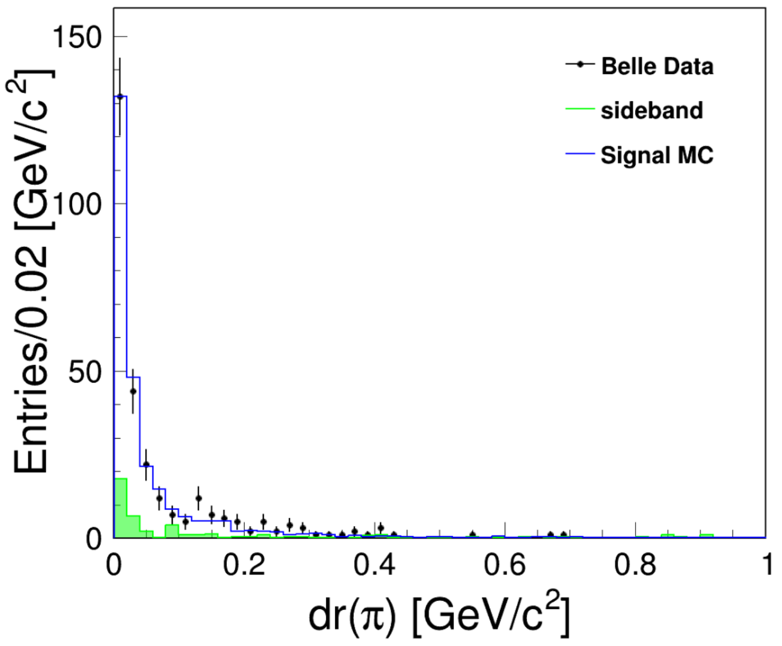
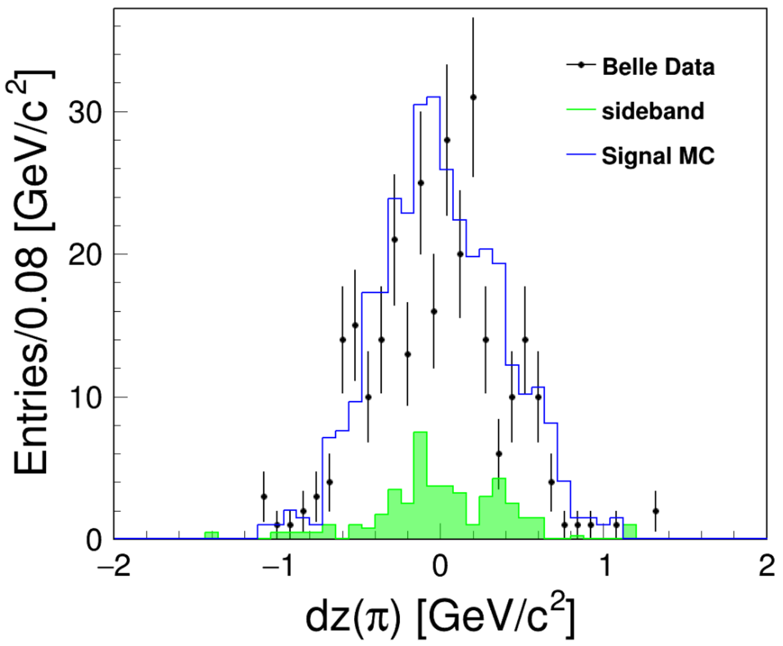
Group meeting

