PS/Int. EA 60-12
20th September 1960

BRIEF NOTES ON BERKELEY CONFERENCE.

(Further information can be obtained from other CERN members who attended).

MONDAY 12TH SEPTEMBER 1960, A.M.

H.P. FURTH : HIGH MAGNETIC FIELDS.

Described magnet in Berkeley using capacitor bank which has had 4×10^4 pulses at 200 kG. External dimensions $\sim 30 \times 30 \times 30$ cm. Wire wound and well bolted with Aluminium end cheeks to use eddy current confinement of the field. The total magnetic energy on pulse is 6.4×10^3 J of which 40 o/o in useful volume.

S.D. WARSHAW : PULSED MAGNETS.

Described helical coil about 10 cm long with 2 cm bore used in polarisation of Λ^0 experiment reaching 200 kG.

L. MARSHALL : USES OF HIGH MAGNETIC FIELDS.

Spoke of possibility of making 12 cm x 12 cm x 100 cm magnetic field for 1/10 sec as switching magnet. Proposed use homopolar generator as portable source to give 500 kG.

Also quadrupoles. Total length of system of 50 cm could focus $\Sigma^{charged}$ in distance of 2 decay lengths.

R.F. POST : CRYOGENIC COILS.

Advances in the production of ultra pure metals and cryogenic engineering have made cryogenic coils possible. Have been worked on in order to attempt to reduce cost for long term operation of steady magnetic fields for plasma devices.

PS/1939

Can obtain 75 kG over several litres for 1 min. Superconductors are presently excluded.

$$\text{Efficiency of refrigeration } \frac{Q}{W} < \frac{T_{operating}}{T_{exhaust} - T_{operating}} \ll 1$$

for practical cases

For the refrigeration

$P_{total} = P_{magnet} \cdot G_R$ where P_{magnet} is the power dissipated in the magnet and G_R is a factor

$$G_R = \left[1 + \frac{1}{\eta} \left(\frac{T_E - T_o}{T_o} \right) \right] \gg 1$$

May have 100 times power in refrigerator compared with coil. (η is efficiency of refrigerator as machine). However magnetoresistance is the real criterion.

Pure Na in ~ 2 o/o cast of pure Cu volume for volume, Is distilled directly into stainless steel tube for conductor. For conductor of ~1 cm^2 by few metres long resistances diminishes by a factor of order of 7000 for a temperature change from 0°C to a few °K and no magnetic field. This is about 3000 times down on resistance of Cu conductor of equivalent dimensions.

Temperature must go below 30°K and preferably down to 10° K before overall efficiency of the system makes competitive proposition with Cu coil.

Calculates for BC magnet coil, inner radius 50 cm, outer 150 cm length 200 cm, weight 15 tons, field 40 kG.

$$\rho \sim 6.1 \times 10^{-10} + 4.7 \times 10^{-10} \, \Omega$$

$I^2 R \sim 3$ kW and compressor for refrigerator ~300 kW.

Na @ $ 1/kg	15000
Construction	60000
Refrigerator @ $ 500 / kW	150000
Miscellaneous	25000
	250000

Power bill $ 6000 per annum

PS/1939

Normal coil would weigh 100 tons and require 6.5 MW

Coil	400000
Power supply	390000
Cooling	130000
	+ 10000
	930000

(In the discussion I mentioned that this figure seemed high, cf. our bubble chamber ~ $ 300000 for equivalent apparatus).

J.J. MURRAY : GLASS CATHODES IN VACUUM INSULATED HIGH VOLTAGE SYSTEMS.

Should be able to obtain electric fields >> 60 kV/cm.

1. Chooses glass for electrode surface (cathode). Must have time constant for equilibrium charge distribution low.
2. Local fields ϵ/ϵ_0 i. $\rho > 10^7$ to 10^8 V/cm
3. Writes down dimensional relation for stability against discharge damage. Only useful variable is ρ

Uses ρ in range 10^4 to 10^8 Ω cm by heating glass electrodes. Over 5 cm gap has obtained 450 kV, i.e. 90 kV/cm.

Hopes to get another factor of 3 - do not understand why. Uses increased pressure in tank.

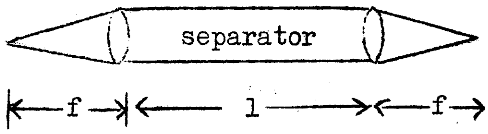
GOOD : ELECTROMAGNETIC SEPARATION AT HIGHER ENERGIES.

