CalcHEP interface with MC generators

Alexander Belyaev

Southampton University & Rutherford Accelerator LAB

In collaboraton with Alexander Pukhov

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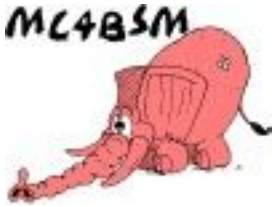
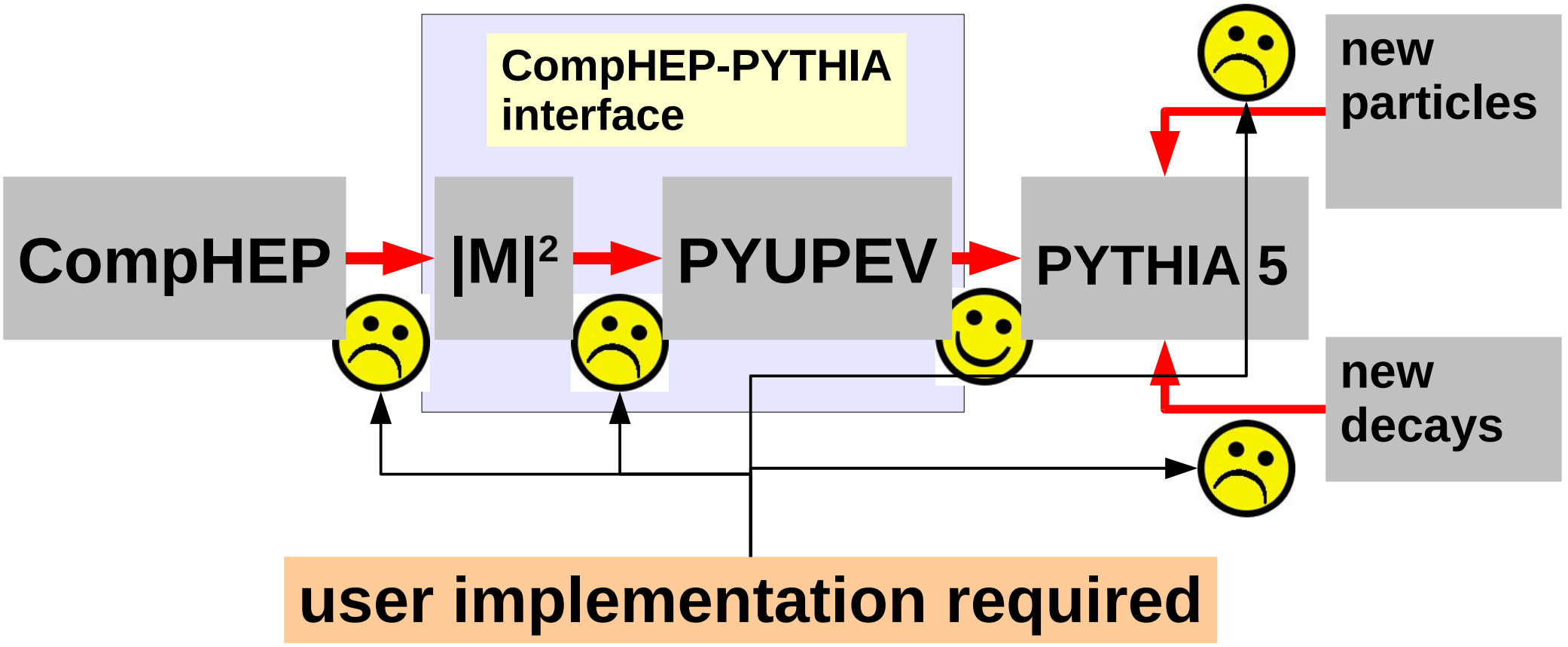


