# HHFW Summary

NSTX Results Review

September 10, 2002

JR Wilson for the HHFW Group

# Goals of the 2002 Campaign

- Recover and extend previous performance (Swain)
- Use scanning NPA to investigate NBI HHFW interaction (Rosenberg)
- Commission full phase feedback and explore current drive (Ryan, Bonoli, Mau)

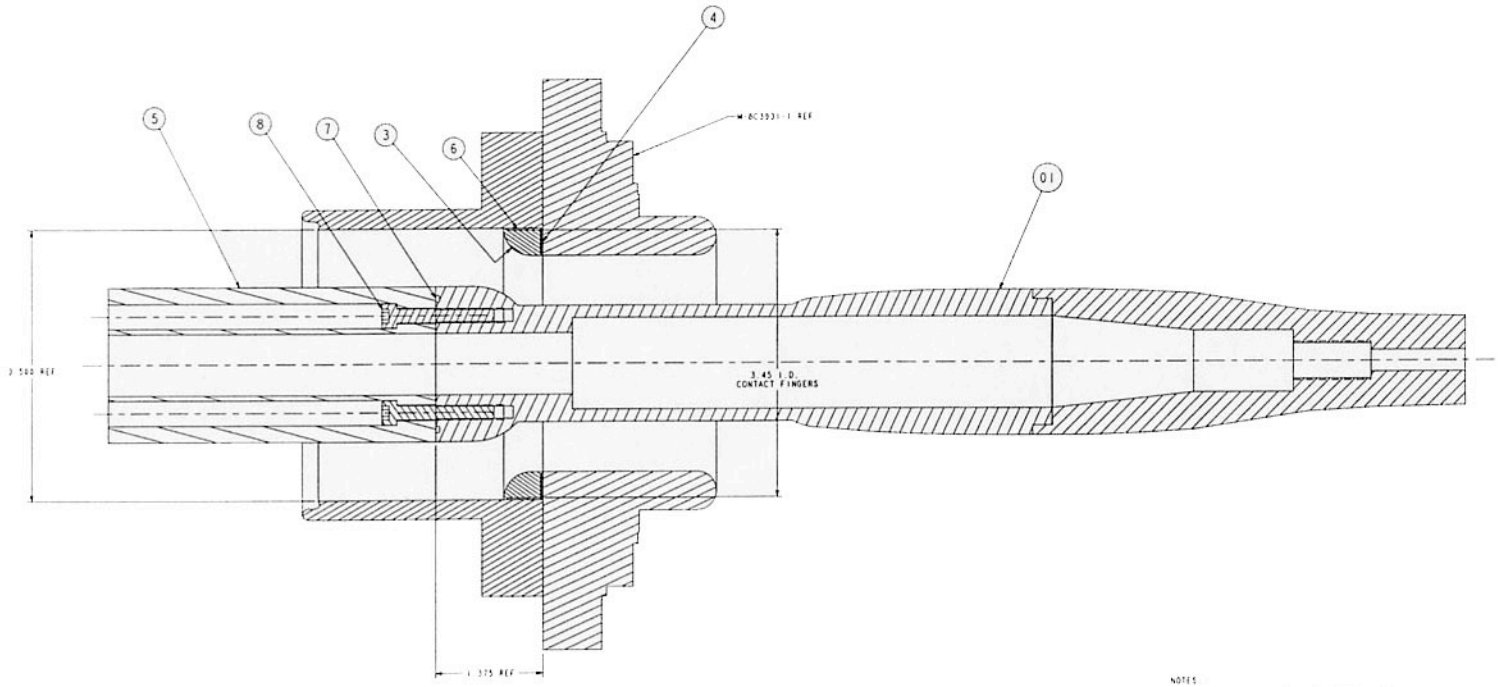
- Did not further explore H-mode physics or steady state sustainement due to time and power constraints

# Technical Aspects of Performance

- Full phase feedback system worked very well - allows phase relationship to be set between shot to an arbitrary waveform including a time dependant evolution during the shot
- Injected Power achieved was not satisfactory

# Power limited by voltage breakdown in the Feedthrough region

- For the first time the antenna performance did not increase this run
  - Power limited to ≤ 3 MW
  - More accurately antenna voltage was limited to ~ 12 kV max
  - All transmitters seemed to be affected (Swain)
  - One strap (#11) seemed somewhat worse
  - During opening arcing was found in the feedthrough region of associated with all transmitters




02

(12 REQ'D)
SCALE 2:00

NOTES:

1. VACUUM FURNACE BRAZE WITH COPPER ALLOY.

2. BRAZING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME B31.9 AND EM-002. VISUAL INSPECTION SHALL BE PERFORMED IN ACCORDANCE WITH THE ACCEPTANCE CRITERIA OF ASME B31.9.