Considered separation of K^- and $\bar{p}$ from π^-. With RF at 10 cm wavelength could work up to 10 Gev/c with 150 ft. (See UCRL 8929).

Considered DC separator. Always aperture 2 1/2" x 5 1/2"

$$\frac{\Delta p}{p} \quad 2\ 1/2\ \text{o/oTransmission} \quad T = \frac{1}{f^2}\left(e^{-n}\left(\frac{1+2f}{Lo}\right)\right)$$

where n is no of stages and



Separation of images $S = \frac{\Delta\theta \, . \, f}{\delta x} = \frac{E\,l\,f}{\delta x} \left(1/p \left(\frac{1}{\beta_\pi} - \frac{1}{\beta_K}\right)\right)$

$$\sim M^2/p^3 = \text{const.}$$

Can write $\frac{E\,l\,f}{\delta x} \sim p^3$

Suggests to scale system as $p^{1/2}$ since then the trajectories in strong focusing part scale. To push to higher momenta would propose separation of lines at 0.5 mm which would need considerable refinement of transport system.

Could introduce component to achromatise the system such that $f_v = A + B_K$.

MONDAY, 12TH SEPTEMBER 1960, P.M.

HUGHES : ON POSSIBILITY OF A BC SENSITISED BY ULTRASONIC RADIATION.

Have observed some effect in isopentane (C_5H_{12}) at 25°C and atmospheric pressure. Some bubble growth from cycle to cycle - but no tracks. Used barium titanate transducer 2" diameter so that the standing wave was in the centre of the cylinder. Tried in neutron beam. Cavitation occurs sooner with beam on then with beam off.

BROWN : XENON CHAMBER.

Volume 21 litres, 10" diam x 12" deep, metal piston driven by fluid. 70 mm film clear base. Radiation length $\sim$3.6 cm. Would need B = 125 kG to get signal as to sign of particle above scattering noise.

60 Mev π or 120 Mev p stopped $\sim$ 60 cm.

Can identify e and distinguish between π and p from stopping. $p\beta$ measured at 790 Mev for π agreed with known value as test of ability to handle scattering. Liquid Xe $\sim \$ 10^4$ per litre.

CHUVILO : RUSSIAN Xe CHAMBER.

Has studied scattering relations experimentally in good agreement with predictions.

BOWEN : RAPID CYCLING CHAMBER.

Small heavy liquid chamber already at 5 cycles per second. Expect to reach 20.

Resonant expansion.

MULLINS : PULSED RESONANT SYSTEM BC.

Small chamber - useful arrangement of filler tube which shuts automatically during expansion to stop geyser.

LOUTTIT : PERFORMANCE OF BROOKHAVEN.

20" HBC
Chamber 19" x 8" x 10" deep - Soft aluminium - Have taken 3.5×10^5 photos.
0.8 o/o ratio - 17 kG.
Residual curvature $\sim$ 200 m Σ (x y) 15μ

HITCHCOCK : REDUCTION OF OPTICAL TURBULENCE IN GAS EXPANDED BC.

Description of modifications to refrigeration of 72" chamber.

KADYK : BUBBLE CHAMBER HODOSCOPE.

4 x 4 array of 4 overlapping scintillators plus one complete coverage. Gives 16 positions. Data read into I B M punch.

SELOVE : USE OF ENTRANCE HODOSCOPE FOR PARTICLE IDENTIFICATION IN VERY H.E. BC EXPERIMENTS.

Array of 15 x 20 scintillators looked at by PM tubes $\not{g}$ 10 each. Circuitry gives spot on oscillo, reproducing particle position. π K or p identified with Čerenkov.

RAMM : CERN P.B.C.

ROSENZON : CAMBRIDGE HEAVY LIQUID CHAMBER.

Methyl Iodide + C^3H^8

ROUSSET : ECOLE POLYTECHNIQUE BUBBLE CHAMBER.

300 litres - 1 m x 50 x 50 cm - 55000 photos in C^3H^8 - 150000 in mixture CF^3Br + C^3H^8 at Saclay - 15000 in p 25 Gev/c - 12000 in π^- 17 Gev/c at CERN.

	l (cm)	Calc. scatter (mm)	Meas. scatter (mm)	Filling
Beam π^- 1.15 Gev/c	50	0.76	0.78	C^3H^8
		1.55	1.48	mixture
p 25 Gev/c	90	0.16	0.21	mixture

Curvature no field ~ 500 m

m d m ~ 300 Gev/c

DZHELEPOV : ONE METER PBC IN MAGNETIC FIELD.

