

PLA - 89 - 6

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1 GeV リニアック検討資料

1 GeV LINAC DESIGN NOTE

題目 (TITLE) Beam simulation in the CCL linac with perturbed field
strength and phase

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概要 (ABSTRACT)

CCLは1本のクライストロンで4タンクを給電する。そこで4タンク毎の内部の電場分布の傾きと位相の傾きを考慮して、縦方向のビームの様子を調べた。

KEY WORDS:

Ion source, RFQ, DTL, CCL, Magnet, Monitor, Beam Dynamics,
Transport, Vacuum, Cooling
Klystron, Low level rf, High power rf, Modulator
Control, Operation, Radiation, Others

Beam simulation in the CCL linac with perturbed field strength and phase

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In our design, four tanks are driven by a klystron. Therefore, field distribution among the four tanks are considered. In this paper, only a longitudinal motion is taken into account, that is, the transverse emittances are set to be zero. The calculation is performed to find the distortion of the longitudinal acceptance and the variation of the energy width of the output beam. The set of injected particles are, therefore, distributed on the rectangular lattice points on the phase-energy plane.

1) Without errors

Transmitted particles are 544 and energy width (90% full)=8.58 MeV.

2) Field errors

Error 1.

The accelerating field varies linearly with cell number in a tank.



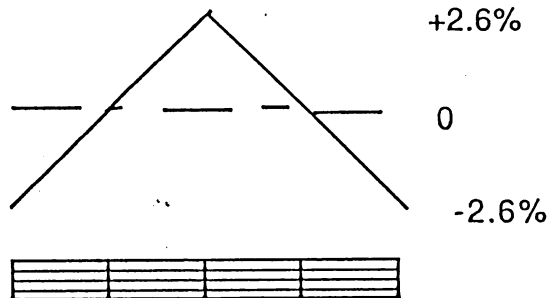
There is little change of acceptance and output energy width with this errors. Transmitted particles are 544 and energy width (90% full)=8.64 MeV.

Error 2.



There is little change of acceptance and output energy width with this errors. Transmitted particles are 545 and energy width (90% full)=8.46 MeV.

Error 3.



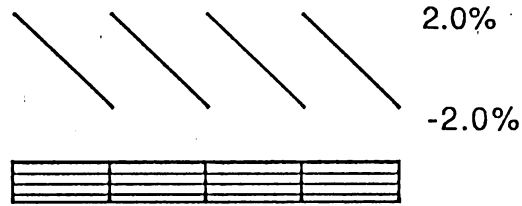
named [ETILT 2.6]

There is little change of acceptance and output energy width with this errors. Transmitted particles are 545 and energy width (90% full)=8.46 MeV.

3) Phase errors

Error 4. Phase error

The phase of the accelerating field varies linearly with cell number in a tank.



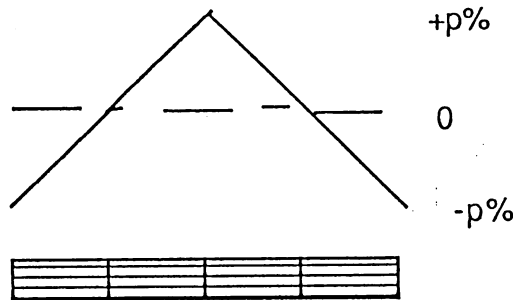
There is little change of acceptance and output energy width with this errors.
Transmitted particles are 545 and energy width (90% full)=8.52 MeV.

Error 5. Phase error



There is little change of acceptance and output energy width with this errors.
Transmitted particles are 543 and energy width (90% full)=8.64 MeV.

