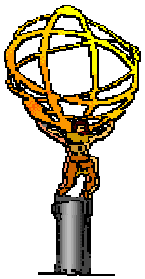
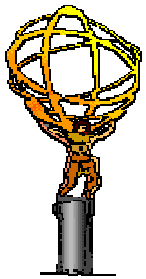


First Test of EvtGen in ATHENA

James R Catmore (Lancaster, UK)

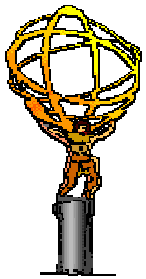
Maria Smizanska (Lancaster, UK)

Malte Muller (University College London, UK)



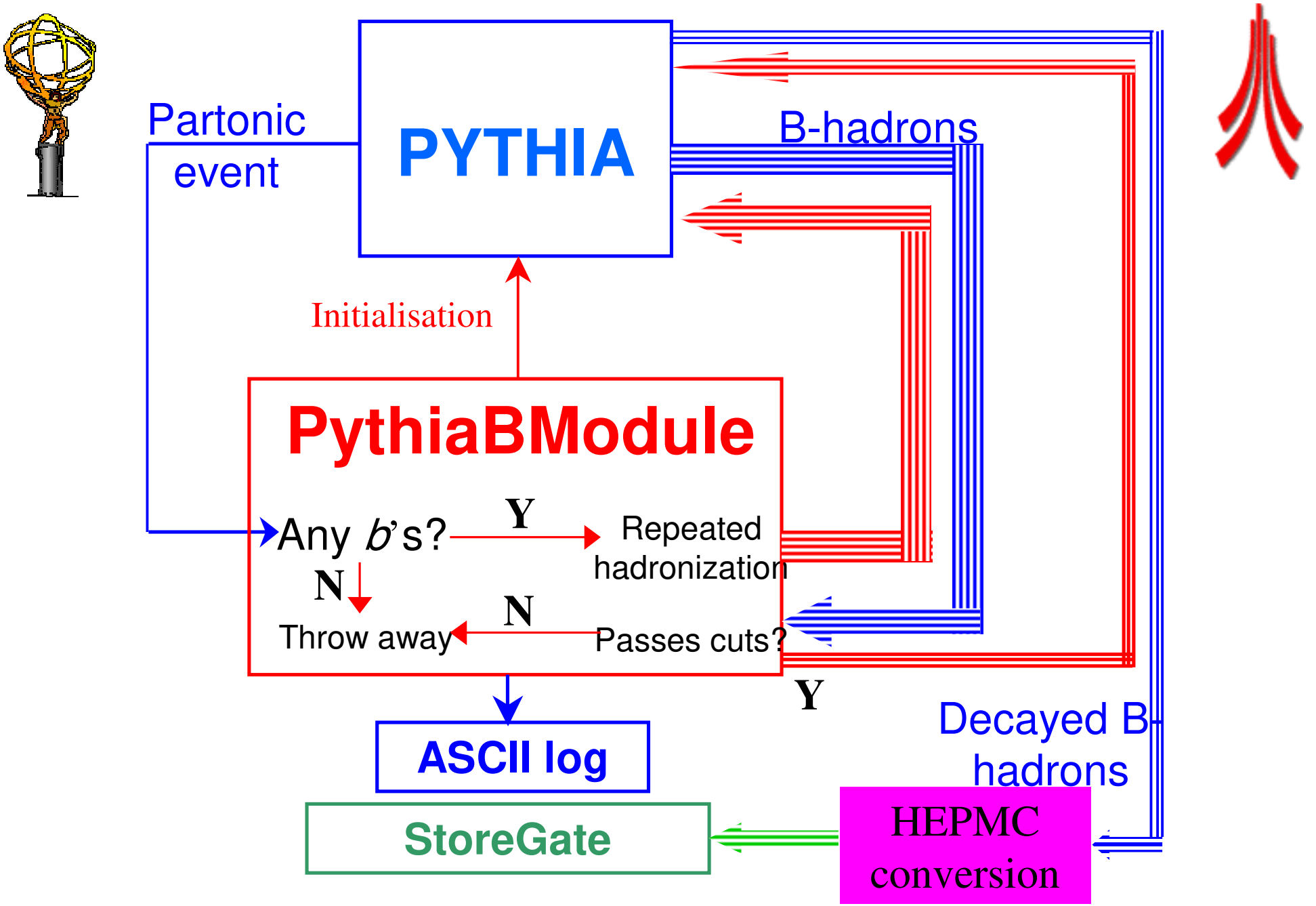
Contents

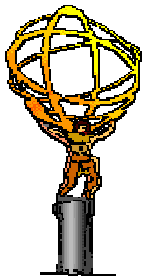
- Current methodology for B-meson decay simulation in ATHENA
- Integrating EvtGen into ATHENA
- First results



