Raster Software Upgrade

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Raster Upgrade - HCANA

- Added additional variables to include second set of raster coils
- Signal offsets are determined from the raw data (SHMS run 452 in our case) and read in as parameters

```
37 THcRaster::THcRaster( const char* name, const char* description,
38                       THaApparatus* apparatus ) :
39   THaBeamDet(name,description,apparatus)
40 {
41
42   fAnalyzePedestals = 0;
43   fNPedestalEvents = 0;
44
45   fRawXAADC = 0;
46   fRawYAADC = 0;
47   fRawXBADC = 0;
48   fRawYBADC = 0;
49
50   fXAADC = 0;
51   fYAADC = 0;
52   fXBADC = 0;
53   fYBADC = 0;
54
55   fXApos = 0;
56   fYApos = 0;
57   fXBpos = 0;
58   fYBpos = 0;
59
60   fFrCalMom = 0;
61
62   fFrXAADCperCM = 1.0;
63   fFrYAADCperCM = 1.0;
64   fFrXBADCperCM = 1.0;
65   fFrYBADCperCM = 1.0;
66
67   fFrXAADC_zero_offset = 0.0;
68   fFrYAADC_zero_offset = 0.0;
69   fFrXBADC_zero_offset = 0.0;
70   fFrYBADC_zero_offset = 0.0;
71
72   frPosAdcPulseIntRaw  = NULL;
73
```

Raster Upgrade - HCANA

- Implemented THcRawAdcHit and THcSignalHit classes to read in FADC data for each coil

```
331
332   while(ihit < fNhits) {
333     THcRasterRawHit*  hit          = (THcRasterRawHit *) fRawHitList->At(ihit);
334     THcRawAdcHit&     rawPosAdcHit = hit->GetRawAdcHitPos();
335     Int_t             nsig         = hit->fCounter;
336
337     for (UInt_t thit=0; thit<rawPosAdcHit.GetNPulses(); ++thit) {
338        ((THcSignalHit*) frPosAdcPulseIntRaw->ConstructedAt(nrPosAdcHits))->Set(nsig,rawPosAdcHit.GetPulseIntRaw(thit));
339        ++nrPosAdcHits;
340     }
341     ihit++;
342   }
343
344     for (Int_t ielem = 0; ielem < frPosAdcPulseIntRaw->GetEntries(); ielem++) {
345        Int_t    nraster           = ((THcSignalHit*) frPosAdcPulseIntRaw->ConstructedAt(ielem))->GetPaddleNumber() - 1;
346        Double_t pulseIntRaw       = ((THcSignalHit*) frPosAdcPulseIntRaw->ConstructedAt(ielem))->GetData();
347        if (nraster ==0) fRawXAADC = pulseIntRaw;
348        if (nraster ==1) fRawYAADC = pulseIntRaw;
349        if (nraster ==2) fRawXBADC = pulseIntRaw;
350        if (nraster ==3) fRawYBADC = pulseIntRaw;
351    }
352     return 0;
353
```

- Pedestal methods were updated to retain backwards compatibility with 6 GeV data

Raster Upgrade – Hall-C Replay

- THcRaster::Init() modified to read in either HMS (H) or SHMS (P) from the THcRasteredBeam Apparatus in the replay script:

```
102 THaAnalysisObject::EStatus THcRaster::Init( const TDatime& date )
103 {
104  // cout << "THcRaster::Init()" << endl;
105
106   // Fill detector map with RASTER type channels
107   char EngineDID[] = "xRASTER";
108   EngineDID[0] = toupper(GetApparatus()->GetName()[0]);
109   if( gHcDetectorMap->FillMap(fDetMap, EngineDID) < 0 ) {
110     static const char* const here = "Init()";
111     Error( Here(here), "Error filling detectormap for %s.", EngineDID);
112     return kInitError;
113   }
114
115   InitHitList(fDetMap,"THcRasterRawHit",fDetMap->GetTotNumChan()+1);
116
117   EStatus status;
118   if( (status = THaBeamDet::Init( date )) )
119     return fStatus=status;
120
121   return fStatus = kOK;
122
123 }
```

```
71   // Add Rastered Beam Apparatus
72   THaApparatus* beam = new THcRasteredBeam("P.rb", "Rastered Beamline");
73   gHaApps->Add(beam);
74   // Add Physics Module to calculate primary (scattered beam - usually electrons) kinematics
75   THcPrimaryKine* kin = new THcPrimaryKine("P.kin", "SHMS Single Arm Kinematics", "P", "P.rb");
76   gHaPhysics->Add(kin);
```