Error 6. Phase error

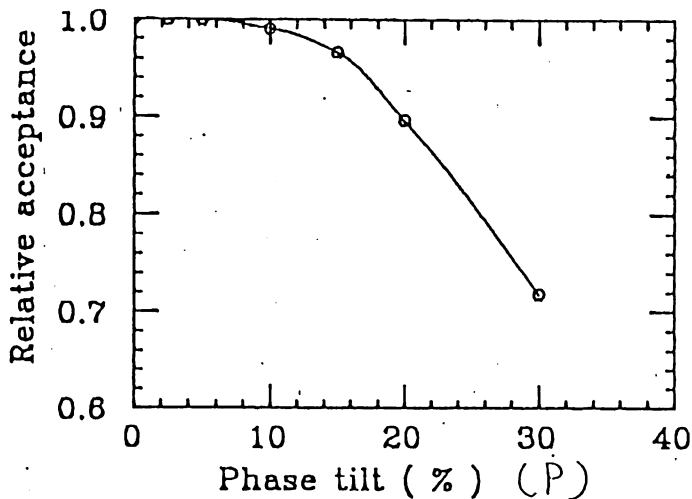


named [PTILT20]

P	N	%	$\Delta W(\text{MeV})$
2.5	544	100	8.46
5	544	100	8.34
10	539	99.1	8.94
15	526	96.7	9.60
20	488	89.7	9.96
30	391	71.9	9.48

N is number of transmitted particles.

% is the ratio compared with the numbers without errors.



4) Random errors

Error 7. Random field error

Random cell-field error of $\pm 10\%$.

Random tank-field error of $\pm 5\%$.

490 90.1 8.34

Random cell-field error of $\pm 5\%$.

Random tank-field error of $\pm 5\%$. named [ERR5,5]

496 91.2 8.04

Random field errors reduce the acceptance but do not change energy width. Longitudinal motion is insensitive to the random cell-field error.

Error 8. Random phase error

Random cell-field error of $\pm 5\%$ (max. is 1.5 degree)

Random tank-field error of $\pm 10\%$ (max is 3 degree).

named [PRR5,10]

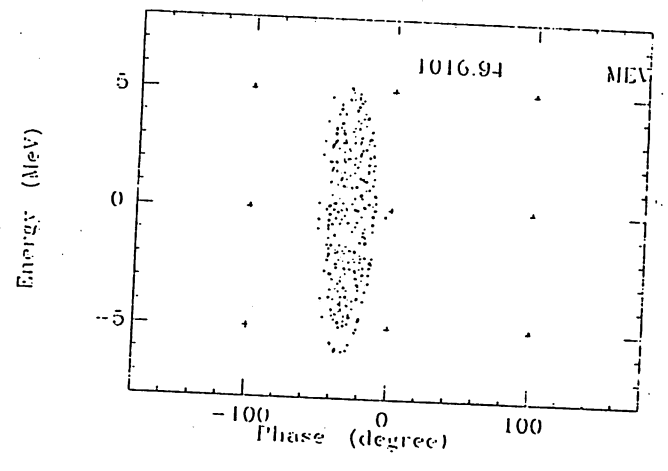
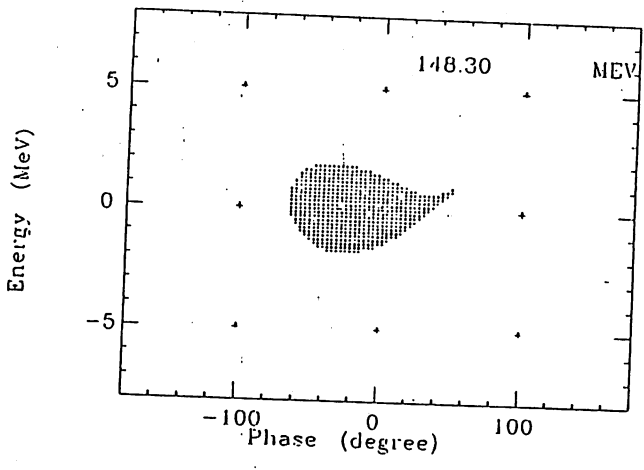
546 100.4 8.70

Random phaser error causes a growth of acceptance and output energy width.

