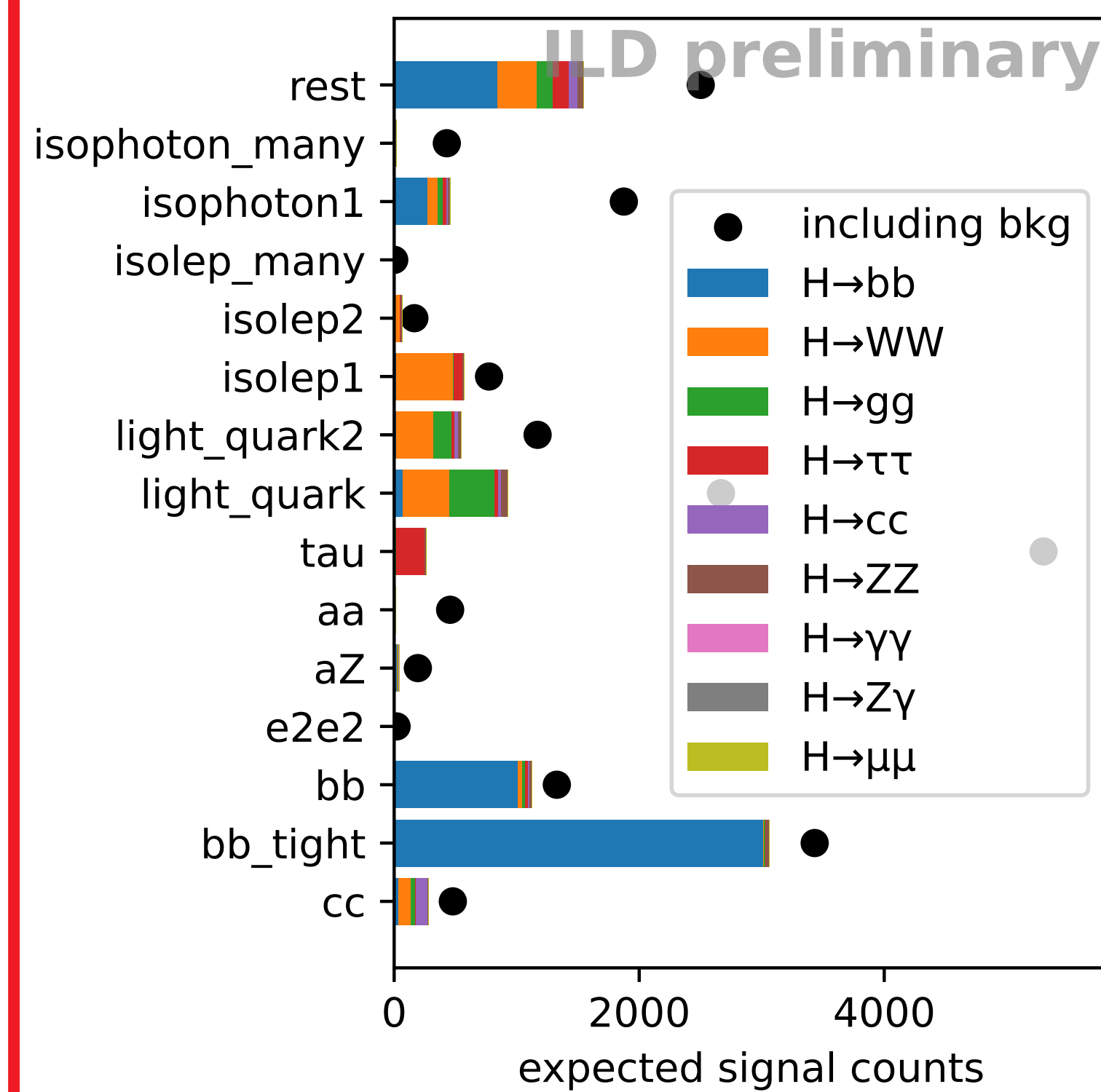


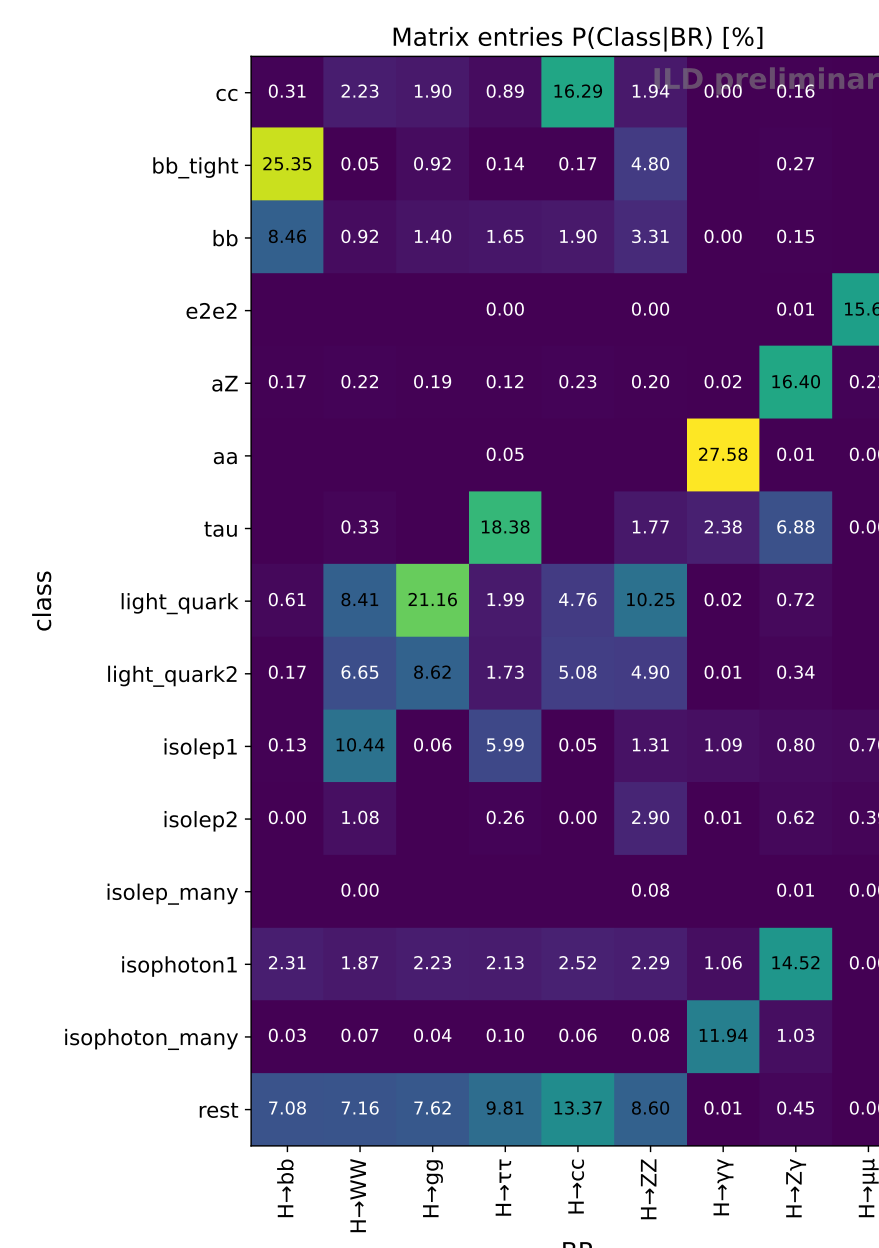
## Schematic overview

### 2. Sample creation



### 3. BR fit:

Probability matrix  $M$  from simulation  
per bkg and decay mode.  
Minimize  $BR = M \cdot Data$



