

**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE**  
2A & 2B, Raja S.C. Mullick Road, Jadavpur, Kolkata-700032, India

## **Seminar Notice**

Org. by  
**School of Physical Sciences**

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| <b>Title:</b>    | <b>Status of Charged Higgs in Two Higgs Doublet Model using CMS <math>\sqrt{s} = 13</math> TeV results and top quark threshold effect at LHC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Speaker:</b>  | <b>Prasenjit Sanyal, IIT Kanpur</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Date:</b>     | <b>January 28, 2020 (Tuesday)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Time:</b>     | <b>16:00 Hours</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Venue:</b>    | <b>Physics Seminar Room (C-406), 3rd Floor, Centenary Building, IACS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Abstract:</b> | <p>The shortcomings of Standard Model of particle physics (SM) call for models beyond the SM (BSM) such as Two Higgs Doublet Model (2HDM) and Minimal Supersymmetric Standard Model (MSSM). In the first half of the talk, I will discuss the latest CMS results on the upper limits on <math>\sigma H_{\pm} \text{BR}(H_{\pm} \rightarrow \tau^{\pm} \nu)</math> and <math>\sigma H_{\pm} \text{BR}(H_{\pm} \rightarrow t \bar{b})</math> for <math>\sqrt{s} = 13</math> TeV at an integrated luminosity of <math>35.9 \text{ fb}^{-1}</math> which are used to impose constraints on the charged Higgs <math>H_{\pm}</math> parameters in 2HDM. The latest results lead to much more stringent constraints on charged Higgs parameter space in comparison to the earlier 8 TeV results. The CMS collaboration also studied the exotic bosonic decay <math>H_{\pm} \rightarrow W_{\pm} A</math> and <math>A \rightarrow \mu^{+} \mu^{-}</math> for the first time and put upper limits on the <math>\text{BR}(t \rightarrow H + b)</math> for light charged Higgs. These constraints lead to exclusion of parameter space which are not excluded by the <math>\tau \nu</math> channel. For comparison the exclusion regions from flavour physics constraints will be discussed. In the second half of the talk, I will discuss the top quark threshold effect at hadron colliders such as LHC. The <math>\gamma\gamma</math> pair production at LHC, plays a very important role in search for new physics. The SM background in this channel should be computed as precisely as possible. The background shows a smooth behaviour with respect to <math>m_{\gamma\gamma}</math>. However at the threshold of particle production, the smooth distribution gets modulated. In my talk, I will discuss one such effect originating within the SM, the top quark threshold effect which appears around <math>m_{\gamma\gamma} \approx 350 \text{ GeV}</math>. At the order of <math>\mathcal{O}(\alpha_{\text{ew}}^2 s)</math> the fermion loop mediated gluon fusion process <math>gg \rightarrow \gamma\gamma</math> starts contributing in the <math>\gamma\gamma</math> pair production at LHC. It is in this process where the top threshold effect appears from the destructive interference between the top loop diagrams containing on-shell top quarks and other diagrams containing light quarks. Once <math>m_{\gamma\gamma}</math> exceeds two times the top quark mass, the gluon fusion process gets contribution from the on-shell tops, creating a dip in the invariant mass distribution. We observed a dip in the <math>\gamma\gamma</math> distribution at a significance of <math>5\sigma</math> at around <math>350 \text{ fb}^{-1}</math> luminosity. Our work motivates that this might be an alternate way of probing the top quark mass experimentally and heavy colored fermion or scalar running in the <math>gg \rightarrow \gamma\gamma</math> loop.</p> |

**All are cordially invited to attend the seminar**