B = 15.5 kG - 1.4 x 0.7 x 0.6 volume of field (not PBC)- Use 80 mm film.

Programme $\Sigma^0 \longrightarrow \Lambda^0 + \gamma$

$\Xi^0 \longrightarrow \Lambda^0 + \pi^0$

Search for hyperons and leptonic modes of decay.

PERFORMANCE AND CAPABILITIES OF BUBBLE CHAMBERS.

TUESDAY, 13TH SEPTEMBER 1960, A.M.

HAHN : RELATIVISTIC INCREASE IN BUBBLE DENSITY IN C Br F_3.

Exposed in 16 Gev/c π^- and 24 Gev/c p beam at CERN. Bubble densities of primary tracks compared with decay tracks of K^0 and Λ^0. In 90 o/o of all cases it was possible to decide whether K^0 or Λ^0, i.e. distinguish π and p.

Showed diagram with ~30 o/o relativistic rise between ~10 and 100 γ

If mean δ - ray energy is much greater than mean ionisation potential of atoms in BC liquid no relativistic rise can be expected.

Has examined distribution of the bubble density of tracks relative to both primary π^- and secondaries and inferred from Coulomb scattering that mean energy of secondaries was 1.17 Gev. Over temperature range from 33°C to 43°C has found same mean γ from relativistic rise curves, i.e. no dependance of relativistic rise on temperature.

ALVAREZ : EXPERIENCE WITH LARGE H.B.C.

No magnet model studies were undertaken, but small HBC used to study cryogenic problems. Design commenced when only a 4" was working.

Chamber is 72" x 20" x 15" ~ 500 litres in 18 kG ± 1 kG - weight 200 tons single pole piece and can walk 60 miles per year - 2 generators each 1 1/2 MW.

No trouble to programme out magnetic field variations and considers this preferable to model studies. Computer time cost for this ~ $ 700 per annum.

Took 10^6 pictures last year - works at 11 pulses per minute. Refrigerator 1500 2000 W. Distortion due to turbulence > 200 m radius of curv.

When chamber first operated engineering runs occupied 2 months. Then worked in $\bar{p}$ beam and found $\bar{\Lambda}$ - Has observed about 22 x 10^3 $\bar{p}$ at 1.1 Bev/c. Runs 24 hrs per day since May. Commenced end of 1959. At present K^- into 15" chamber and π^- into 72". Described accident due to cooling of expansion line. Has heated Grove valve by water circulation. Tracks have ~ 10 bubbles/cm.

Magnetic field contained in 4th order polynomial. 6th order is required and is being programmed.

Costs : uses 5500 litres liquid nitrogen per day.

	\$/day
Nitrogen	350
Power	1100
Film	1300
Crew (15 men)	950
Services	650
	4350

Reliability is about 90 o/o of Bevatron "on" time which is 80 o/o but chamber servicing is often during Bevatron "off" time. Lost time - expansion line 2 o/o, film change 4 o/o other 3 o/o.

Can be warmed up and cooled down in 5 days (record). Has operating crew and beam watchers who see that beam is as planned.

Most of Bevatron time is devoted to strange particle experiments.

Large chamber is good for kinematics and double scattering, e.g. of $\bar{p}$ and K^o. - Can be used as energy degrader.

There are plans to make a much thinner window since Landau effect spoils energy definition. With new window will subtract energy of δ rays to define primary energy. Will use narrow momentum pass band.

The curvature of δ rays is used as a powerful aid in particle identification for $\gamma \sim 10$. Can certainly distinguish π from μ. $E_\delta \sim (\frac{M_1}{M_2})^2$

The film is available for inspection by bubble chamber crew 2 -3 hours after exposure.

In the discussion Glaser claimed (and Alvarez disagreed) that velocities of BC liquid could have been calculated in 1955. MacMillan stated Bevatron energy was originally planned at 10 Bev as sound figure but reduced for economic reasons. However, the reduced energy was kept about the threshold of $\bar{p}$ production.

It was thought that the cost of picture analysis was about $ 3000 per day. Each event~$ 50. Lundby thought $\bar{p}$ scattering was a typical counter event. Rosenfeld estimated with 15" chamber 1 event / 1 to 2 man/hours.