2025/03/28

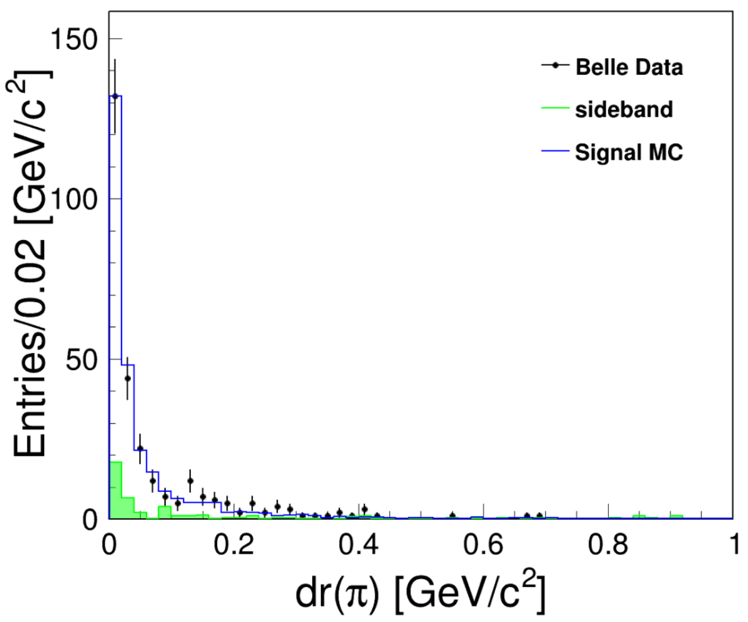
dr dz check



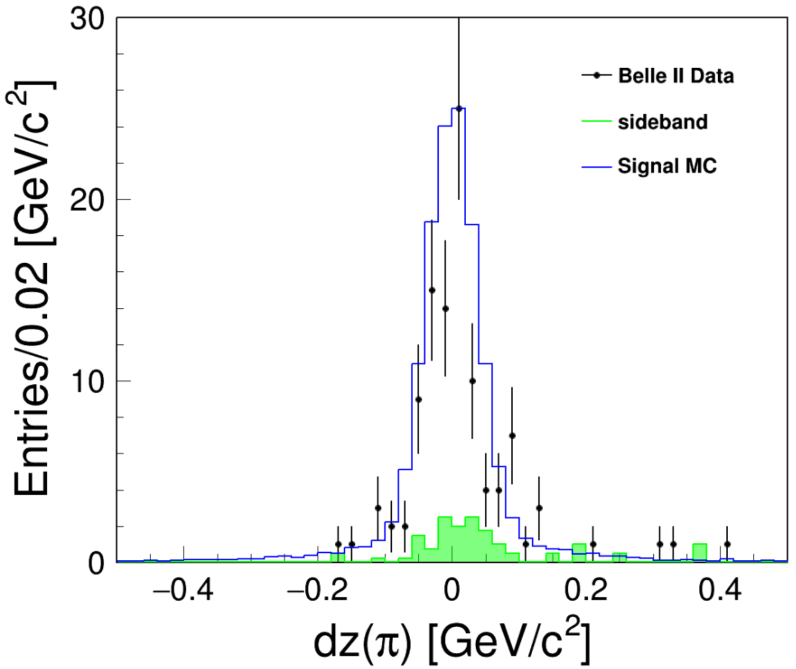
Belle Data
sideband
Signal MC
Entries/0.02 [GeV/c^2]
dr(π) [GeV/c^2]



Belle Data
sideband
Signal MC
Entries/0.08 [GeV/c^2]
dz(π) [GeV/c^2]



Belle Data
sideband
Signal MC
Entries/0.02 [GeV/c^2]
dr(π) [GeV/c^2]

