Summary of AIDA Operation 2024

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Standalone Analysis AIDA Data

Data files S100/R21_0 – R21_99 (c. 5h data) ^{162}Eu setting

Data analysis assumes

- **All** LEC channels with valid ADC offset included (1012/1024)
- No clustering
- No multiplex timestamp correction
- No p+n junction – n+n Ohmic strip time gates
- FEE64 **not** DSSSD strip ordering
- LEC energy threshold

  p+n junction 100keV
  n+n Ohmic 150keV
  Hardware slow comparator settings
- Energy difference ±150keV (ADC offset calibration only)
- Valid LEC events

  0 < m_p+n < 8 AND
  0 < m_n+n < 8
- Valid HEC events

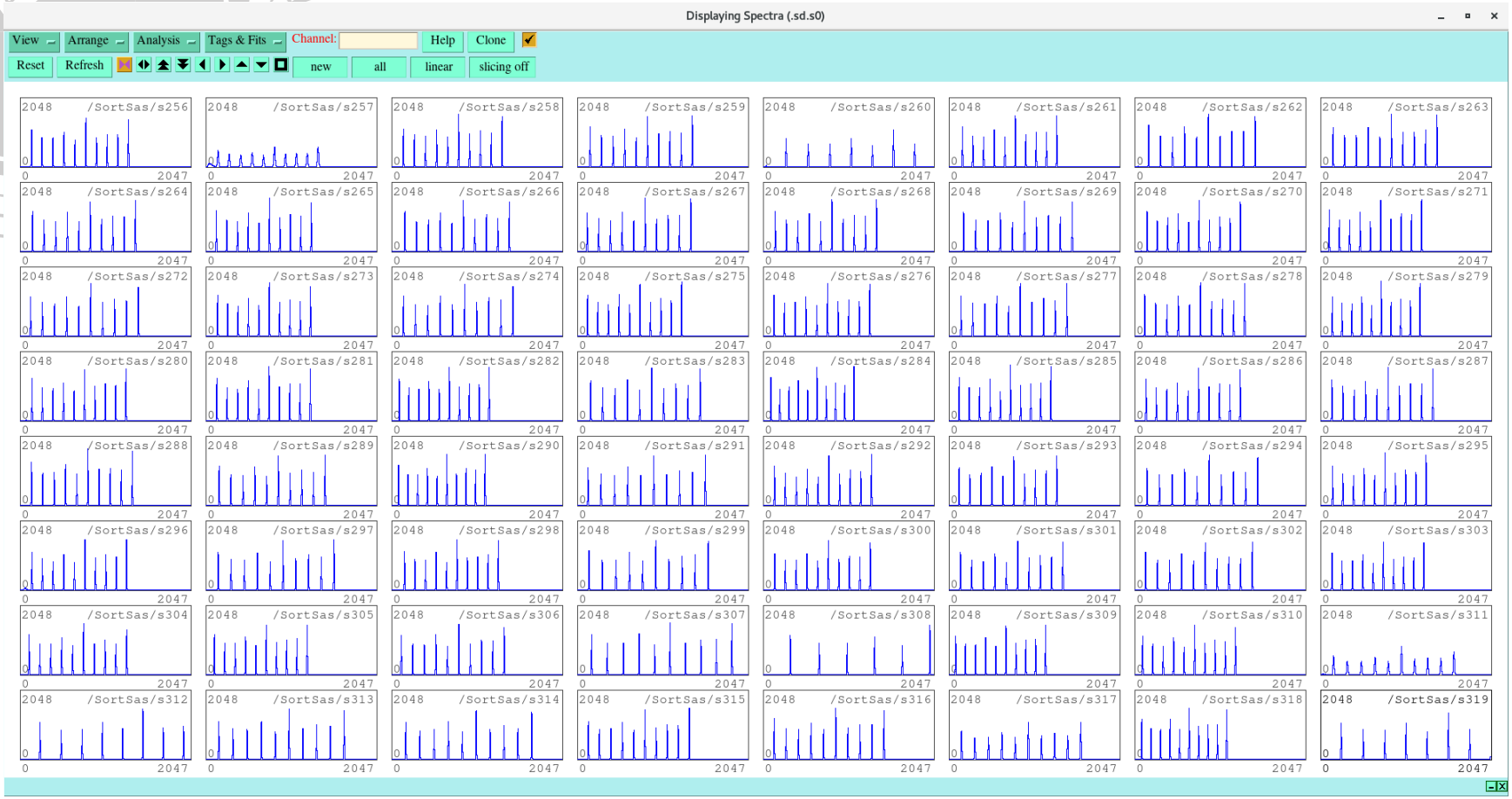
  m_p+n > 0 OR
  m_n+n > 0
- Per pixel correlations

Electronic Noise

Pulser walkthrough S100_alpha/R12-R13

- Calculated ADC offsets for 1012 of 1024 channels
- See https://elog.ph.ed.ac.uk/DESPEC/582
- LEC 1.8.L ADC spectra pulser peak widths
- p+n junction side FEE64s 48(12) keV FWHM
  min 38keV FWHM, max 83keV FWHM
  11 of 12 FEE64s < 45keV FWHM
- n+n Ohmic side FEE64s 97(9) keV FWHM
- Pulser peak widths appear little changed at end of run
- p+n junction – n+n Ohmic energy difference gate ±90keV
  assuming ADC offset **and** gain calibration
- p+n junction – n+n Ohmic energy difference gate ±150keV
  assuming ADC offset **only**

