Fortran90/NCAR Postprocessor for ICOOL Output Files

- Goals

  - to permit interactive examination of ICOOL macroparticle output information

  - to examine general properties of macroparticle subsets, *e.g.*

    How does the initial phase space distribution of particles surviving the induction linac/mini-cool section differ from the lost particles?

  - to determine and plot envelope properties vs. z for macroparticle subsets, *e.g.*

    Is $r_{max}(z)$ for ultimately surviving particles much smaller than $r_{max}(z)$ of local survivors, thus permitting a smaller beam pipe, magnet bore, RF cavity bore, *etc.* ?

- From this data-mining, one hopes to discover strategies to better optimize transport lattice properties to increase surviving muon fraction, decrease cost

Why use Fortran90, NCAR?

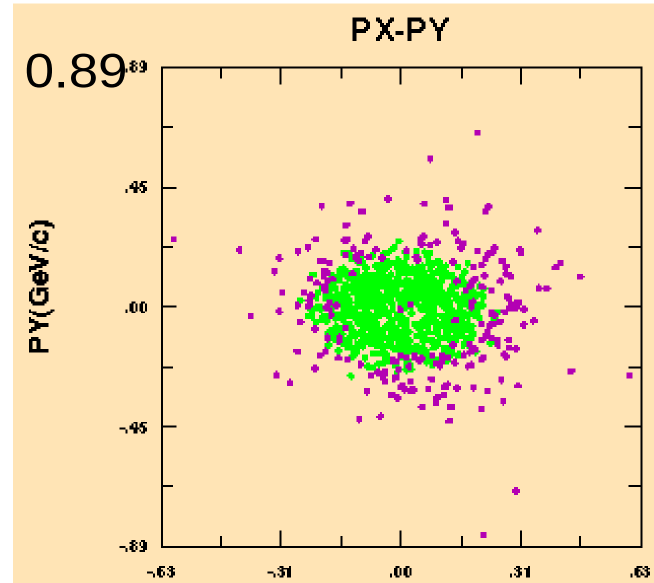
- Personal preference (obviously) & experience in porting FEL code GINGER

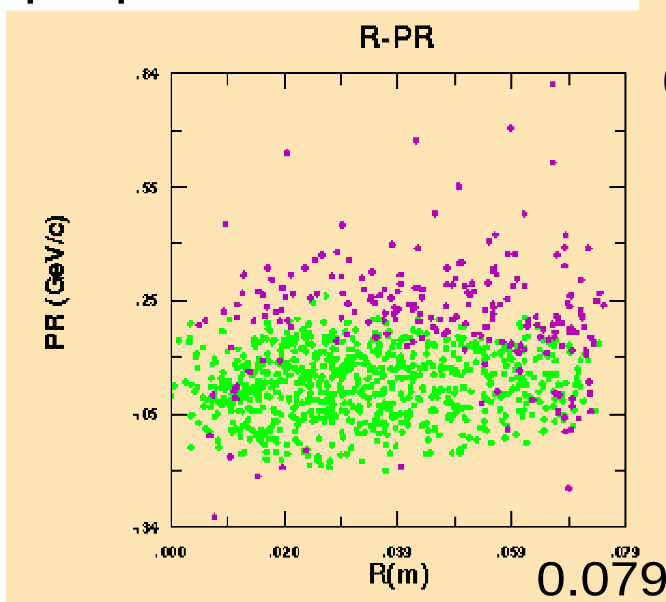
- Compared with previous Fortrans, F90
  - is very efficient (array processing) and a reasonably modern language
  - has good memory allocation routines
  - is very safe compared with F77 (use of IMPLICIT NONE for type checking),
  - some new features are extremely useful: multicomponent types (like C-structures), optional arguments for subroutines, *module* feature is much more powerful than simple COMMON blocks
  - has good portability (from WINTEL boxes to MPP-Crays and IBM's)