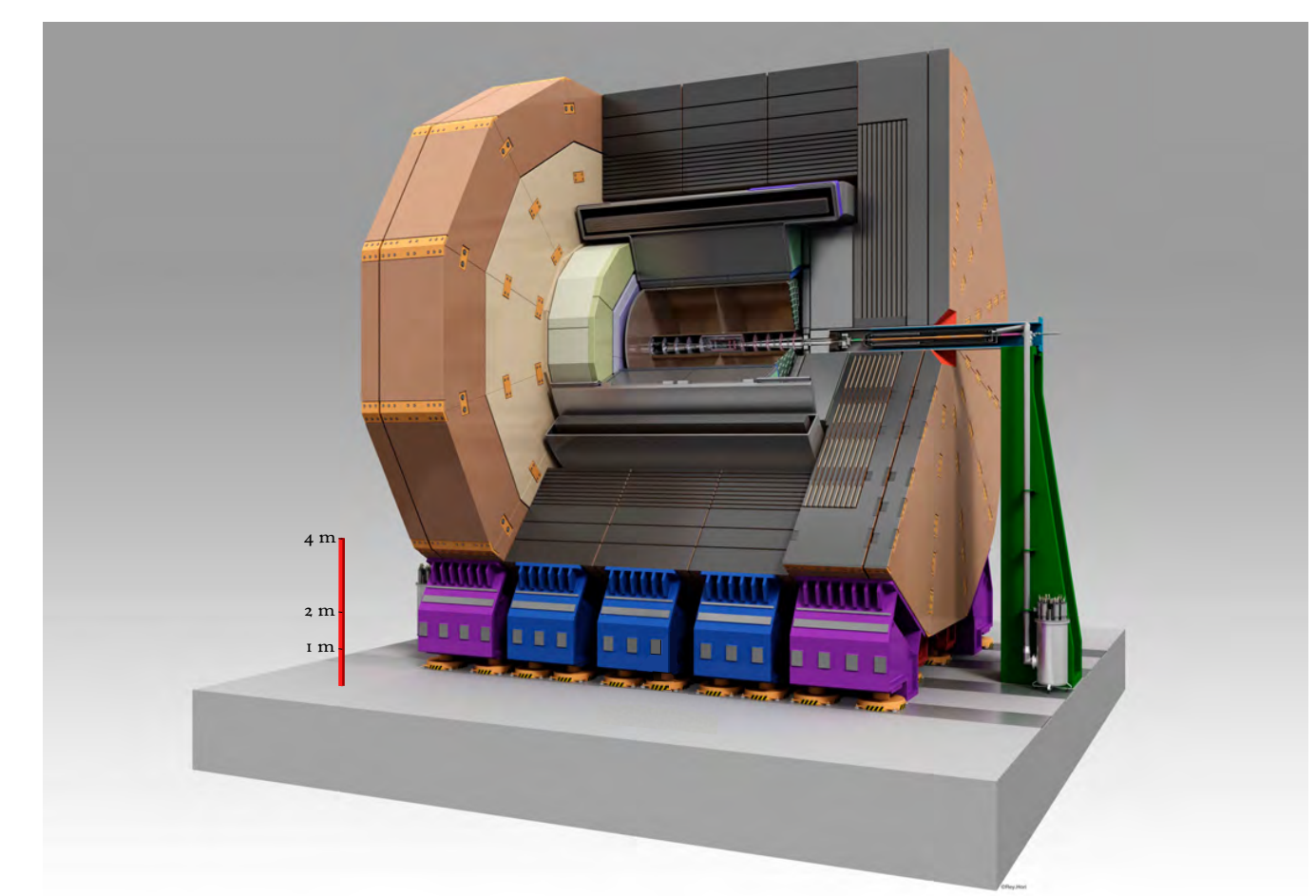
### 1. Event selection:

$$M_{\text{recoil}}^2 = s + M_Z^2 - 2\sqrt{s} \cdot E_Z$$

## Implementation

Full simulation study at  $\sqrt{s} = 250$  GeV (MC2020 ILD mass production).

- ▶  $\sqrt{s} = 250$  GeV ideal for the Higgsstrahlung process.
- ▶  $Z \rightarrow e^+e^-$  and  $Z \rightarrow \mu^+\mu^-$  as signal channels.
- ▶  $\geq 400k$  simulated events/Standard Model decay mode.
- ▶ Considered backgrounds: Standard model processes with 2 or 4 fermions in the final state.
- ▶ Polarized initial beams: 80% left(30% right) polarized electron (positron) beam.
- ▶  $2000 \text{ fb}^{-1}$  integrated luminosity.



## Results

These results show the expected/Standard Model values.  
The method works equally well for non-SM data.

