

New Features in UCLA-PARMELA v 2.1
R. J. England
UCLA Particle Beam Physics Laboratory
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This document describes modifications to the UCLA-PARMELA source code version 2.0. The modifications were made by R. J. England during the period from 2003 to 2005. The changes to the code consist of: (1) the implementation of the "SEXT" card for sextupoles, and (2) changes to the "TRWAVE" card which permit the fields to be printed out to a data file. These changes are detailed in the following subsections. In addition, (3) I document the input structure for the CELL card in versions 2.0 and 2.1 since this was found to differ from the description given in the UCLA-PARMELA manual. The modified code version number has been increased to v 2.1.

1. "SEXT" (SEXTUPOLE) CARD

Note that the UCLA-PARMELA manual includes a description of a SEXTUPOLE card. However, for whatever reason, no such card actually existed in version 2.0 of UCLA-PARMELA prior to the implementation discussed here. Consequently, the information here is independent of any information in the PARMELA manual about a card called SEXTUPOLE. The code for "SEXT" is contained primarily in the source file "sext.f". The SEXT card in UCLA-PARMELA has been benchmarked (with space charge turned off) against ELEGANT with excellent agreement. The structure of the card in the parmin6000 file is as follows:

```
SEXT L APER IOUT K2
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where L, APER, and IOUT are as described in the UCLA-PARMELA manual, and K2 is the sextupole field strength in units of m^{-3} (like the SEXT element in ELEGANT).

2. TRWAVE MODIFICATIONS

It was discovered that the implementation of the NPRINT parameter in the card TRWAVE for travelling wave structures was broken in UCLA-PARMELA v 2.0. According to the PARMELA manual, when NPRINT is nonzero, TRWAVE will print out a data file called "trwdata" which contains the Fourier coefficients of the traveling wave tank as well as a printout of field values for E_z , E_r , and B_θ at NPRINT locations along the beamline from Z1 to Z2 at two different radii (R1 and R2) and at various RF phase values (relative to the master clock, **not** the TRWAVE card frequency) in increments of DWT. Several problems were discovered in UCLA-PARMELA v 2.0 which prevented this from actually happening:

1. A problem with the *open* command in TRWAVEFIELD.f which opens or creates the data file 'trwdata' where the field data is to be written. The path for the file was set to a nonexistent location resulting in an error and a premature abortion of the code execution.
2. An IF loop in TRWAVE.f (which appears to be intended to save processor time by preventing repeated calculations of the sine and cosine of the TRWAVE phase if the phase value has not changed). However, the values of the sine and cosine of the TRWAVE phase are reset at the beginning of the TRWAVE routine to 0 and 1 respectively. So when the routine TRWAVE is called repeatedly (with the same phase value) in order to get field values at different longitudinal and radial positions, the sine and cosine were correctly calculated on the first data point, and then reverted to 0 and 1 on all subsequent passes. Consequently, the traveling waveform field data

which was output to 'trwdata' had the wrong phase (except on the very first data point in each iteration of the phase value WT).

3. The TRWAVE card is intended to print out not only the fields of any adjacent TRWAVE card but also of any CELL cards that lie within the specified range of Z1 to Z2. This is because a CELL card can be used at the entrance and exit of a series of TRWAVE cards to model the fringing field of a multicell traveling wave tank. However, the phase of the CELL card was incorrectly defined in TRWAVE.f where the cfield subroutine is called to retrieve the field values for the CELL. This causes the field data of the CELL to appear out of sync with the field data for the TRWAVE cards, even if they are actually in sync.

These problems were discovered and corrected in the order listed above (since due to their nature, the ability to observe each new problem was dependent upon having corrected the previous one). At present, the author believes the statements in the UCLA-PARMELA manual for the use of NPRINT in TRWAVE to now be correct for UCLA-PARMELA v 2.1.

In addition, note that only the CELL card at the beginning of the TRWAVE tank will be included in the field printout. Field data from any CELL cards which come *after* the final TRWAVE card in a given tank do not get printed out in 'trwdata' because the trwdata file is generated by the final TRWAVE card in the tank. Consequently, when the 'trwdata' file is generated, any cards coming after the final TRWAVE card in the present tank have not yet been read by cread, and so no information can be extracted from them. A way to circumvent this limitation would be to temporarily put a "dummy" TRWAVE card at some location after the real tank (and its terminating CELL card) solely as an instrument to print out the fields of the "real" tank.

3. STRUCTURE OF THE CELL CARD

Additional input parameters are present in the CELL card in v 2.0 (and now 2.1) of UCLA-PARMELA which are not mentioned in the manual. The correct input structure for the CELL card is as follows:

```
CELL L APER IOUT PHI0 E0 CELLTYPE DPHI CONFIG FREQ LINTYPE B
      NCOEFF NOFFSET C1 C2 ... CNCOEFF
```

The new parameters are NCOEFF and NOFFSET which specify the total number and any offset respectively of the Fourier coefficients. The number of Fourier coefficients can therefore differ from the number (14) indicated in the manual.