

HIJING Model
(Heavy Ion Jet INteraction Generator)

Wei-Tian Deng

(Huazhong University of Science and Technology)

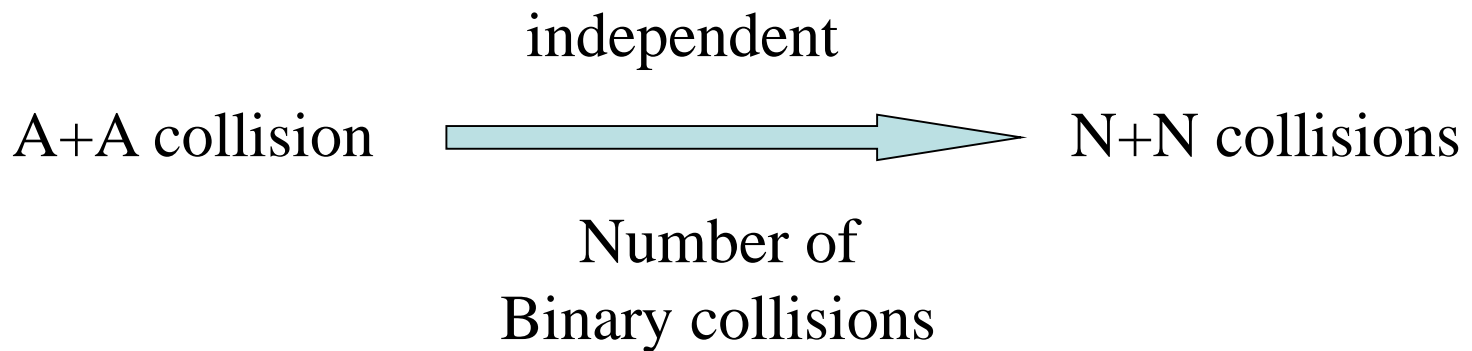
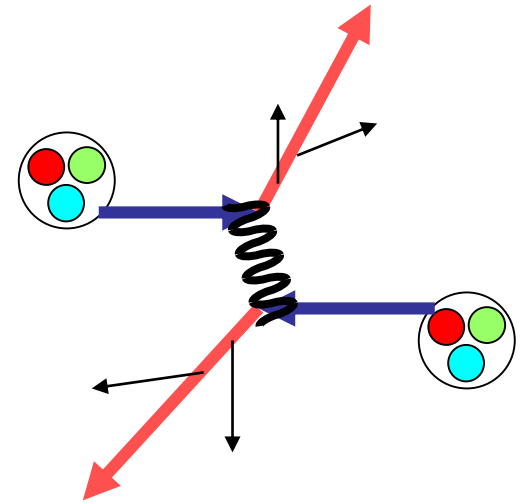
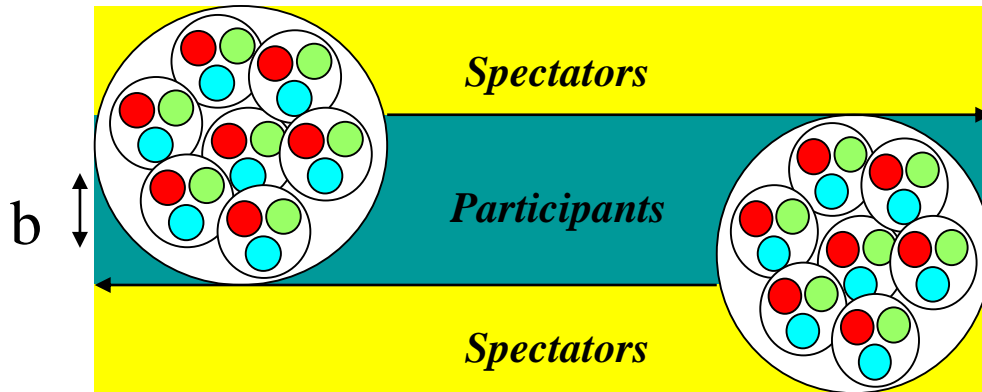
Outline