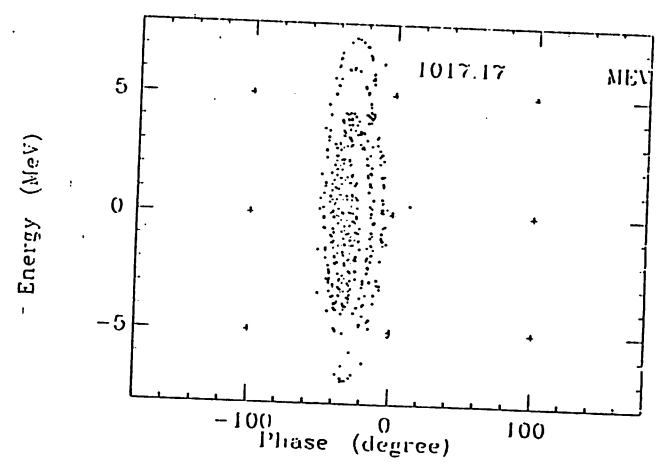
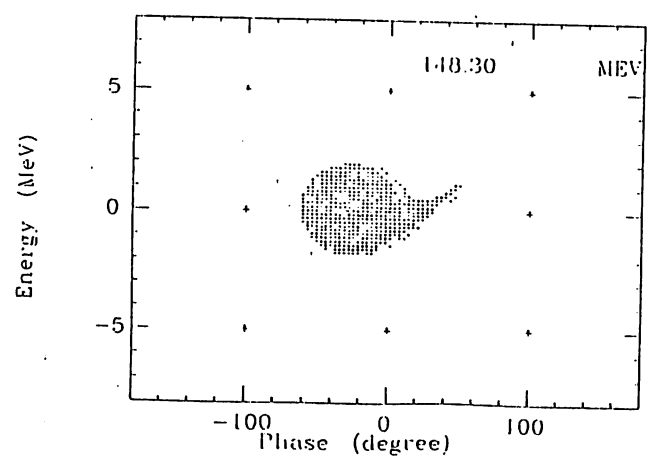
5) Mixing of errors

	N	%	$\Delta W(\text{MeV})$
1. no errors	544	100	8.58
2. [PTILT20]	488	89.7	9.96
3. [ETILT2.6]	545	100.2	8.46
4. [PTILT20] + [ETILT2.6]	482	88.6	9.42
5. [ERR5,5]	496	91.2	8.04
6. [PRR5,10]	546	100.4	8.70
7. [PTILT20] + [ETILT2.6] + [ERR5,5]	452	83.1	8.64
8. [PTILT20] + [ETILT2.6] + [PRR5,10]	480	88.2	10.02
9. [PTIL] + [ETIL] + [ERR] + [PRR]	454	83.5	9.48

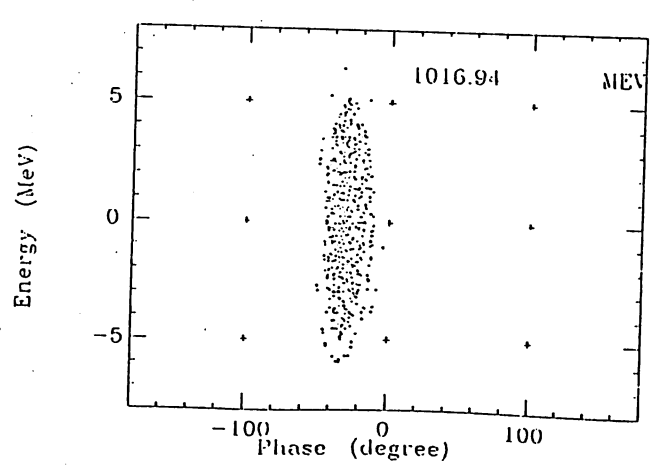
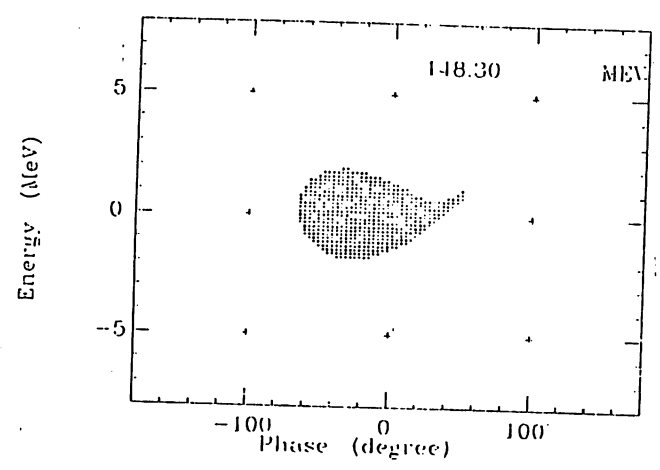
Now we are preparing ^{for} a bunched beam to study beam loss in the high-energy part of the CCL.