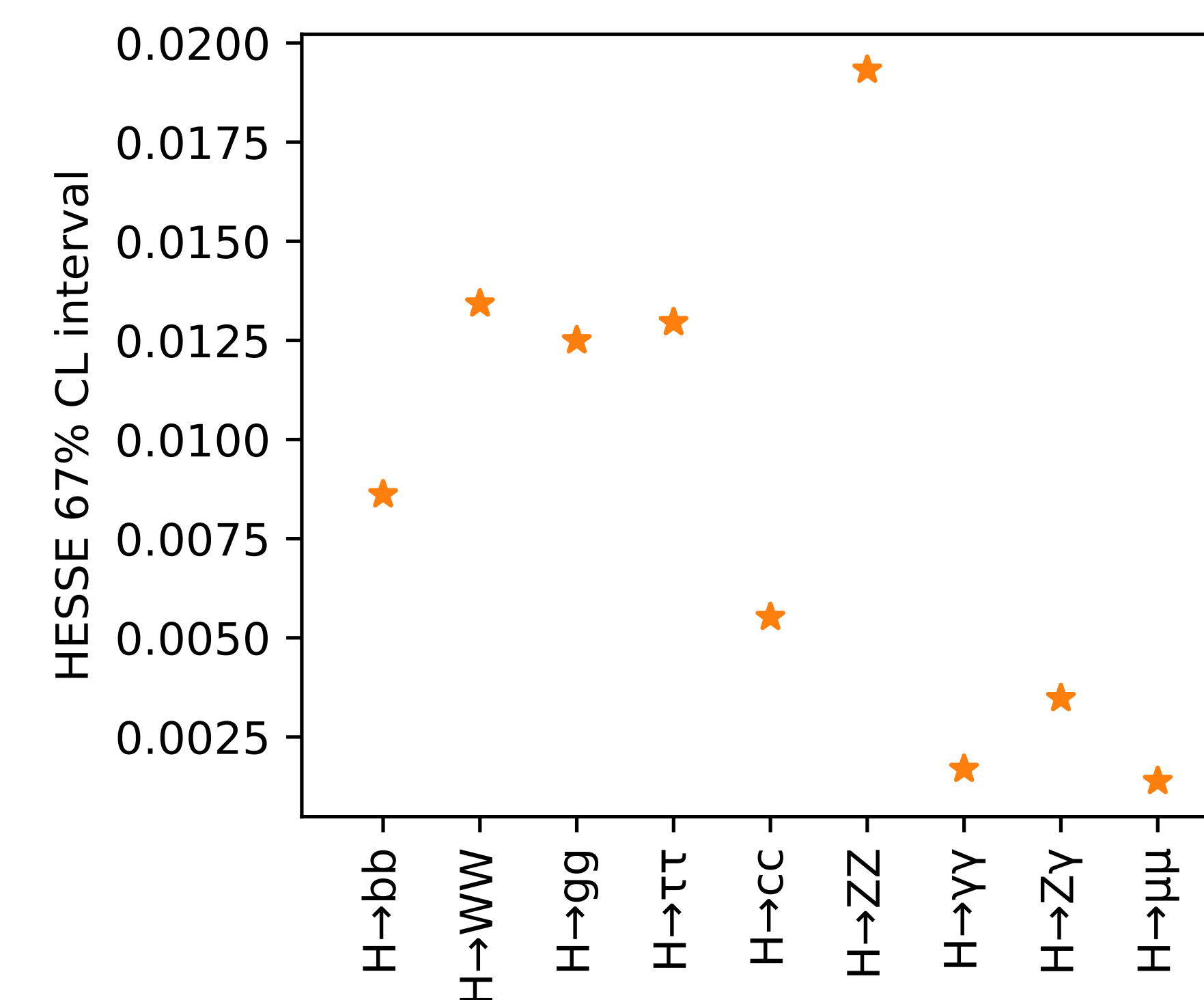