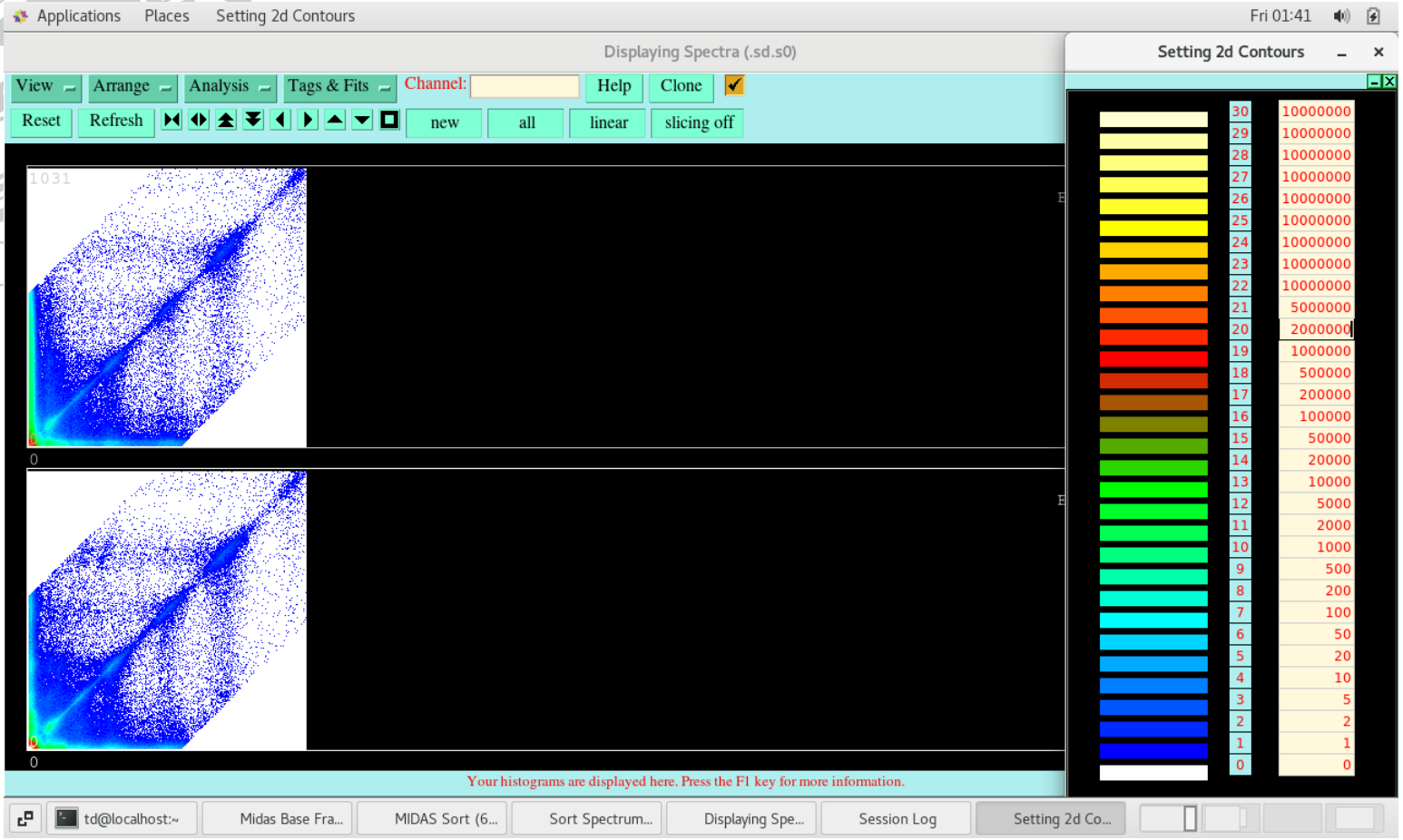
Electronic noise contd.