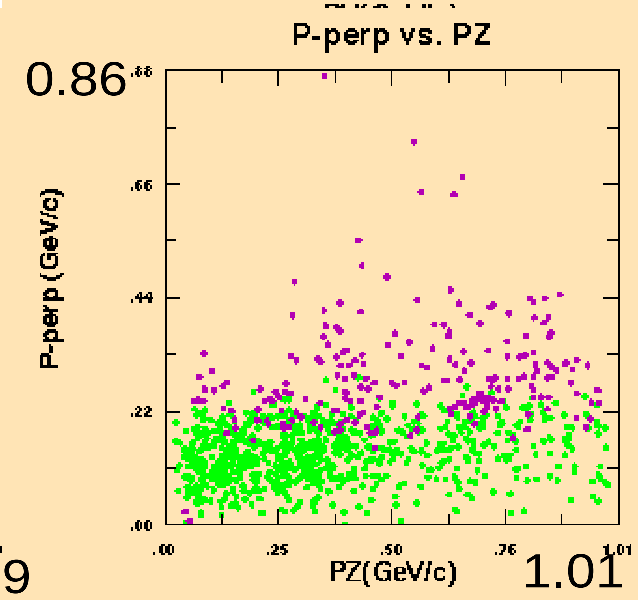
- NCAR/GKS graphics widely available for UNIX boxes, many device drivers
  - evolving to open source (version 4.2); may be available for Windows

Example of Initial Particle Loss in Palmer Non-Distorting Lattice

- Input file ND3i (“non-distorting phase rotation with minicool”) from Palmer, run on NERSC CrayJ90
- 20% of particles lost over 1st 35 m with loss highly correlated with initial perpendicular momentum
- Plots have survivors in green, lost macroparticles in purple

