The JBDK Package

Yet Another Event Generator Java Interface

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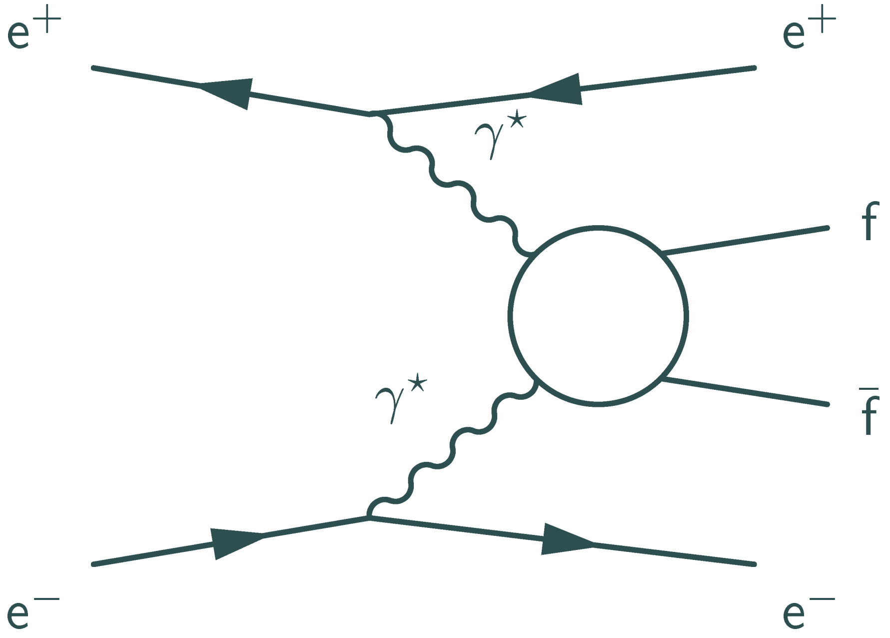
Outline

- Two-photon events in e^+e^- collisions
- The BDK two-photon event generator
- The Java interface
- Status
- Outlook

Two-photon Events in e^+e^- Collisions

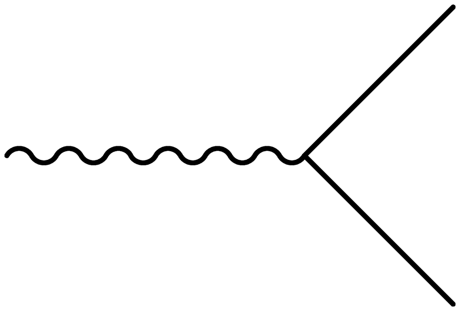
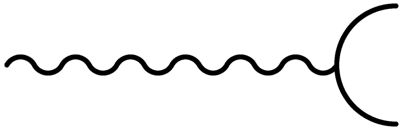
- in the following I will talk about:



- an apparently simple interaction, but . . .

The Nature of Two-photon Interactions

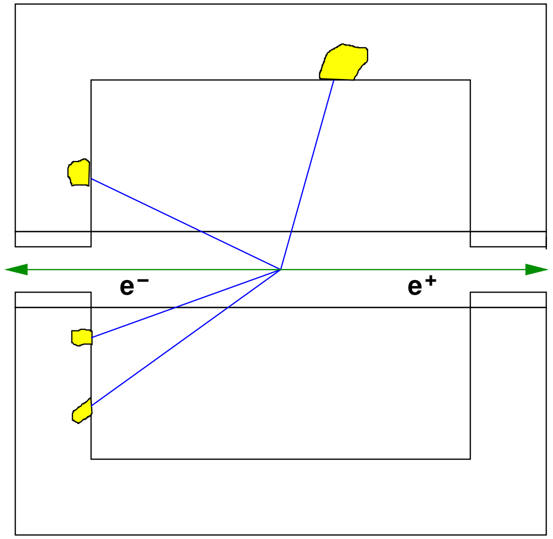
- the photon can interact in several ways:

direct	resolved	
γ	$\gamma \rightarrow$ ff	$\gamma \rightarrow V(J^{CP} = 1^{--})$
bare	point-like	hadron-like
		