- **HIJING Model**
 - **Binary collisions approximation** for $p+A$ and $A+A$.
 - **Two component model** for $p+p$ / $N+N$ collision.
 - **Nuclear effects** for $p+A$ and $A+A$.
 - Lund string fragmentation.
- **Output of HIJING**
 - Parton Level
 - Hadron Level

HIJING Model:

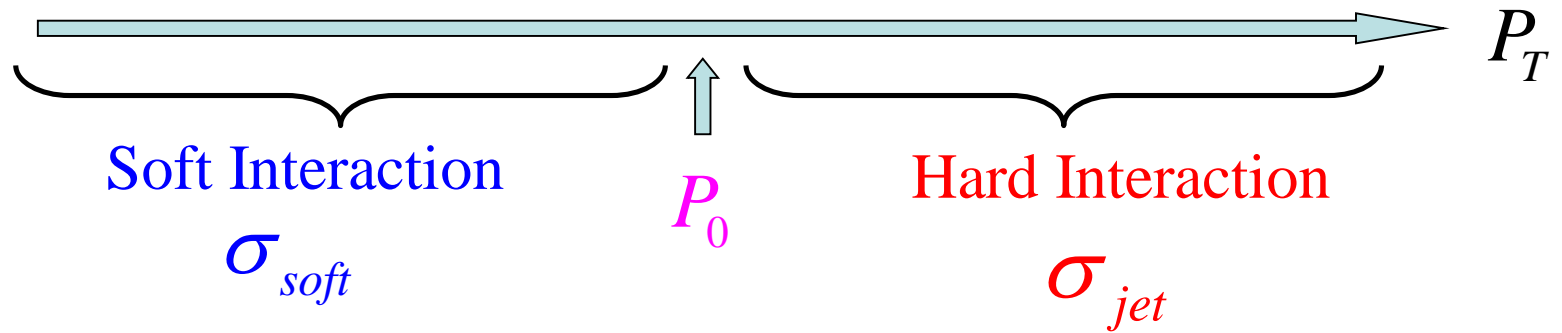
Binary Collisions Approximation

Woods-Saxon nuclear density



HIJING Model:

Two-Component Model in N+N Collisions



$$\sigma_{jet} = \int_{p_0^2}^{s/4} dp_T^2 dy_1 dy_2 \frac{1}{2} \frac{d\sigma_{jet}}{dp_p^2 dy_1 dy_2} \Rightarrow \sigma_{ine}, \sigma_{total}$$

$$\frac{d\sigma_{jet}}{dp_p^2 dy_1 dy_2} = K \sum_{a,b,c,d} x_1 f_a(x_1) x_2 f_b(x_2) \frac{d\sigma_{a,b \rightarrow c,d}}{d\hat{t}}$$

σ_{soft} is a parameter.

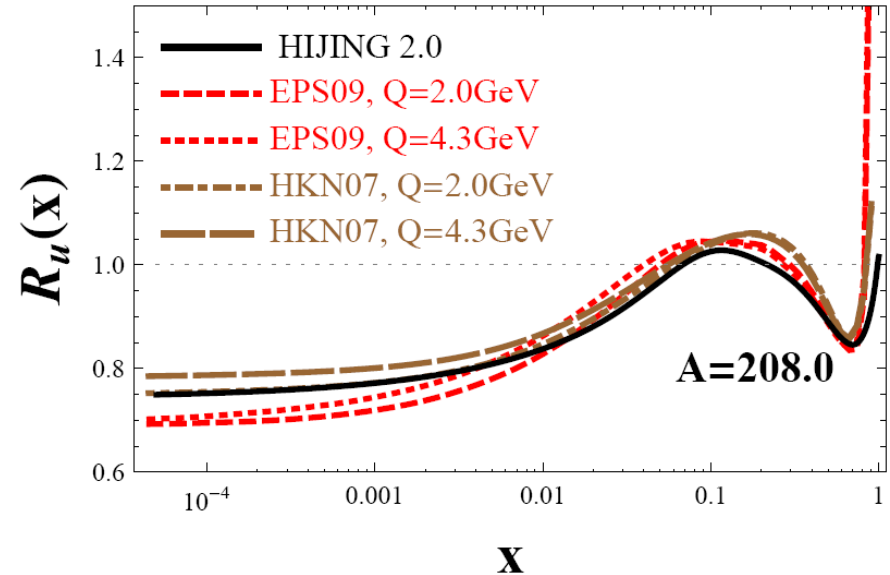
PDF

HIJING Model:

