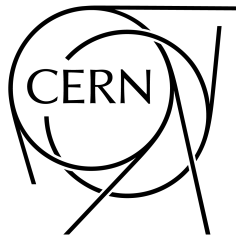


# Strange Quark as a Probe for new physics in the Higgs sector

So far, only Higgs Boson couplings to the 3<sup>rd</sup> generation demonstrated...  
Is Yukawa coupling really universal between families?  
Could current flavour anomalies have origin in the Higgs sector?

Snowmass 2021 - [EF01 Meeting](#) - Nov 3<sup>rd</sup>, 2021

*Valentina Maria Martina Cairo*



# Lol for Snowmass 2021

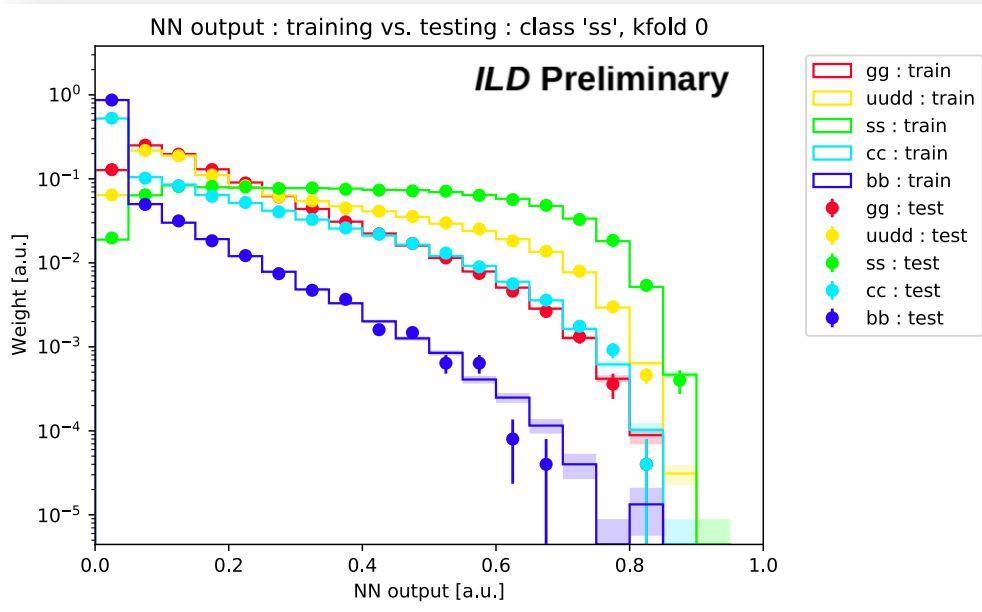
- ***Strange Quark as a probe for new physics in the Higgs Sector***
  - Study **Higgs** boson couplings to light quarks, in particular to the **strange quark**
    - Very rare in the SM
      - $BR(H \rightarrow s\bar{s}) \cong 10^{-4}$
    - Powerful channel to investigate the big questions in the previous page!
  - Calls for **lepton colliders** and dedicated **detector technologies** and **reconstruction techniques!**

- Somewhat related to the Instrumentation Frontier Lol on [4D Tracking](#)

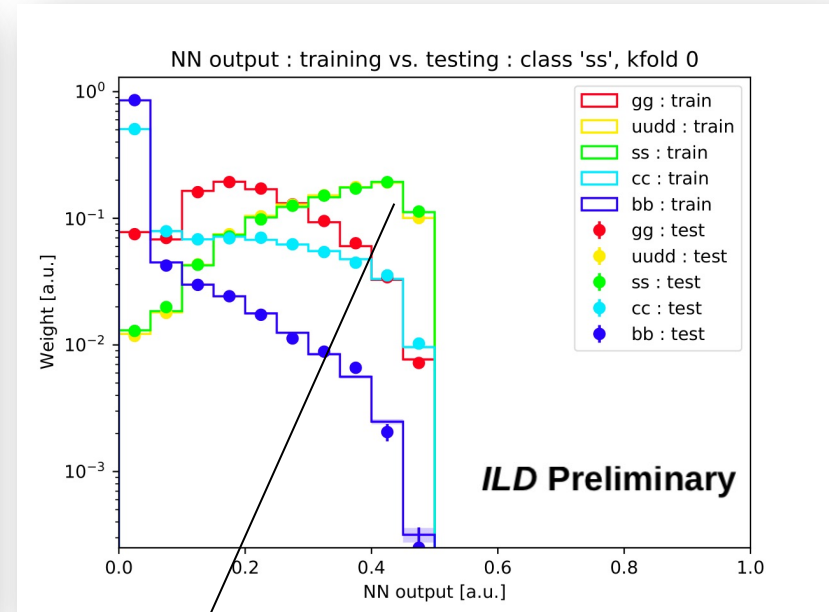
- Most recent presentations: [ILCx 2021](#), [Higgs 2021](#)
- Studies performed in ILD, but of general applicability

# Performance: Strange Tagger with & without PID

## With (truth) PID



## Without PID



No discrimination between s and u/d without PID!

