

ACoRNE Software Status Update



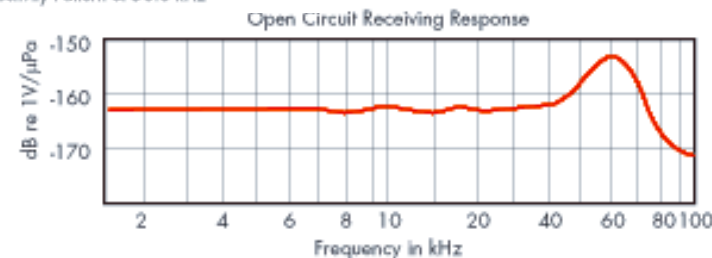
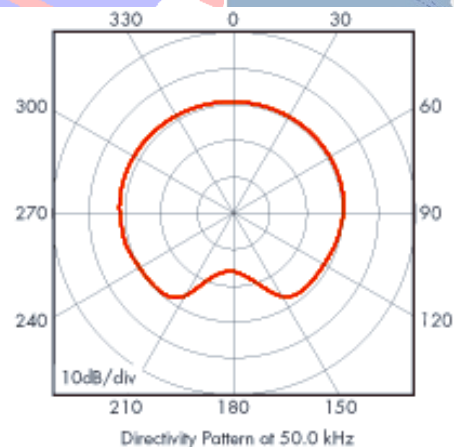
Anthony Brown
ACoRNE Collaboration

HEAPNET FP7 JRA
Radio & Acoustic Meeting

19th September 2007

Rona acoustic range

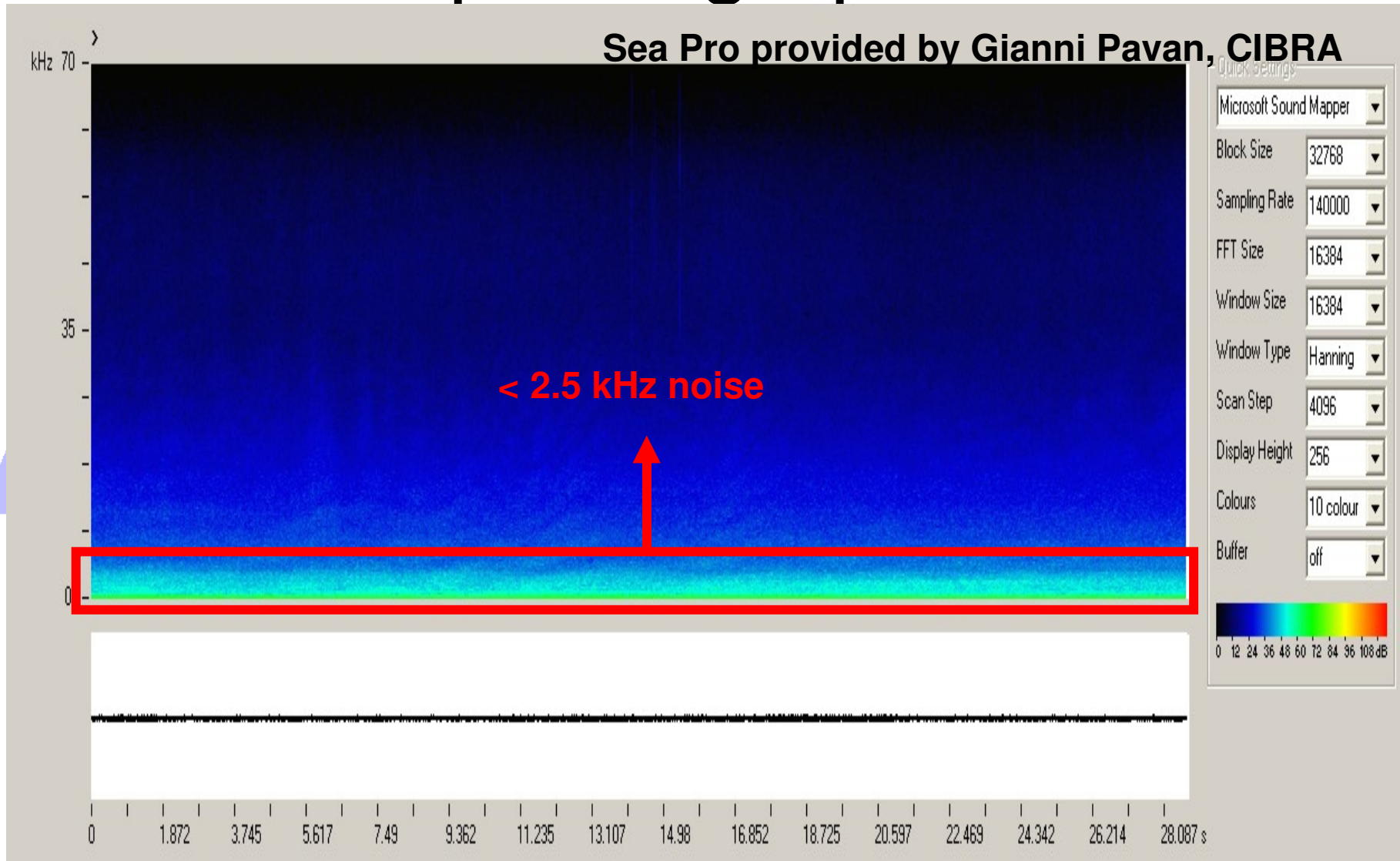
- 8 wideband hydrophones distributed over 1200 m by 200 m at depth 130 m
- Omnidirectional, flat response ~ 0.01 – 65 kHz
- 16 bit readout at 140 kHz
- All data sent to shore **unfiltered**
- Stored on 8TB RAID interfaced to tape robot
- Analysis completed **offline**

