41
$m_{\tilde{\chi}_2^0}$	1.89	1.94	1.72
$m_{\tilde{\chi}_3^0}$	2.46	2.47	1.95
$m_{\tilde{\chi}_4^0}$	2.47	2.45	2.10
$m_{\tilde{\chi}_1^\pm}$	2.00	2.02	1.50
$m_{\tilde{\chi}_2^\pm}$	2.45	2.45	2.06
$m_{\tilde{g}}$	5.04	5.07	5.15
$m_{\tilde{q}_L}$	5.67	5.58	6.04
$m_{\tilde{q}_R}$	5.67	5.56	6.00
$m_{\tilde{b}_1}$	4.77	4.78	5.16
$m_{\tilde{b}_2}$	5.13	5.19	5.42
$m_{\tilde{t}_1}$	4.06	4.06	4.48
$m_{\tilde{t}_2}$	4.80	4.75	5.20
$m_{\tilde{l}_L}$	4.36	4.54	4.66
$m_{\tilde{l}_R}$	4.60	4.50	4.50
$m_{\tilde{\tau}_1}$	4.06	4.07	4.07
$m_{\tilde{\tau}_2}$	4.34	4.38	4.44

Table 2: *List of sparticle masses for different constraints for CMSSM base model and for NMFV framework respectively. All masses are in TeV except m_h is in GeV, $tan\beta$ and δ_{ct}^{LR} are dimensionless.*

Unified scalar and gaugino mass approach towards lower mass after the inclusion of NMFV framework on CMSSM model i.e. from 5.99 TeV to 4.34 TeV and 3.58 TeV to 2.42 TeV respectively. The tanβ approach to 12.96 from 36.8 after involving this effect. Our analysis predict the mass value of gluino, lighter stop, lighter chargino and lightest neutralino are to be 5.15 TeV, 4.48 TeV, 1.50 TeV and 1.41 TeV respectively.

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