Example – p+n junction FEE64 #3

Note - common x and y scales – peak height proxy for peak width

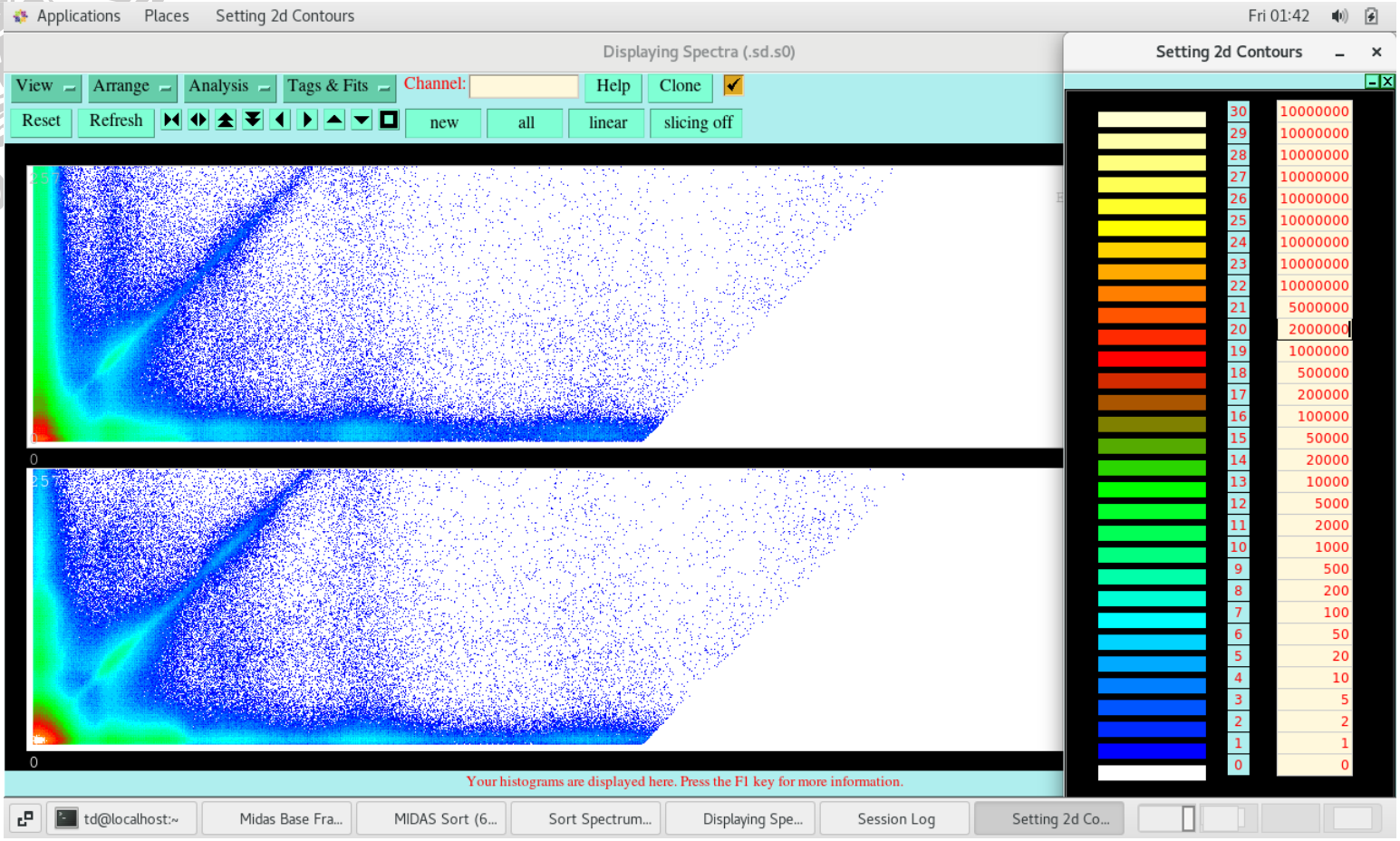
p+n junction versus n+n Ohmic energy (LEC data)



x and y axis – 20MeV FSR, 20keV/channel (nominal)

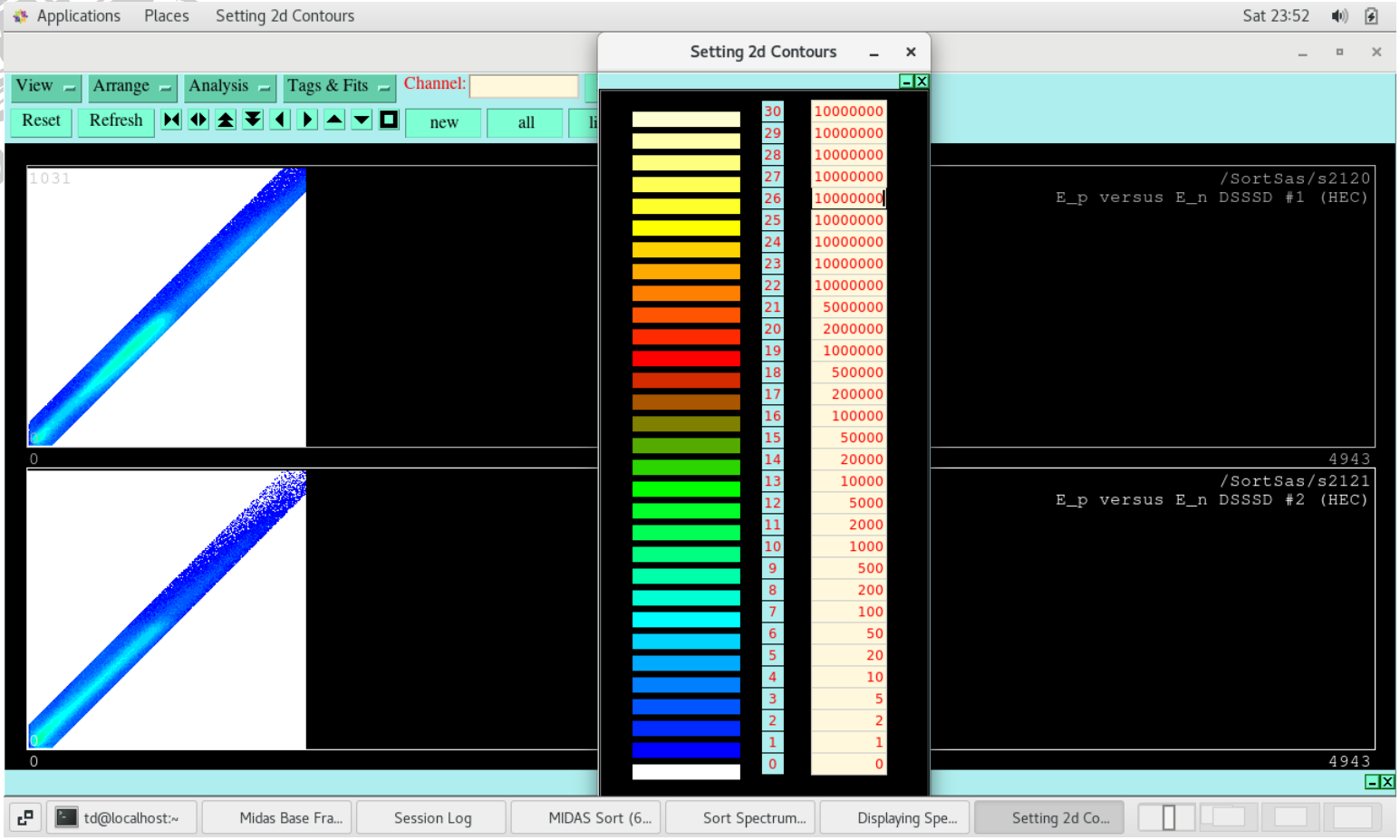
Wide energy difference gate (±2000 channels) to illustrate expected response