Raster Upgrade – Hall-C Replay

- pstackana_production.def modified to read new RawADC histograms

```
661 #-------------
662 # Fast Raster
663 #-------------
664
665 # Assume FADC range is set to 1V and the integration is 25 channels
666 # Offset in the FADC is about 0.122V or 500 channels.
667
668 formula FRXA_V P.rb.raster.frxaRawAdc*(1./4096.)/25.
669 formula FRXB_V P.rb.raster.frxbRawAdc*(1./4096.)/25.
670 formula FRYA_V P.rb.raster.fryaRawAdc*(1./4096.)/25.
671 formula FRYB_V P.rb.raster.frybRawAdc*(1./4096.)/25.
672
673 TH1F pFRXA 'SHMS FRXA; FRXA RAW ADC (chan); Counts' P.rb.raster.frxaRawAdc 1000 0 100000
674 TH1F pFRXA_V 'SHMS FRXA; FRXA RAW ADC (Volts); Counts' FRXA_V 1000 0 1.0
675 TH1F pFRXB 'SHMS FRXB; FRXB RAW ADC (chan); Counts' P.rb.raster.frxbRawAdc 1000 0 100000
676 TH1F pFRXB_V 'SHMS FRXB; FRXB RAW ADC (Volts); Counts' FRXB_V 1000 0 1.0
677 TH1F pFRYA 'SHMS FRYA; FRYA RAW ADC (chan); Counts' P.rb.raster.fryaRawAdc 1000 0 100000
678 TH1F pFRYA_V 'SHMS FRYA; FRYA RAW ADC (Volts); Counts' FRYA_V 1000 0 1.0
679 TH1F pFRYB 'SHMS FRYB; FRYB RAW ADC (chan); Counts' P.rb.raster.frybRawAdc 1000 0 100000
680 TH1F pFRYB_V 'SHMS FRYB; FRYB RAW ADC (Volts); Counts' FRYB_V 1000 0 1.0
681 TH2F pFRA_XvsY 'HMSFRA_XvsY; FRXA RAW ADC (Volts); FRYA RAW ADC (Volts)' FRXA_V FRYA_V 1000 0 1.0 1000 0 1.0
682 TH2F pFRB_XvsY 'HMSFRB_XvsY; FRXB RAW ADC (Volts); FRYB RAW ADC (Volts)' FRXB_V FRYB_V 1000 0 1.0 1000 0 1.0
```

Raster Upgrade – Hall-C Replay

- New ADCperCM and ADC_zero_offset values were calculated from 452 raster data run and included within gbeam.param file
- Used the midpoint of the XA, XB and YA, YB coils as the frx_dist and fry_dist values