Current Methodology

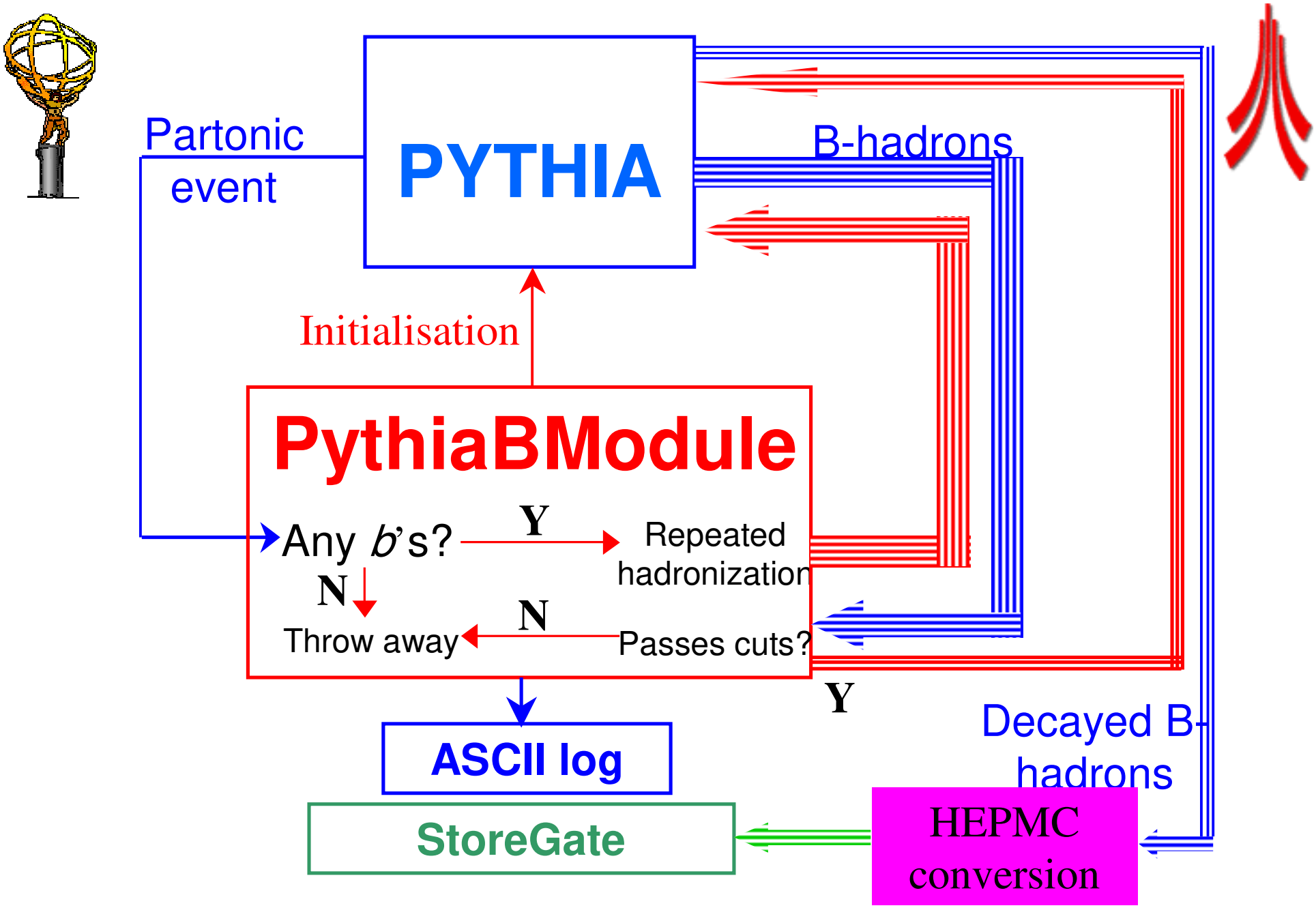
- **Generate partonic events using PYTHIA**
- **Passed to PythiaBModule (M. Smizanska)**
  - **Checked for b-quarks**
  - **If found, passed back to Pythia for hadronization**
    - **Each b-event is *repeatedly* hadronized to save CPU time**
- **Hadrons from PYTHIA checked for the desired mother particles**
  - **If found and if they pass the appropriate cuts, passed back to PYTHIA for decay**
- **Results converted to HepMC format and displayed**