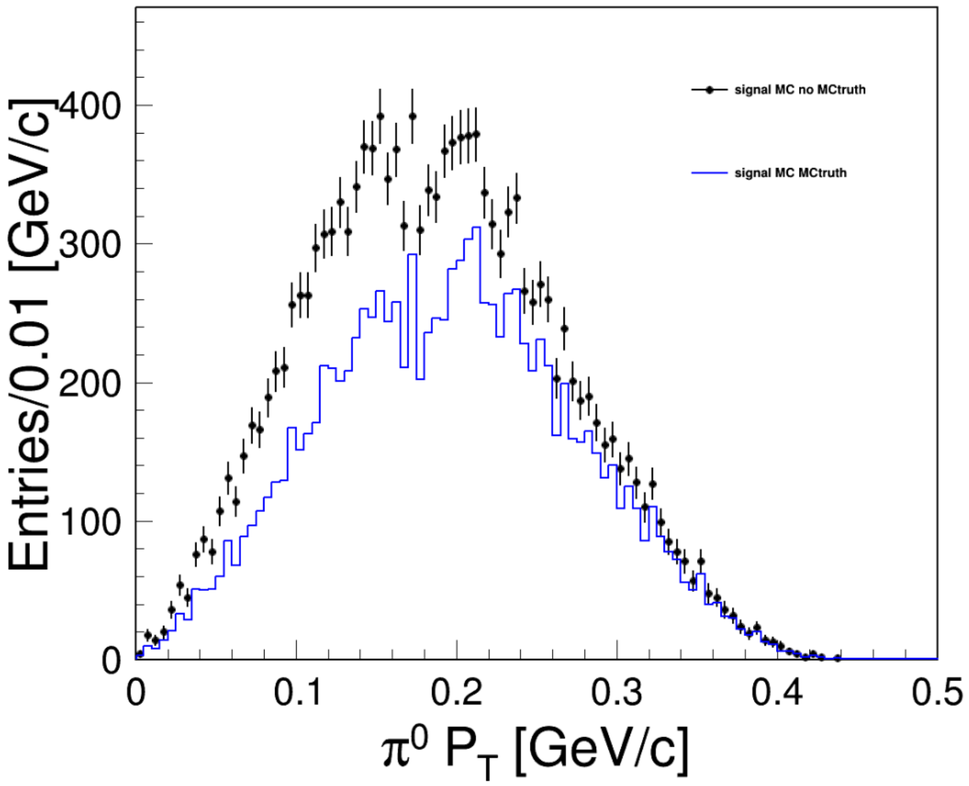


Belle II Data
sideband
Signal MC
Entries/0.02 [GeV/c^2]
dz(π) [GeV/c^2]