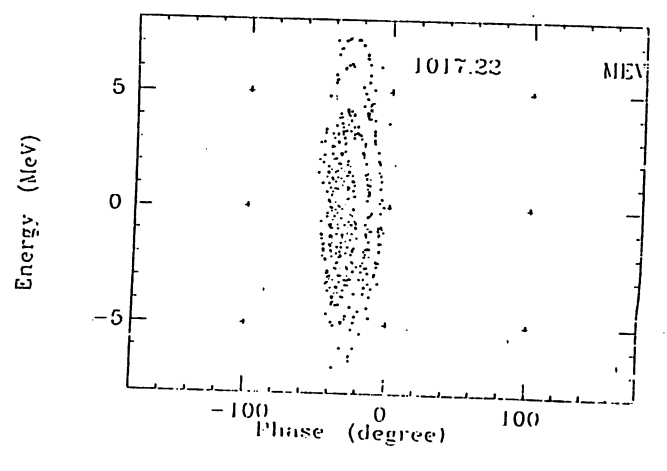
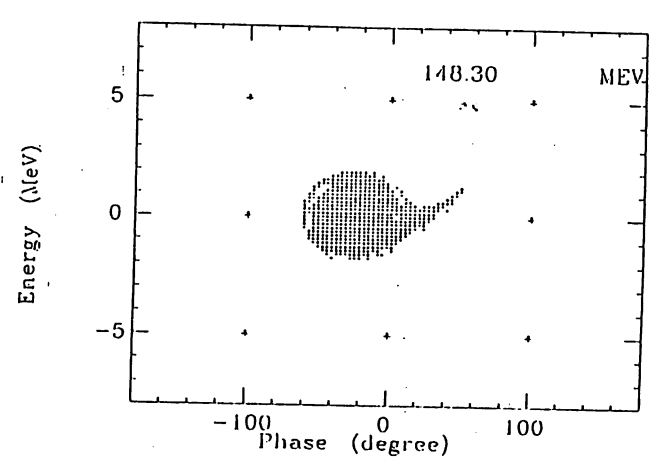
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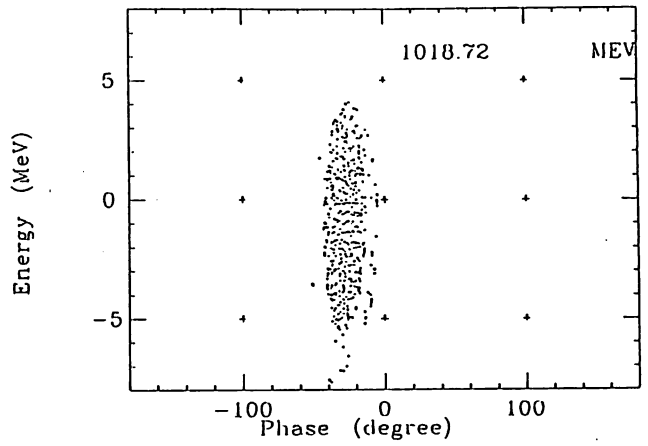
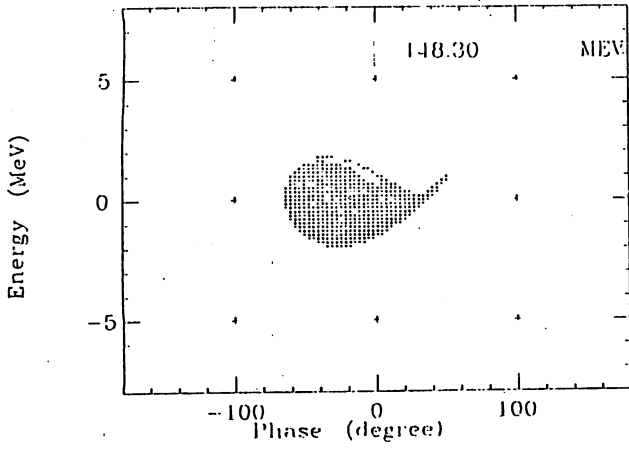
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