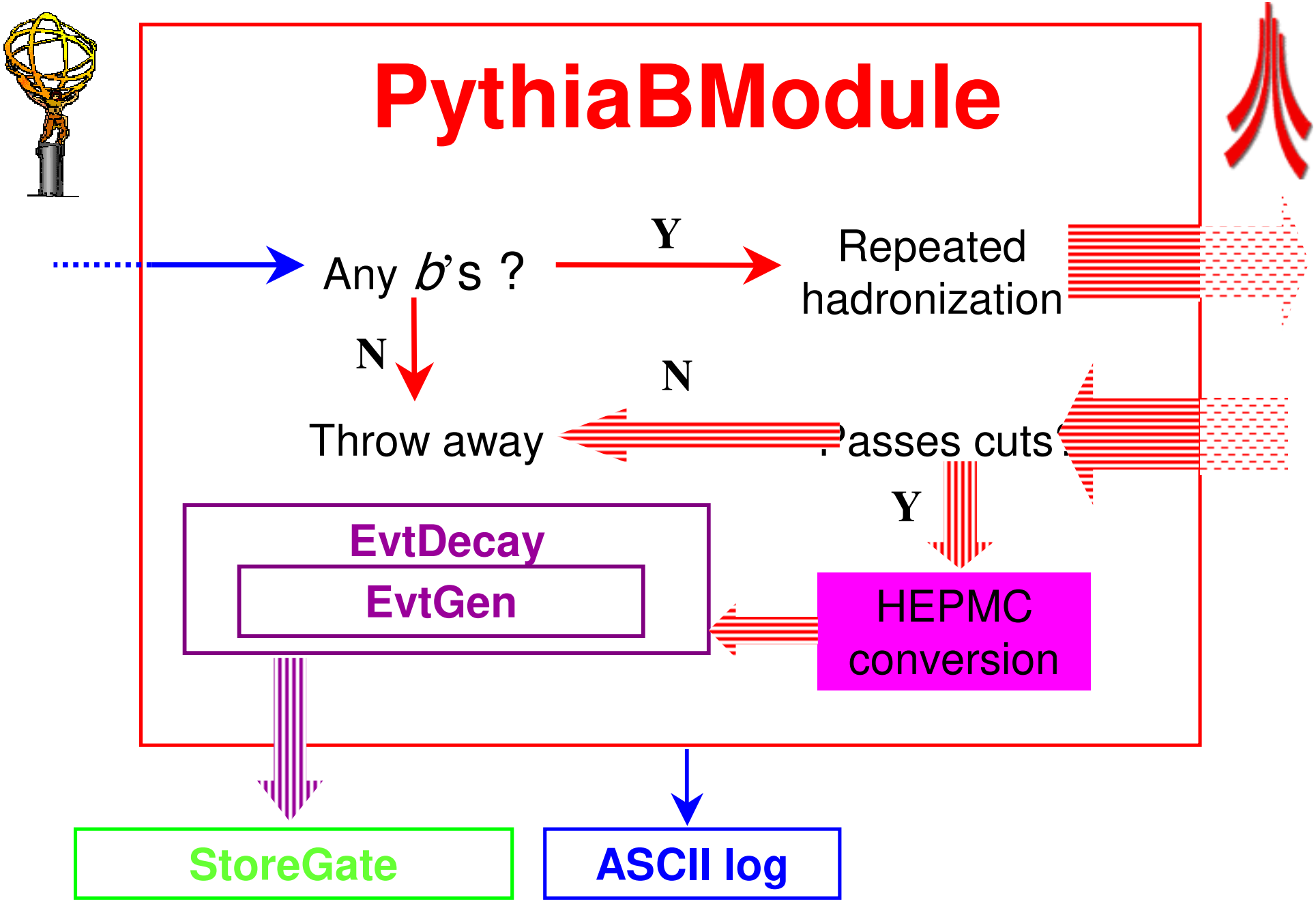

Partonic event
PYTHIA
B-hadrons
Initialisation
PythiaBModule
Any b's?
Y
Repeated hadronization
N
Throw away
N
Passes cuts?
Y
ASCII log
StoreGate
HEPMC conversion
Decayed B hadrons