- each process requires a theoretical description of its own
- unsurprisingly, there are several two-photon generators on the market (and are needed), each covering another part of the two-photon interaction phase-space

Two-photon Events at the NLC

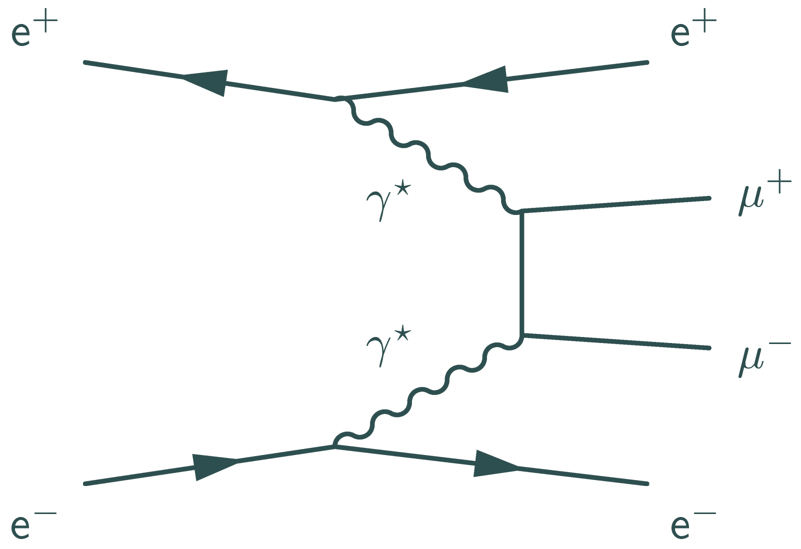
- event signature of a two-photon interaction:
  - ➜ little detector activity
  - ➜ **missing energy** (beam electrons), oops. . .



- despite the fact that two-photon interactions are of interest (photon structure) . . .
- . . . these events might also be a severe background
- need for tools to study them is obvious

Introduction to BDK

- there are quite a few two-photon event generators on the market (partly highly specialized)
- the **BDK** generator (by Berends, Daverveldt, Kleiss)
  - ➜ describes only the QED part of the two-photon interaction,
  - ➜ was written for the muon pair final state:



- BDK takes higher order corrections into account (**initial state radiation**)
- unique in that sense

More on BDK

- details of the program can be found at
  - F.A. Berends, P.H. Daverveldt, and R. Kleiss; Monte Carlo Simulation Of Two-photon Processes. 1. Radiative Corrections to Multiperipheral $e^+e^-\mu^+\mu^-$ Production"; Comput. Phys. Commun. 40, **1986**, 271-284.
  - F.A. Berends, P.H. Daverveldt, and R. Kleiss; Monte Carlo Simulation of Two-photon Processes. 2. Complete Lowest Order Calculations for Four Lepton Production Processes in Electron Positron Collisions; Comput. Phys. Commun. 40, **1986**, 285-307.
  - F.A. Berends, P.H. Daverveldt, and R. Kleiss; Monte Carlo Simulation of Two-Photon Processes. 3. Complete Lowest Order Calculations for $e^+e^- \to e^+e^-\mu^+\mu^-$ with Large Angle Tagging Conditions; Comput. Phys. Commun. 40, **1986**, 309-326.
- BDK is written in `FORTRAN`

Mission Statement

- BDK is a nice alternative/cross check to event generators already been used within the NLC community

- we do not want to go back and lose benefits of our existing analysis tools (mainly OO based)

- as long as there is no modern BDK version, an interim solution is needed: e.g. a **Java interface to BDK**