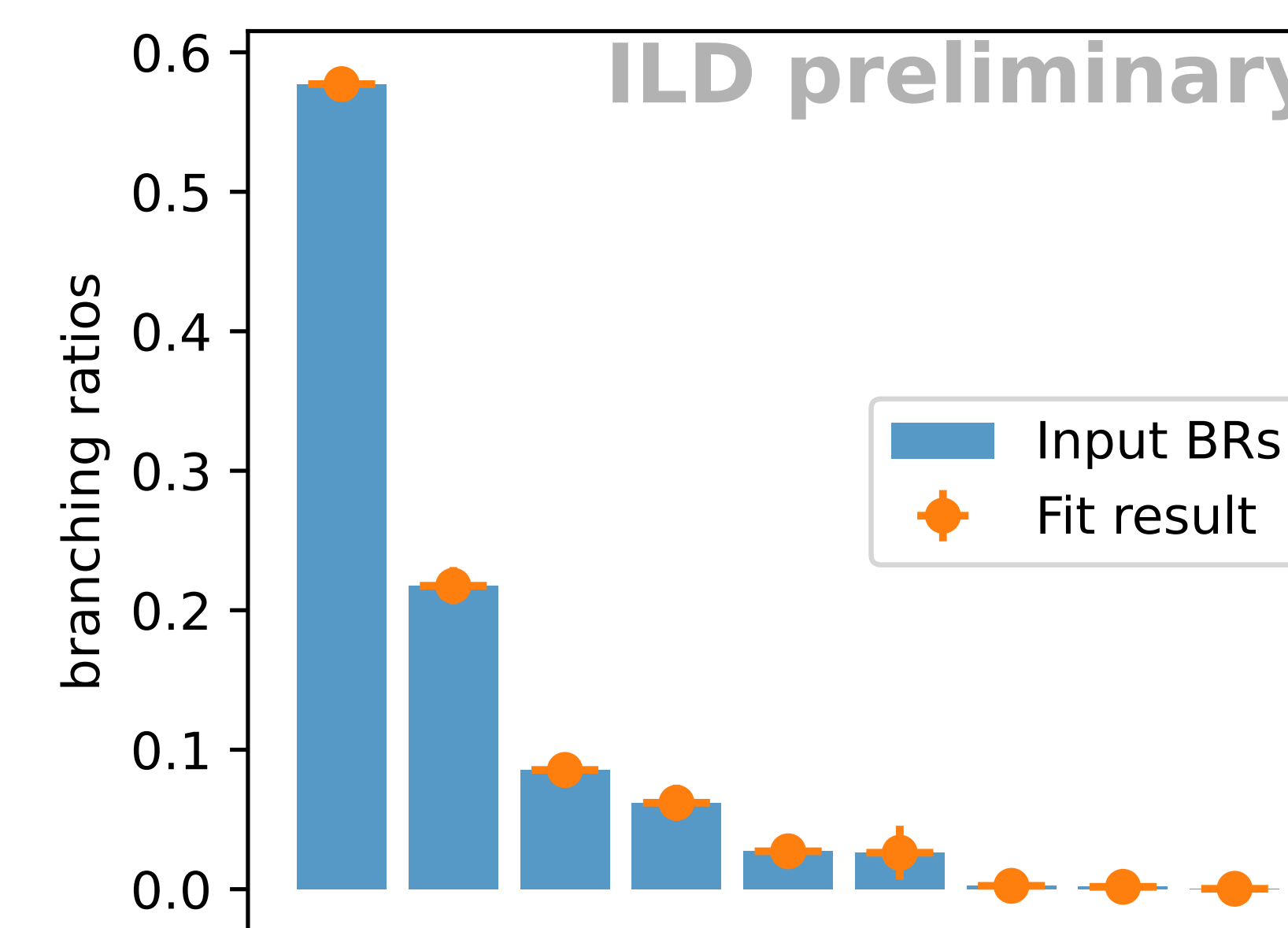