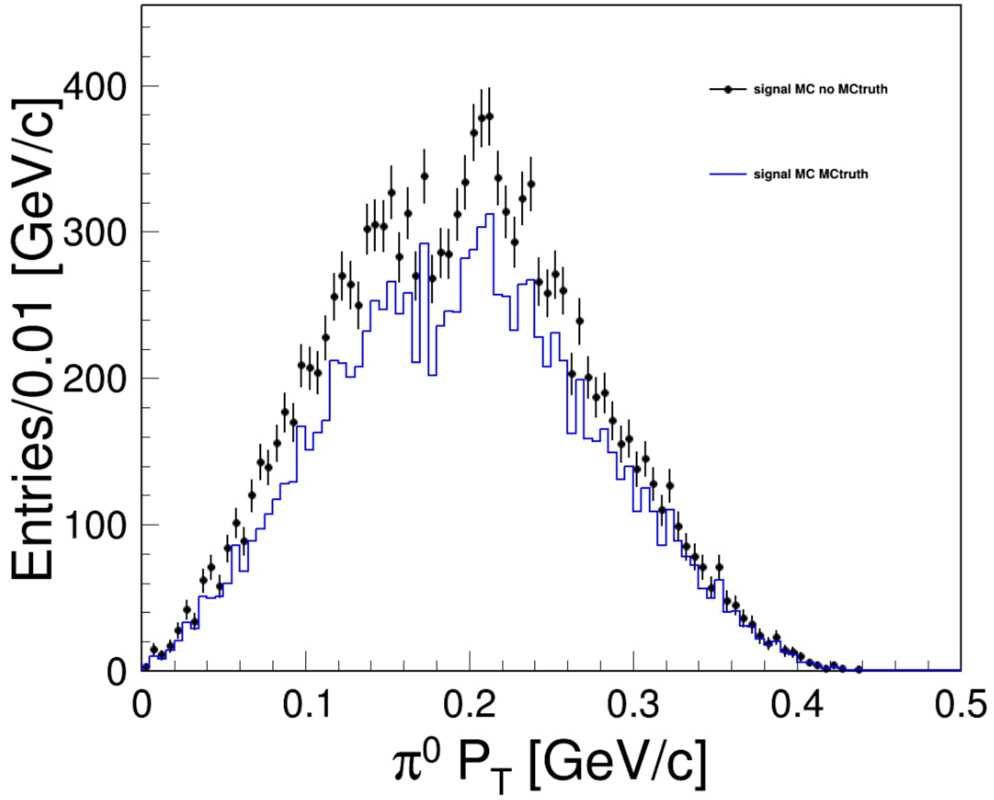
Best candidate selection

Preselect events → Pass all selection && pt < 0.2, rank by pi0 chi2

→ Pass all selection or pt > 0.2, rank= -100



Before

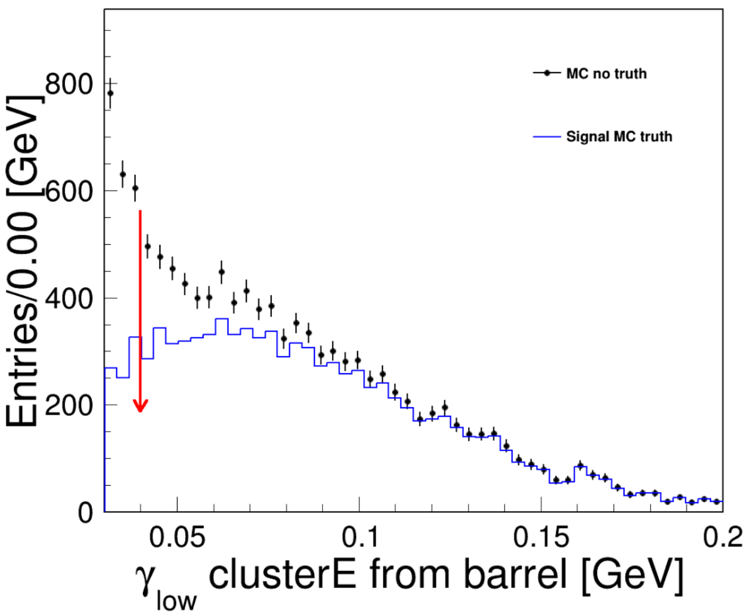


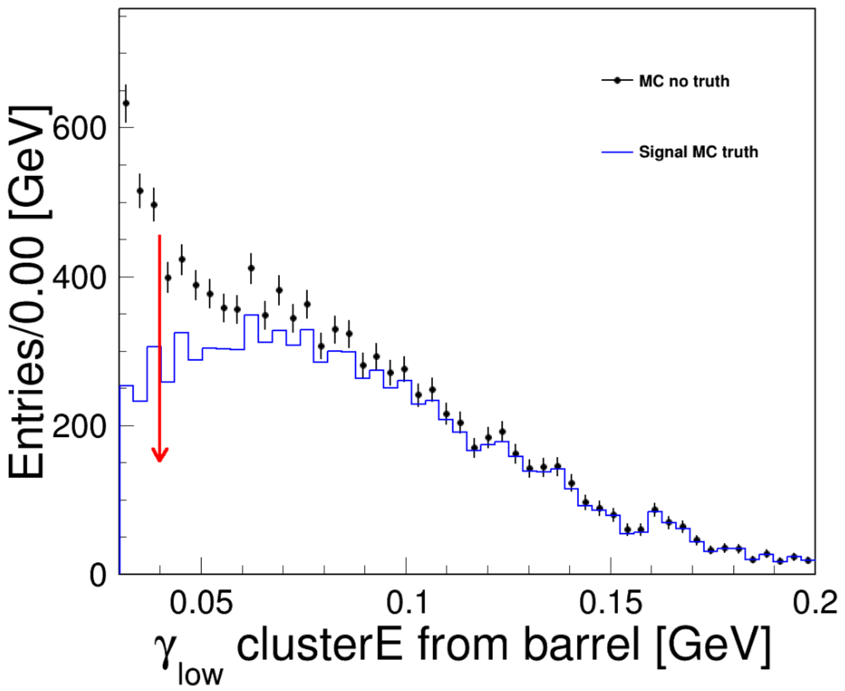
AFTER

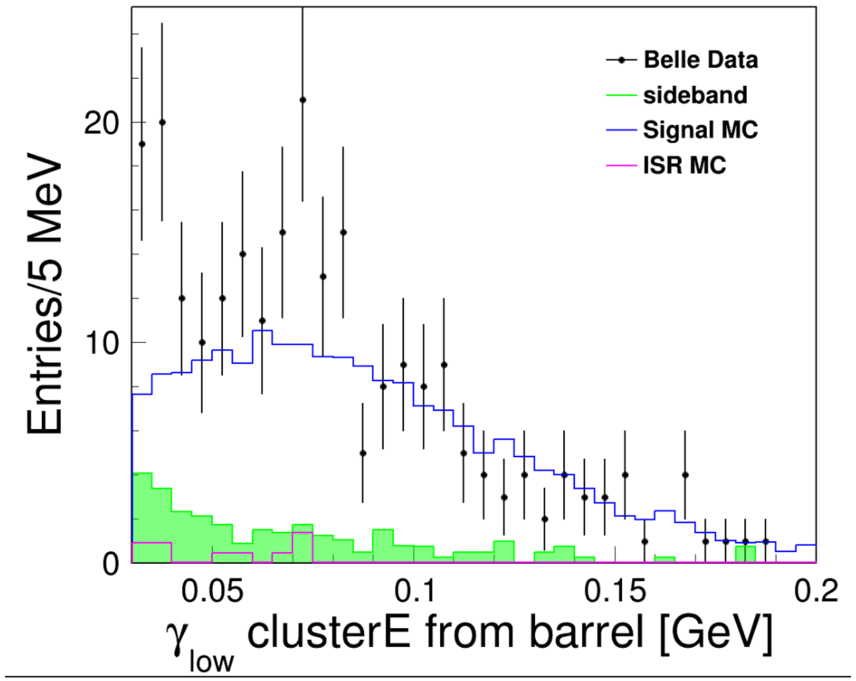
Efficiency: 96.2%

$\frac{S}{1.5+\sqrt{N}}: 172.5 \rightarrow 192.3$

Best candidate selection







NEXT TO DO: change pt select for pi0

Efficiency difference between Belle and Belle II:

TABLE II: Selection criteria and their efficiencies for $\gamma\gamma \to \omega\ J/\psi$ at Belle

Selection	Events remained	absolute efficiency (%)	relative efficiency (%)
Preselection	24323	12.16	-
π PID	23964	11.98	98.52
ℓ PID	23422	11.71	97.73
photon clusterE	23080	11.54	98.83
$\pi^0\chi^2$	20516	10.25	88.89
J/ψ mass window	18446	9.23	89.91
ω mass window	17459	8.72	94.64
$P_t^*(\pi^+\pi^-\pi^0\ell^+\ell^-)$	11846	5.92	67.85