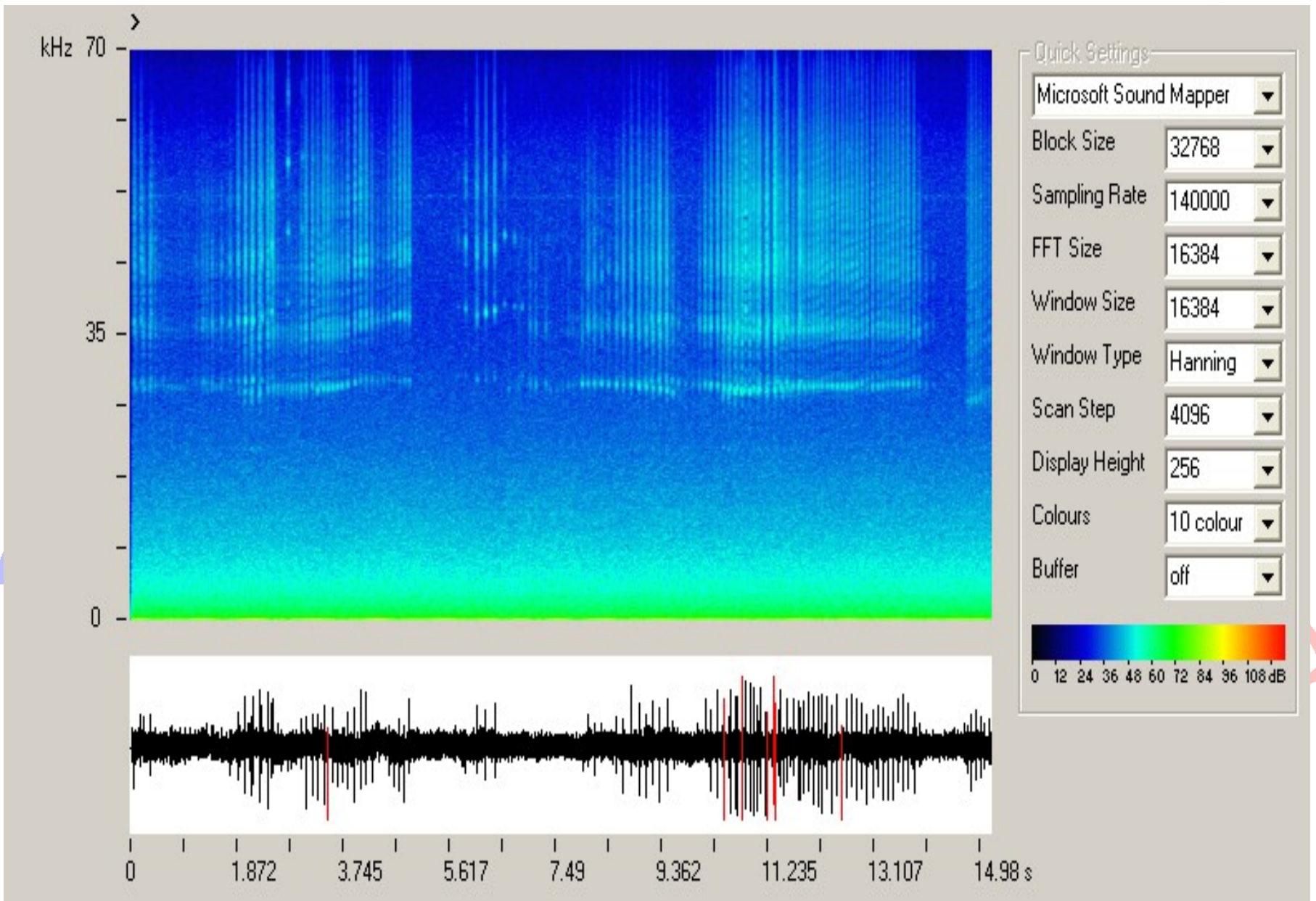


To date...

