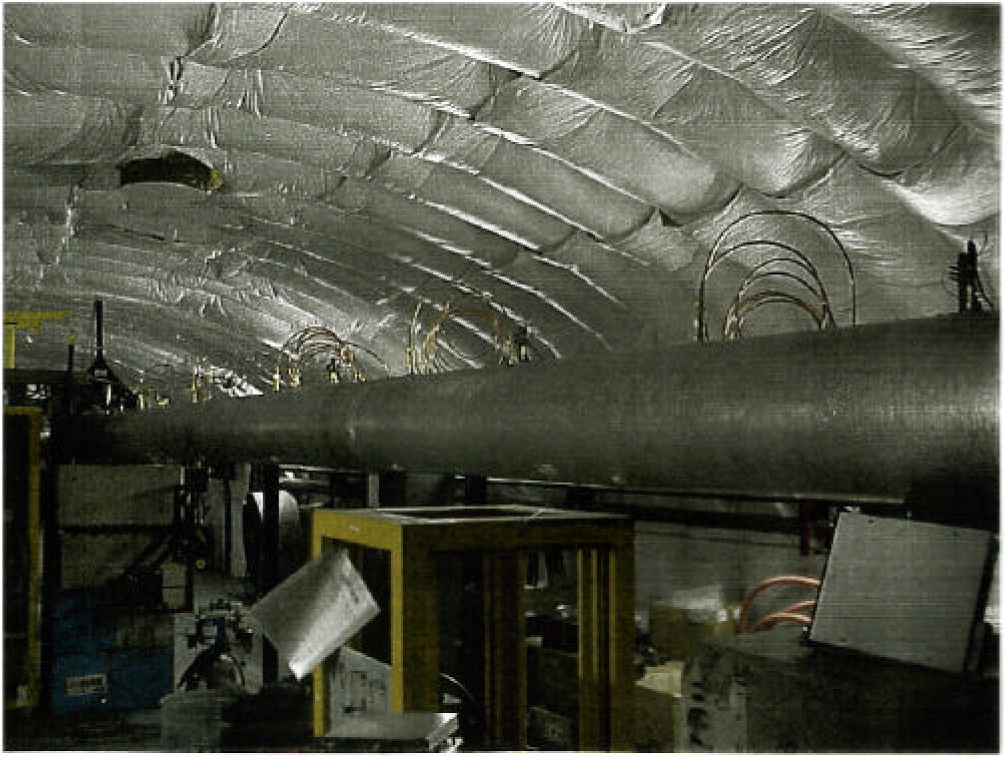
Beam Cerenkov Counters

- Status:
  - Counter vessels in place with preliminary alignment **And final alignment**
  - Mirrors installed and aligned **Again**
  - Remote primary mirror motion systems operational
  - Gas temperature sensors installed
  - Pressure vessel safety analysis complete

- To Do:
  - Install pressure transducers **Done**
  - Attach vacuum pumps **Done**
  - Install gas piping and valves **Done**
  - Vacuum and pressure test vessels **Done**
  - Install photomultiplier tubes
  - Wire/cable up tubes, monitors and controls **Done**
  - Install electronics in rack 6 **No, rack 3, Done**
  - Insulate counters
- Good News:
  - It appears vessels will be approved to run at one atmosphere above atmospheric pressure as well as one atmosphere below **No, only ½ atmosphere above.**
  - Expensive phototubes look to be very good
  - Technicians are returning from shutdown work! **Did**



COMMISSIONING AND CALIBRATING BEAM CERENKOV COUNTERS

1. Mirror alignment: All four mirrors have been aligned with respect to the Cerenkov counter bodies. Once stable beam is obtained, the primary mirrors must be aligned with respect to it for best resolution.

2. Density curves: For each T0 trigger, record the outputs of the four phototubes as a function of gas density in both counters. Study various combinations of phototubes in coincidence and anticoincidence to obtain optimum logic for tagging pions, kaons and protons and triggering the rest of our experiment.

   This is likely to be a time consuming task, as for each point for one counter several points for the other will be needed in critical areas. We have tried to speed this up by automating and calculating density "on the fly."

   Start with nitrogen in both counters. If beam momentum is less than 40 GeV/c, C4F10 will be required in both counters to detect protons. This is due to the rule that we can have a maximum of ½ atmospheric pressure above ambient.

3. Efficiency and purity: As noted, the maximum efficiency we can expect for these counters in differential mode is 96.3%. Efficiency and purity are negatively related. For example, cleanly separating kaons from more numerous pions requires increasing the index of refraction somewhat to prevent any pion light from getting through the hole in the focal plane mirror. This, of course, means that some kaon light in turn will hit the focal plane mirror and be sent to the anti channel, and that kaon will be lost.