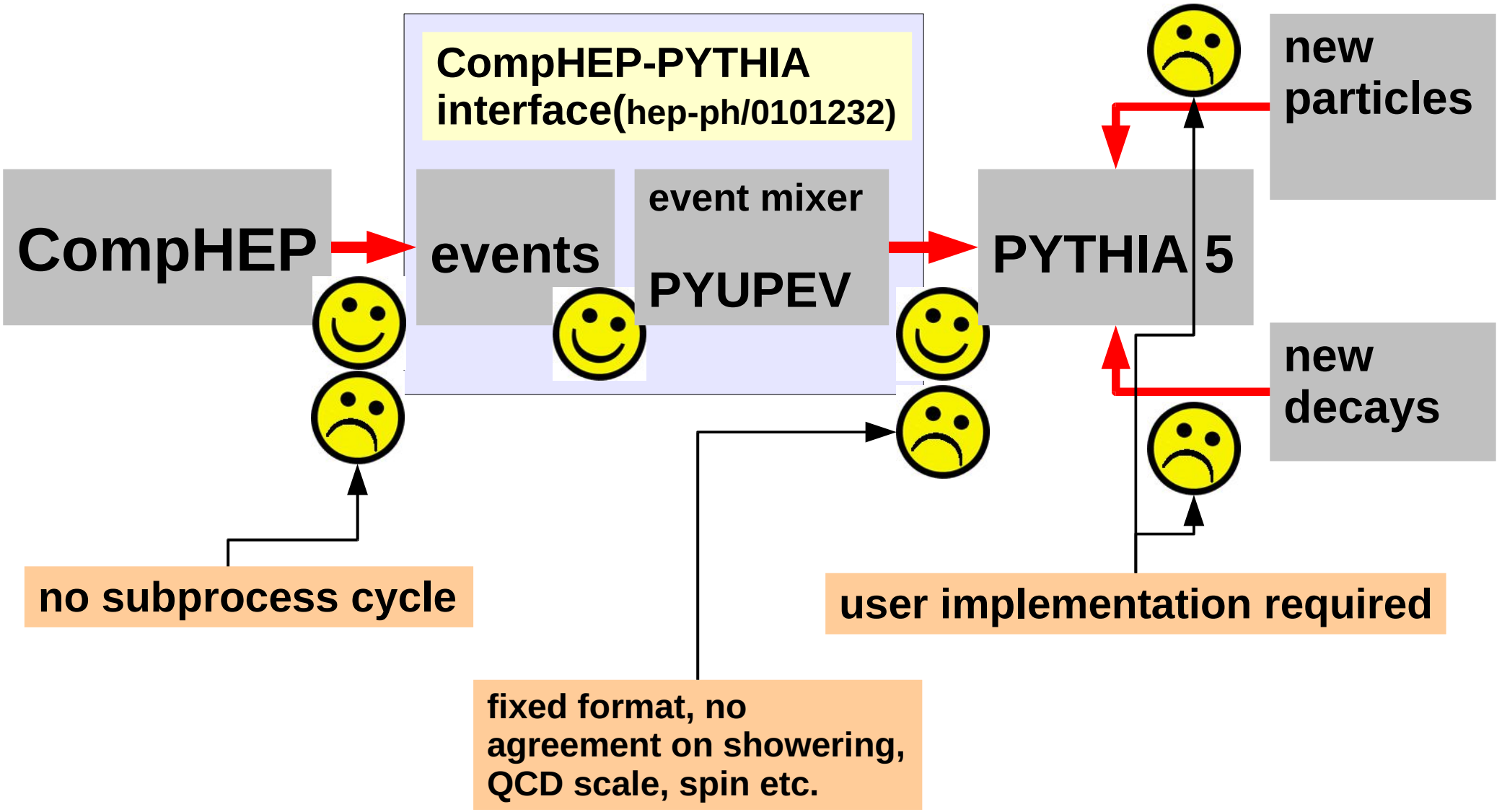
OUTLINE

- **Short history**
- **CalcHEP interface with MC generators: present status**
  - **essential features**
  - **short user guide**
  - **examples**
- **Future of CalcHEP interface with MC generators**