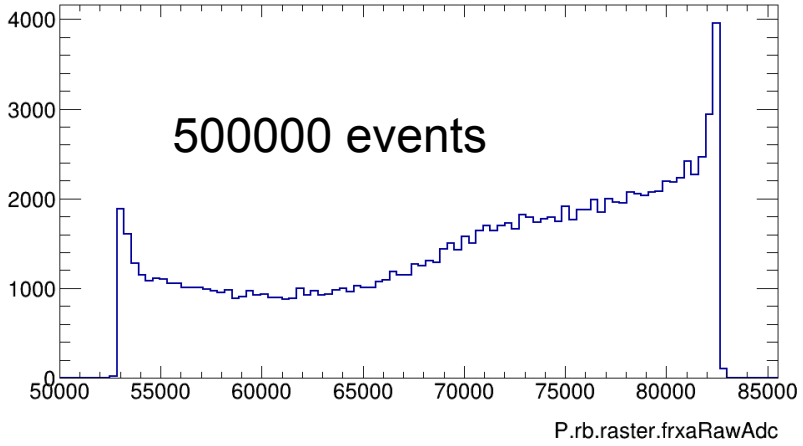
```
;             Fast Raster calibration constants
;             =================================

; Various fast raster quantities: gUse* are flags

  gusefr              = 1  ; if 1 correct for FRY in reconstruction

  guse_frdefault      = 1  ; if 1 do no phase correction (default)
                           ;if 0 apply phase correction
      gfr_cal_mom     = 6.4    ; = beam momentum during KPP '17 calibration run

;     gfr_cal_mom     = 2.038  ; = beam momnetum during calibration run

      gfrxa_adcpercm  = 97666.67 ; FR channels per cm deflection on target from
                                   KPP 2017
      gfrya_adcpercm  = 113666.67;
      gfrxb_adcpercm  = 97333.33;
      gfryb_adcpercm  = 114333.33;

      gfrxaADC_zero_offset = 67800;
      gfryaADC_zero_offset = 67700;
      gfrxbADC_zero_offset = 69050;
      gfrybADC_zero_offset = 67000;

      gfrx_adcmax     = 1000   ; ADC amplitude in channels.
      gfrx_maxsize    = 0.1    ; fast raster amplitude in centimeter.

      gfry_adcmax     = 1000   ; ADC amplitude in channels.
      gfry_maxsize    = 0.1    ; fast raster amplitude in centimeter.

; The latest FR phase analysis from spring '96 showed, that there is no
; measurable phase shift. During early running (E91-13, E89-12) the FRY-phase
; was determined to be 5.8 degree.

; positions of FR magnets relative to target
  gfrx_dist  = 1375   ; cm
  gfry_dist  = 1337   ; cm
```

Raster Run 452

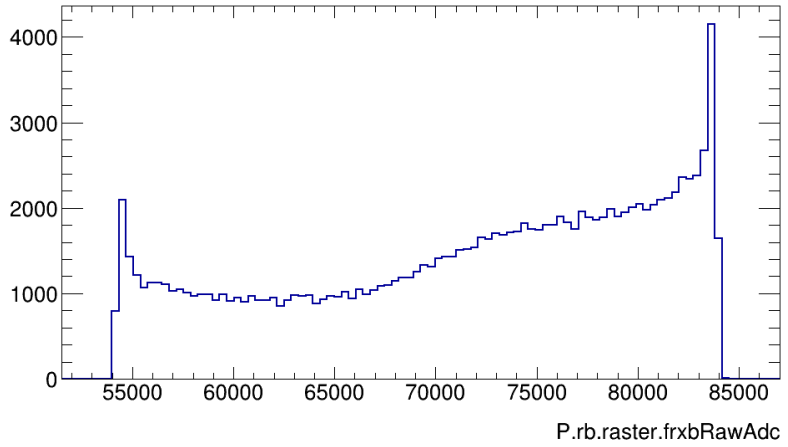
- 3x3mm raster
- Carbon foil target with a 2mm diameter hole.
- Since the SHMS magnet polarities were wrong and the SHMS trigger was not clean → the hole can be seen but not super clean.
- The beam isn't centered on the target in this run.