Nuclear Effects

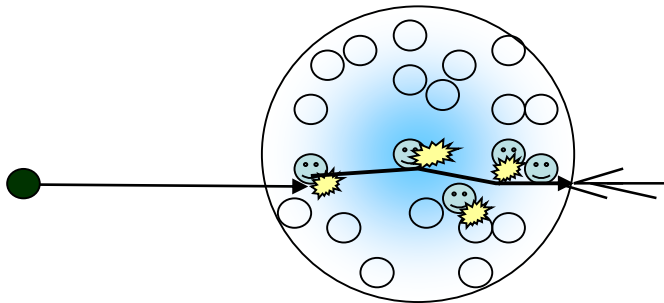
➤ Nuclear shadowing:

$$R_a^A(x, Q^2) = \frac{f_a^A(x, Q^2)}{A f_a^N(x, Q^2)}$$



➤ Cronin effect

kT kick in p+A collisions:



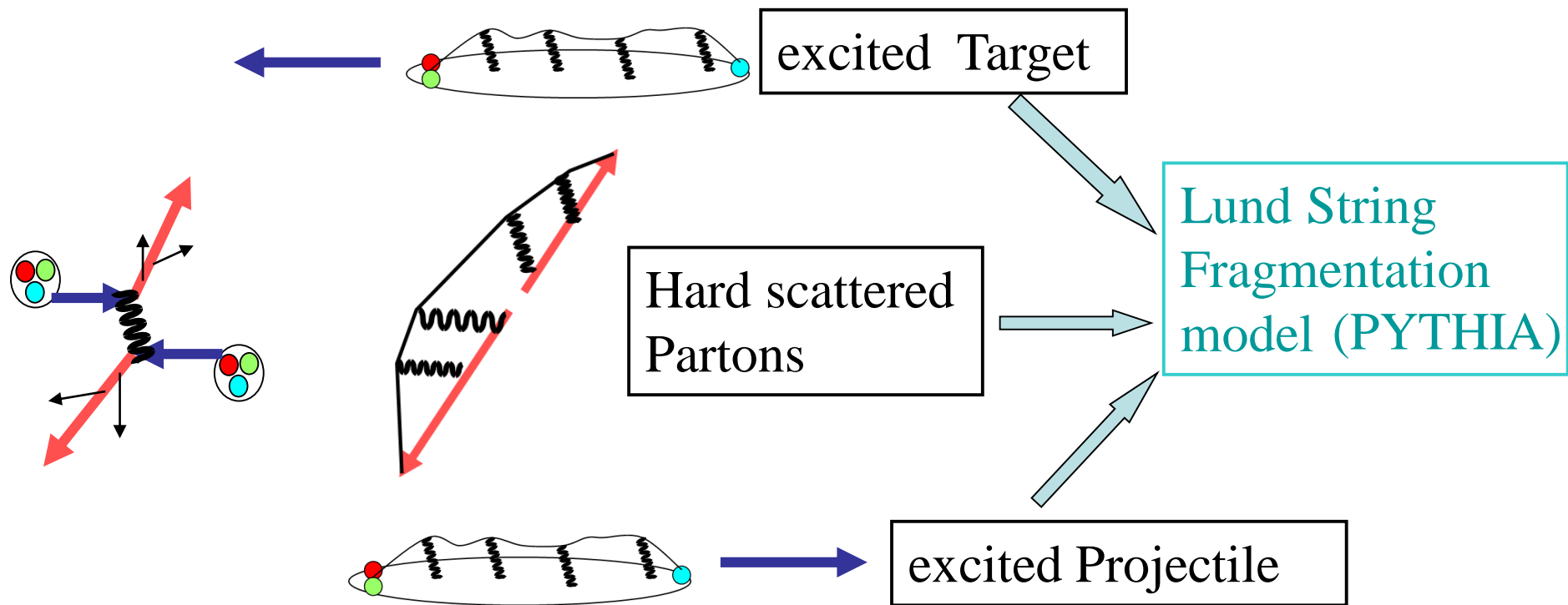
Multiple inelastic scattering



KT broadening of initial and final partons, with Gaussian distribution

HIJING Model:

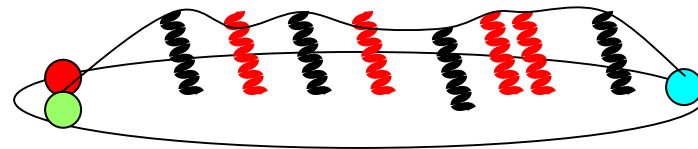
