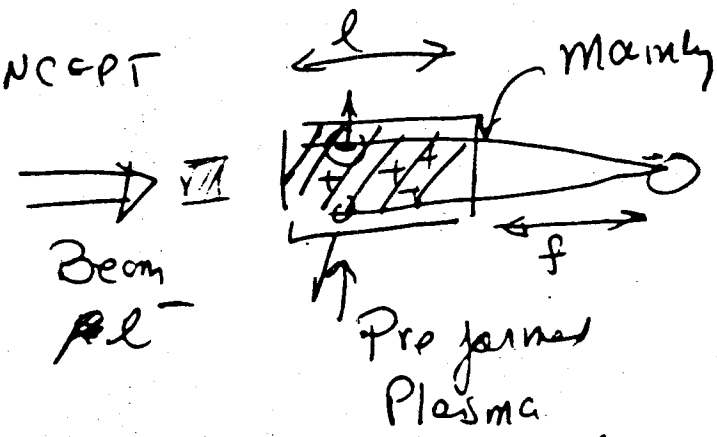
THE USE OF A PLASMA LENS FOR HIGH ENERGY COLLIDERS

D. Cline

D. CLINE UCLA

CONCEPT



Idea Partially compensate Field of Beam SELF PINCH

$f \sim$ (cm) $l \sim$ (few mm) Fields $\sim 10^3$ T

CONCEPT – Focus – x and y / Very short focal length Reduce chromatic effects etc etc

Three modes A) UNDER DENSE

NEARLY A PERFECT LENS

$d_{Plasma} < d_{Beam}$

$d_p \sim 10^{17}$

$d_{Beam} \approx 10^{18}\ cm^{-3}$ for SLC

B) NORMAL

STRONG LENS – Shorter f than underdense

$d_p \sim d_{Beam}$

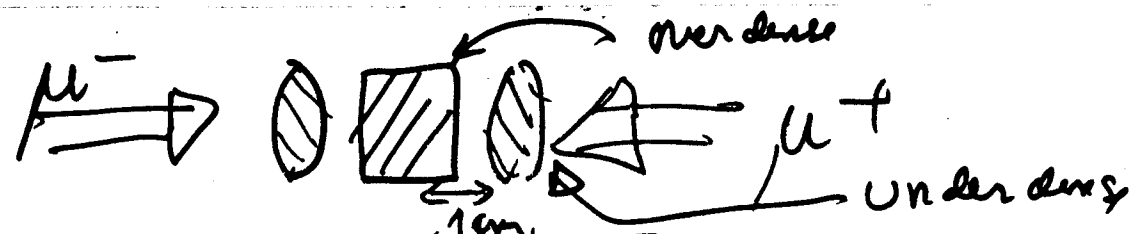
$d_p \sim 10^{18}$

C) OVERDENSE

$d_p \sim 10^{19}$

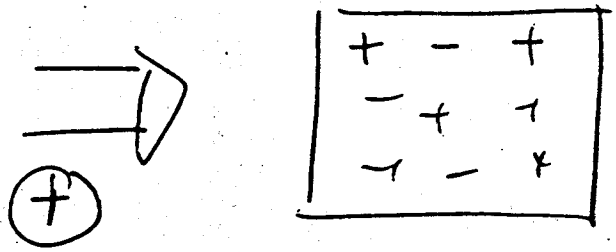
– Mainly for compensation? the Beam – Beam effects in Collider

$d_p > d_{Beam}$



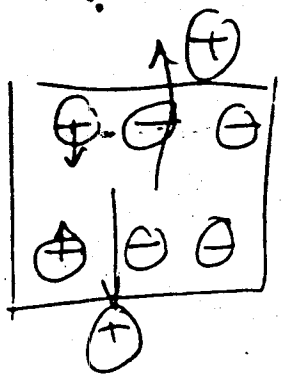
WHAT ABOUT ℓ^+ FOCUSSING

- EXPECT A SIMILAR EFFECT



PLASMA OR GAS

↓ AS BEAM GOES THROUGH



⊖ charges overdense in region of Beam

MONTE CARLO SHOW $f_{\oplus} \sim f_{\ominus}$

HOWEVER THIS HAS NEVER BEEN TESTED EXPERIMENTALLY

$\boxed{\text{EXPERIMENTS}}$ — FIRST TEST OF ⊖ PL

AT ANL IN ~ 80. ⟨ J ROSENZWEIG THESIS ⟩
U WISC (DBC/F. Mills, J Simpson)