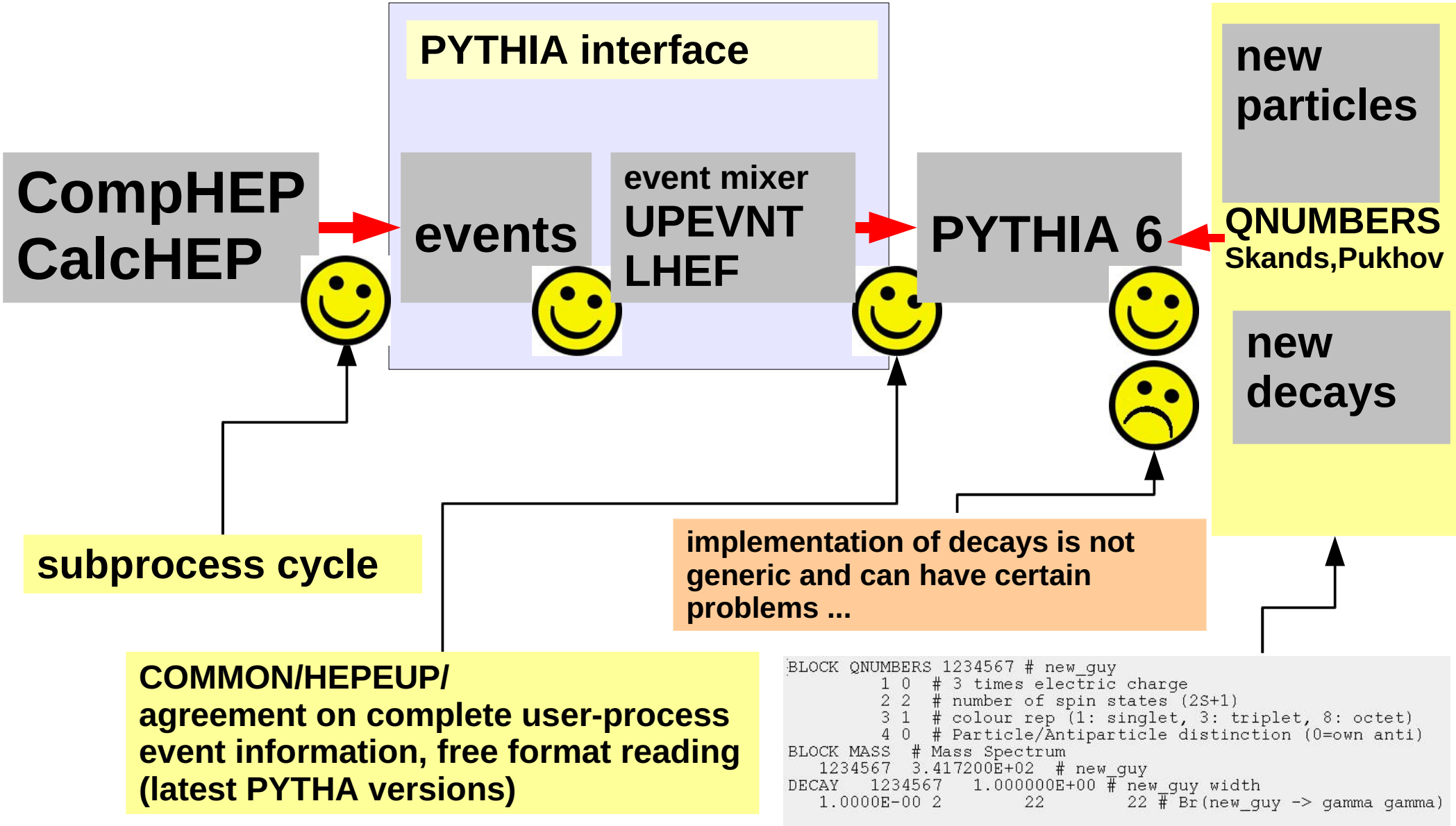
TIMELINE: 90's



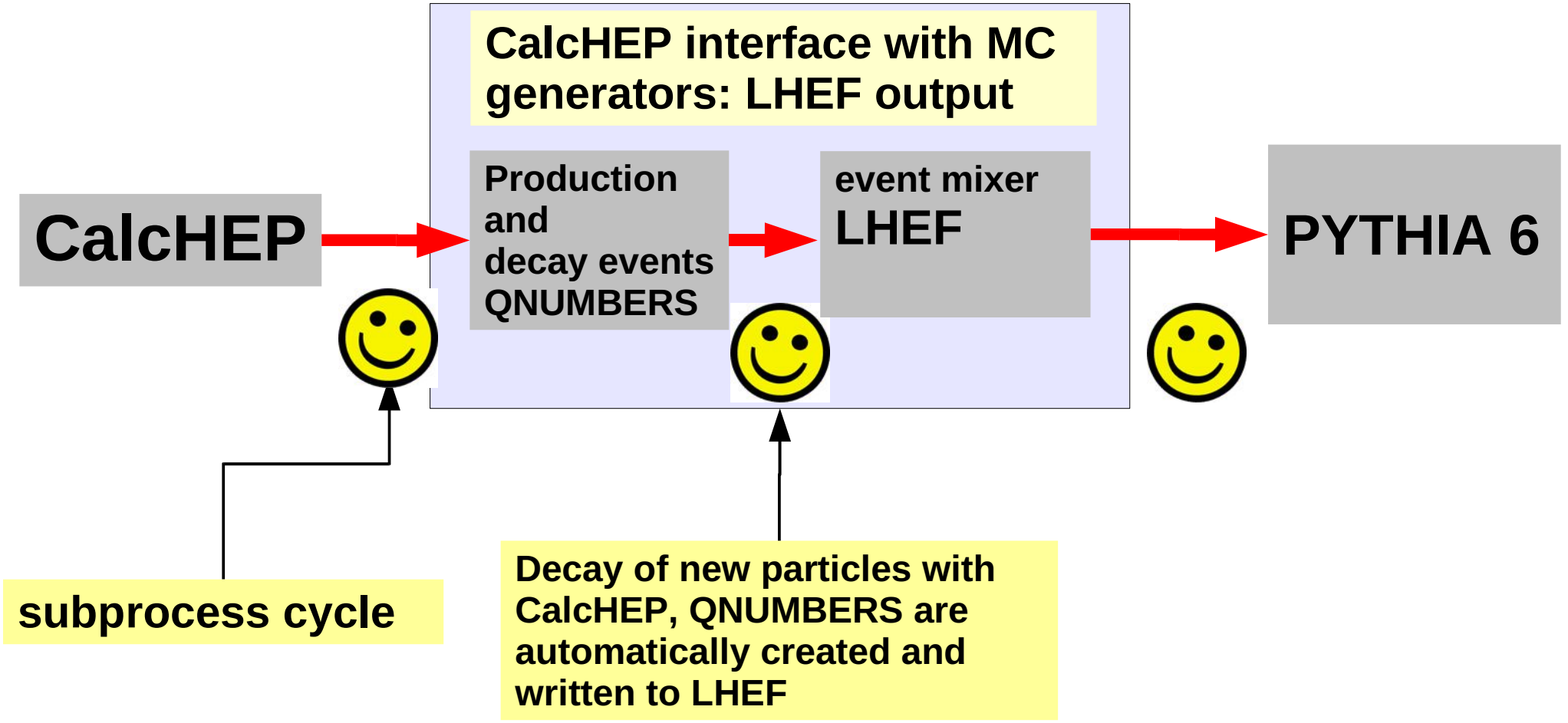
TIMELINE: end of 90's



TIMELINE: 00's, LHEF accord [hep-ph/0609017]



Status of CalcHEP-MCG interface



CalcHEP-MCG interface features

- **production and decay events are connected**
- **decays of new particles automatically included**
- **Qnumbers automatically written into LHEF**
- **VTIMUP , invariant lifetime cτ is stored now (widths are calculated 'on the fly') so any long-living particle and displaced vertices are in LHEF!**

CalcHEP-MCG interface guide

http://www.hep.phys.soton.ac.uk/~belyaev/public/calchep/

1. **download calc_pyth.zip**

   from http://hep.pa.msu.edu/people/belyaev/comphep/calchep_pyth/calc_pyth.zip

   event2pyth.c , event_mixer.f, call_pyth_mix

2. ***subproc_cycle***

   'link_event_mixer'

   ('f77 -o event_mixer.x event_mixer.f event2pyth.c -lm')