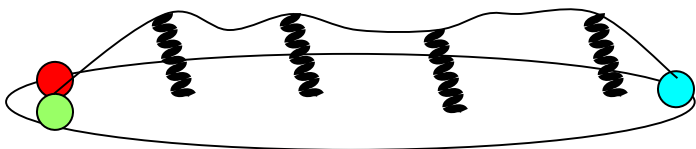
Lund String Fragmentation



p+p collisions

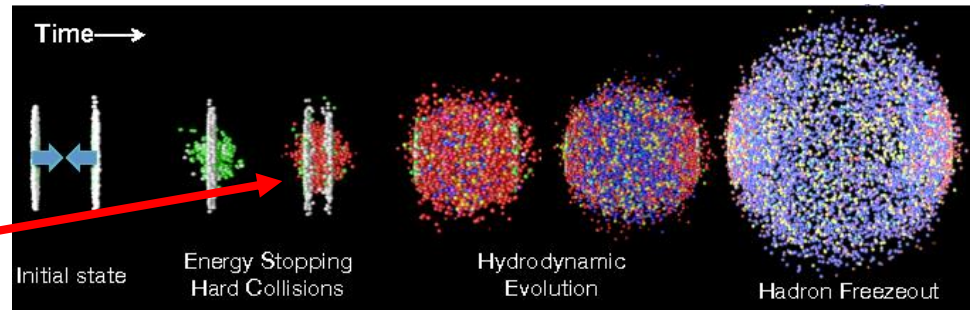
The excited nucleon

p+A and A+A collisions

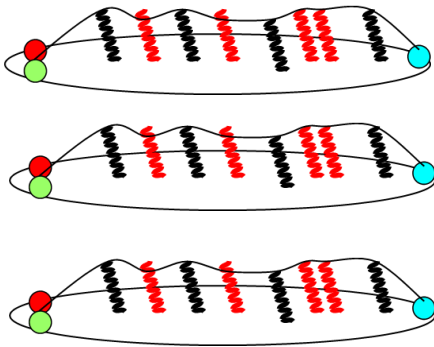


Output of HIJING

Parton level
(before frag.)

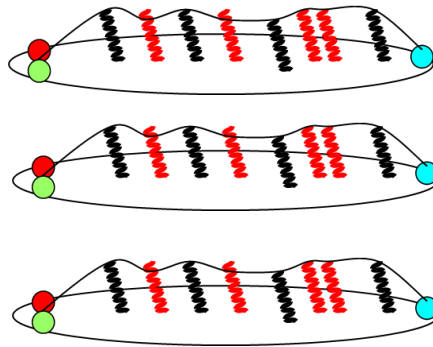


Projectile
Nucleon



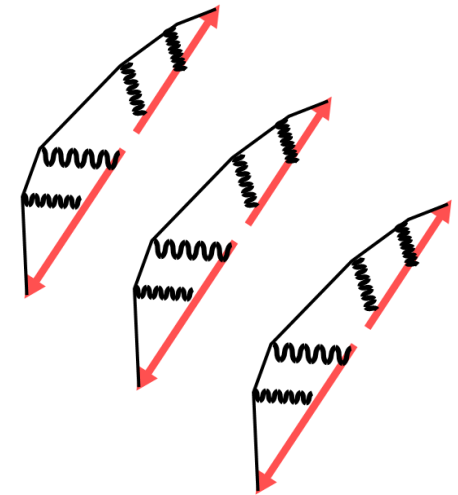
.....