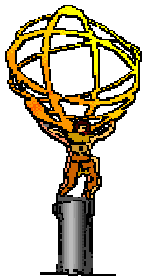


EvtGen Interface

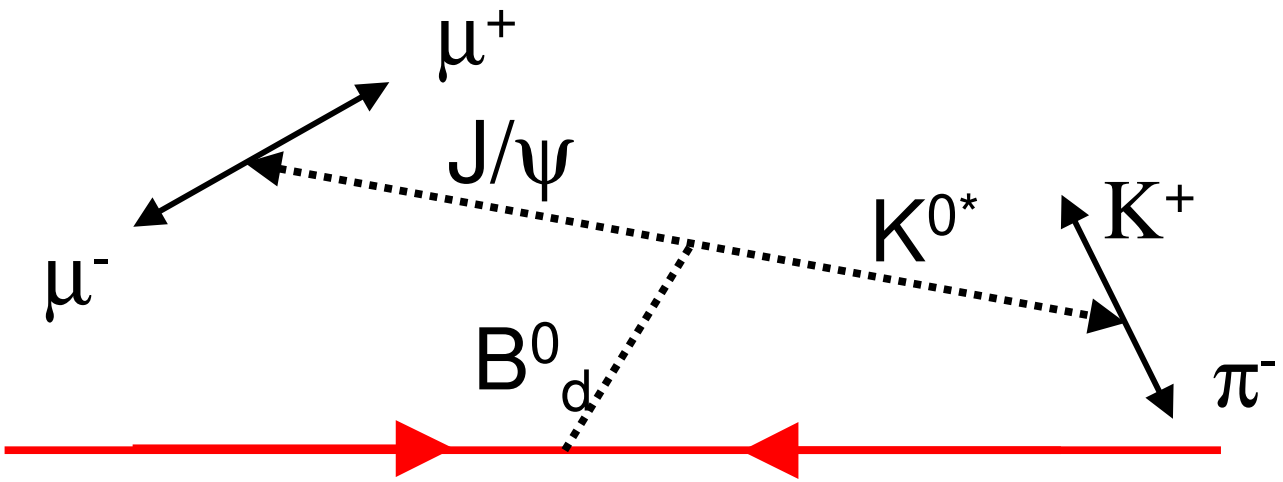
- **EvtGen has several advantages for B-decays**
  - Amplitude approach
  - Helicity amplitudes
  - ‘Nodal’ approach to decay tree - efficient
- **PYTHIA still needed for the hadronic event generation**
- **Use an interface class “EvtDecay” (adapted for ATHENA by Malte Muller) to decay B-mesons with EvtGen code**
  - Instantiated within PythiaBModule
  - DECAY.DEC and MY.DEC read in via ATHENA JobOptions


Partonic
event
PYTHIA
B-hadrons
Initialisation
PythiaBModule
Any b's?
Y
Repeated
hadronization
N
Throw away
N
Passes cuts?
Y
ASCII log
StoreGate
HEPMC
conversion
Decayed B-
hadrons