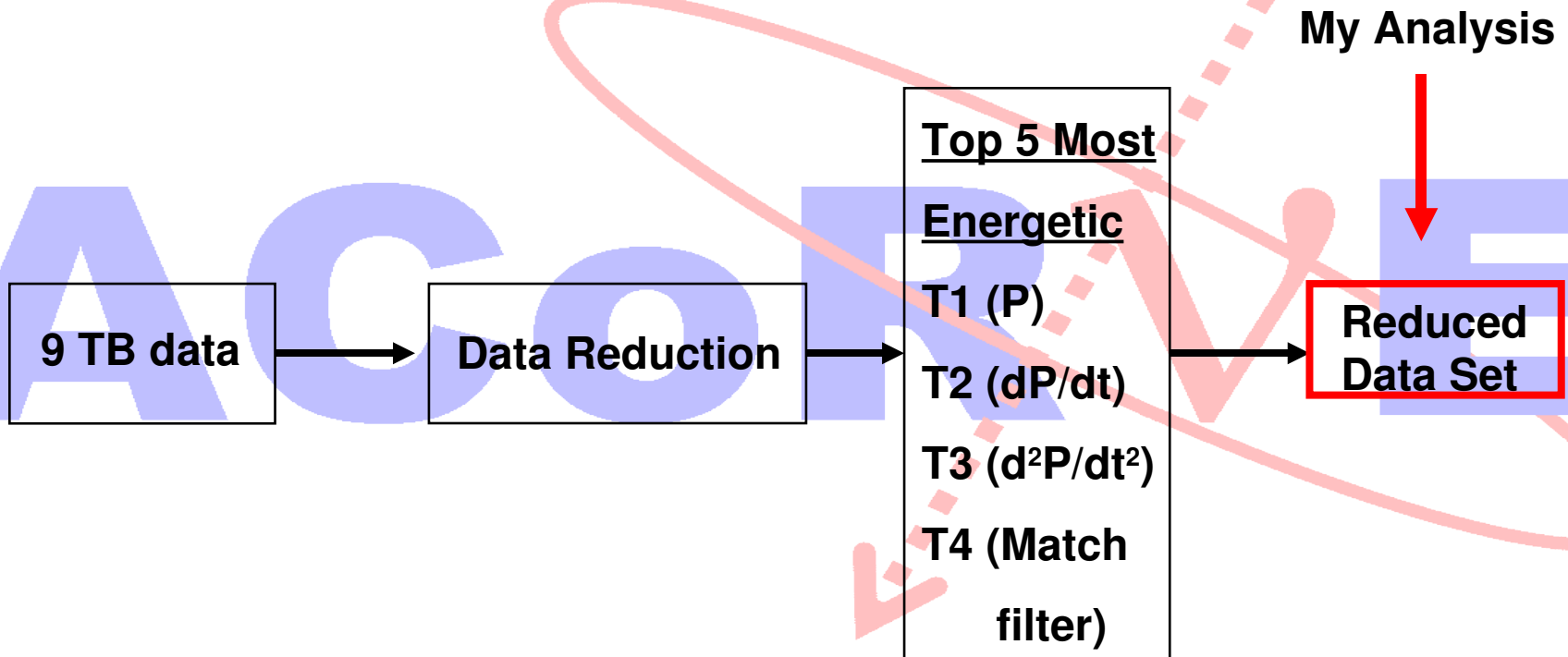
- Currently have 24 tapes in Sheffield
 - Tapes 1-4 (December 2005)
 - Tapes 5-24 from September 2006 onwards
- Total 8.69 TB (1.23 TB from Dec'05)
 - Equates to approximately 116 days continuous, for 7 hydrophones

