

GamGam Two Photon Generator

J Boyd

Introduction

- GamGam can generate exclusive gamma gamma decay modes (either continuum or through resonances)
- Has been integrated into the BaBar generator framework for some time but really only been used for Benjamins

$\gamma\gamma \rightarrow \eta_C \rightarrow K_s K \pi$ analysis

- Package co-ordinator has changed from B Mayer to me (J Boyd)
- Will Roethel has expressed some interest in working on putting some small improvements into the generator
- BaBar activity in 2 photon analysis has increased in last few months (looking at $\gamma\gamma \rightarrow 2\text{tracks}$, $\pi^0\pi^0$ as well as resonance structure (η_C , χ_C))

Things that work...

- Can generate $\gamma\gamma \rightarrow \eta_c$ (& various other resonances χ_c ...)
 - $\eta_c \rightarrow Ks K \pi$ is only mode that has really been validated at the analysis level
- And $\gamma\gamma \rightarrow \pi\pi, \mu\mu, p\bar{p}$...
- Full list can be seen in `GenFwkInt/GfiGamGam.cc`
- Can not generate inclusive gamma gamma decays (which would be nice for background studies)

Things that don't work & difficulties

- I have had problems generating $\gamma \gamma \rightarrow e^+ e^-$ and $\gamma \gamma \rightarrow \pi^0 \pi^0$ (continuum) MC
- I will look into why these don't work as I want to use both of these for my analysis (Will Roethel may have fixed $\pi^0 \pi^0$ problem)
- Gautier has found a bug in the vertex of the e^+e^- pair after the gamma gamma reaction - which I am going to investigate (probably not immediately)
- There are many parameters which have to be set right for stuff to work (random seed and weight)
 - If these are set too high the jobs run very slow
 - If set too low the job crashes (or results are compromised)
 - I usually optimize using GeneratorsQA before running a Moose job
 - Bad for running in production...
- $K_s \rightarrow \pi^+ \pi^- / \pi^0 \pi^0$ etc.. Can we use generator level filter to choose one of these?
- Unclear if the cross-section the generator give is reliable
 - need to do a study to see if generated cross-section * acceptance & reco efficiency – background = number of events we see

Things which will be improved

- Will Roethel is adding a host of new decay modes for η_c (for his & Gautiers analysis) modes are
 - $K^+ K^- \pi^0$, $K_s K_s \pi^0$, $\eta \pi^+ \pi^-$, $\eta K^+ K^-$, $\eta' \pi^+ \pi^-$, $\eta' K^+ K^-$, $\pi^+ \pi^- \pi^+ \pi^-$, $K^+ \pi^- K^- \pi^+$, $K^+ K^- K^- K^+$, $p \bar{p}$, $\lambda \bar{\lambda}$, $\omega \bar{\omega}$ (here we look at $\eta \rightarrow \gamma \gamma$, $\eta' \rightarrow \rho \gamma$ or $\eta \pi^+ \pi^-$)
- I am adding some 'pentaquark' decay modes
 - $p K_s \bar{p} K_l$, $p K_s n K^-$, ...
- Will is looking into replacing old random number generators with new cernlib ones

Things which should be fixed but wont be (yet)

- Adding new decay modes is a lot of hassle
 - Have to change 2 packages (gamgam & GenFwkInt) and have to hardcode masses / widths inside gamgam
- Gamgam uses different resonance params from other generators (ie. If change etaC width in babar MC it wont change in gamgam)
- At the moment making Ks decay to only pi+pi- is difficult

Conclusions

- Gamgam is ok for generating some exclusive 2photon decay modes
- Some work (adding modes / tidying up stuff) is going to be done by Will Roethel and myself in the near future
- There are some useful things which should be done but wont (by us) of course volunteers would be welcome to do this
- 2 photon physics effort is increasing in BaBar so this generator will be used more often and in different ways than previously
- There has been talk of trying to get an inclusive 2photon generator going – this would probably be very useful for some analyses
 - Possible generators: Herwig or Pythia (?)
- Havent had a chance to do any real data MC comparisons but will do sometime soon (when we have looked at the data in detail)