p+n junction versus n+n Ohmic energy (LEC data)



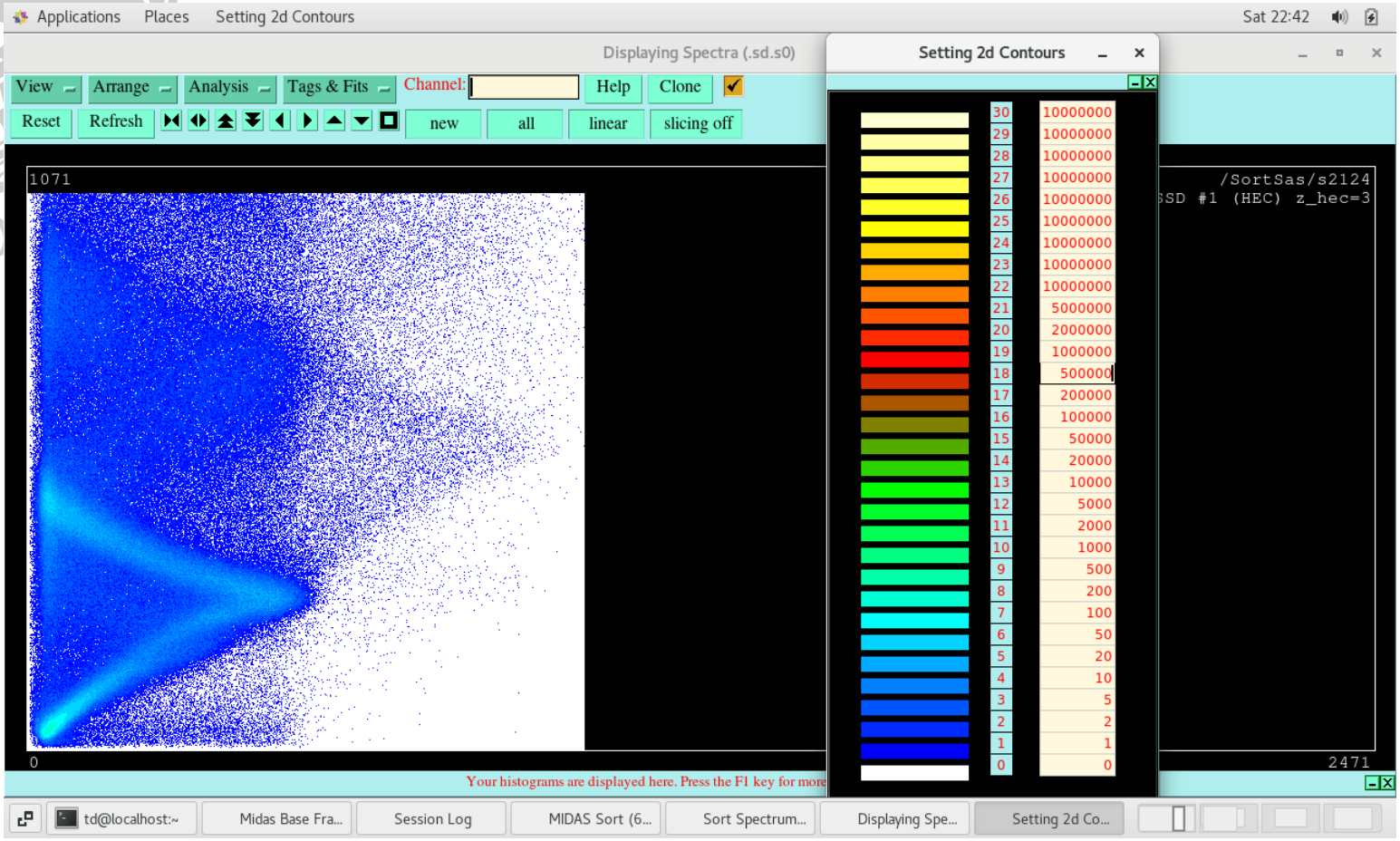
x and y axis – 20keV/channel (nominal)