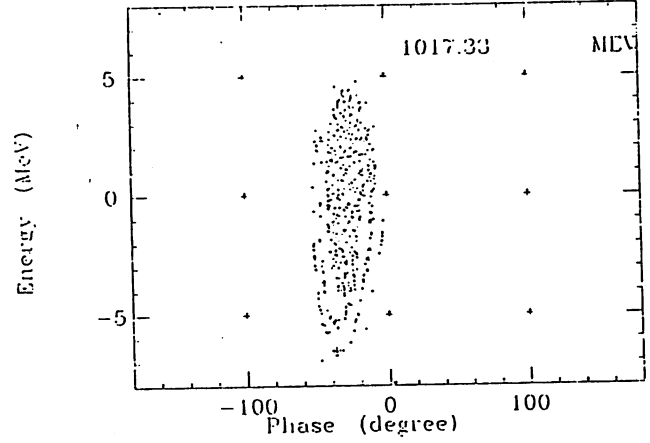
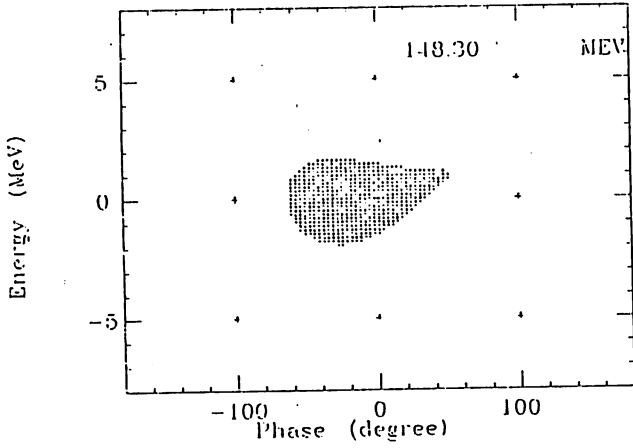
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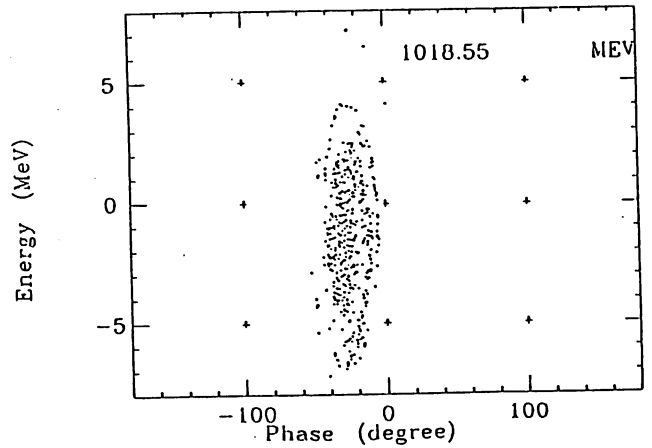
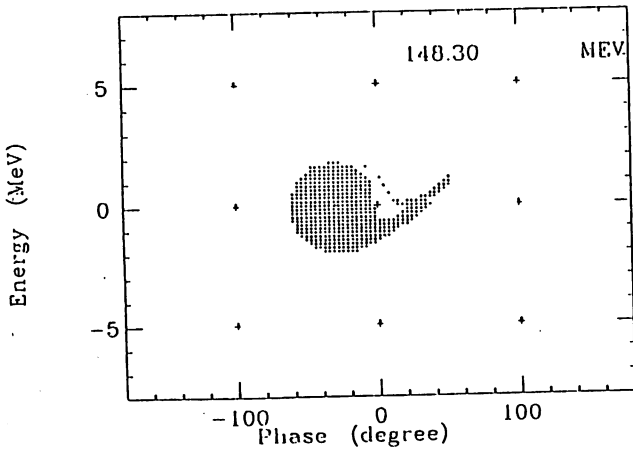
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