**PID is a crucial ingredient** for discriminating  
**strange** from **up/down** initiated jets!

# Analysis Overview and Results

## Define Signal/Bkg

- Signal:  $Z(\text{inv})H(ss)$ ,
- Bkg:  $Z(\text{inv})H(bb,cc,gg)$ ,  
 $Z(qq)$ ,  $ZZ(qqqq)$

## Select Events

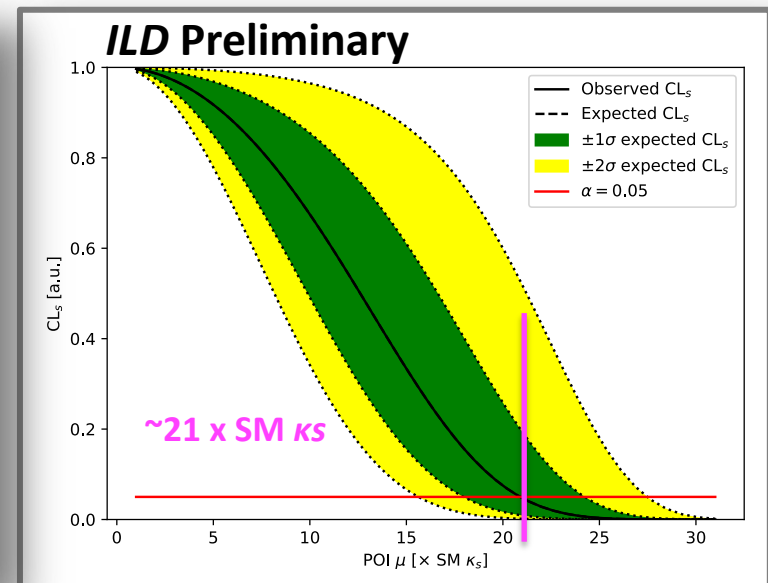
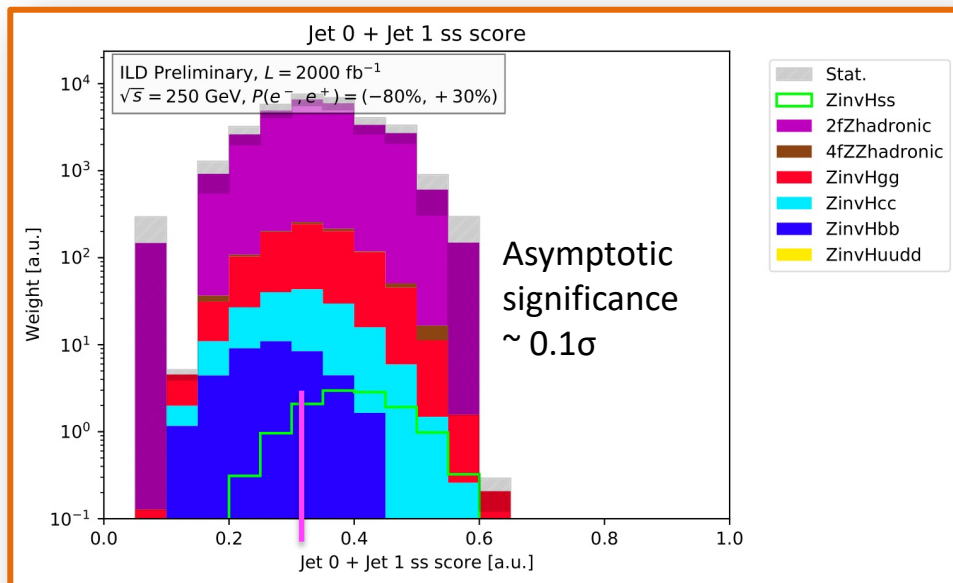
Most powerful cut on  $M_{jj}$  (see previous [talks](#) for more details)