| | | | | | |
|---|---|---|---|---|---|
| 6 | | 8 | SCREW, SOC HD CAP #10-32 x 1.25 LEN | COMM | SST |
| 1 | | 7 | ORING, PARKER 2-030 | COMM | |
| 1 | | 6 | CONTACT RING, INSTRUMENT SPECIALTIES#97-241 | COMM | |
| 1 | | 5 | FEEDTHRU CENTER CONDUCTOR EXTENSION | C-8C3843 | SEE DW |
| 1 | | 4 | GASKET, SPINNER | E-8C3H37 | SEE DW |
| 1 | | 3 | FILLER RING | E-8C3H36 | SEE DW |
| | 1 | 2 | CENTER CONDUCTOR INNER | THIS DWG SHT2 | OFHC COP |
| | 1 | 1 | CENTER CONDUCTOR | THIS DWG SHT2 | OFHC COP |

# Voltage limit (cont.)

- Breakdown occurring along field line
  - Interestingly, the region involved was present on TFTR and did not breakdown at this voltage
  - May indicate that the neutral pressure is higher in this region on NSTX
- We are increasing the separation between inner and outer conductors in this region to reduce E by ~ 40%
- If we went to a double end fed design as was discussed at the 5 year planning workshop a further ~40% reduction could be achieved

# Fast Ion Interaction

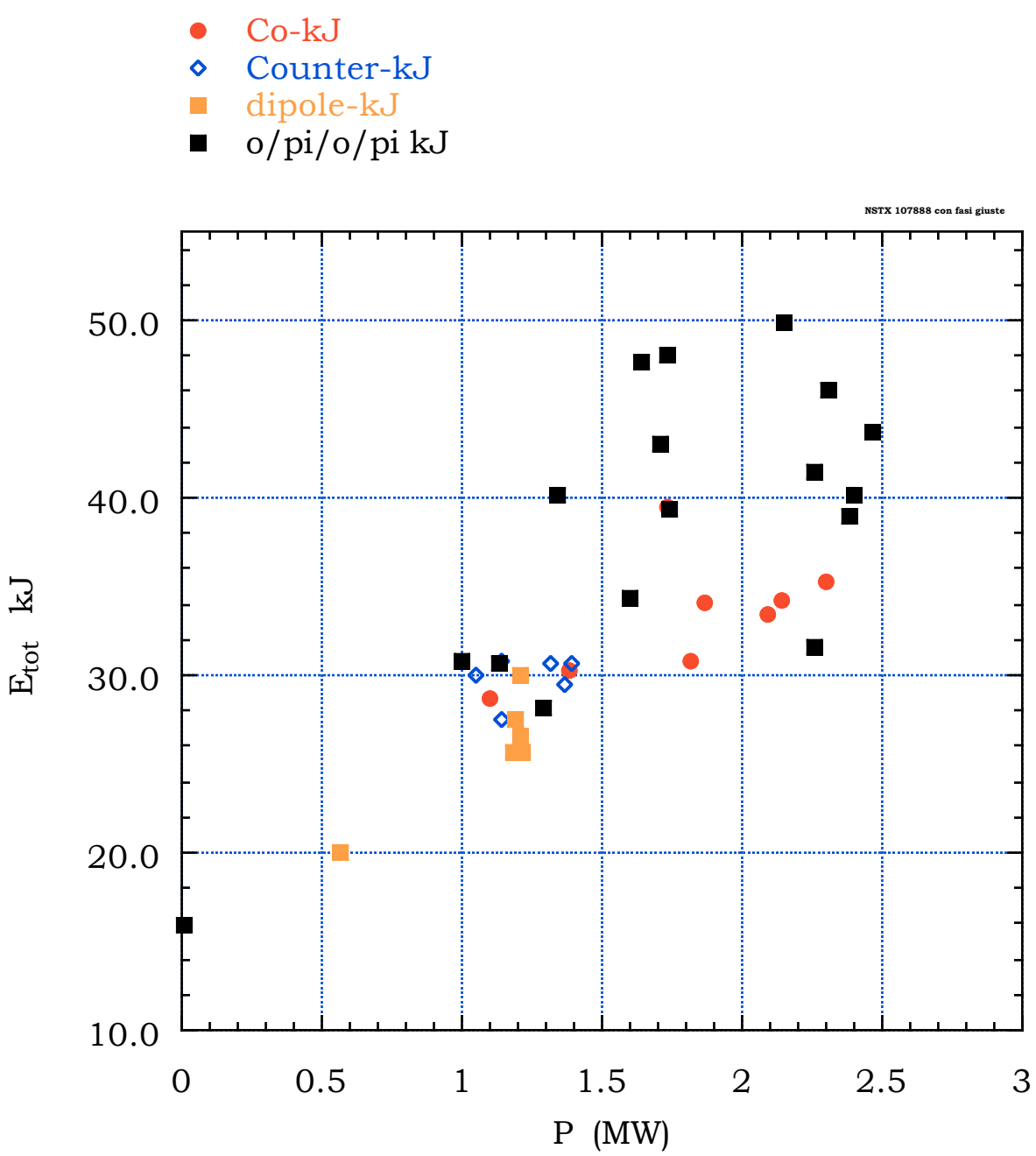
- An experiment was conducted to characterize HHFW- NBI fast ion interaction (Rosenberg)
- Was observed in previous run
- Utilized scanning NPA to look at velocity space structure, dependence on phasing, B etc.