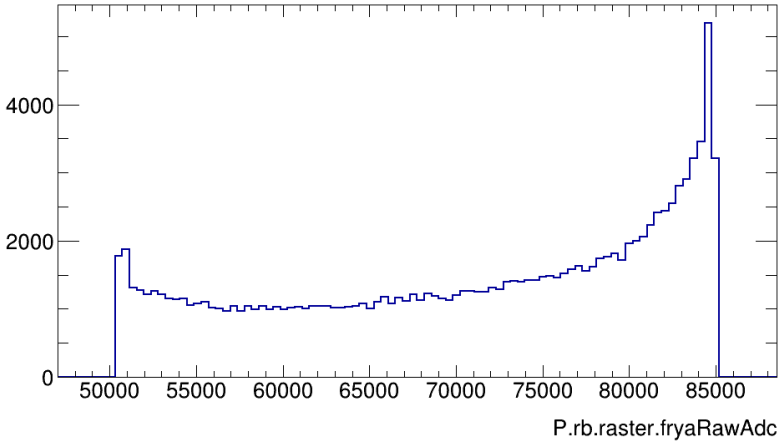
Raw Adc Plots

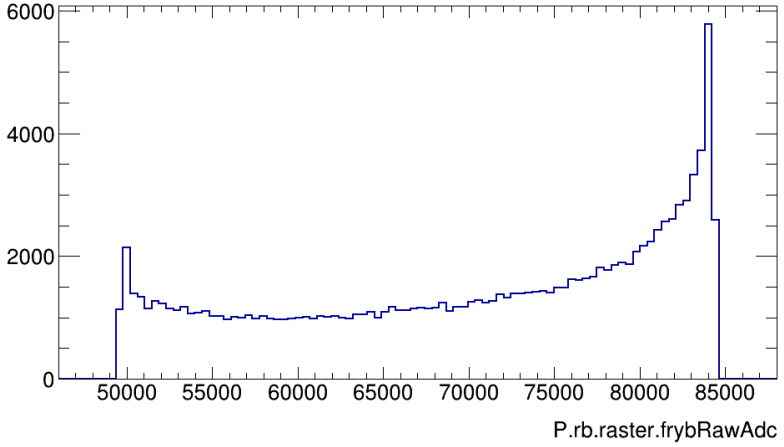
Raster A
X and Y coils



Raster B
X and Y coils

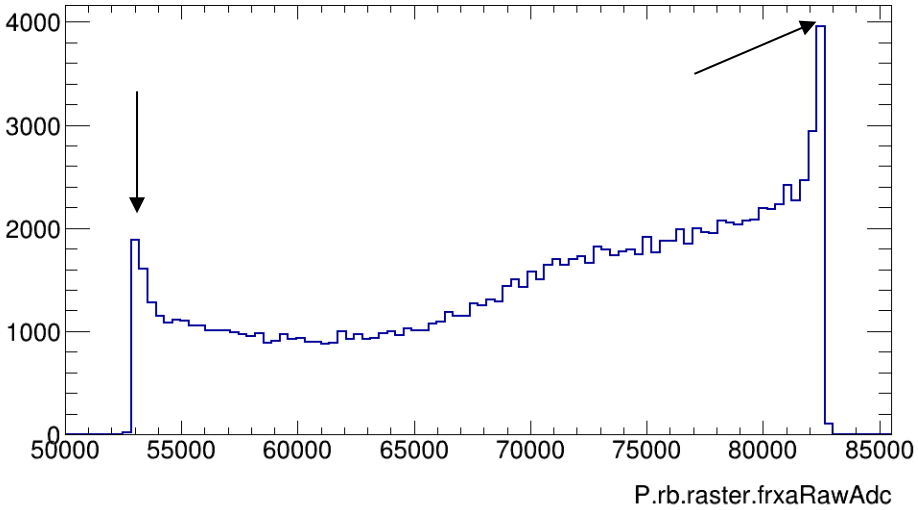






Determination of the Adc zero offset & Adc per cm values

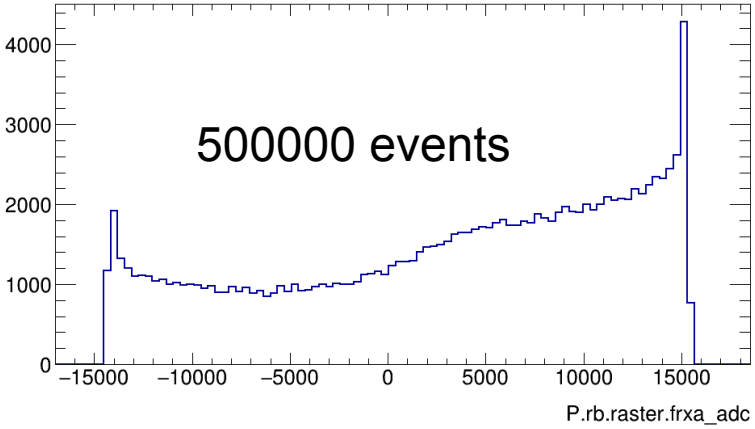
- A ROOT script is written to get the lower and upper edges of the raw ADC plots, and calculate the ADC zero offsets and