p+n junction versus n+n Ohmic energy (HEC data)



x and y axis – 20GeV FSR, 20MeV/channel (nominal)

DSSSD #2 versus DSSSD#1 (HEC data)



x and y axis – 20GeV FSR, 20MeV/channel (nominal)
No ADC offset or gain calibration

FEE64 deadtime

```
*** TDR format 3.3.0 analyser - TD - May 2021
                    blocks:      32000
          ADC data format:  257504742 ( 1406851.0 Hz)
        Other data format:    4415258 (   24122.3 Hz)
  Sample trace data format:          0 (       0.0 Hz)
       Undefined format:             0 (       0.0 Hz)
Other data format type:          PAUSE:       1610 (       8.8 Hz)
                                RESUME:       1611 (       8.8 Hz)
                               SYNC100:      32682 (     178.6 Hz)
                               WR48-63:      32682 (     178.6 Hz)
                             FEE64 disc:         0 (       0.0 Hz)
                               MBS info:   4346673 (   23747.6 Hz)
                             Other info:         0 (       0.0 Hz)

ADC data range bit set:       386233 (    2110.1 Hz)

                Timewarps:        ADC:         0 (       0.0 Hz)
                                PAUSE:         0 (       0.0 Hz)
                                RESUME:        0 (       0.0 Hz)
                               SYNC100:        0 (       0.0 Hz)
                               WR48-63:        0 (       0.0 Hz)
                             FEE64 disc:       0 (       0.0 Hz)
                               MBS info:       0 (       0.0 Hz)
                              Undefined:       0 (       0.0 Hz)
                           Sample trace:       0 (       0.0 Hz)
```

Analysis of AIDA data file R20_748 (beam ON)

FEE64 deadtime

```
*** Timestamp elapsed time:      183.036 s
 FEE  elapsed dead time(s) elapsed idle time(s)
  0                0.284                0.000
  1               10.840                0.000
  2                0.188                0.000
  3               23.217                0.000
  4                0.100                0.000
  5                2.070                0.000
  6                0.000                0.000
  7                2.151                0.000
  8                0.000                0.000
  9                0.000                0.000
 10                8.754                0.000
 11                0.009                0.000
 12                0.000                0.000
 13                0.000                0.000
 14                0.015                0.000
 15                2.919                0.000
```

Analysis of AIDA data file R20_748 (beam ON)

Maximum **time averaged** deadtime = 12.1% (n+n Ohmic FEE64 #4)