SEVERAL OTHER TEST SO FAR

(UCLA (C Pellegrini / C Joshi
LBL / KEK

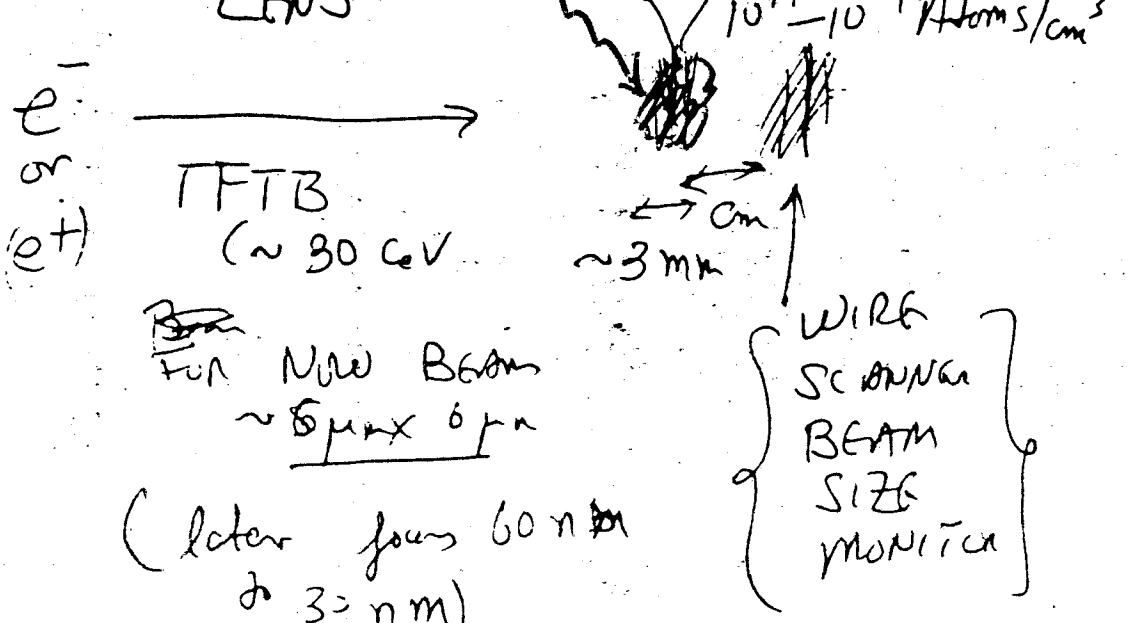
EARLY CALCULATIONS — PISIN CHEN (WHILE UCLA POST DOC) — RASA — (MY UCLA STUDENT)

SHOWED THE A P L COULD BE USED FOR THE SLC TO INCREASE $\mathcal{L}$ (~1994) AND FOR THE NLC TO ~~REPLACE~~ REPLACE SOME OF THE FINAL FOCUS (SIMILAR TO $\mu\mu$ COLLIDER)

EXPERIMENT E150 AT SLAC (SLAC/UCLA/USC/LBNL/LLNL/FNAL/... Coll.)

D. BC AND P. CHEN CO SPOKESPERSON (Bob Noble/FNAL/etc) + many good SLAC people

USE FFTB e^- (later e^+) BEAMS TO TEST PLASMA LENS FOCUS — AND TO STUDY THE QUALITY OF THE "LENS"



FOR NLC REQUIRE $d_{PLASMA} \sim 10^{19}$ Ions/cm^3 for UNDERDENSE CASE

STATUS of E150

- APPROVED IN 97-98
- STARTED RUN THIS SUMMER

- New UCLA Stand

MS Vidya Kumar Very good

TWO MODES OF OPERATION

1) SELF IONIZATION of GAS TO FORM PLASMA

EXPECT ~ 1-3 % IONIZATION

So $d_{GAS} \sim 10^{19}$ A/cm^3 $\Rightarrow$ 10^{17} Ions/cm^3

PLASMA UNDERDENSE CASE

2) PREFORMED PLASMA

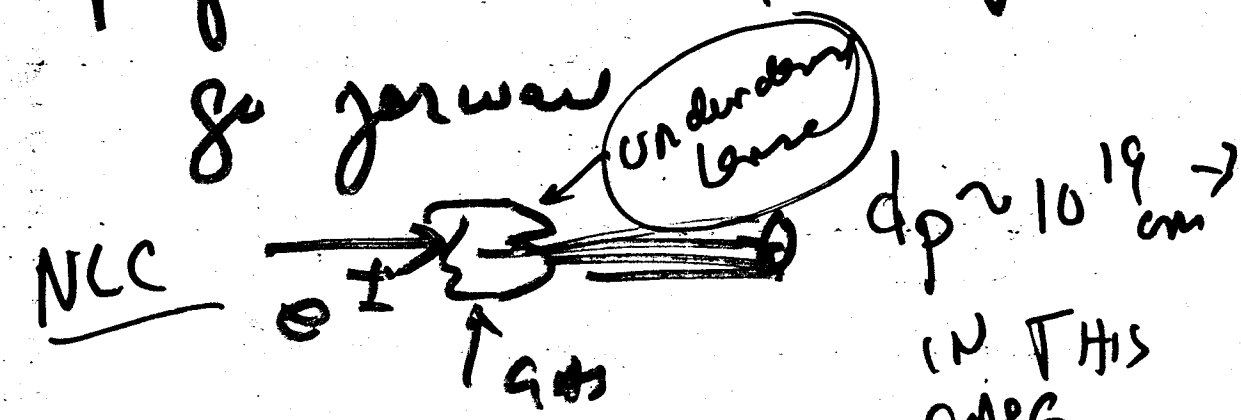
- USE E144 LASER TO PRODUCE PLASMA $d_p \sim 10^{17} - 10^{19}$?