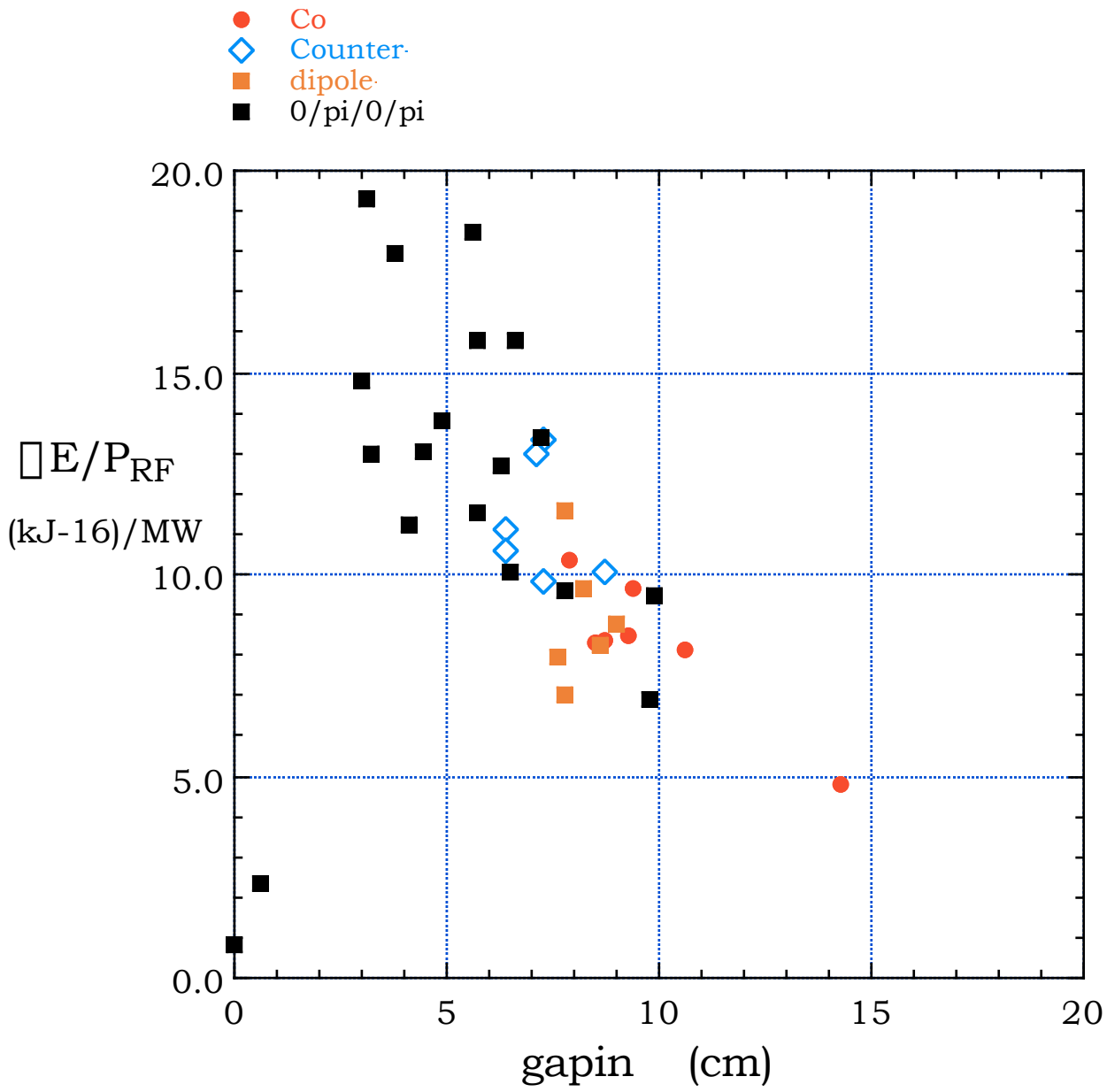
# Current Drive investigations

- Began investigation of CD by looking at $V_{loop}$ (Ryan)
- Found that we had to match discharge Temperatures and Densities very closely
  - Less power required for counter phasing
- Loop voltage differences were observed when central MHD absent
- Quantitative determination of total current driven difficult

# Other data analysis underway

- Systematic data base scan underway to understand parametric dependences of electron heating (Bernabei)
  - Looking at incremental confinement time as a function of inner and outer gap, D-alpha level, $n_e$, antenna phase etc.
  - Some indication of sweet spot in outer gap and dependence on inner gap
  - Some indication of ion heating
- Should provide insight for heating and current drive scenario progress


Co-kJ
Counter-kJ
dipole-kJ
o/pi/o/pi kJ
NSTX 107888 con fasi giuste
50.0
40.0
30.0
20.0
10.0
E_tot kJ
0
0.5
1
1.5
2
2.5
3
P (MW)


Co
Counter·
dipole·
0/pi/0/pi
20.0
15.0
10.0
5.0
0.0
0
5
10
15
20
ΔE/P_RF
(kJ-16)/MW
gapin (cm)

# Next steps

- Physical changes should raise arcing limit
- Looking forward to MSE measurements to help quantify CD
- Complete fast ion studies