$\mathrm{M}^2_{\mathrm{rec}}(\ell^+\ell^-\ \pi^+\pi^-)$	11677	5.84	98.57
$\mathrm{M}^2_{\mathrm{rec}}(\ell^+\ell^-\ \pi^+\pi^-)$	11074	5.53	94.83

TABLE III: Selection criteria and their efficiencies for $\gamma\gamma \to \omega\ J/\psi$ at Belle II

Selection	Events remained	absolute efficiency (%)	relative efficiency (%)
Preselection	41624	20.81	-
π PID	40467	20.23	97.22
ℓ PID	38329	19.16	94.71
J/ψ mass window	34178	17.09	89.17
ω mass window	31790	15.89	93.01
$P_t^*(\pi^+\pi^-\pi^0\ell^+\ell^-)$	21361	10.68	67.19
$\mathrm{M}^2_{\mathrm{rec}}(\ell^+\ell^-\ \pi^+\pi^-)$	21045	10.52	98.52
$\mathrm{M}^2_{\mathrm{rec}}(\ell^+\ell^-\ \pi^+\pi^-)$	20340	10.17	96.65

B1 B2 consistent:
B1: 247 events from 980fb
B2 expected from B1: 169 events
B2 real :110 events

TREPS

Currently use:

$\gamma\gamma \to X,\ \ X \to \omega J/\psi$ (TREPS) (mode 202)

$J/\psi \to \ell^+\ell^-, \ell = e/\mu, \omega \to \pi^+\pi^-\pi^0$ (EVTGEN)