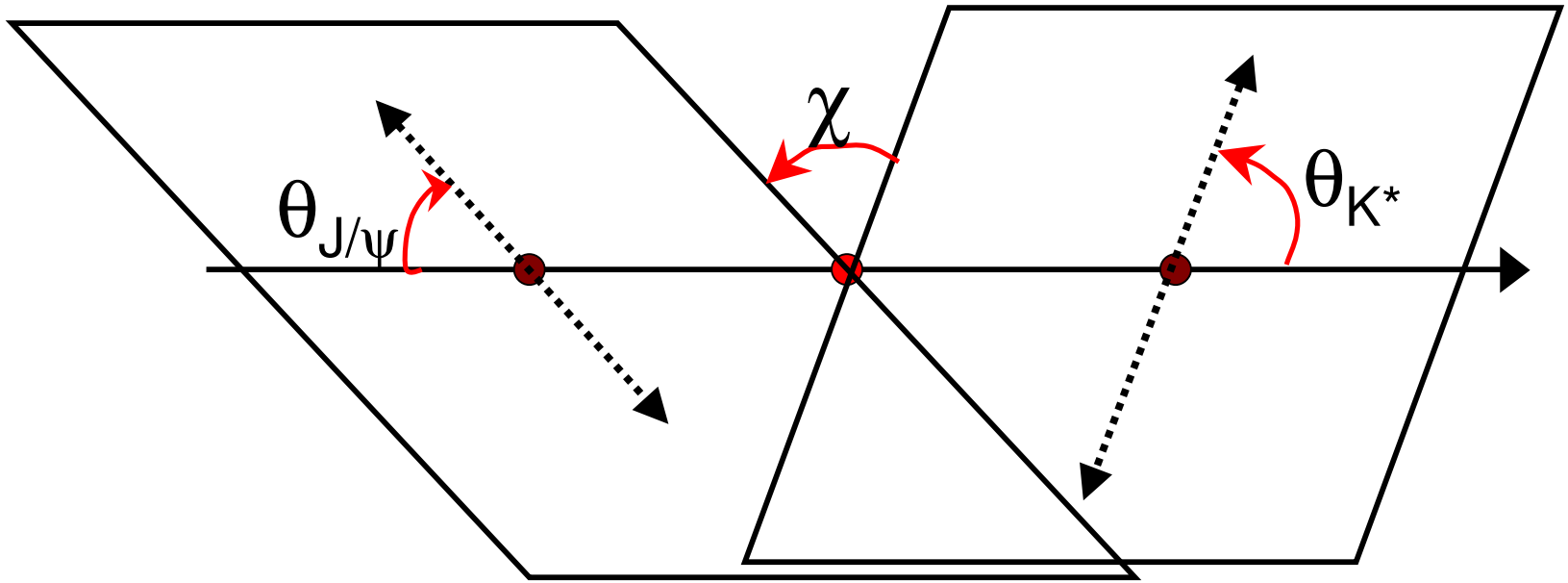

PythiaBModule
Any b's ?
Y
Repeated hadronization
N
N
Throw away
Passes cuts?
Y
EvtDecay
EvtGen
HEPMC conversion
StoreGate
ASCII log

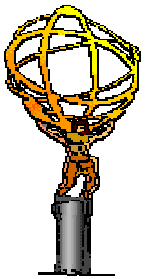


First Attempt – angular distribution of $B^0_d \rightarrow J/\psi\,(\mu^+\mu^-)K^{0*}(K^+\pi^-)$