Target
Nucleon



.....

Independent
Strings



.....

- The sequence number of string on which each parton attached

Example: One excited nucleon in one event of Au+Au at 200GeV

Event listing (standard)

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)	
1	(u)	A	12	2	0	14	14	-1.54755	-0.01236	21.57159	21.62704	0.00560
2	(g)	I	12	21	0	14	14	0.10332	-0.24793	-0.02829	0.27008	0.00000
3	(g)	I	12	21	0	14	14	-0.99086	0.22313	-0.30346	1.06004	0.00000
4	(g)	I	12	21	0	14	14	-1.27391	1.26577	-0.92576	2.02041	0.00000
5	(g)	I	12	21	0	14	14	0.35821	1.83228	-5.06942	5.40228	0.00000
6	(g)	I	12	21	0	14	14	-2.30036	-0.33864	-6.27521	6.69213	0.00000
7	(g)	I	12	21	0	14	14	-0.16055	0.04916	-0.15134	0.22604	0.00000
8	(g)	I	12	21	0	14	14	4.25344	-2.97730	-5.40159	7.49222	0.00000
9	(g)	I	12	21	0	14	14	2.39383	-0.11805	-1.47406	2.81375	0.00000
10	(g)	I	12	21	0	14	14	1.90593	-0.81664	1.38931	2.49593	0.00000
11	(g)	I	12	21	0	14	14	-1.17622	0.25897	0.88586	1.49509	0.00000
12	(g)	I	12	21	0	14	14	-0.24015	0.09190	-17.63762	17.63949	0.00000
13	(ud_0)	V	11	2101	0	14	14	-1.06484	0.94771	-17.90083	17.96684	0.57933
14	(string)		11	92	1	15	38	0.26029	0.15799	-31.32081	87.20133	81.38174