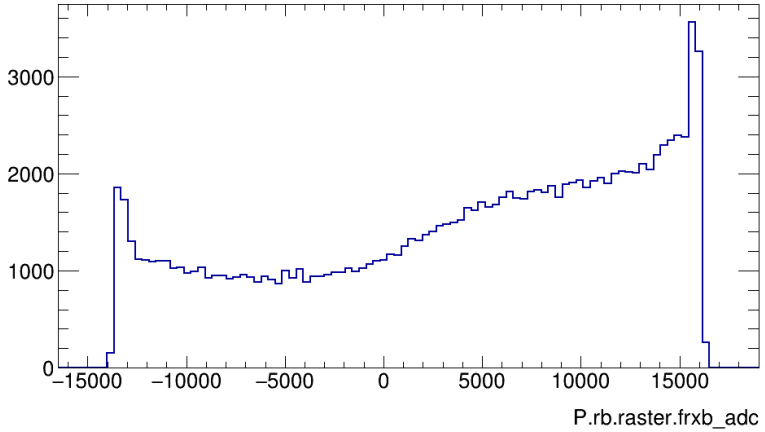
- ADC_zero_offset = (lower_edge + upper_edge) / 2
- ADC_per_cm = (upper_edge - lower_edge) / 0.3 (cm)
- These values are implemented in the parameter file.
- ADC = raw ADC – ADC_zero_offset