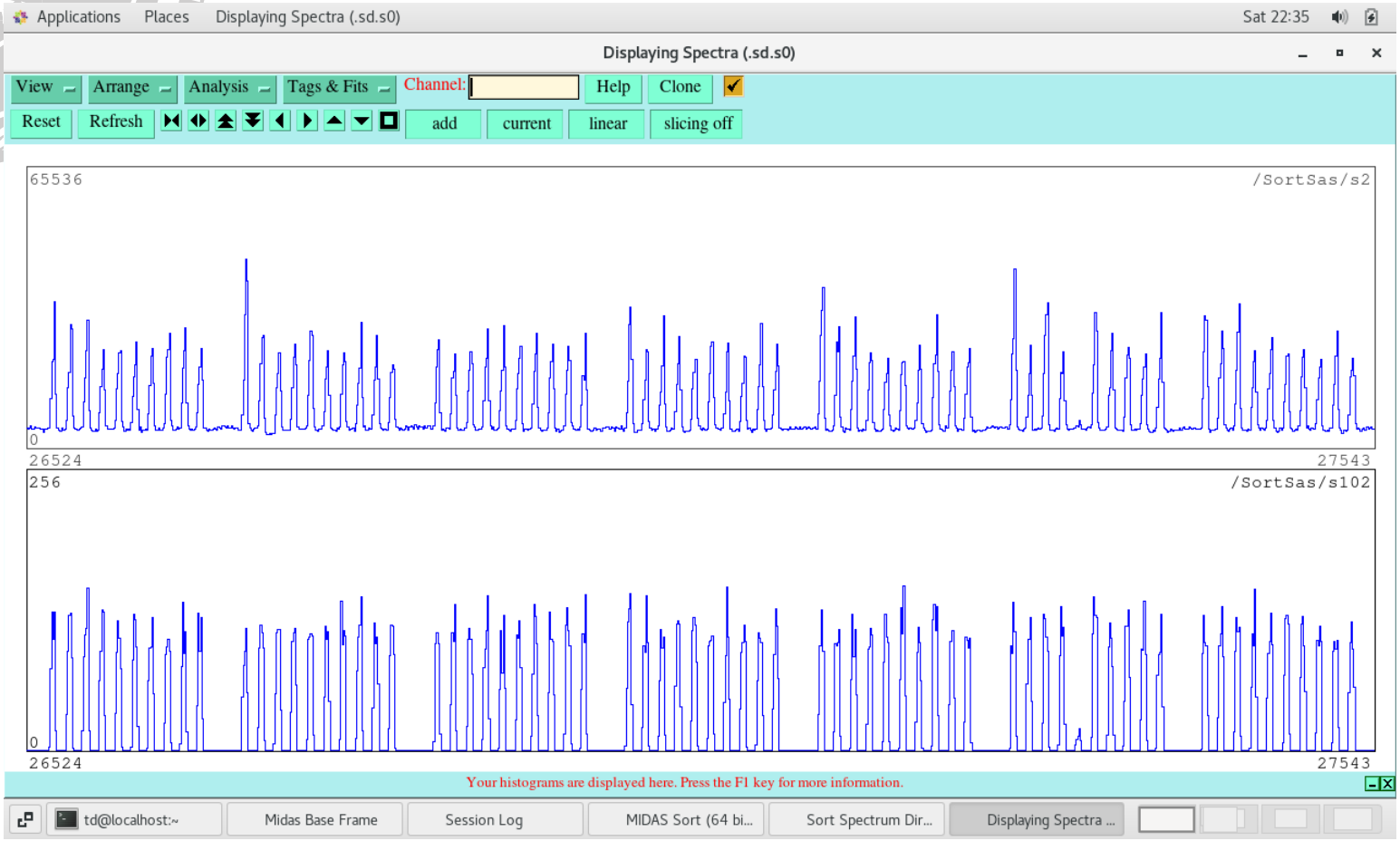
Beam OFF *all* deadtimes low e.g. https://elog.ph.ed.ac.uk/DESPEC/585

LEC & HEC data rates

p+n junction FEE64 #3 data item rate (Hz) (1 channel = 268ms)

LEC

HEC



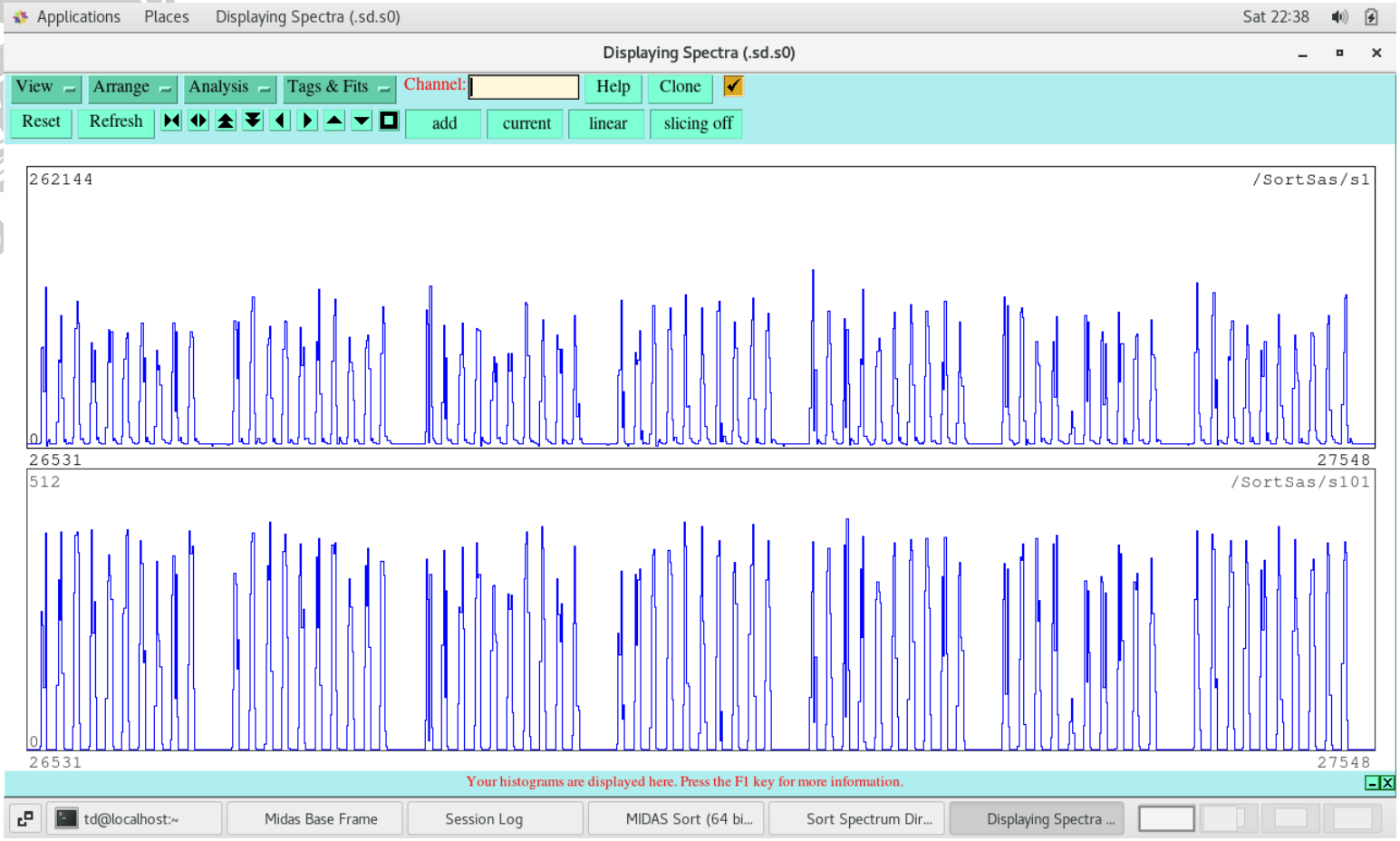
Note – **all** LEC & HEC data items – no events, no cuts
p+n junction FEE64s *very* low deadtime (beam ON)