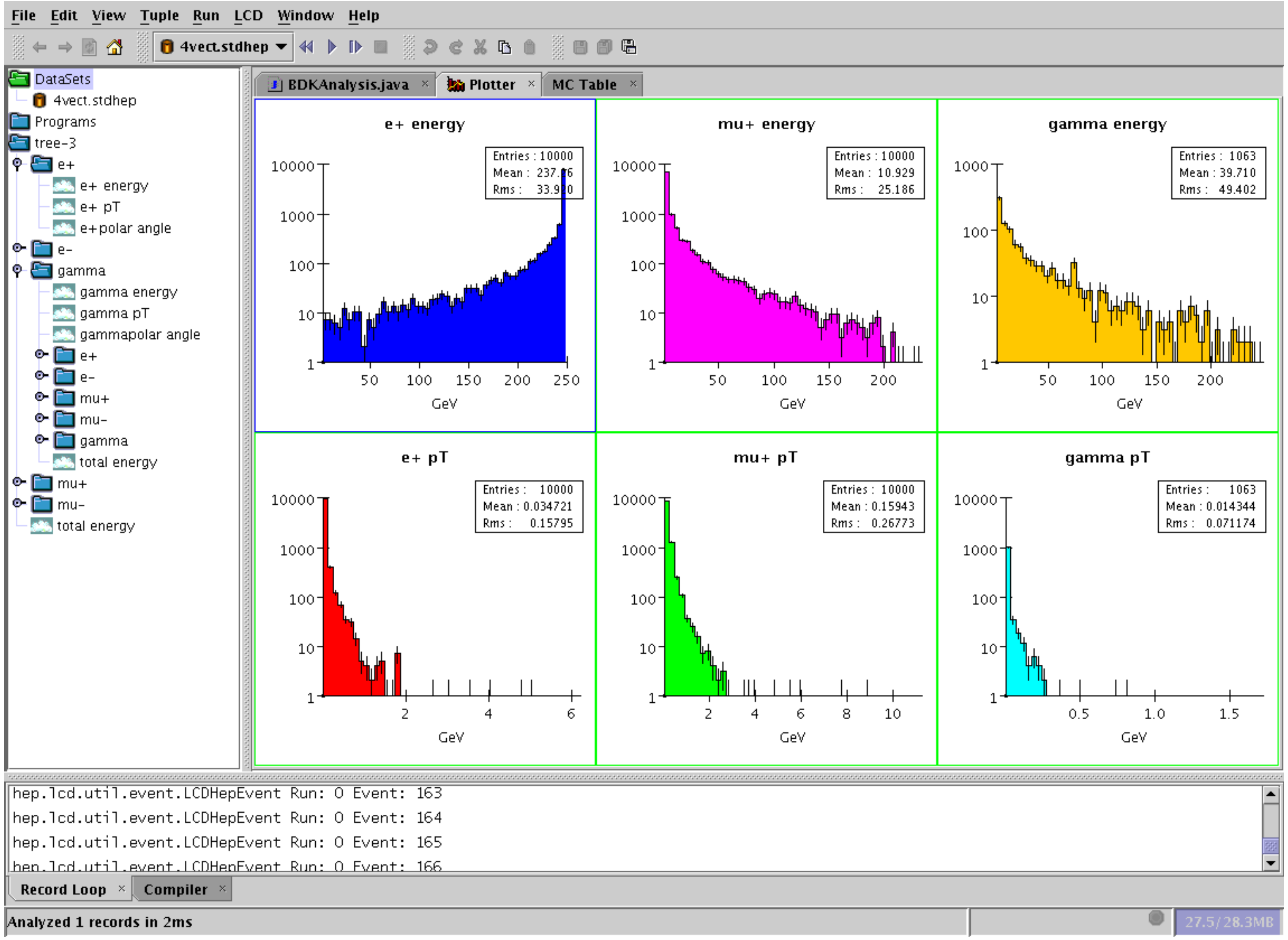
The JBDK Package

- the **JBDK package** contains everything to run the BDK program
- main component is the `BDKDriver` class, which can be used to configure and steer the program flow:

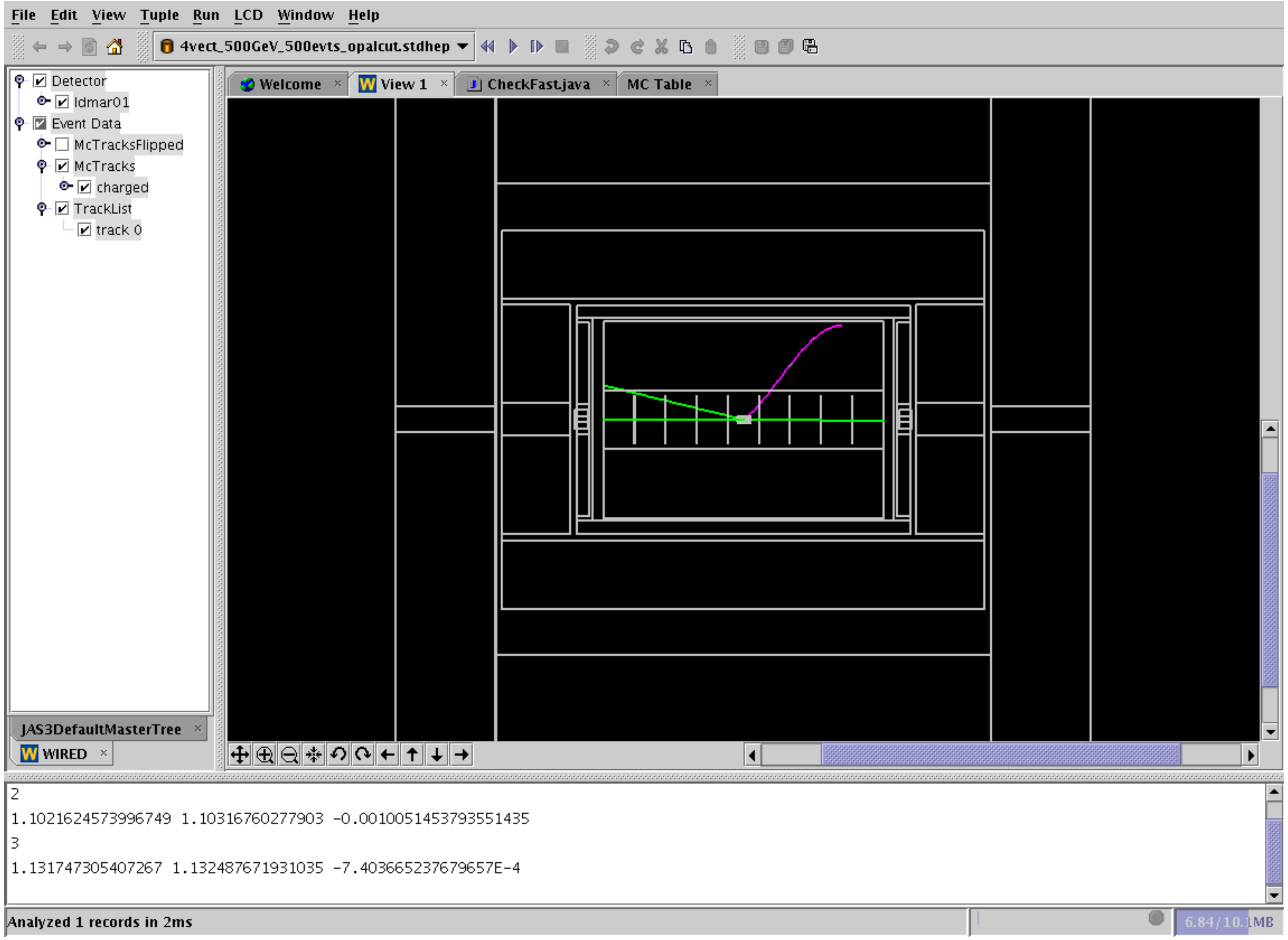
```
BDKDriver driver = new BDKDriver();
driver.job.setBeamEnergy(250.0);
driver.job.setNumberOfEvents(10000);
driver.job.setFirstEvent(1);
driver.job.setSeed(16072003);
...
driver.startBDK();
```