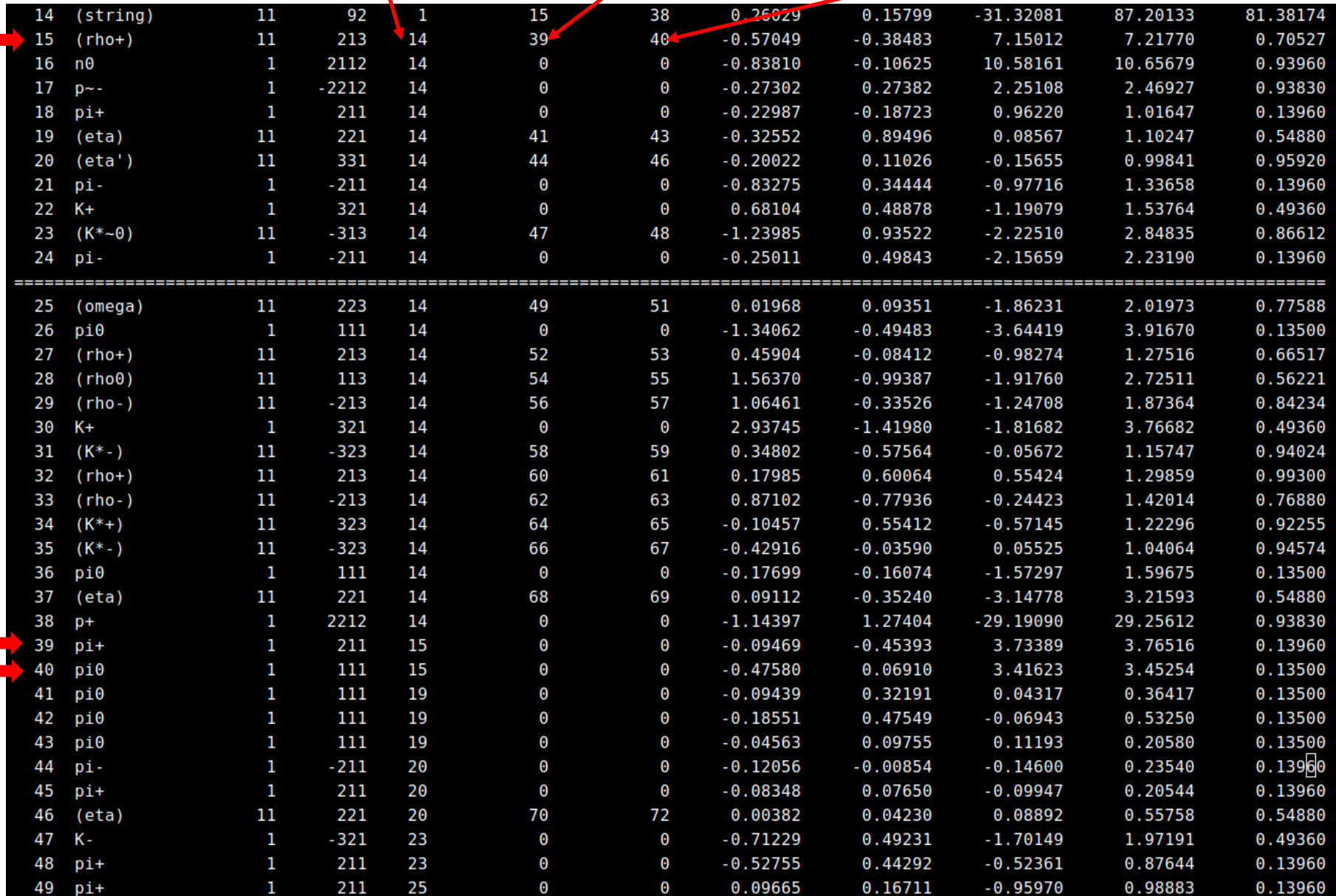
The whole string structure

- Flavor, four momentum (P_x, P_y, P_z, E), and mass of each parton
- The sequence number of string on which each parton attached

parent

1st daughter

Last daughter



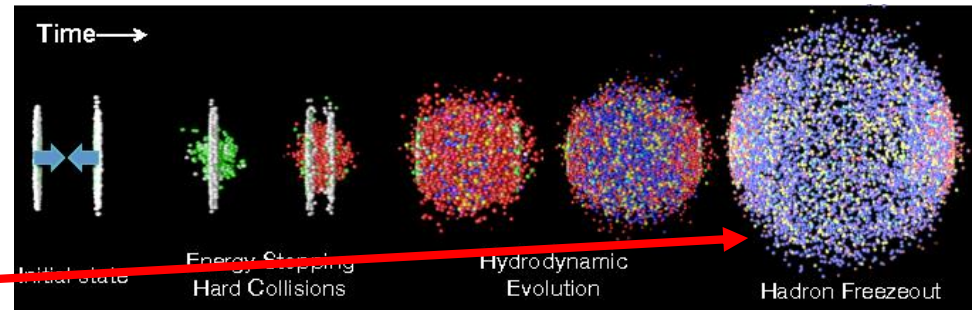
The table displays particle physics data with columns for particle name, parent, 1st daughter, and Last daughter. Red arrows point to row 15 (rho+), row 39 (pi+), and row 40 (pi0). A red arrow also points to the first column of row 15.