Spectrographs





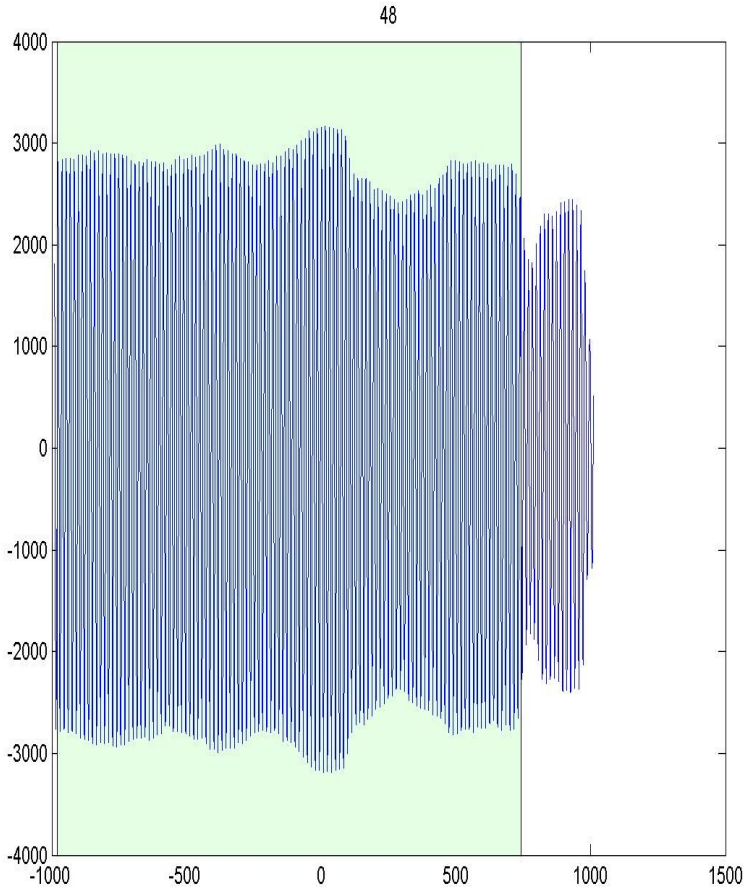
Data Analysis Rational



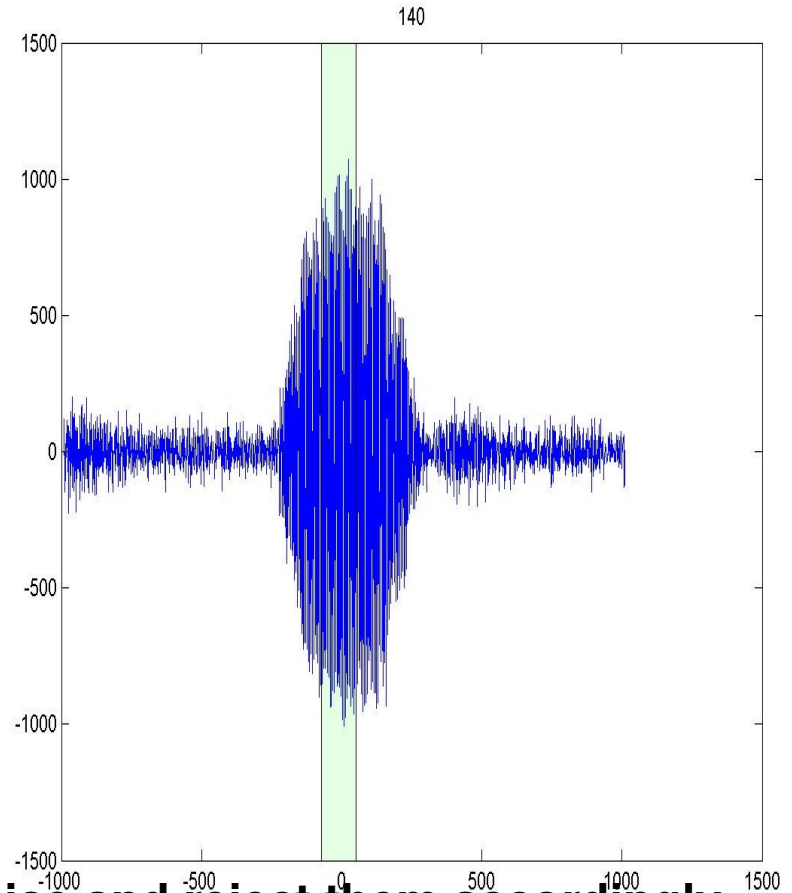
- Reduce the data set down to a reasonable size whilst keeping the best bipolar candidates and a large enough noise data set

Two Sinusoidal Examples

10kHz Ship?