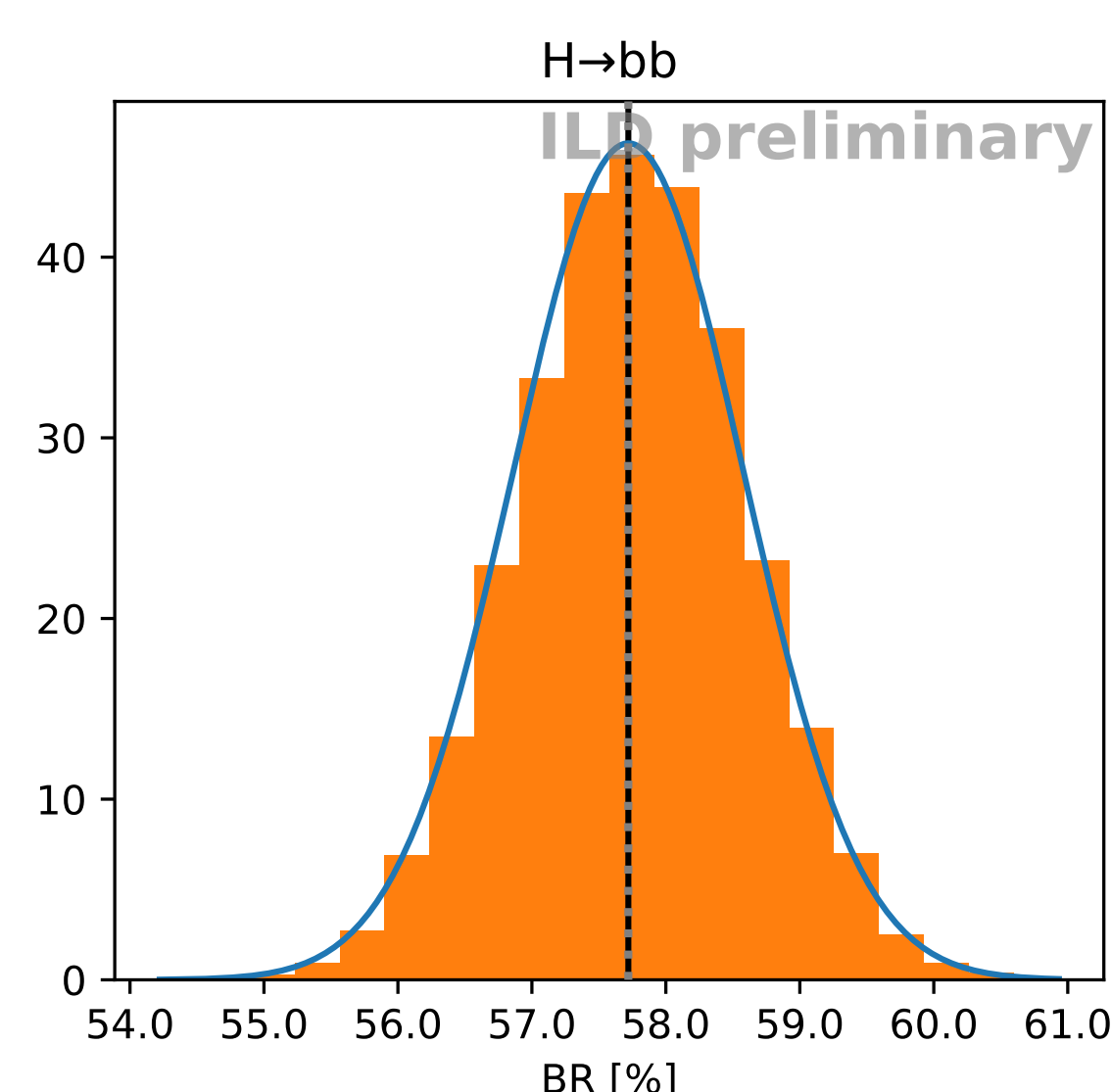
Figure 1: Higgs branching ratios and their uncertainty.