GLASER : COMPARISON AMONG TYPES OF BUBBLE CHAMBERS.

		H_2	C_3H_8	CF_3Br	Xe
Density (gm/cm^3)		0.06	0.44	1.5	2.3
Radiation Length (cm)		1145	110	11	3.7
Mean Free Path (cm)		445	115	59	56
KE slipped in 25 cm (Mev)	π	27	60	100	115
	K	47	100	165	178
	p	62	132	210	227
Mom.error o/o in magnetic field		1.4	4.5	14	24

Magnetic field 20 kG track 25 cm

Until now largest amount of HBC time at Berkeley is study of associated production

$$\pi^- + p \longrightarrow Y + K$$

$$\underset{(ord)}{K + p} \longrightarrow Y + \pi$$

There are techniques to identify hydrogen events in propane up to 1 Gev. May be much more difficult at CERN energies.

μ catalysis was studied in HBC.

Helium chamber is completely safe and works at 1 atm. No special properties as regards stopping or radiation detector but has special nuclear properties. Spin and isospin zero. May be used to determine relative parity of K and Λ and in general study of hyperfragments. The resonance in p, He scattering gives useful polarising facility.

PS/1939

In C_3H_8 polarisation studies also possible on account of zero spin of C^{12}.

At Carnegie Tech $\mu^- + C^{12} \longrightarrow B^{12} \longrightarrow e^-$ decay

The μ's are produced by π decay in flight and are longitudinally polarised. Experiment is to see if B^{12} remembers polarisation of μ and is performed by having film motion and flashing twice to distinguish between μ - e decay and μ capture and delayed B^{12} decay.

List of experiments is impressive. φ values of negative cascades, mass difference of K_1 and K_2. Leptonic decay of Λ^{15} in both HBC and PBC. For a given running time K^- beam produces many more Λ's. Fraction of Σ's getting out of interaction is influenced by presence of other nucleons. The Σ^0 was first seen in a PBC. Freon and Xenon not yet produced much physics. Can be used to study branching ratios in neutral modes of decay.

For future heavy liquid chambers for neutrino interactions. p + e identification should be good. Also useful for background measurements.

In case of freon filled chamber and 10 Gev/c K's and π's should be able to separate bubble density of π from K on 25 cm track within 3 standard deviations giving 1/20 chance of error.

Possible to have scintillator in bubble chamber liquid - liquid helium is a good scintillator. Imagines may be useful to have small HBC in centre of PBC, may be useful to have plates in chamber.

NIKITIN : - Described use of He refrigerator for cooling HBC in order to make safer installation. Could also be used for cryogenic pulsed magnet.

PEYROU : - Stated CERN liquefier will be low pressure in any case. It is possible to dissolve 20 mole o/o of He in liquid hydrogen at vap. press. < 3 atm.

SHUTT : - Brookhaven will have 80" chamber with retrodirected illumination and resonant expansion. In the present beam set up with 20" have a skew bending magnet to make better beam entry into the chamber.

ALVAREZ : - At present studying 25" HBC with upper glass condenser lens and photography from below. Without recirculation for high purity of hydrogen.

THOMPSON : - Spoke of enormous PBC for neutrino experiments may be. Linear dimensions 2 to 5 m. Wondered where the window would come from (so did I!).

PEYROU : - A change in operating temperature of 0.02 ^{o}K gives 5 o/o change in mean gap length. Cannot refer from one photo to another.

ALVAREZ : - Is not convinced of utility of bubble density measurements because of small total number of bubbles in a track with 10 bubbles/cm. Better to use a hodoscope technique for identifying particles - also δ-rays. Difficulty is to determine angle between δ ray + track. Suggests use of a special stereo viewing system.

DEVELOPMENTS OF GENERAL INTEREST IN DETECTORS AND CIRCUITS.

TUESDAY, 13TH SEPTEMBER 1960, P.M.

SANDS : - Reviewed some of major points from papers of previous day which included low noise wide band amplifier (O'Hara). Italian paper on multi channel pulse analyser. Tunnel diode.
He considered most important development needed is a fast transistor gate.

VON DARDEL : - Recent developments in Cerenkov Counters.

$\text{Cos } \theta_c = \frac{1}{\beta n}, \quad I = K\, l \sin^2 \theta_c$

Over visible region K $\sim$ 500 photons per cm. With quartz optics can gain factor 2 to 3.