3. ***event_mixer.x -> 'event_mixer.lhe'***

4. ***create call_pyth_mix.x***

   link_pythia_mix

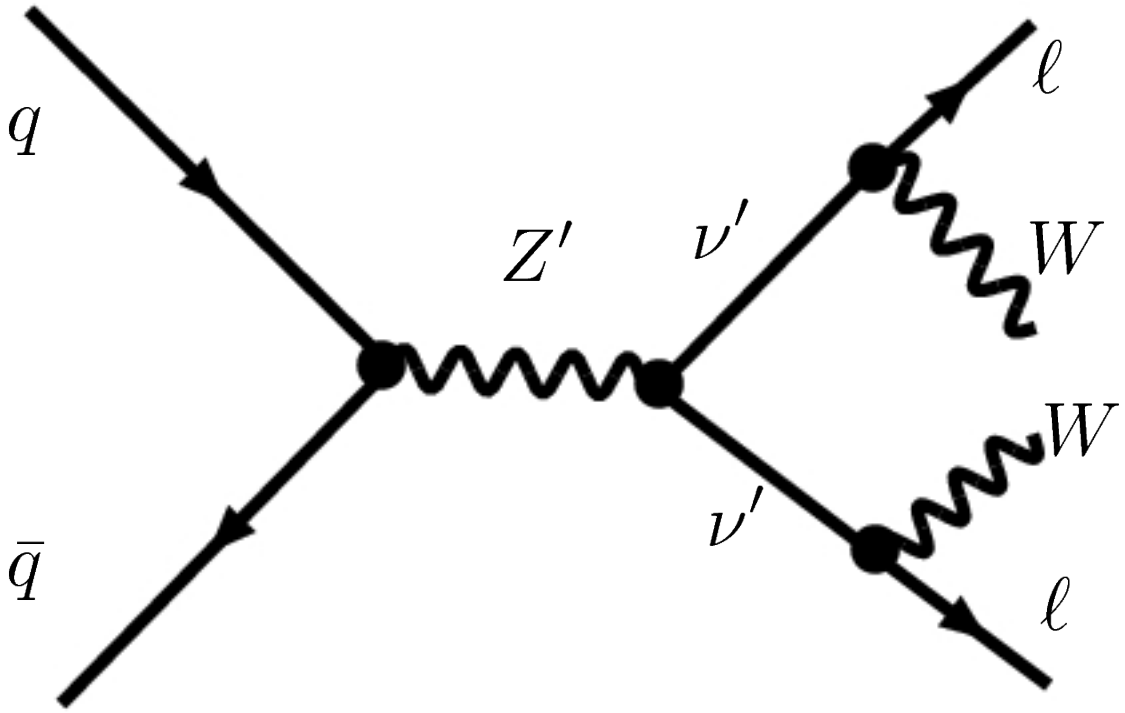
   (f77 -o call_pyth_mix.x call_pyth_mix.f pythia64xx.o)

5. ***"call_pyth_mix.x" this read mixed events from file into PYTHIA***

Example of application: B-L extension of SM

Extra U(1)' : Z', heavy long leaving neutrino

(in collaboration with S. Moretti and L. Basso)



Example of application: B-L extension of SM

```
localhost:~/comphep/calchep_pyth> sh run_mix
 Enter the name of the directory with the events to mix
 directory
 pp__zp__nh1_nh1

 4 subprocesses found
 Add another directory with the events to mix?(Y/N)
 Enter the name of the directory with the events to mix
 directory
 nh1__2x

 1 subprocesses found
 Add another directory with the events to mix?(Y/N)
 total cross section   0.015774796
 Max number of events  31112
 Enter the number of events you want ot get
 Would you like events in LHA format? (y/n)
```