Resolving power is determined by the angular spread of the Cerenkov light. Many factors contribute to this. In most cases the angular spread of the beam dominates. Fortunately in the new beam design this has been reduced to +/-0.3 mr. Other contributing factors are the momentum spread of the beam, multiple scattering, chromatic dispersion in the gas and temperature variation along the counter. Except for beam divergence and temperature variation these effects decrease with increasing momenta as does the angular separation of the Cerenkov light from different particles. At 100 GeV/c what few kaons are still present are 1.9 mr from the pions.

We can measure the efficiencies directly by setting the two counters to count the same particle. Similarly we can measure the "purity" by using one counter to tag the particles the other counter is not set to tag and see how many "leak" through. This will require extra calibration time, as the particle most likely to leak through will be the majority particle, which is not tagged but inferred during data taking.

4. Beam chambers: With the wire beam chambers' individual track coordinates, improvements should be possible off-line; but this will not help the trigger. Some time should be devoted to this.

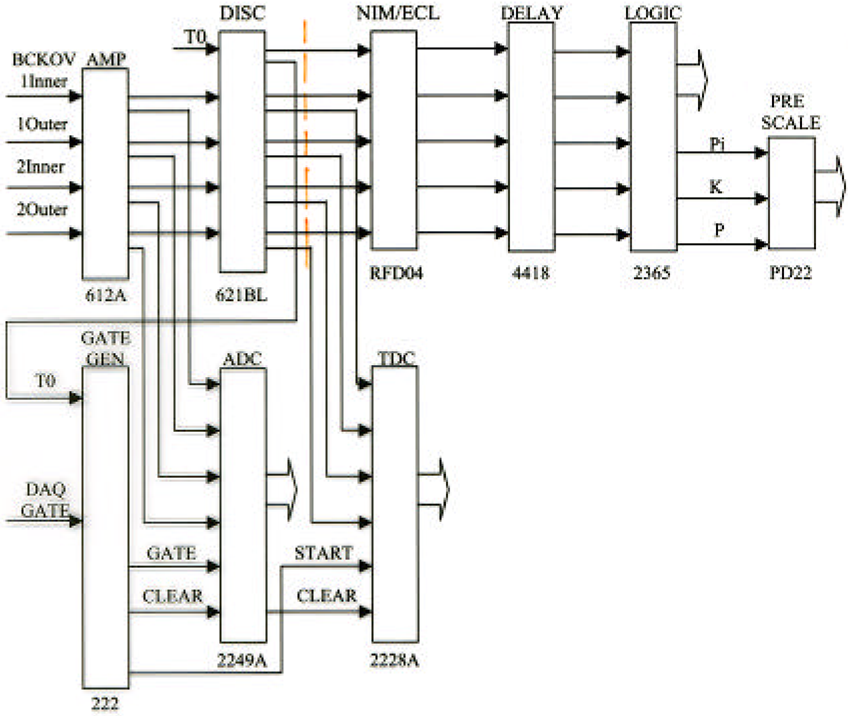
								He	N	CO2	C4F10	C5F12
mass=			0.94		0.14	0.49	0.938	3E-05	3E-04	5E-04	0.001	0.002
mom	%p-	%p+	p(mr)	index-1	pi(mr)	k(mr)	p(mr)	psia	psia	psia	psia	psia
5	6.20	5.92	7.00	0.01748	183.55	157.65	7.00	#####	#####	#####	#####	132.46
10			7.00	0.00442	92.78	79.83	7.00	#####	#####	#####	44.66	33.47
15	3.88	17.58	7.00	0.00198	62.17	53.57	7.00	#####	#####	64.65	20.01	15.00
20			7.00	0.00112	46.88	40.47	7.00	#####	60.50	36.73	11.37	8.52
25	2.91	30.26	7.00	0.00073	37.75	32.66	7.00	#####	39.20	23.80	7.37	5.52
30	2.53	37.13	7.00	0.00051	31.70	27.49	7.00	#####	27.63	16.77	5.19	3.89
40	1.83	52.23	7.00	0.0003	24.23	21.14	7.00	#####	16.12	9.79	3.03	2.27
50	1.22	67.46	7.00	0.0002	19.83	17.42	7.00	92.22	10.79	6.55	2.03	1.52
60	0.73	80.29	7.00	0.00015	16.97	15.03	7.00	67.49	7.90	4.79	1.48	1.11
70	0.39	89.38	7.00	0.00011	14.99	13.38	7.00	52.57	6.15	3.73	1.16	0.87
80	0.17	94.91	7.00	9.3E-05	13.55	12.18	7.00	42.89	5.02	3.05	0.94	0.71
90	0.06	97.88	7.00	7.9E-05	12.46	11.30	7.00	36.25	4.24	2.58	0.80	0.60
100	0.00	99.29	7.00	6.9E-05	11.62	10.61	7.00	31.51	3.69	2.24	0.69	0.52
110	0.00	99.85	7.00	6.1E-05	10.96	10.08	7.00	27.99	3.28	1.99	0.62	0.46

TABLE 5: Angles and Gas Pressures for Protons at 7 mr

BEAM CERENKOV COUNTERS LOGIC DIAGRAM

19 December 2003

W. Baker



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