$\frac{\Delta\beta}{\beta} = \Delta\theta_c \tan \theta_c$. Need low Čerenkov angle for high resolution.
Use of Axicon for compensation of dispersion.

VON DARDEL (continued) : - For gas Cerenkov - length $\alpha\ \gamma^2$ for a given energy selection.

For energy resolution $\delta = \frac{\Delta E_t}{E_t} \sim 0.1$ and $K = \frac{\Delta\theta_c}{\theta_c} \sim 0.05$

have $L = 0.1\ \gamma^2 \sim 40$ cm for 2C Gev/c

$W = 0.3\ g/cm^2$

Described Gas Cerenkov in CERN

KOZODAEV : - Review of spark chambers.

For efficient use probability of breakdown should approach 100 o/o.

1) Filling is important, 2) Memory for air, N_2, $CO_2 \sim 100$ µs. For A,Ne ~ 1 µs, 3) Will operate only if free electrons are available, 4) Counters with efficiency 100 o/o can be made by filling with He, Ne A.

Accidental breakdowns ~ 1 o/o, operate 2 - 5 kV. At press. ~ 20mm Hg discharge spreads and inefficient. Normally ~ 0.5 atm.

Possible to register number of particles at once in very short time. Applied voltage rise time must be fast $\sim 10^{-8}$ sec.

With 30 mm gap precision 0.5 to 1 mm. Spark follows direction of ionising particles to 35 to 40°.

When direction of ionising particle parallel to plates wave appears as line of spots.

Impulses switched from hydrogen thyratron, 2000 pf. ~ 10 to 20 KV DC clearing field. Transparent plates can be coated with SnO_2 thickness 1.7 to 2 µ.

YUAN : - Application of solid state devices to high energy particle detection.

Energy resolution of 0.3 o/o has been achieved. Response is linear and independent of particle at low energies. Solid state detector is analogous to a gaseous ion chamber. Requires 3.5 ± 0.7 e.v. to produce electron - hole pair, cf ~ 30 ev per gas. Get $\sim 4.6 \times 10^{-14}$ Coulombs/Mev.

Rise time $\sim 10^{-9}$ sec and signal $\sim 10^{-3}$ volts. One major source of noise is leakage current.

For Co^{57} γ have seen 122 Kev line with 6 Kev half width. Base material ~ 12000 Wcm p type. Reverse bias 200 V. Counters of order of diameter one centimeter and thick enough to absorb 300 Kev electron. Has used detector in 85 Mev π^- beam (Si (p,n) type) and line width as expected. Also in 750 Mev/c beam. Calibration constant over several days.

WIEGAND : - Handling of counter data.
Described data storing system.

HIGGENBOTHAN: - Counter data recording system.

PERL : - Use of NaI chamber to study (π,p) unelastic scattering.

LANDE : - Particle velocity measurement with a filamentary chamber - Image intensifier system.
Chamber ~ 2" face. Can see δ rays if ~1 Mev. Can measure velocity by use of deflecting plates in image intensifier with RF applied.
There is a 10" RCA tube available.

NEUTRINO EXPERIMENTS

WEDNESDAY, 14TH SEPTEMBER 1960.

YANG : - Reviewed current theories.
The process $\nu + n \quad p + e^-$ is independent of existence of W boson. Saturation value of σ at high energy of ν is ~ 10^{-38} cm^2.
If W boson has mass ~ 500 m_e then for
$\nu + Z \rightarrow Z + \mu^- + W^+$ could get $\sigma \sim 10^{-36}$

BLOKHINZEV : - Reviewed theoretical work in Dubna. Had predicted for $E \sim 10^{11}$ Gev that $\sigma \sim 10^{-35}$ cm^2.

REINES : - The ZGS at Argonne is expected to give 10^{13} protons/pulse at 12 Gev. Could have 30 ν events per hour in 1 ton water.

LEDERMANN : - Thought one should look for new ways of doing experiment. Has designed a new spark chamber ν detector.

RAMM : - Described possibilities with PBC and stressed difficulties.

COWAN : - Described scintillation counters filled with decalin.

GREISEN : - Described possible plasma solenoidal lens for pion concentration. For 6 Gev π and 10^6 amps could confine π's over 0.1 radians so that $10^{11} \nu$ /pulse ever 2 M^2 at 100 M from source.

REINES : - Estimates cosmic ray rate would give 1 event per day in 5×10^3 M^3 of water. At 2000' underground reduction of μ by 10^6.

