**Q’s answered in this document (answers below bolded and underlined):**

1. **Where current\_intervals array is created, what start\_points is**
2. **Index j—loop over FACs that have made the cut**
3. **Definition of max current time**
4. **Get the electron current, determine whether to keep event**
5. **Get electron energy flux, determine whether to keep event**
6. **What ‘elec\_energy\_flux’ is: the “maximum size of the electron energy flux mapped to the ionosphere”, which does not have anything to do with sign (lines 718-721)**
7. **How “integrated downgoing electron flux” is calculated (748-775)**
8. **Note on units, w/ plot**
9. **Definition of units of integrated flux**

At the end of Alfven\_Stats\_3.pro, extensive use is made of the array ‘current\_intervals’

**Lines 662-666: Create the current interval array, where n\_elements(start\_points) is number of FACs**

So current\_intervals is an array of size (# FACs)x35

current\_intervals=make\_array(n\_elements(start\_points),35,/double)

current\_intervals(\*,0)=start\_points

current\_intervals(\*,1)=stop\_points

current\_intervals(\*,2)=sign\_jtemp(start\_points)

current\_intervals(\*,3)=1 ;‘1’ if keeping this FAC (see L692, where some are discarded)

**Line 671: j is loop over FACs that have made the cut**

for j=0L,n\_elements(start\_points)-1 do begin

**Line 699: “;define the time of the max current”**

current\_intervals(j,20)=magz.x(intervalfields(indjmax))

**Lines 705-10:”;get the electron current and determine if to keep this event”**

maxJe=max(abs(je\_tmp\_data(intervalparts\_electrons)),ind)

maxJe=maxJe\*sign(ind)\*1.6e-9 ;in microA/m2

current\_intervals(j,5)=maxJe

if abs(maxJe)/abs(jmax) LE esa\_j\_delta\_bj\_ratio\_threshold then begin

current\_intervals(j,3)=0.0

endif

**Lines 712-24: ;get the electron energy flux and determine if to keep this event**  sign=-1.\*jee\_ionos\_tmp\_data(intervalparts\_electrons)/abs(jee\_ionos\_tmp\_data(intervalparts\_electrons)) maxJEe\_ionos=max(abs(jee\_ionos\_tmp\_data(intervalparts\_electrons)),ind)

maxJEe\_ionos=maxJEe\_ionos\*sign(ind)

current\_intervals(j,6)=maxJEe\_ionos

if abs(maxJEe\_ionos) LE electron\_eflux\_ionos\_threshold then begin

current\_intervals(j,3)=0.0

endif

**PSSSSH--Array definition lines 624-659!**

**;in this array 0-interval start index**

**; 1-interval stop index**

**; 2-sign of the current (field-aligned is pos)**

**; 3-validity of the point-i.e does it satisfy the thresholds**

**; 4-maximum size of the current in that interval**

**; 5-maximum size of the current from the Electron esa**

**; 6-maximum size of the electron energy flux mapped to the ionosphere**

**; 7-integrated downgoing electron flux over that interval at ionosphere**

**; 8-maximum characteristic electron energy from that interval**

**; 9-maximum ion energy flux**

**; 10-maximum ion flux**

**; 11-maximum upgoing ion flux**

**; 12-integrated upgoing ion flux over the interval at the ionosphere**

**; 13-integrated upgoing only ion flux over the interval at the ionosphere**

**; 14-maximum characteristic ion energy**

**; 15-time width of the current filament in s**

**; 16-width of the current filament at the s/c altitude**

**; 17-magnetic field amplitude (nT)**

**; 18-electric field amplitude (mV/m)**

**; 19-Orbit number**

**; 20-max current time (based on location of max current**

**; 21-max current altitude**

**; 22-max current MLT**

**; 23- max current ILAT**

**; 24-average value of B**

**; 25-average value of E**

**; 26-field sample rate**

**; 27-fields mode**

**; 28-maximum upgoing proton flux**

**; 29-maximum characteristic proton energy**

**; 30-maximum upgoing oxygen flux**

**; 31-maximum characteristic oxygen energy**

**; 32-maximum upgoing helium flux**

**; 33-maximum characteristic helium energy**

**; 34-spacecraft potential -1.\*V8\_S**

**It’s settled: ‘elec\_energy\_flux’ is the “maximum size of the electron energy flux mapped to the ionosphere”, which does not have anything to do with sign, as you see here (lines 718-721):**

sign=-1.\*jee\_ionos\_tmp\_data(intervalparts\_electrons)/abs(jee\_ionos\_tmp\_data(intervalparts\_electrons)) maxJEe\_ionos=max(abs(jee\_ionos\_tmp\_data(intervalparts\_electrons)),ind)

maxJEe\_ionos=maxJEe\_ionos\*sign(ind)

current\_intervals(j,6)=maxJEe\_ionos

**Note here that [line 1165]**

“8-maximum size of the electron energy flux mapped to the ionosphere-positive is downwards”

“9-integrated downgoing electron flux over that interval at ionosphere”