- the output contains two files: a log file and a 4vector file in stdhep format

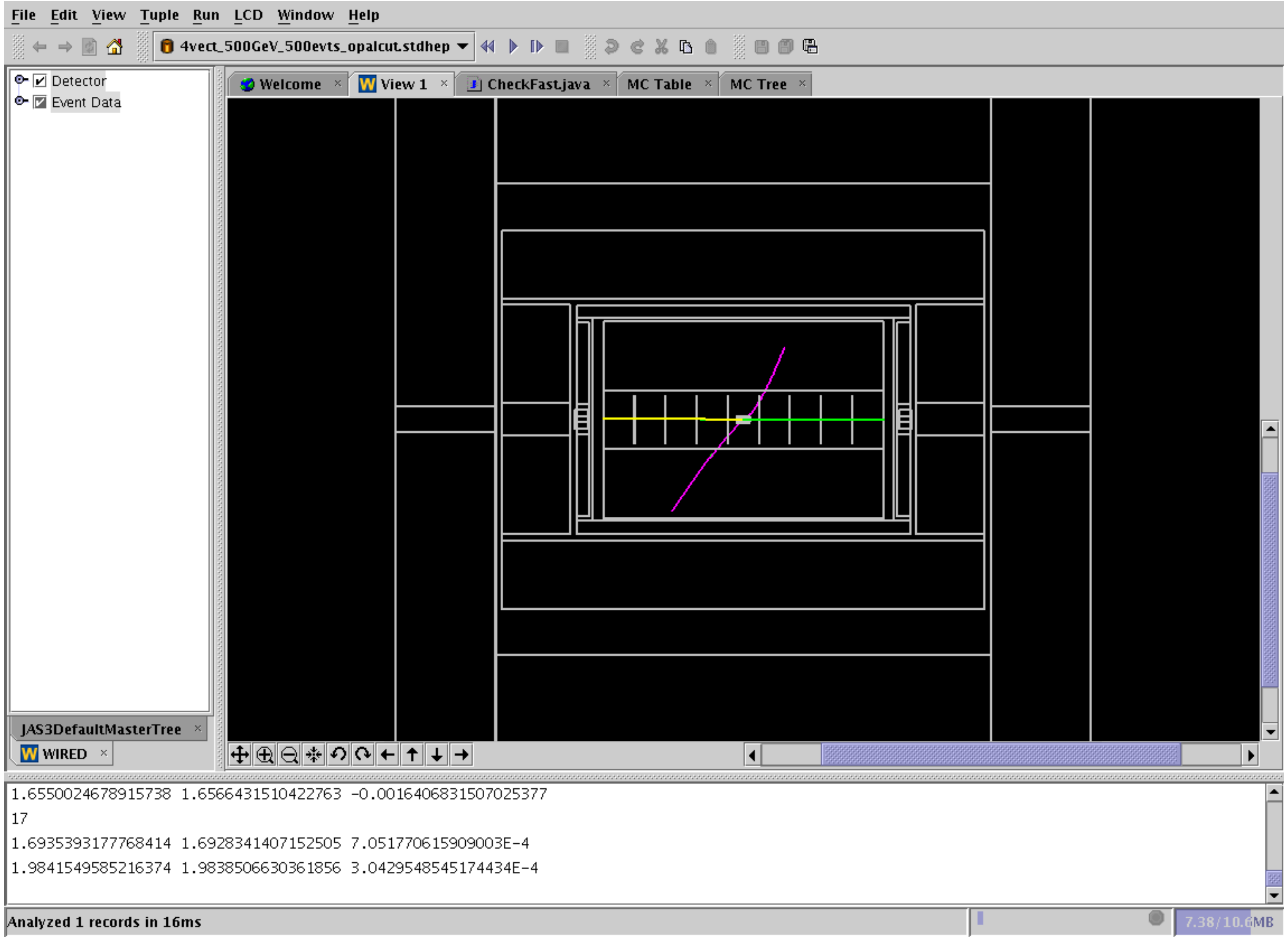
BDK Events Analyzed with JAS3



BDK Events and MCFast + WIRED



BDK Events and FastMC + WIRED



The JBDK Status

- JBDK version 0.5 is available
- it runs as a stand-alone application
- all basic features of BDK can be used/steered

Plans

- package needs to be documented
- want lo let it run from within the JAS3 framework
- add option for cuts on detector level
- crossing angle not taken into account so far: add option for event boost

Summary

- two-photon events are a rich source of physics programs (and nuisance)
- process should not be excluded from the NLC studies
- BDK - a rather 'old fashioned' event generator for $e^+e^- \to e^+e^- \, (\gamma)\gamma^\star\gamma^\star \to e^+e^- \, (\gamma) \, \mu^+\mu^-$ events
- the JBDK interface can now be used to benefit from BDK from within OO analysis tools
- **a new old two-photon event generator is available for physics studies, background estimations or simply as a cross check**