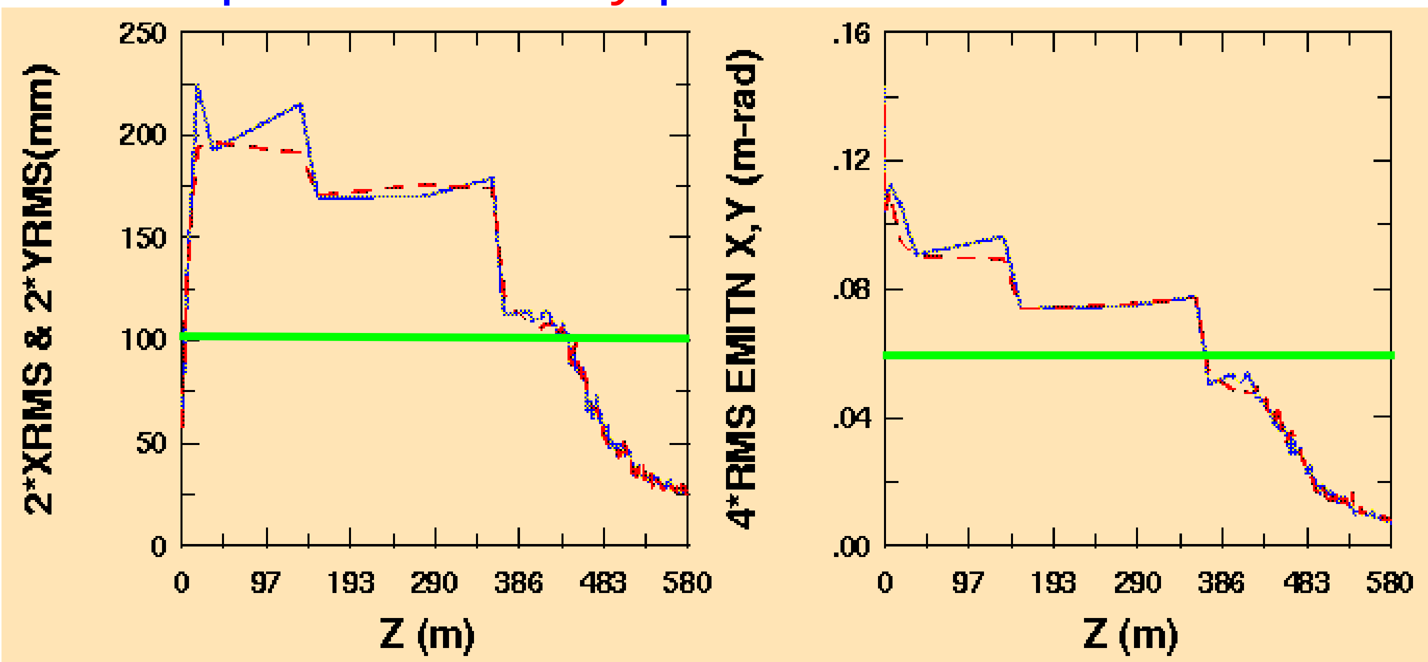




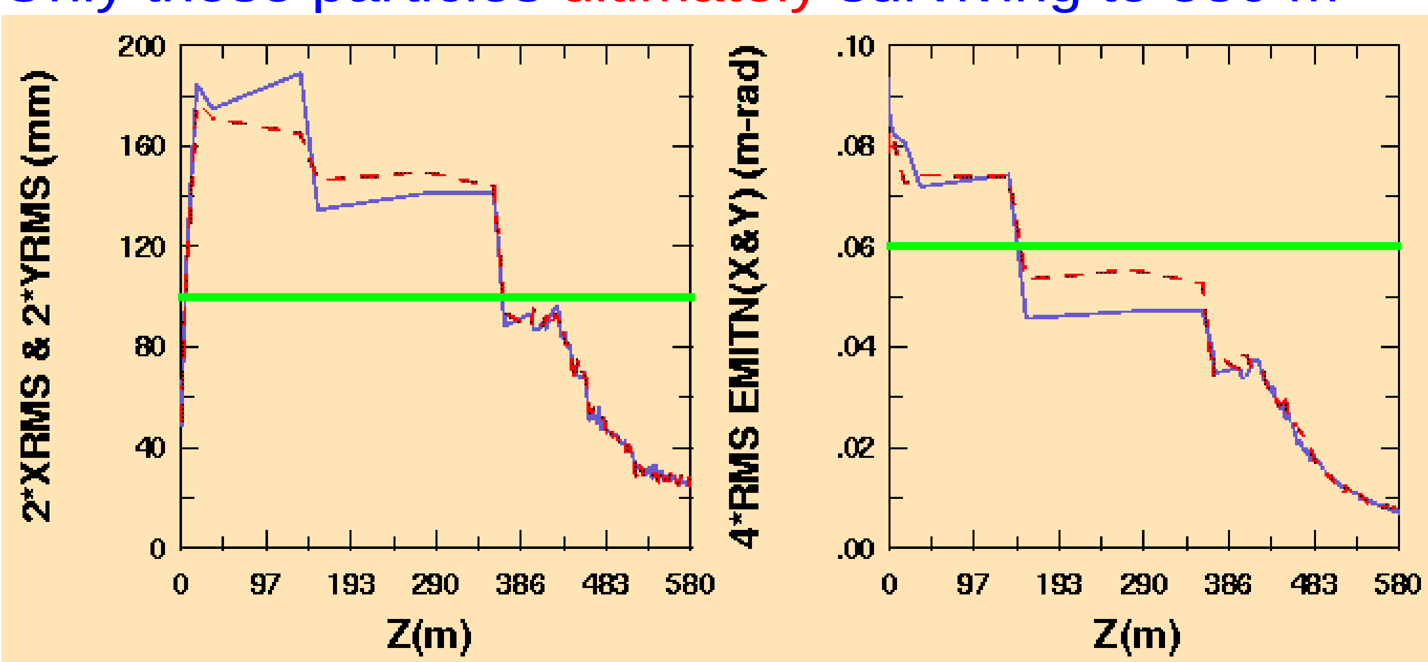


Plots of envelope properties for both locally and ultimately surving particles

All particles locally present at each z location



Only those particles ultimately surviving to 580 m



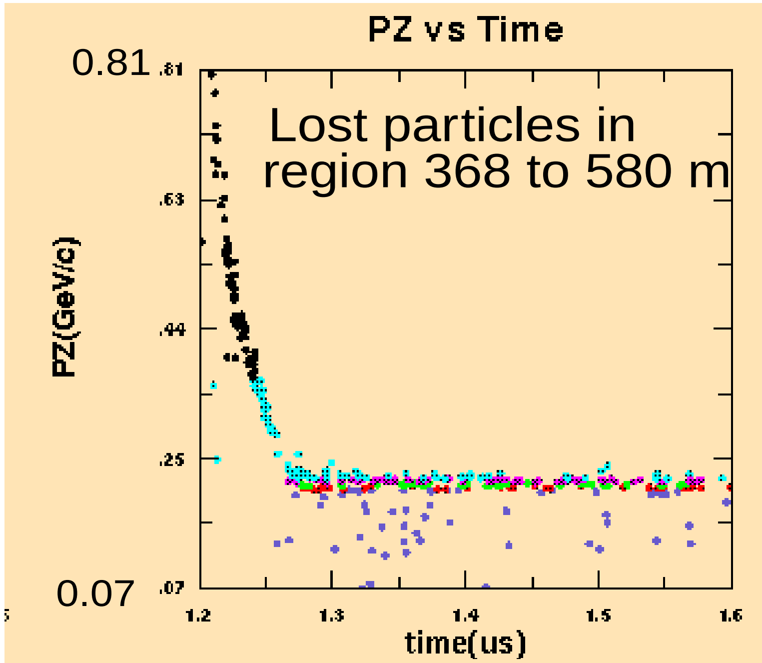
Particle loss in RF/cooling region shows strong correlation with pz