**Also note that the eighth and ninth position correspond to current\_intervals(jj,6),current\_intervals(jj,7):**

for jj=0L,n\_elements(keep)-1 do begin printf,unit1,format='(I9,A24,27G13.6)',current\_intervals(jj,19),time\_to\_str(current\_intervals(jj,20),/ms),$ current\_intervals(jj,21),current\_intervals(jj,22),current\_intervals(jj,23),current\_intervals(jj,4),$ current\_intervals(jj,5),**current\_intervals(jj,6),current\_intervals(jj,7)**,current\_intervals(jj,8),$ current\_intervals(jj,9),current\_intervals(jj,10),current\_intervals(jj,11),current\_intervals(jj,12),$ current\_intervals(jj,13),current\_intervals(jj,14),current\_intervals(jj,15),current\_intervals(jj,16),$ current\_intervals(jj,17),current\_intervals(jj,18),current\_intervals(jj,26),current\_intervals(jj,27),$ current\_intervals(jj,28),current\_intervals(jj,29),current\_intervals(jj,30),current\_intervals(jj,31),$

current\_intervals(jj,32),current\_intervals(jj,33),current\_intervals(jj,34)

endfor

**From rdf\_stats\_1.pro, line 7 (note eighth and ninth position--we should be using integ\_elec\_energy\_flux):**

fieldnames=['orbit','time','alt','mlt','ilat','mag\_current','esa\_current',**'elec\_energy\_flux','integ\_elec\_energy\_flux'**,'char\_elec\_energy','ion\_energy\_flux','ion\_flux','ion\_flux\_up',$

**Now, let’s find out how “integrated downgoing electron flux” is calculated:**

AS3 lines 748-775:

;get the integrated electron dflux in ionosphere over this interval

if intervalparts\_electrons(0) NE -1 then begin

if n\_elements(intervalparts\_electrons) EQ 1 then begin

current\_intervals(j,7)=speed(intervalparts\_electrons)\*part\_res\_Je(intervalparts\_electrons)\*jee\_tmp\_data(intervalparts\_electrons)/2.0

endif else begin

;calculate the integrated contribution to electron dflux over this interval and add it to get total

current\_intervals(j,7)=int\_tabulated(findgen(n\_elements(intervalparts\_electrons))\*speed(intervalparts\_electrons)\*part\_res\_je(intervalparts\_electrons),jee\_tmp\_data(intervalparts\_electrons),/double)

endelse

;map result to ionosphere (sqrt of B since have integrated in x)

current\_intervals(j,7)=current\_intervals(j,7)\*sqrt(ratio(intervalparts\_electrons(0)))

endif

**part\_res\_Je(109-110):** get\_data,'Je',data=je part\_res\_je=make\_array(n\_elements(Je.x),/double)

**jee\_tmp\_data(384-392):**

get\_data,'JEe',data=tmp

;remove crap

;keep=where(finite(tmp.y) NE 0)

tmp.x=tmp.x(keep1)

tmp.y=tmp.y(keep1)

;keep=where(abs(tmp.y) GT 0.0)

jee\_tmp\_time=tmp.x(keep2)

jee\_tmp\_data=tmp.y(keep2)

store\_data,'JEe',data={x:jee\_tmp\_time,y:jee\_tmp\_data}

**intervalparts\_electrons:** This is merely the indices array for electron flux data

**int\_tabulated**: This function “Returns the area under the curve represented by the function.“

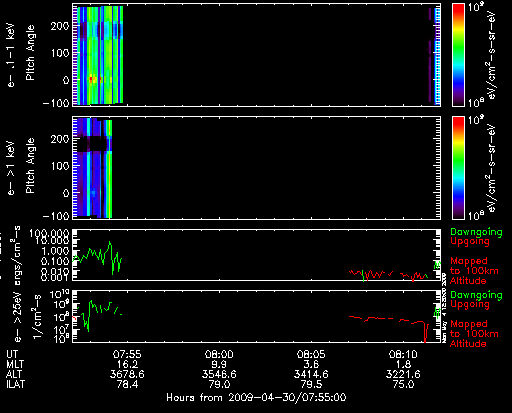
**speed(L523):**speed=sqrt(vel.y(\*,0)^2+vel.y(\*,1)^2+vel.y(\*,2)^2)\*1000.0

**vel(L522)**:get\_data,'fa\_vel',data=vel

**3. WHAT ABOUT UNITS??** Plots suggest that the units are eV/(cm^2-s-sr-eV) for spectrogram. Also seeing ergs/(cm^2-s), which must be the deal.

(Note, ergs/(cm^2-s) ->

“fast\_ef\_summary.pro” has all the info: “Jee” corresponds to first line plot below. “Je” corresponds to the second.



**4. Units of integrated flux:**

current\_intervals(j,7)=int\_tabulated(findgen(n\_elements(intervalparts\_electrons))\*speed(intervalparts\_electrons)\*part\_res\_je(intervalparts\_electrons),jee\_tmp\_data(intervalparts\_electrons),/double)

endelse

Speed\*time\*