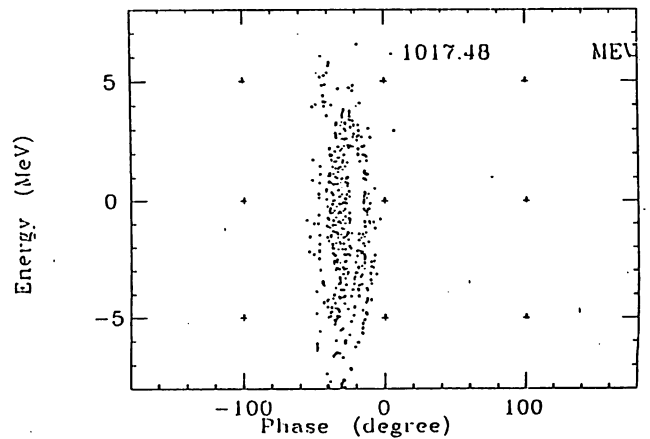
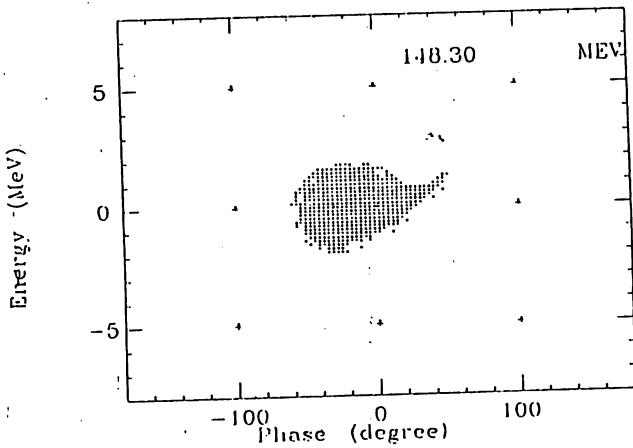
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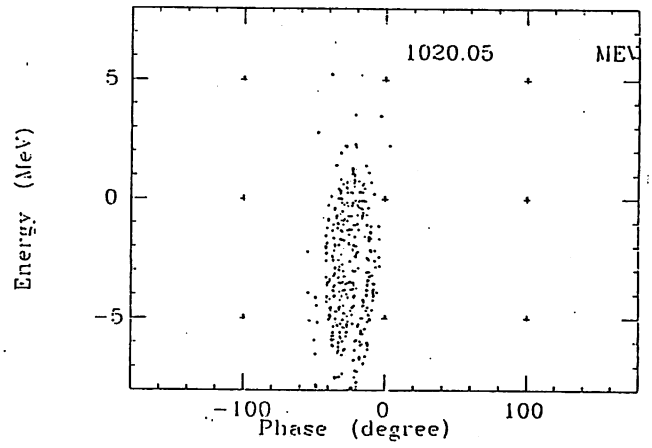
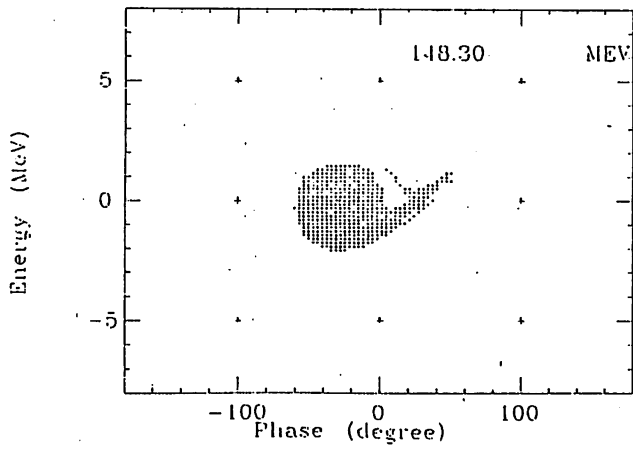
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