PEYROU : - Claimed appearance of a single high energy e in PBC could be taken as certain identification of neutrino induced interaction.

ALVAREZ : - Produced a photo of a δ ray to indicate possibility of confusion.

HINE : - Features of CERN PS for experimenters.
Paper available in CERN

GREEN : - Report on AGS
Beam circulated end of May. Accelerated end of July to 31 Gev. Has not run above few Gev since. Expects 20 hrs/week for experimenters in January.

$R = 128.5$ M $\quad R_o = 85.37$ M $\quad Q = 8\ 3/4$
$B_{max} = 13$ kG, $\quad T_{max} = 32$ Gev, $\quad \dot{B} \approx 14$ kG sec^{-1}
Rep. rate 1 per 3 sec. At 10 - 12 Gev 1 pulse/sec.
Harmonic order 12 $\quad$ 95 Kev/turn
Have ordered 30 power supplies for experimental purposes, 30 quadrupoles and 14 bending magnets, 5000 tons concrete.

DISCHARGE CHAMBERS, BEAMS AND MISCELLANEOUS.

WEDNESDAY, 14TH SEPTEMBER 1960, P.M.

FUKUI : - Described microwave discharge chamber. Tracks seen, but poorly.

CRONIN : - Beautiful spark chamber. About 20 plates ~ 7" x 7" with 1.5 atm. Ne. Pulser 0.0025 μF through hydrogen thyratron in coaxial arrangement. Rise time ~15 ns. Decay time ~0.25 μs with 50 W dissipating resistor, ~10 kV. Two windows and 90° stereo photos with cylindrical lens to see inside.
Plates 9 mm space, 6 mm thick, copper plated Al. Has run 10^5 pulses with 300 Mev p no deterioration.

MEYER : - Thin foil discharge chamber. Very simple arrangement with Cu foil glued on perspex pictureframes to bring edges outside sensitive region 14" x 14". Can pulse again in 10 ms.

CORK : - Parallel plate spark chamber.
UCRL 9313 . Can put ~ 10^6 particles/sec in a magnetic field 13 kG. Beautiful examples of forking of track $\pi^- + p \rightarrow \pi^- + p$, believed surface unimportant.

FISCHER : - Face view spark chamber, A, 5 - 10 kV. repeated pulsing (always break down in old place) to increase sensitive time. Vacuum tube pulser with 4 PR68.

HEER : - Proposal for a scintillation coordinate counter. Reduction of PM tubes by light splitting and coding, e.g. 1000 fibres with 30 PM's.

CITRON : - High intensity μ - beam. CERN SC. With momentum analysis of π - then decay in quadrupole channel and subsequent μ analysis gets ~ 6000 μ/sec.

RAMM : - Beam handling equipment at CERN-PS.

SCHLEIN : - A new 800 Mev/c K^- beam of high purity at the Bevatron. Uses double separator system bent in centre.

STEFAN : - Generalised amplitude + phase functions for beam transport system. Proposes to construct analogue model.

BUMILLER : - Described two beam monitors for high energy electrons.

HOFSTADTER : - Described double spectrometer and also new proposal for Dumont type of solenoidal spectrometer. May be with cryogenic coils.

LEVEL : - Can photograph beam profile on 5" diam x 0.9" NaI crystal with $\sim 2 \times 10^5\ \pi/cm^2$ at 85 Mev.

INFORMAL DISCUSSION ON BERKELEY AND CAL TECH PROPOSALS FOR NEW HIGH ENERGY ACCELERATORS

THURSDAY, 15TH SEPTEMBER 1960, A.M.

	CERN	BERKELEY	BROOKHAVEN	CAL. TECH.
E Gev	25	100	30	300
B	12	12	12	12
E_i Mev	50	200	50	10^4
B_i	147	73	120	300
Radius M	100	400	130	1300
Aperture cm^2	7 x 15	7 x 15	7 x 15	1.5 x 4
$B/\frac{\delta B}{\delta x}$	11	11	11	4
Q	6.25	12.5	8.75	48
λ	16	32	15	27
n	288	1150	360	10^4
No of periods	50	100	60	330
Rel. sensitivity	1	1.4	1	2
Acc. Time sec	1	1	1	1
KeV/turn	50	800	90	8000
Harmonic	20	80	12	?

A study group is at work in Berkeley. Looking for possible site.

PS/1939
/fv

C.A. Ramm

Distribution : (closed)
PBC Group
Parameter Committee