event_mixer.lhe from CalcHEP

```
<LesHouchesEvents version="1.0">
<!--
File generated with CalcHEP-PYTHIA interface
-->
<header>
<slha>
BLOCK QNUMBERS 3000023 # Zp
 1      0 # 3 times electric charge
 2      3 # number of spin states (2S+1)
 3      1 # colour rep (1: singlet, 3: triplet, 8: octet)
 4      0 # Particle/Antiparticle distinction (0=own anti)
#
BLOCK QNUMBERS 3000012 # ~n1
 1      0 # 3 times electric charge
 2      2 # number of spin states (2S+1)
 3      1 # colour rep (1: singlet, 3: triplet, 8: octet)
 4      0 # Particle/Antiparticle distinction (0=own anti)
#
</slha>
</header>
<init>
  2212  2212  0.70000000000E+04  0.70000000000E+04    -1
  0.15774796000E-01  0.00000000000E+00  0.10000000000E+01
</init>
<event>
 8   1  0.1000000E+01  0.1500000E+04 -0.1000000E+01 -0.10000
        2   -1    0    0  500    0  0.00000000000E+00  0.000
       -2   -1    0    0    0  500  0.00000000000E+00  0.000
  3000012    2    1    2    0    0 -0.54291804312E+03 -0.360
  3000012    2    1    2    0    0  0.54291804312E+03  0.360
       24    1    3    3    0    0 -0.53529210214E+03 -0.367
       11    1    3    3    0    0 -0.76259409773E+01  0.717
       24    1    4    4    0    0  0.32477862334E+03  0.274
       11    1    4    4    0    0  0.21813941978E+03  0.858
</event>
```

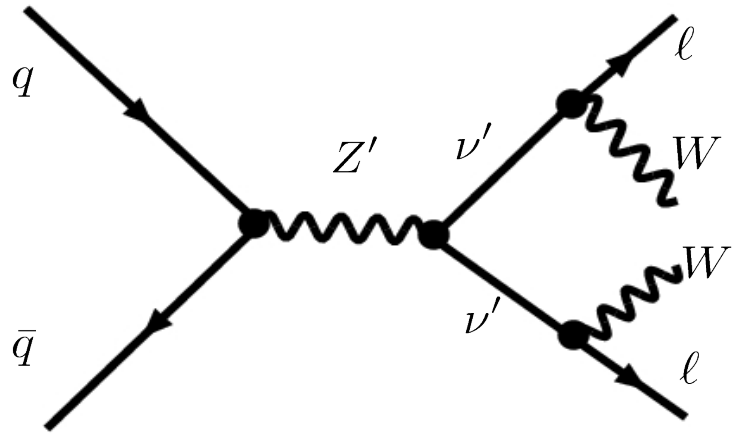
PYTHIA event list

Event listing (with vertices)