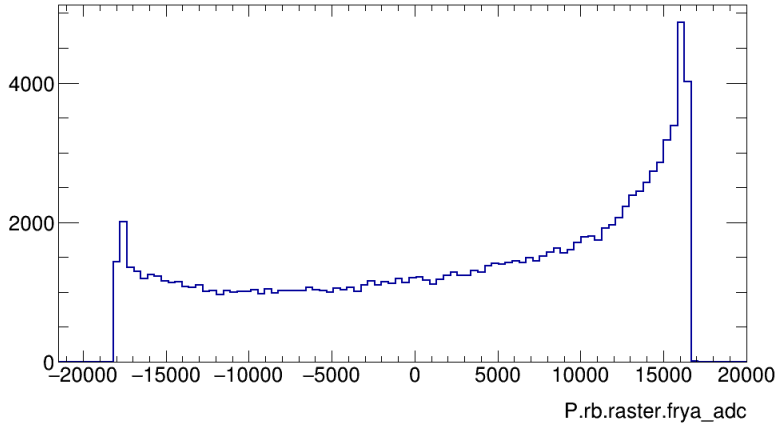
Adc Plots

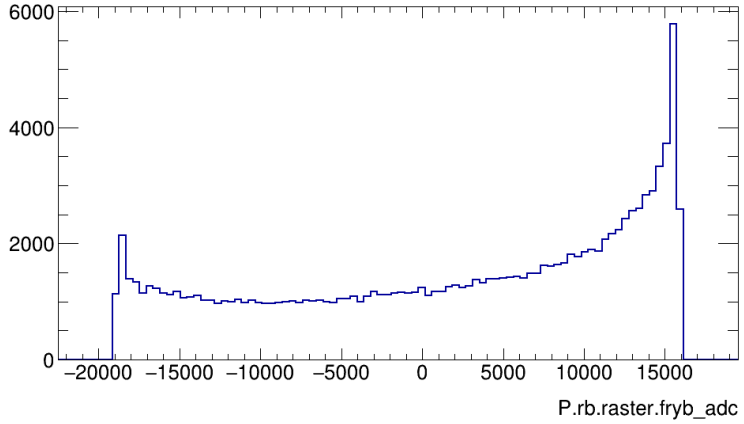
Raster A
X and Y coils



Raster B
X and Y coils

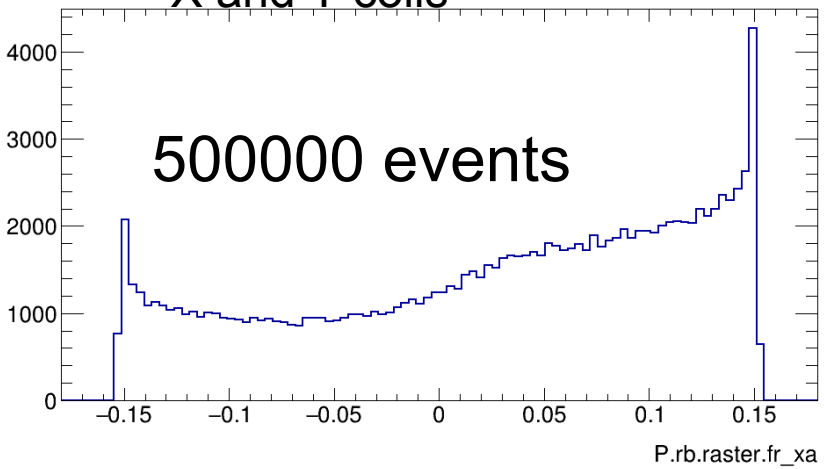




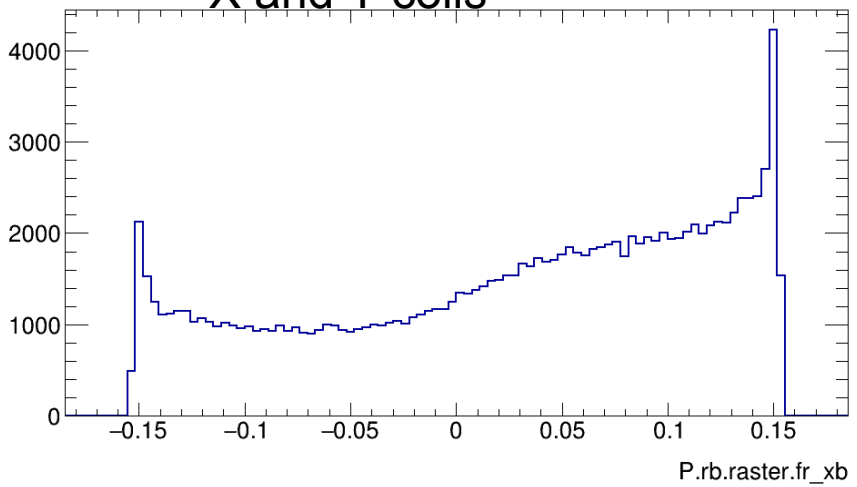


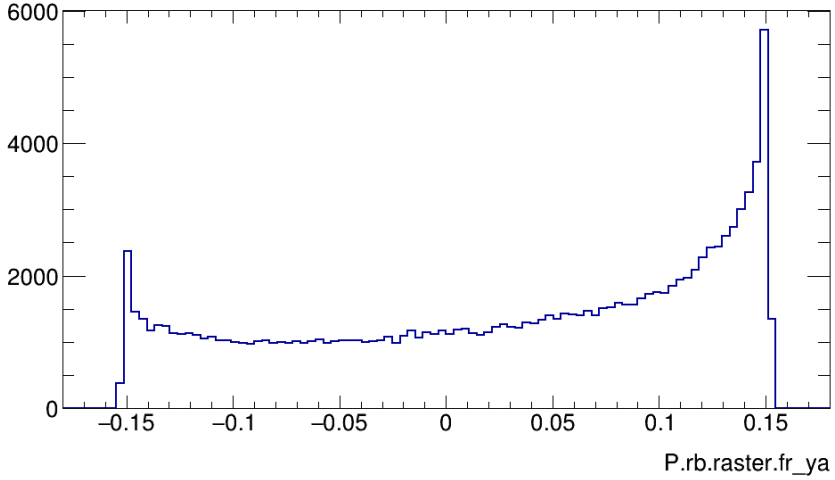
Fast Raster Position Plots