Correlations

H to bb	.196	.196	-.081	.022	-.475	-.001	.045	-.029
H to WW	-.196	-.220	-.533	-.060	-.269	.006	.014	-.005
H to gg	.196	-.220	.211	-.098	-.615	-.001	-.026	.049
H to tau tau	-.081	-.533	.211	-.053	-.132	-.034	-.077	.016
H to cc	.022	-.060	-.098	-.053	-.180	.004	-.003	.015
H to ZZ	-.475	-.269	-.615	-.132	-.180	.002	-.032	-.063
H to gamma gamma	-.001	.006	-.001	-.034	.004	.002	-.026	.000
H to Z gamma	-.045	.014	-.026	-.077	-.003	-.032	-.026	-.010
H to mu mu	-.029	-.005	.049	.016	.015	-.063	.000	-.010

Figure 2: Correlations from MINUIT multinomial likelihood minimization.

## Toy validation



Draw toys from Multinomial ( $N_{\text{data}}$  fixed). The histogram stores the  $H \rightarrow b\bar{b}$  branching ratio at the fit minimum. The distribution can be described by a Gaussian with mean and variance obtained from the fit on the expected event counts.

## References

- ▶ The International Linear Collider: [Technical Design Report](#) (2013).
- ▶ The International Large Detector: Interim Design Report: [arXiv:2003.01116](#).
- ▶ EPS-HEP 2021 [talk](#) and repository <https://github.com/LLR-ILD/EPS-HEP2021>.

	SM BR	$\sigma_{\text{stat}}$
$H \rightarrow b\bar{b}$	57.72	0.86
$H \rightarrow W\bar{W}$	21.76	1.34
$H \rightarrow g\bar{g}$	8.55	1.25
$H \rightarrow \tau\bar{\tau}$	6.20	1.30
$H \rightarrow c\bar{c}$	2.72	0.55
$H \rightarrow Z\bar{Z}$	2.62	1.93
$H \rightarrow \gamma\gamma$	0.24	0.17
$H \rightarrow Z\gamma$	0.17	0.35
$H \rightarrow \mu\bar{\mu}$	0.03	0.14

Table 1: Fit on the expected event counts. In percent. ILD preliminary.