14	(string)	11	92	1	15	38	0.26029	0.15799	-31.32081	87.20133	81.38174
15	(rho+)	11	213	14	39	40	-0.57049	-0.38483	7.15012	7.21770	0.70527
16	n0	1	2112	14	0	0	-0.83810	-0.10625	10.58161	10.65679	0.93960
17	p~-	1	-2212	14	0	0	-0.27302	0.27382	2.25108	2.46927	0.93830
18	pi+	1	211	14	0	0	-0.22987	-0.18723	0.96220	1.01647	0.13960
19	(eta)	11	221	14	41	43	-0.32552	0.89496	0.08567	1.10247	0.54880
20	(eta')	11	331	14	44	46	-0.20022	0.11026	-0.15655	0.99841	0.95920
21	pi-	1	-211	14	0	0	-0.83275	0.34444	-0.97716	1.33658	0.13960
22	K+	1	321	14	0	0	0.68104	0.48878	-1.19079	1.53764	0.49360
23	(K*~0)	11	-313	14	47	48	-1.23985	0.93522	-2.22510	2.84835	0.86612
24	pi-	1	-211	14	0	0	-0.25011	0.49843	-2.15659	2.23190	0.13960
=====											
25	(omega)	11	223	14	49	51	0.01968	0.09351	-1.86231	2.01973	0.77588
26	pi0	1	111	14	0	0	-1.34062	-0.49483	-3.64419	3.91670	0.13500
27	(rho+)	11	213	14	52	53	0.45904	-0.08412	-0.98274	1.27516	0.66517
28	(rho0)	11	113	14	54	55	1.56370	-0.99387	-1.91760	2.72511	0.56221
29	(rho-)	11	-213	14	56	57	1.06461	-0.33526	-1.24708	1.87364	0.84234
30	K+	1	321	14	0	0	2.93745	-1.41980	-1.81682	3.76682	0.49360
31	(K*-)	11	-323	14	58	59	0.34802	-0.57564	-0.05672	1.15747	0.94024
32	(rho+)	11	213	14	60	61	0.17985	0.60064	0.55424	1.29859	0.99300
33	(rho-)	11	-213	14	62	63	0.87102	-0.77936	-0.24423	1.42014	0.76880
34	(K*+)	11	323	14	64	65	-0.10457	0.55412	-0.57145	1.22296	0.92255
35	(K*-)	11	-323	14	66	67	-0.42916	-0.03590	0.05525	1.04064	0.94574
36	pi0	1	111	14	0	0	-0.17699	-0.16074	-1.57297	1.59675	0.13500
37	(eta)	11	221	14	68	69	0.09112	-0.35240	-3.14778	3.21593	0.54880
38	p+	1	2212	14	0	0	-1.14397	1.27404	-29.19090	29.25612	0.93830
39	pi+	1	211	15	0	0	-0.09469	-0.45393	3.73389	3.76516	0.13960
40	pi0	1	111	15	0	0	-0.47580	0.06910	3.41623	3.45254	0.13500
41	pi0	1	111	19	0	0	-0.09439	0.32191	0.04317	0.36417	0.13500
42	pi0	1	111	19	0	0	-0.18551	0.47549	-0.06943	0.53250	0.13500
43	pi0	1	111	19	0	0	-0.04563	0.09755	0.11193	0.20580	0.13500
44	pi-	1	-211	20	0	0	-0.12056	-0.00854	-0.14600	0.23540	0.13960
45	pi+	1	211	20	0	0	-0.08348	0.07650	-0.09947	0.20544	0.13960
46	(eta)	11	221	20	70	72	0.00382	0.04230	0.08892	0.55758	0.54880
47	K-	1	-321	23	0	0	-0.71229	0.49231	-1.70149	1.97191	0.49360
48	pi+	1	211	23	0	0	-0.52755	0.44292	-0.52361	0.87644	0.13960
49	pi+	1	211	25	0	0	0.09665	0.16711	-0.95970	0.98883	0.13960

Output of HIJING

Hadron level

(after frag. and decay)



- Flavor, four momentum (P_x, P_y, P_z, E), and mass of each hadron
- The sequence of string from which each hadron produced
- Parentage of hadrons (decay history)

Summary

- HIJING model
- Output of HIJING
 - Parton level:
 - Flavor, four momentum and mass
 - Parent string
 - Hadron level:
 - Flavor, four momentum and mass
 - Parent string
 - decay history