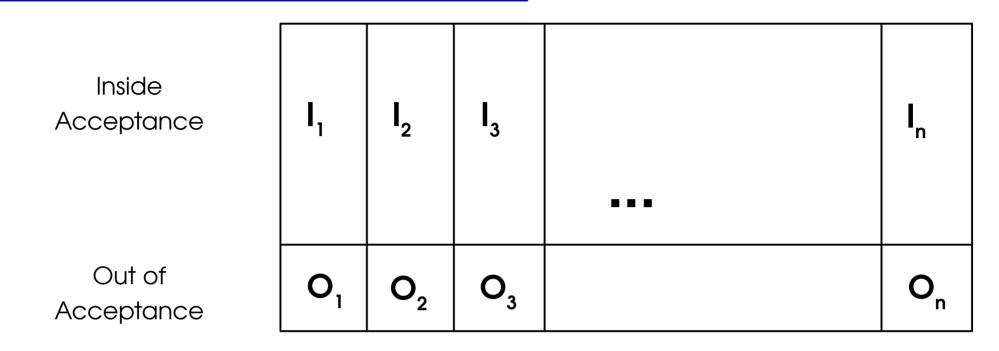
## **Out-of-Acceptance Treatment: Concept**



Measurement bins

There are 2n POIs (I<sub>i</sub> and O<sub>i</sub> for each measurement bin), but only n observables (the bin yield N<sub>i</sub>). So we need some assumption about the O<sub>i</sub> in order to measure the I<sub>i</sub> :

- **Option 1**: All the  $O_i$  are fully correlated to each other  $\Rightarrow$  all scale with a global O parameter not constrained by data, so fix to the SM.
- **Option 2**: Each  $O_i$  is fully correlated to the corresponding  $I_i$ .
- **Option 3**: All the O<sub>i</sub> are fully correlated to each other, and to  $\Sigma_i I_i$

## **Out-of-Acceptance: Math**

Measured bin yields are N\_i =  $\Sigma_j m_{ij} I_j + \Sigma_j f_{ij} O_j$  where

- $I_i = L \sigma_i^{fid}$ : Fiducial contribution
- $O_i = L.\sigma^{\text{out-of-fid}} = L(\sigma^{\text{tot}} \sigma^{\text{fid}})$ : Out-of-fiducial contribution
- $-m_{\mu}$ : migration coefficients for the fiducial contributions into reco bins
- $f_{ii}$ : contamination coefficients for non-fiducial contributions
- Option 1 : We assume  $O_i = \alpha_i O^{SM}$ , with  $\alpha_i = O_i^{SM}/O^{SM}$  taken from SM MC  $\Rightarrow N_i = \Sigma_j m_{ij} l_j + \Sigma_j f_{ij} \alpha_j O^{SM}$ 
  - **Option 2**: We assume  $O_i = \beta_i I_i$ , with  $\beta_i = O_i^{SM}/I_i^{SM}$  taken from SM MC  $\Rightarrow N_i = \Sigma_j (m_{ij} + \beta_i f_{ij}) I_j$
- Option 3 : We assume  $O_i = \gamma_i \Sigma_j I_j$ , with  $\gamma_i = O_i^{SM} / \Sigma_j I_j^{SM}$  taken from SM MC  $\Rightarrow N_i = \Sigma_j m_{ij} I_j + \Sigma_j f_{ij} \gamma_j \Sigma_k I_k = \Sigma_j (m_{ij} + \Sigma_k f_{ik} \gamma_k) I_j$

## What can go wrong

- Consider a 1-bin analysis with a spectacularly bad fiducial selection, m=0.1 and f=0.9  $\Rightarrow$  N = 0.1 I + 0.9 O; assume I<sub>SM</sub> ~ O<sub>SM</sub> and consider
  - **Case A**:  $I_{true} = I_{SM}$  and  $O_{true} = O_{SM}$
  - **Case B**:  $I_{true} = I_{SM}$  and  $O_{true} = 10 O_{SM}$
  - **Case C**:  $I_{true} = 10 I_{SM}$  and  $O_{true} = 10 O_{SM}$
- Option 1: N = 0.1 I + 0.9 O<sub>SM</sub>.
  - Case A
    - $I = (N 0.9 O_{SM})/0.1 = (0.1 I_{SM} + 0.9 O_{SM} 0.9 O_{SM})/0.1 = I_{SM} = I_{true}$  accurate
    - $\delta I = sqrt(N)/0.1$  : error larger due to low purity
  - Case B:  $I = I_{SM} + 81O_{SM} \sim 82 I_{true}$ , biased
  - Case C: I = 10 I<sub>SM</sub> + 81 O<sub>SM</sub> ~ 91 I<sub>true</sub> biased
  - **Option 2**: N =  $(0.1 + 0.9 O_{SM}/I_{SM})$  | (Option 3 is equivalent in this 1-bin case)
    - Case A:

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- $I = N/(0.1 + 0.9 O_{SM}/I_{SM}) = I_{SM} = I_{true}$  accurate
- $\delta I = sqrt(N)/(0.1 + 0.9 O_{SM}/I_{SM})$ , error ~ insensitive to purity
- **Case B**: I = (0.1  $I_{SM}$  + 9  $O_{SM}$ )/(0.1 + 0.9  $O_{SM}/I_{SM}$ ) ~10  $I_{true}$  biased
- Case C: I = (1  $I_{SM}$  + 9  $O_{SM}$ )/(0.1 + 0.9  $O_{SM}/I_{SM}$ ) =  $I_{true}$  accurate