## Build Signal discriminant

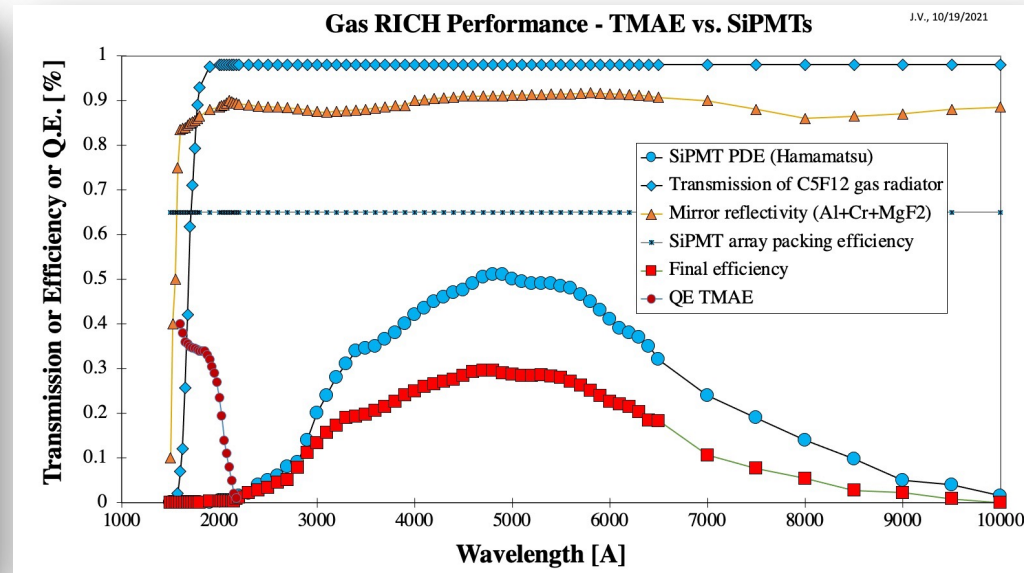
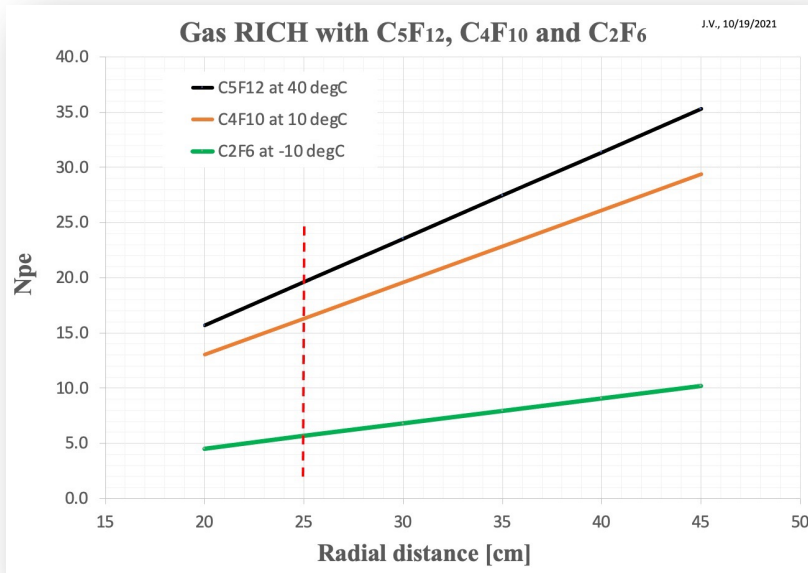
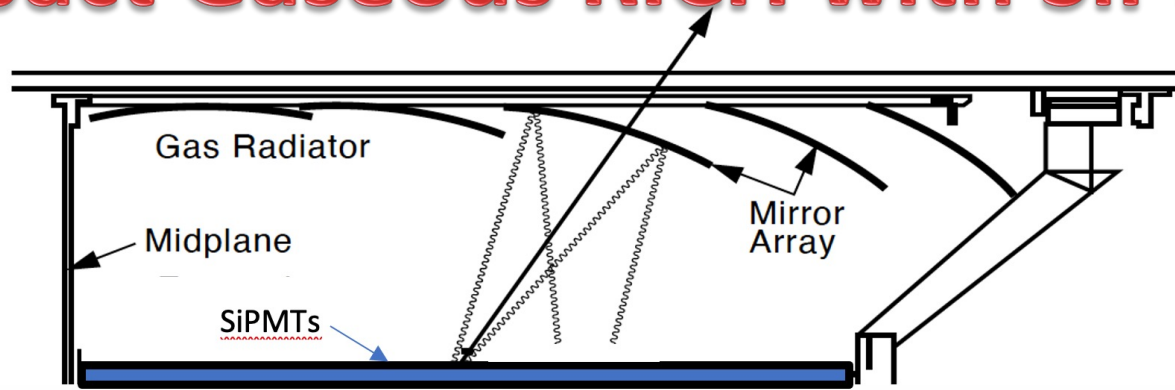
Sum of leading and sub-leading **strange-jet score**

## s-Yukawa coupling

Probe various BSM regimes



# Compact Gaseous RICH with SiPMTs



**C<sub>4</sub>F<sub>10</sub>** seems a possible solution with SiPMT readout even for 20-25 cm radial distance!

Much better Cherenkov Photon Detection efficiency over a wider wavelength compared to [TMAE](#)

# Publication plans

## Analysis already being documented

- Includes s-tag performance &  $H \rightarrow ss$  limits in the  $Z(\text{inv})H(qq)$  channel
  - This is based on ILD samples & first draft can be **ready by ~end of the month**

## Wish list

- Include signal (and signal regions) from  $Z(\text{ll})H(qq)$ 
  - Samples have been produced, being migrated on the grid
- Generate  $H \rightarrow cs$  events and perform analysis interpretation for this BSM scenario
  - In touch with the Whizard generator experts & in collaboration with new colleagues from Cornell

## To be decided:

- How much to add on the detector part
  - We have a complete and very informative back-of-the-envelope study to support the case for a RICH detector
  - No full simulation studies available yet
  - We think it is still valuable to document what we have done as a basis for future studies

# Thanks for your attention!



F. Cairo, From Conn(II)ecting the dots

*Valentina Cairo*