LEC & HEC data rates

n+n Ohmic FEE64 #2 data item rate (Hz) (1 channel = 268ms)

LEC

HEC



Note – **all** LEC & HEC data items – no events, no cuts

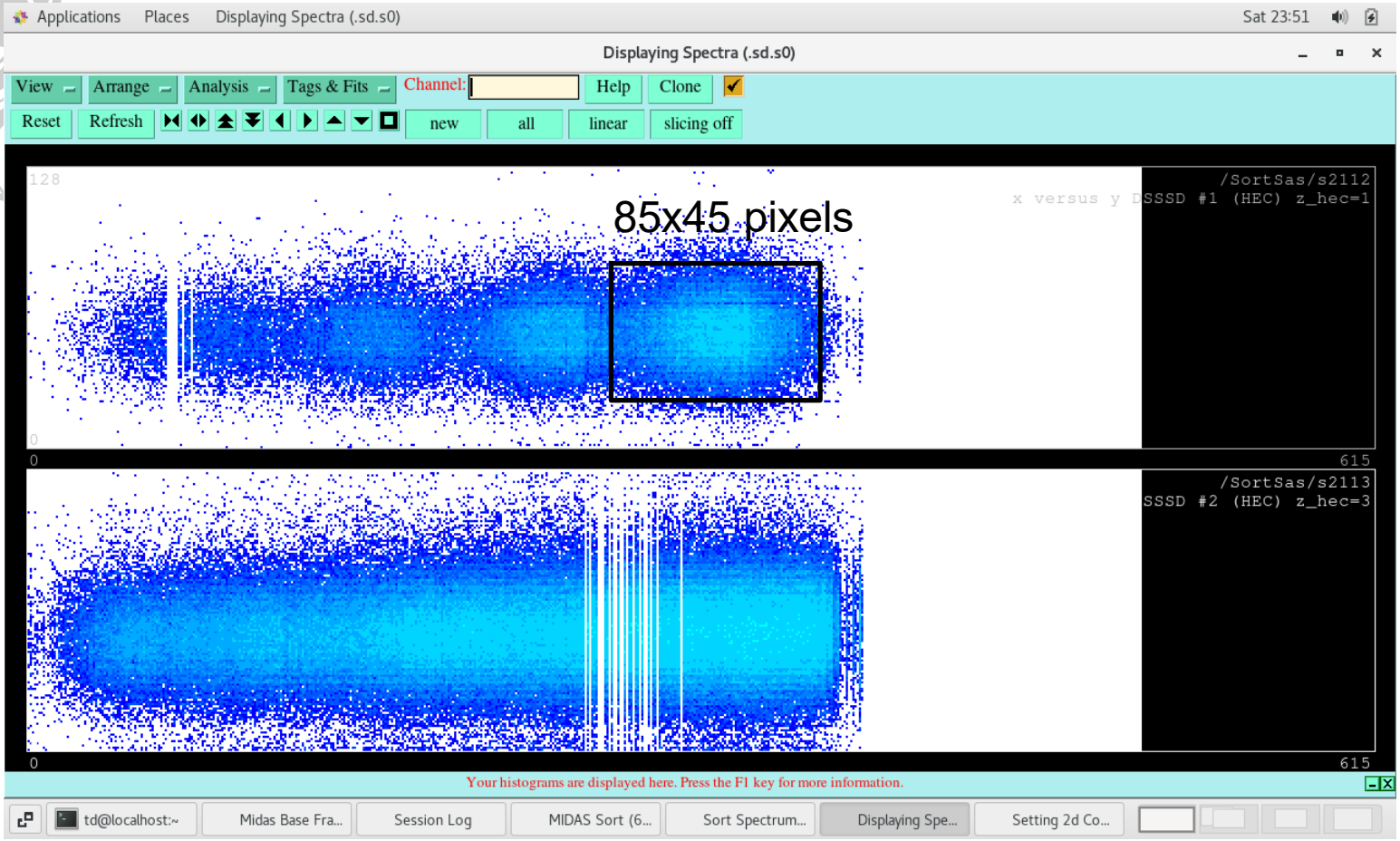
n+n Ohmic FEE64s *significant* deadtime (beam ON) – c.10-25% for S100 & S181

