Spin Status

J. Pela
Imperial College London

Proposed binning method

- A “simple” grid search for the best possible binning should able to find good results.
  - Keep diphoton BDT categories, optimize in cos(Theta*)
- Maximize a variable which shows the separation in terms of the errors (statistical and/or systematics) associated with the test models (A and B) and the backgrounds in the signal area(s)
- Use where possible data information
  - Background contribution in each category
  - Expected signal Yield(?)

Maximized Variable

- In order to define the best binning we must define a variable that reflects how much each bin is able to separate Models A and B.

$$\sum_{bins} \frac{\left|\left(entries\left(Model_A\right)-entries\left(Model_B\right)\right)\right|}{\sqrt{error\left(entries\left(Model_A+Bkg\right)\right)^2+error\left(entries\left(Model_A+Bkg\right)\right)^2+syst\left(\ldots\right)^2}}$$

$$\sum_{bins} \frac{\left|\left(entries\left(Model_A\right)-entries\left(Model_B\right)\right)\right|}{\sqrt{entries\left(Model_A+Bkg\right)+entries\left(Model_A+Bkg\right)}}, considering\ systematics\ 0\ for\ now$$

- Systematics like fit uncertainty or MC statistics can be include to see the influence in the end result
- Currently the background estimation, from fitting side bands on data, is not implemented so we get:

$$\sum_{bins} \frac{\left|\left(entries\left(Model_A\right)-entries\left(Model_B\right)\right)\right|}{\sqrt{entries\left(Model_A\right)+entries\left(Model_A\right)}}$$

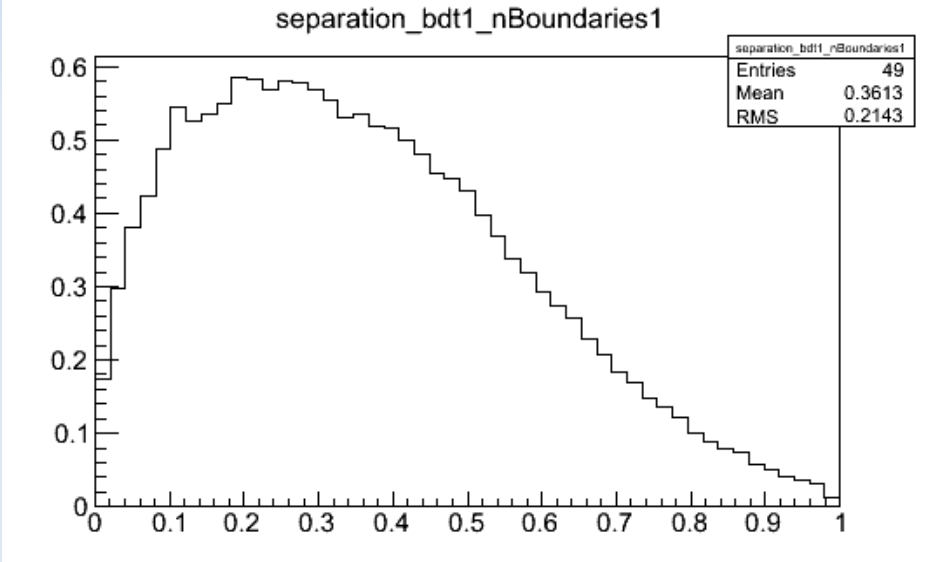
Combinations

- Found some articles from ~1970, where algorithms for getting all the combinations from a set of elements are described
- Implemented a version of such algorithm, which is based on the ideia:
  - 11100
  - 11010
  - 11001
  - 10110
  - (…)
  - 00111

Normalization and Models

- Since both models will typically have different acceptances on experiment and all samples weights where calculated assuming SM Higgs cross section, implemented Normalization to of Model B to Model A (SM Higgs), by:
  - BDT bin
  - Global number of entries
- This can in principle be done to the data yield in terms of the extracted signal from fit.
- Tested both available models on official samples: 2PM and 2LP

Example of running over Models



- Single boundary study for 0P versus 2PM on Diphoton BDT bin 1
- Axis
  - X axis: Boundary position
  - Y axis: Value of test variable
- This is the expected behavior so implementation looks correct

Conclusions

- First function implementation of the code.
  - Results out (very) late last night. Still digesting...
  - Indications that some improvements will come from this method.
- Implementation of background estimation from data underway.
- Next systematics study.