!! HAVE NOW OBSERVED FOCUSSING WITH APPROXIMATE CORRECT PARAMETERS !!!

IN 2000 RUNS WE EXPECT TO TEST e^+ FOCUSSING FOR THE FIRST TIME

Backgrounds -

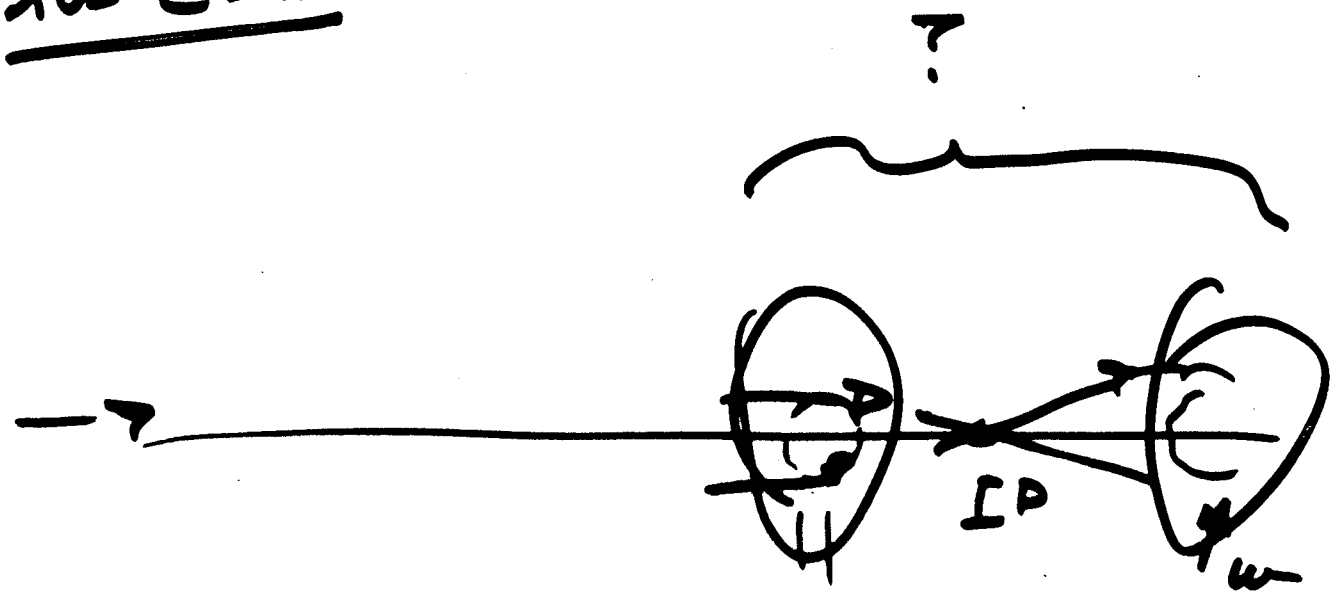
In order to get E150 approved by the SLAC EPAC we had to estimate the Backgrounds in a Detector for the NLC - this is an over proposal - Most of the particles go forward



IN THIS CASE

WE CAN CARRY OUT THE SAME CALCULATION FOR pp COLLIDER IN NEXT FEW MONTHS

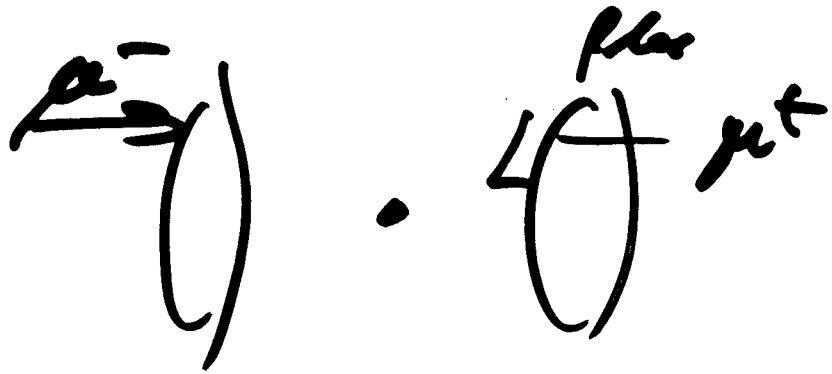
DAVE CLINE



→ Pision?
Clin

1) Plasma ionized by laser

2) Laser.. seeded the ionization



Mossy