Problems:
202 for 2+ -> PP not VV
角分布有误，进而影响探测效率

MODEL 404：无抽样

```
if (_npart == 4 && TrepsB::pmodel >= 401  && TrepsB::pmodel <= 499) {

  int index1 = 0, index2 = 1, index3 = 2, index4 = 3;
  double z, m12, zp, phip, zs, phis, m34, zpp, phipp, zss, phiss, phi0;

  tpkin4(part,
         index1, index2, index3, index4, z, m12, zp,
         phip, zs, phis, m34, zpp, phipp, zss, phiss, phi0) ;

}
```

```
5. Physics Models
PhysicsModel =
0: General, isotropic(phase space)
201: 2+(0) --> PP
202: 2+(2) --> PP
251: pi+pi-  (fit to experimental angular distributions)
252: K+K-  (fit to experimental angular distributions)
253: ppbar fit to experimental angular distributions)
301: 0- -> VP -> 3P
302: 2+(0) -> VP -> 3P
303: 2+(2) -> VP -> 3P
304: 0- -> TP -> 3P
305: 2+(0) -> TP -> 3P
306: 2+(2) -> TP -> 3P
307: 2- -> SP -> 3P
308: 2- -> VP -> 3P
309: 2- -> TP -> 3P
331: 2+(0) -> VP -> PgP  (g is a photon)
332: 2+(2) -> VP -> PgP
333: 0+/- -> Vg -> PPg
334: 0+ -> Vg (E1) --> llg
335: 2+(0) -> Vg (E1) --> llg
336: 2+(2) -> Vg (E1) --> llg
```

TREPS

1.产生$\gamma\gamma$质心系动量

2.产生各级子粒子动量（PHSP）

3.用各级子粒子动量，计算角分布，进行舍选抽样

目标函数通过计算不同Helicity下对应的角分布得到

$X \rightarrow \omega J/\psi$， $2^{++} \rightarrow 1^{--}1^{--}$, 取 X Helicity = 0

末态有 4种helicity combination：
(+1, +1), (+1, 0), (+1, -1), (0, 0).

BASF old TREPS
SEEMS NO COMBINE ,NEED TO CALCULATE

末态包括omega Dalitz JPSI VLL 似乎未考虑

```
tpkin5( part, 0,1,2,3,4, z, m12, zp,
    phip, zs, phis, ps3, ps4, ps5, phi0, zss, phiss  );
```

```
Hep3Vector omegaj = ps3.cross(ps4);
double zpp = abs(omegaj.z())/omegaj.mag();
double phipp = omegaj.phi();

double wei=0, weimax = 9999.;

if( 0 ){
  // JP=2+, lambda=2
  wei = (1.+zp*zp)*omegaj.mag2()*(1.-zpp*zpp);
  weimax = pow(0.782,4)/6.;
}
if( 0 ){
  // JP=0+
    wei = (1.-(1.-zp*zp)*pow(cos(phip-phipp),2))*(1.-zpp*zpp)
    + (1.-zp*zp)*zpp*zpp;
    wei = wei*omegaj.mag2();
    weimax = pow(0.782,4)/6.;
}
if( 0 ){
  // JP=0-
  wei = (1.-z*z)*(1.-zp*zp+2.*zp*zp*zpp*zpp)
    + 2.*z*z*(1.-zpp*zpp)*(1.-(1.-zp*zp)*pow(sin(phip-phipp),2));
  wei = wei*omegaj.mag2();
  weimax =  pow(0.782,4)/12.*5.;
}

  if( 1 ){
//phase space
 wei = 1.001;
 weimax = 1.;
  }
```

TREPS

目前解决方法:
1. 先将BASF TREPS 中OMEGA JPSI pmode 移植到BASF2上
2. 计算该过程整体角分布，添加到TREPS中。
3. 尝试在BASF2 中添加 MODE： $\gamma\gamma \rightarrow X$ 将X的信息传递到EVTGEN中，用HELAMP处理后续

A.12 HELAMP

Author: Ryd
Usage:

```
BrFr M D1 D2 HELAMP Amplitudes;
```

Explanation:
This model allows simulation of any two body decay by specifying the helicity amplitudes for the final state particles. The helicity amplitudes are complex numbers specified as pairs of magnitude and phase. The amplitudes are ordered, starting by the highest allowed helicity for the first particle. For a fixed helicity of the first particle the amplitudes are then specified starting with the highest allowed helicity of the second particle. This means that the helicities $H_{\lambda_1\lambda_2}$ are ordered first according the the value of λ_1 and then the value of λ_2.

Example:

Decay of $B^0 - > D^*\rho$,

```
Decay B+
1.000   anti-D*0  rho+          HELAMP 0.228 0.95 0.283 1.13 0.932 0;
Enddecay
```