high instantaneous LEC rate observed on spill

Implant hit pattern

DSSSD #1

DSSSD #2



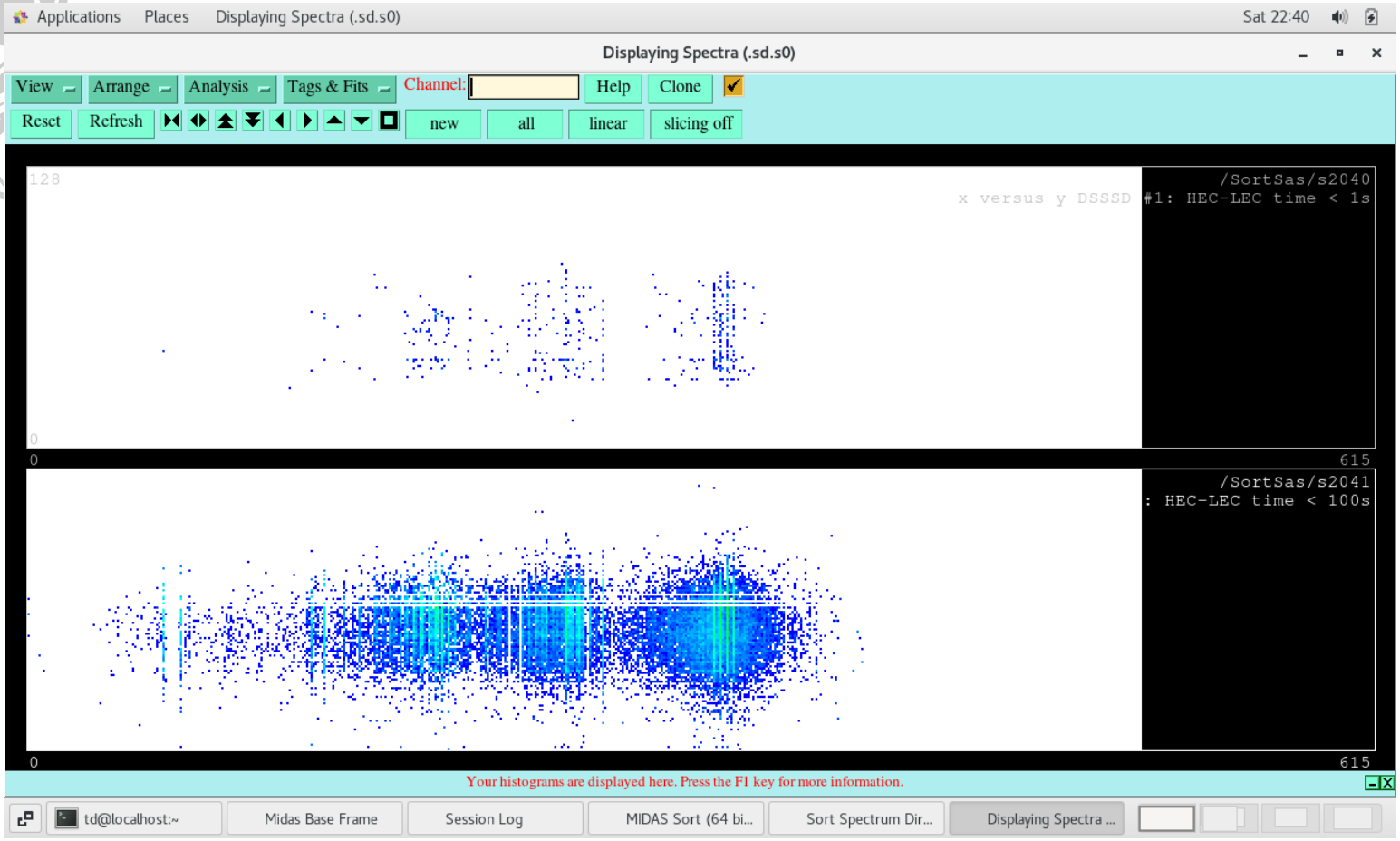
Implants stopped in DSSSD#1, *not* stopped in DSSSD#2

p+n junction versus n+n Ohmic strip #

DSSSD#1 implant-decay correlations

< 1s

< 100s



Implants stopped in DSSSD#1
p+n junction versus n+n Ohmic strip #

Conclusions

- Intrinsic and extrinsic noise stable on/off spill
- Intrinsic noise at start and end of S100 very similar
- Time machine scalers to AIDA MACB (scaler) inputs corresponding to *p+n junction* FEE64s
- Upstream/downstream plastic scintillator would be very useful
  - veto ff, light ions
  - tag implants
  - low/zero deadtime DAQ readout
    - MACB (scaler) input?
- Remember implantation rate limitations of segmented detectors
  - implantation rate per pixel
  - relatively low # pixels for 24cm x 8cm AIDA DSSSD implants
    - *c*. 3825 of 49152 pixels (1 pixel = 0.56mm x 0.56mm)