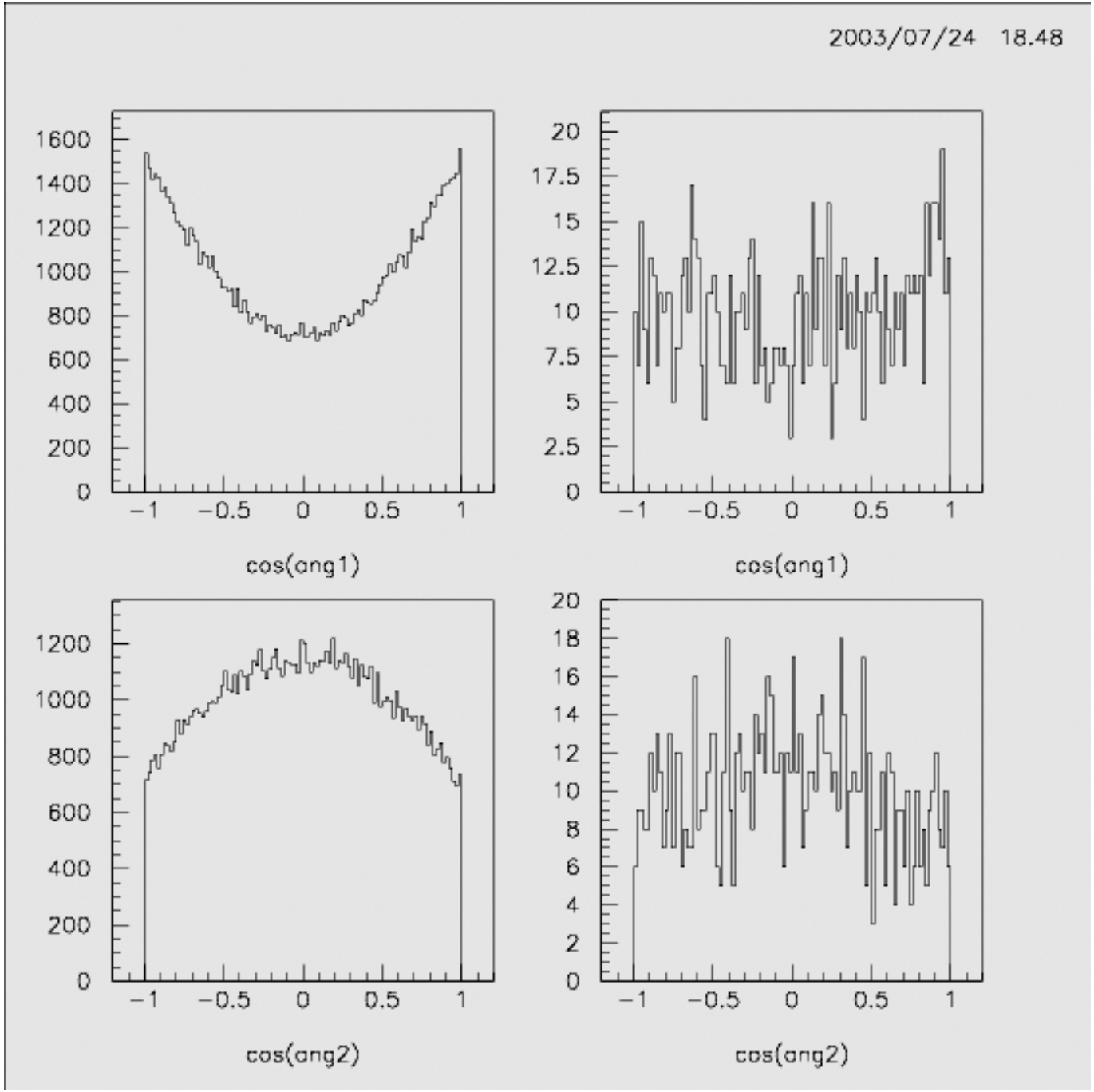


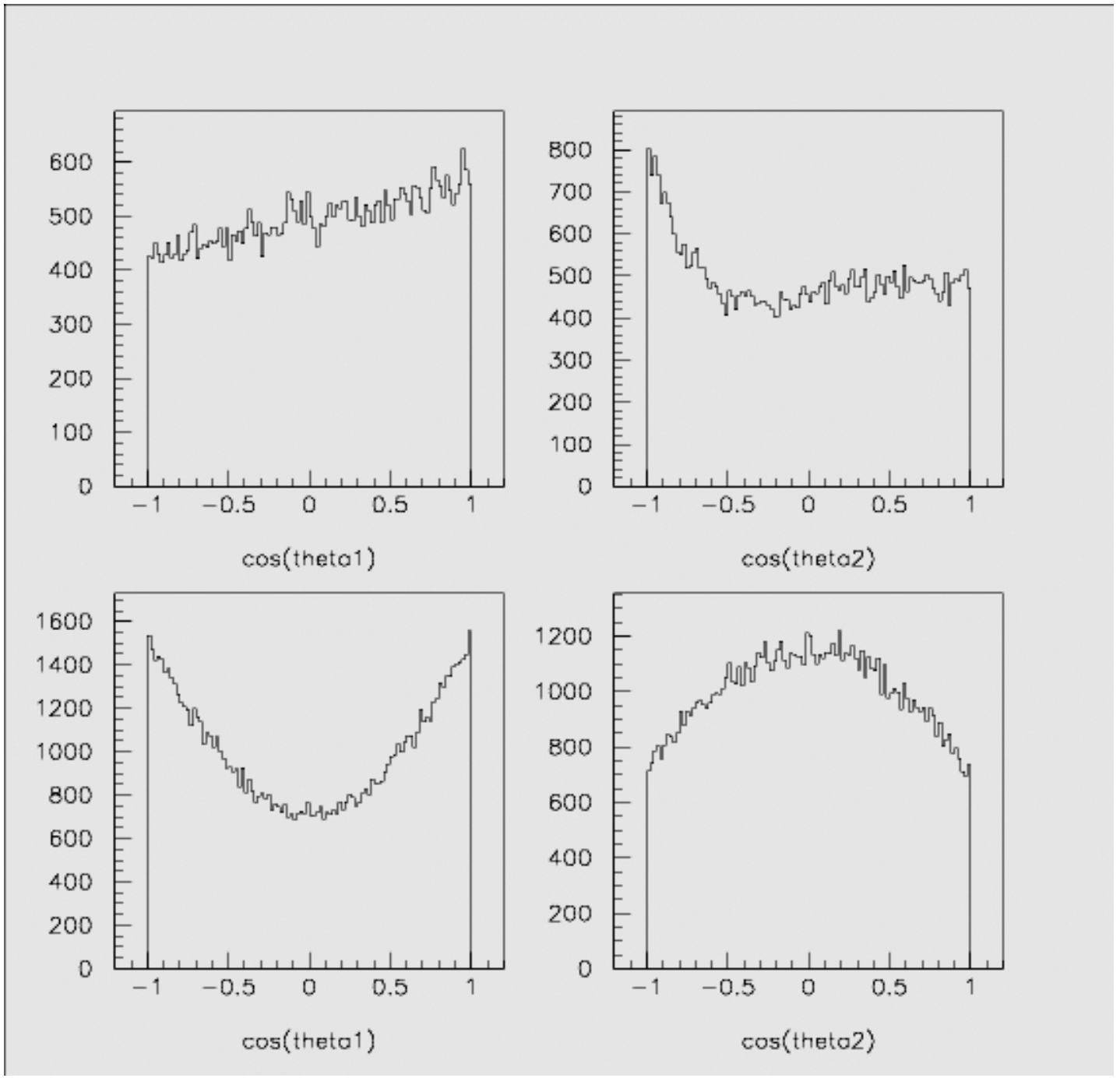
Angles

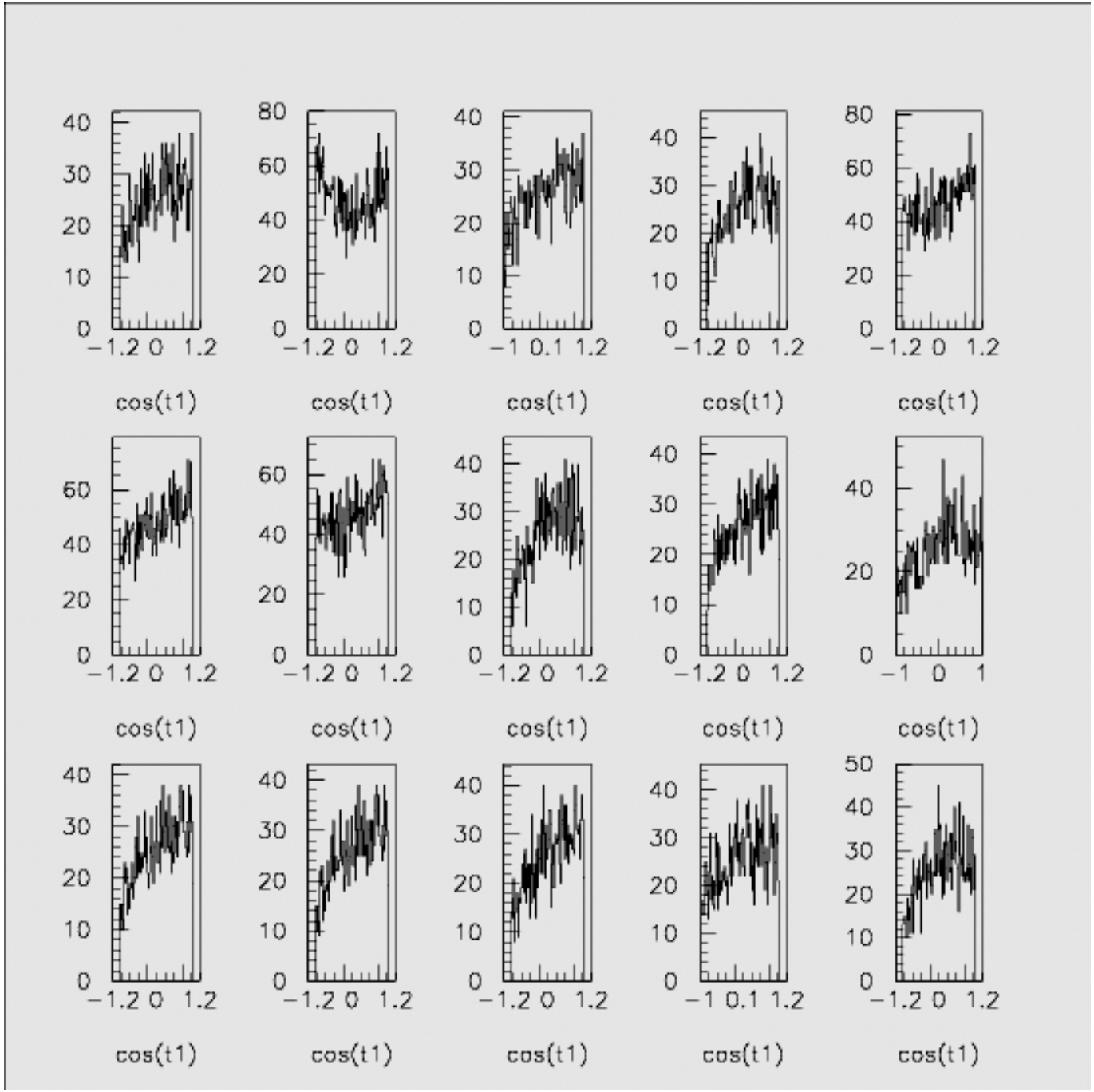


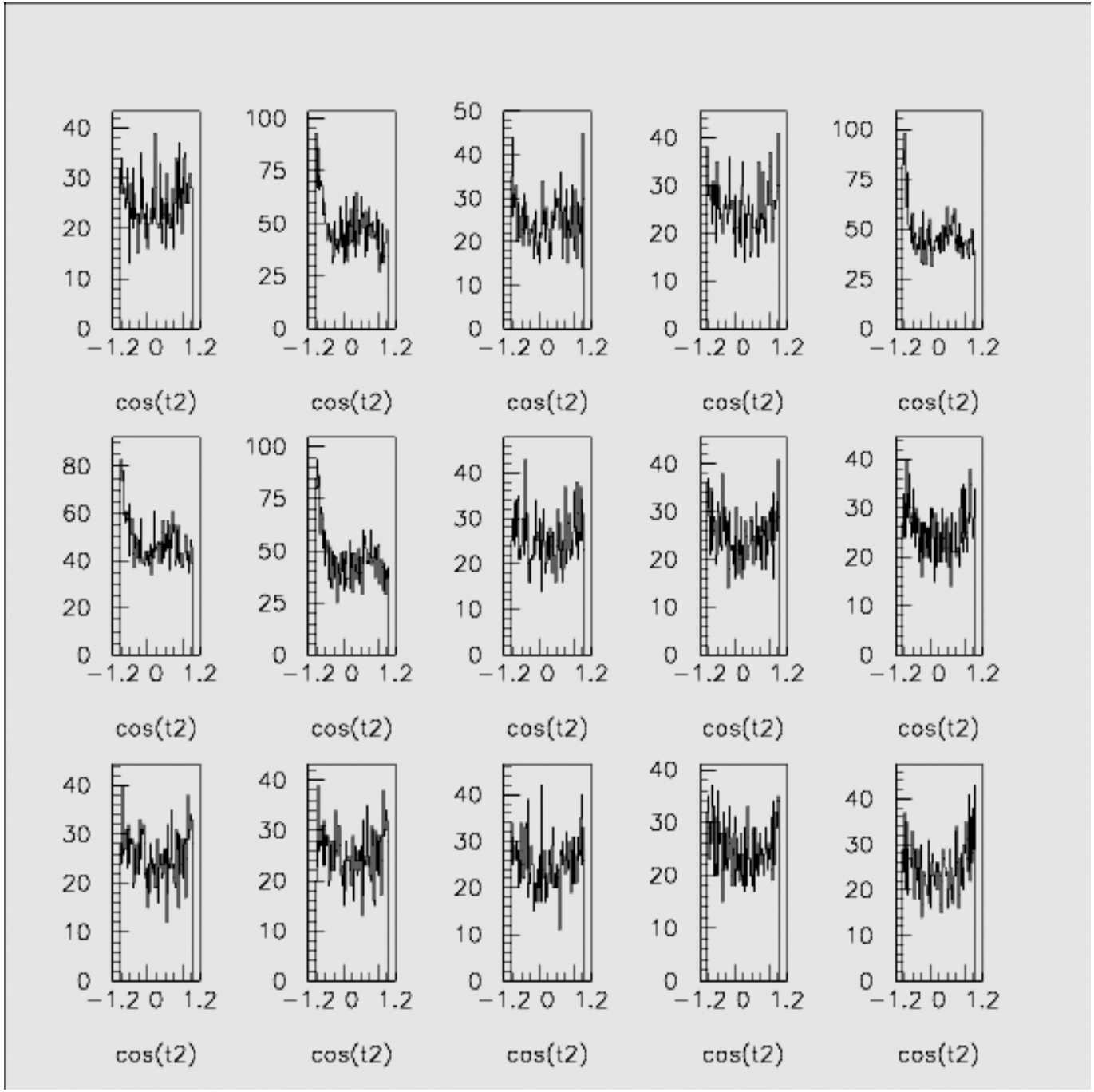


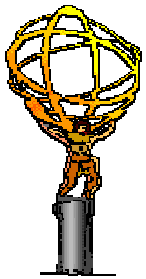
Results


2003/07/24 18.48
1600
1400
1200
1000
800
600
400
200
0
−1
−0.5
0
0.5
1
cos(ang1)
20
17.5
15
12.5
10
7.5
5
2.5
0
−1
−0.5
0
0.5
1
cos(ang1)
1200
1000
800
600
400
200
0
−1
−0.5
0
0.5
1
cos(ang2)
20
18
16
14
12
10
8
6
4
2
0
−1
−0.5
0
0.5
1
cos(ang2)


600
500
400
300
200
100
0
−1
−0.5
0
0.5
1
cos(theta1)
800
700
600
500
400
300
200
100
0
−1
−0.5
0
0.5
1
cos(theta2)
1600
1400
1200
1000
800
600
400
200
0
−1
−0.5
0
0.5
1
cos(theta1)
1200
1000
800
600
400
200
0
−1
−0.5
0
0.5
1
cos(theta2)

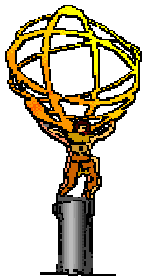

cos(t1)


cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)
cos(t2)



The plan for the next month

- **Investigate instabilities in results**
- **Fix various memory leaks**
- **Develop code so that EvtGen can be invisibly operated within ATHENA following a single request from the user**
  - **Automatic generation of MY.DEC**
- **CP violation studies?**



Conclusions

- EvtGen can be operated smoothly from within ATHENA
- The preliminary results require investigation