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Electrostatic Element Procedures for COSY-∞ version 10.2

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Abstract: This is an update to Jim Maloney's note TRI-BN-14-03, as his instructions for version 9.1 fail in version 10.2

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1 Introduction

Changes to COSY-∞[1] require changes to the implementation of elements that are specified by electric potential maps. The original note[2] written by Jim Maloney contains instructions on use but also modification to the beam optics package `cosy.fox`.

2 MFD

Firstly, there seems to have been an error in ver.9.1, requiring to comment out the statement `MFD(1):= MFD(1)+J;`. This is no longer necessary, as this error has been corrected in ver.10.2.

Secondly, not mentioned in Jim's note is that the allocation for the array `MFD` in the original and current version is woefully inadequate for our purposes. Search for `VARIABLE MFD 6 700 30;` and replace the 30 with something large enough to cover at least the size of the potential array in the call to `MELP`. I suggest to set `VARIABLE MFD 6 701 701;`.

3 UPDATE

It now appears that this command, which updates the transfer map, must be invoked every time the map is integrated with the routine `SDELE`. This was not the case in ver.9.1. Moreover, it now has only two arguments. I do not fully understand why, and since I do not have a `ELFF` case to test, I cannot guarantee that that routine is working. However, the `MELP` routine now works well and produces exactly same transfer maps as the original version of Jim's routine did when embedded in ver.9.1 of COSY.

4 All Changes

For completeness, I include a `diff` executed between the official version 10.2 `cosy.fox` and the one that includes Jim's routines.

```
74c74
<    VARIABLE DR 10 ; VARIABLE DMAX 1 ; VARIABLE MFP 1 8 ; VARIABLE MFD 6 700 30;
---
>    VARIABLE DR 10 ; VARIABLE DMAX 1 ; VARIABLE MFP 1 8 ; VARIABLE MFD 6 701 701;
2680a2681,2693
>         {Code for new procedures - J. Maloney  triumf.ca 30/50/2014}
>          ELSEIF NSDP=-15;  {Electrostatic Potential Function in Midplane}
>     V:=PPOL(1);
>     V:=V+PPOL(2)*x;
>     V:=V+PPOL(3)*x*x;
>     V:=V+PPOL(4)*x*x*x;
>     V:=V+PPOL(5)*x*x*x*x;
>     V:=V+PPOL(6)*x*x*x*x*x;
>     V:=V+PPOL(7)*x*x*x*x*x*x;
>     V:=V/(1+exp(PPOL(8)+(PPOL(9)*z)));
>  ELSEIF NSDP=-16 ;  {Measured Electrostatic Potential Data}
>          V:= GAUSS(x,z,PPOL(1),PPOL(2),PPOL(3),PPOL(4),PPOL(5),MFD,J);
>    write 26 SF(cons(x),'(G23.10)')&SF(cons(z),'(G23.10)')&SF(cons(v),'(G23.10)') ;
3760a3774,3802
>    PROCEDURE ELFF B1 B2 B3 B4 B5 B6 B7 A1 A2 L S1 S2 D ; {Non-bending Electrostatic element}
>    {Specifies 1/2 of an electrostatic element of multipole order 2 and higher via a function
>  that denotes the potential in the x-z midplane.  Assumes non-bending reference orbit}
>   {J. Maloney  triumf.ca  05/03/2014}
>       VARIABLE LLPI 1 ; VARIABLE LLPI 1 ;
>    PPOL(1):= B1; PPOL(2):= B2; PPOL(3):= B3; PPOL(4):= B4; PPOL(5):= B5; PPOL(6):= B6;
>    PPOL(7):= B7; PPOL(8):= A1; PPOL(9):= A2; NSDP:=-15; LLPI:= LPI; LOFF:=2; CE:='ELFF';
>       IF S1<0; DL S1; LOCSET 0 S1 0 S1 0 0; SDELE S1 S2 D/100 D/20 D/10 D;
>    ELSEIF S1=0; LOCSET 0 -L 0 -L 0 0; SDELE S1 S2 D/100 D/20 D/10 D; DL -(S2-L); ENDIF;
>    LPI:=LLPI; UPDATE 0 1; ENDPROCEDURE;
>    {update used to have 3 aruments: UPDATE 0 1 1. Version 10 has two. -- RAB}
>
>    PROCEDURE MELP L A NX NZ DX DZ SIGMA D SX SZ SPHI ; {MEASURED ELECTROSTATIC POTENTIAL DATA}
>  {NEW PROCEDURE - J. Maloney triumf.ca 03/05/2014}
>       VARIABLE DS1 1 ; VARIABLE IX 1 ; VARIABLE IZ 1 ;
>       IF (SIGMA<0.5)+(SIGMA>5.0) ;
>          WRITE 6 ' *** ERROR IN MELP, SIGMA < 0.5  OR  SIGMA > 5.0' ; ENDIF ;
>       IF (DX<0)+(DX=0)+(DZ<0)+(DZ=0) ;
>          WRITE 6 ' *** ERROR IN MELP, DX =< 0  OR  DZ =< 0' ; ENDIF ;
>       MFP(1) := 0 ;
>       LOOP IX 1 NX ; LOOP IZ 1 NZ ; MFD(IX,IZ) := A(IX,IZ) ; ENDLOOP ; ENDLOOP ;
>       PPOL(1) := NX ; PPOL(2) := NZ ; PPOL(3) := DX ; PPOL(4) := DZ ;
>       PPOL(5) := SIGMA ; NSDP := -16 ; LOFF := 2 ; DS1 := MIN(DX,DZ) ;
>       LOCSET SX SZ -SPHI*DEGRAD 0 0 0 ; CE := 'MELP' ;
>   SDELE 0 L DS1/100 SQRT(DS1*L/5) L/5 D ; UPDATE 1 1 ;
>   {Jim's version lacked an UPDATE command. It's needed in Version 10 -- RAB}
>       IF MFP(1)>0 ; WRITE 6 (' --- WARNING IN MELP, OUT OF RANGE OF DATA AT '&
>         SF(MFP(1),'(I8)')&' POINTS') ; ENDIF ; ENDPROCEDURE ;
>
```

References

[1] M. Berz, Computational aspects of optics design and simulation: Cosy infinity, Nuclear Instruments and Methods in Physics Research 298 (1990) 473–479.

[2] J. Maloney, New Electrostatic Element Procedures for COSY Infinity, Tech. Rep. TRI-BN-14-03, TRIUMF (2014).