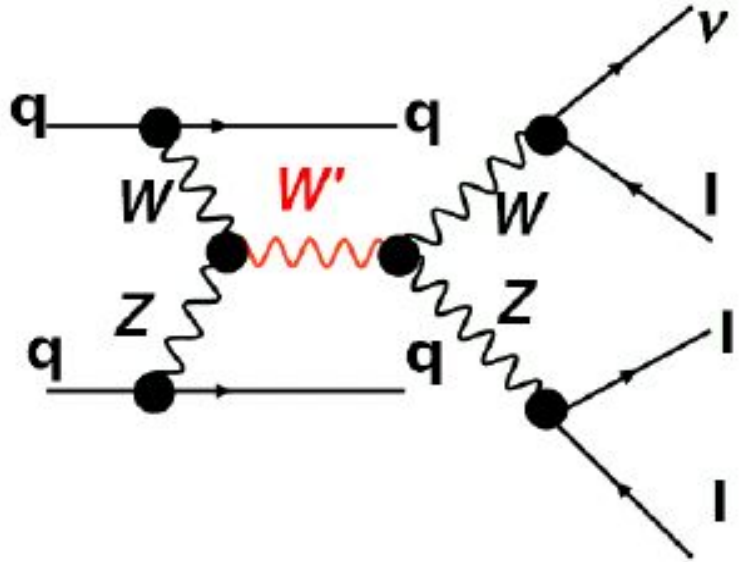
I	particle/jet	K(I,1)	K(I,2)	K(I,3)	K(I,4)	K(I,5)	P(I,1)	P(I,2)	P(I,3)	P(I,4)	P(I,5)
							V(I,1)	V(I,2)	V(I,3)	V(I,4)	V(I,5)
1	!p+!	21	2212	0	0	0	0.00000	0.00000	6999.99994	7000.00000	0.93827
							0.000	0.000	0.000	0.000	0.000
2	!p+!	21	2212	0	0	0	0.00000	0.00000	-6999.99994	7000.00000	0.93827
							0.000	0.000	0.000	0.000	0.000
3	!u!	21	2	1	0	0	-2.10537	-1.48639	2327.19321	2327.19464	0.00000
							0.000	0.000	0.000	0.000	0.000
4	!u!	21	2	2	0	0	-1.66199	-0.79291	-2414.72258	2414.72328	0.00000
							0.000	0.000	0.000	0.000	0.000
5	!u!	21	2	3	0	0	-3.55732	-1.71327	2071.96908	2071.97285	0.00000
							0.000	0.000	0.000	0.000	0.000
6	!ubar!	21	-2	4	0	0	7.08577	6.41931	-271.43918	271.60752	0.00000
							0.000	0.000	0.000	0.000	0.000
7	!~n1!	21	3000012	0	0	0	-543.54768	-359.62239	1419.53255	1569.18609	150.00000
							0.000	0.000	0.000	0.000	1.133
8	!~n1!	21	3000012	0	0	0	547.07614	364.32842	380.99736	774.39427	150.00000
							0.000	0.000	0.000	0.000	1.133
9	!W+!	21	24	7	0	0	-535.97405	-366.85460	1411.98584	1556.27805	80.29242
							-4.106	-2.716	10.722	11.853	0.000
10	!e-!	21	11	7	0	0	-7.57362	7.23222	7.54671	12.90804	0.00051
							-4.106	-2.716	10.722	11.853	0.000
11	!W+!	21	24	8	0	0	327.66867	277.14747	222.48682	490.02525	80.29242
							4.132	2.752	2.878	5.849	0.000
12	!e-!	21	11	8	0	0	219.40746	87.18095	158.51054	284.36903	0.00051
							4.132	2.752	2.878	5.849	0.000
13	!sbar!	21	-3	11	0	0	119.27149	138.43161	63.43121	193.42380	0.50000
							0.000	0.000	0.000	0.000	0.000
14	!c!	21	4	11	0	0	208.39719	138.71586	159.05562	296.60144	1.50000
							0.000	0.000	0.000	0.000	0.000
15	!tau+!	21	-15	9	0	0	-157.56279	-132.30006	523.70286	562.66969	1.77700
							0.000	0.000	0.000	0.000	0.000
16	!nu_tau!	21	16	9	0	0	-378.41121	-234.55450	888.28284	993.60821	0.00000
							0.000	0.000	0.000	0.000	0.000

Current applications of CalcHEP-MCG interface

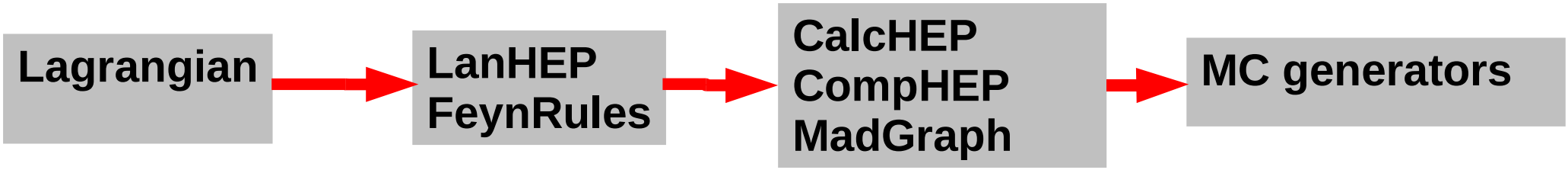
- **CMS: Z' production within B-L model**



- **ATLAS: W' 3-lepton signatures from 3-site Higgsless model**



We have powerful tools in one chain!



What is the most time consuming link?

We have powerful tools in one chain!

What is the most time consuming link?

Future plans

- **Including finite width into production-decay connection**
- **Including polarization effects into production-decay connection**