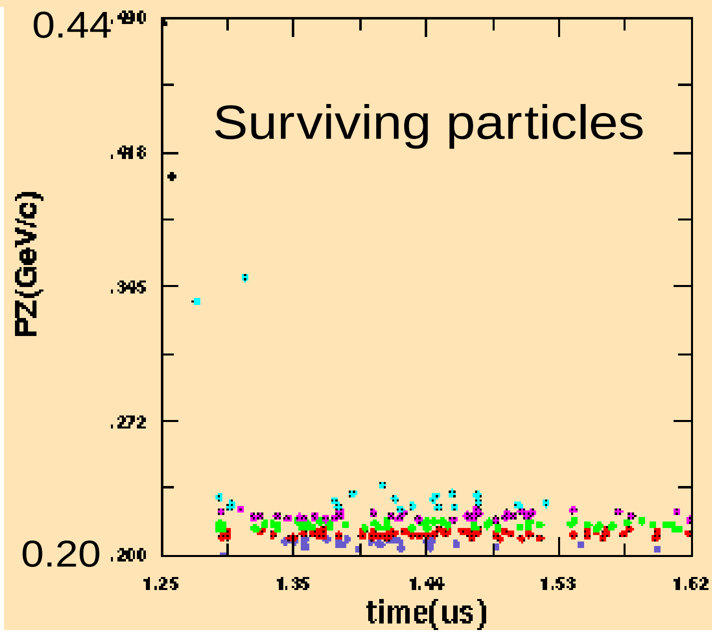
Particles color-coded by parallel momentum at z=368 m

Over next 200m surviving fraction drops from ~0.55 to 0.21

Acceptance band in pz is ~0.05 GeV/c centered at 0.225

Additional loss for those particles with perpendicular momenta exceeding 0.055 GeV/c





Tcl/TK “Macro” Preprocessor
NIME for text files

- ICOOL input files tend to be “opaque” to mere mortals

- Idea for general, simple preprocessor to expand text sequences in ASCII file born in late Oct. conversation with Bob Palmer

- Individual macro definitions may appear *anywhere* in the file and in any order

- Each macro may have zero, one, or many variables whose value can vary from one local expansion to another; default values may also be set in the macro definition

```
\def RFcavity
 %freq  %length(2.0)  %gradient(0.0)   0.2  8
\enddef

\RFcavity freq=200.e6 gradient=1.5 !* 200 MHz
```

expands to:

```
200.e6  2.0  1.5  0.2
```

NIME preprocessor - continued

- Program written in Tcl; graphical interface in TK; both freely available for nearly all platforms from UNIX to PC to Mac
- Useful to produce more understandable ICOOL input files where many regions get repeated with slight changes

```
\def block
%length 1 %stepsize
1 0 %rmax(1.0)
NONE
0. 0. 0. 0. 0. 0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
%material
CBLOCK
0. 0. 0. 0. 0. 0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
\enddef

\def RF
SREGION
%length 1 %stepsize
1 0 %rmax(1.0)
ACCEL
%model %RFfreq %peakgrad %phase 0. 0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0.
VAC
NONE
0. 0. 0. 0. 0. 0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
\enddef

\block %length=0.063 %stepsize=1.e-3 %rmax=0.15
   %material=LH  ! 1st LH absorber
\block %length=400.e-6 %stepsize=400.e-6 %rmax=0.15
    %material=AL !* 1st LH window
\block %length=200.e-6 %stepsize=200.e-6 %rmax=0.19
    %material=BE  !* Be window before RF cavity
\RF %length=0.3293 %stepsize=1.e-3 %rmax=0.3 %model=2
   %RFfreq=201.25 %peakgrad=15. %phase=30.
```