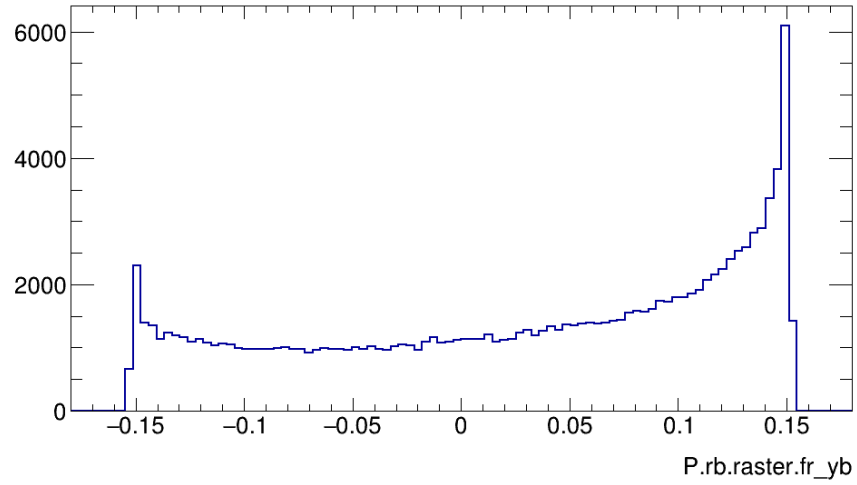
Raster A
X and Y coils



Raster B
X and Y coils





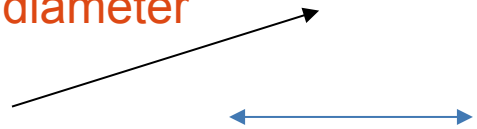


Fast Raster 2D Raw Adc Plots

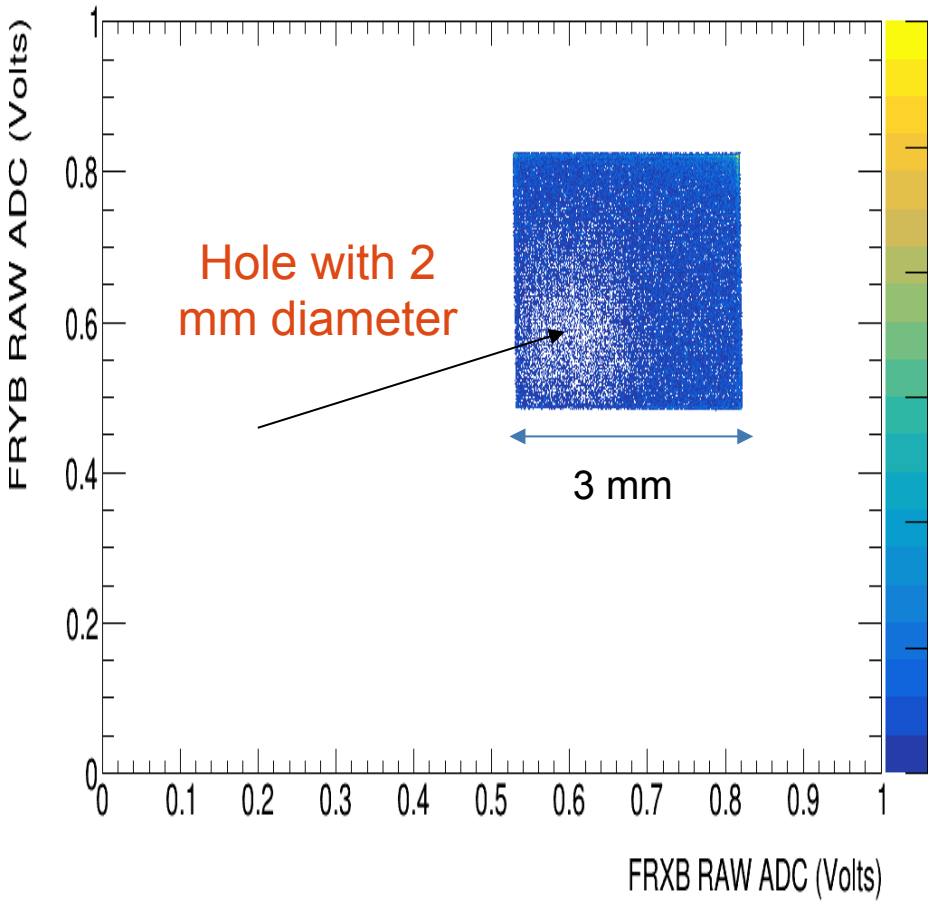
Raster A

500000 events

Hole with 2
mm diameter



Raster B



Bonus → Raster Run 455

- The beam is better centered on the target