30kHz Bio?



Identify classes of events that are noise and reject them accordingly

Particle Physics Approach

Possible Discriminators

- 13 dimensional phase space to explore

Signal Processing
Techniques

- Pulse Width
- Pulse Number
- Relative Energy
- Multiple Pulse
- Dominant Frequency (kHz)
- Sinusoidal Quality (1=perfect)

- Bipolarity
- standard deviation

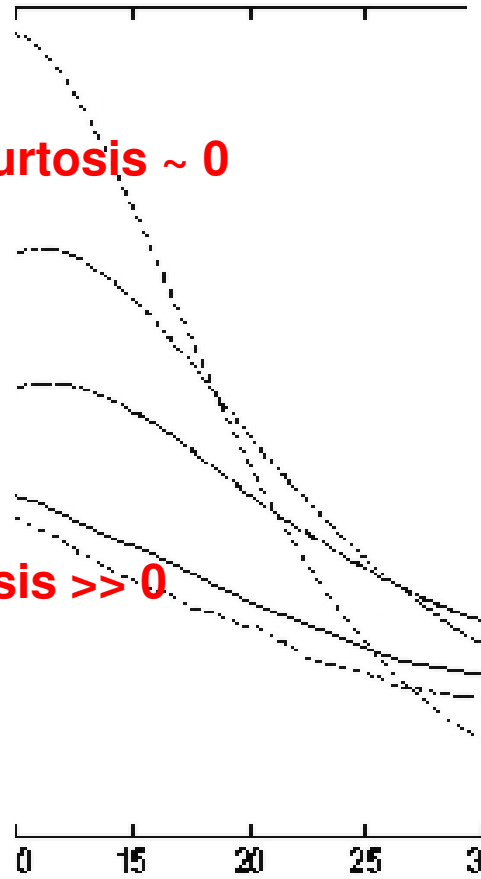
- Skewness
- Kurtosis

- As1 (standard deviation)
 - As2 (skew)
 - As3 (kurt)

Slightly more abstract

Kurtosis/Skewness of Power Spectrum

Power Spectrum of a Pulse from a 10³

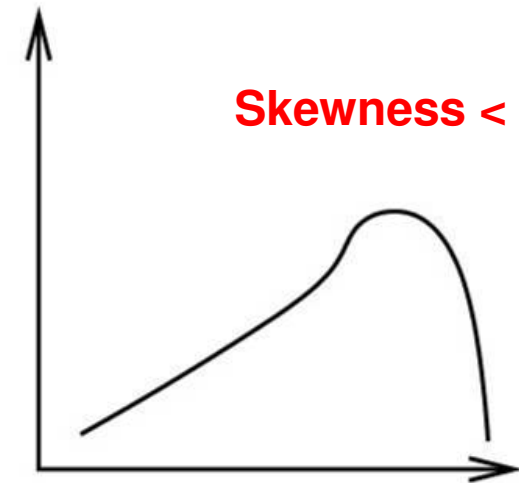
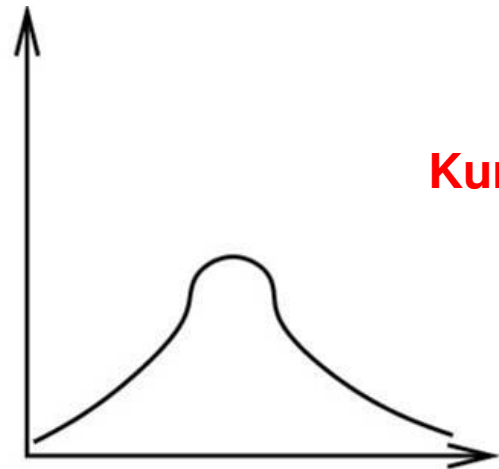
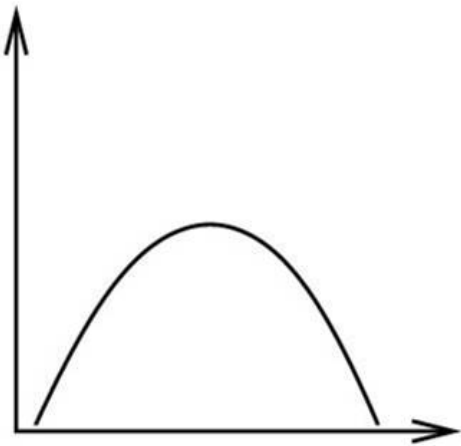


Kurtosis ~ 0

Kurtosis >> 0

Skewness > 0

Skewness < 0

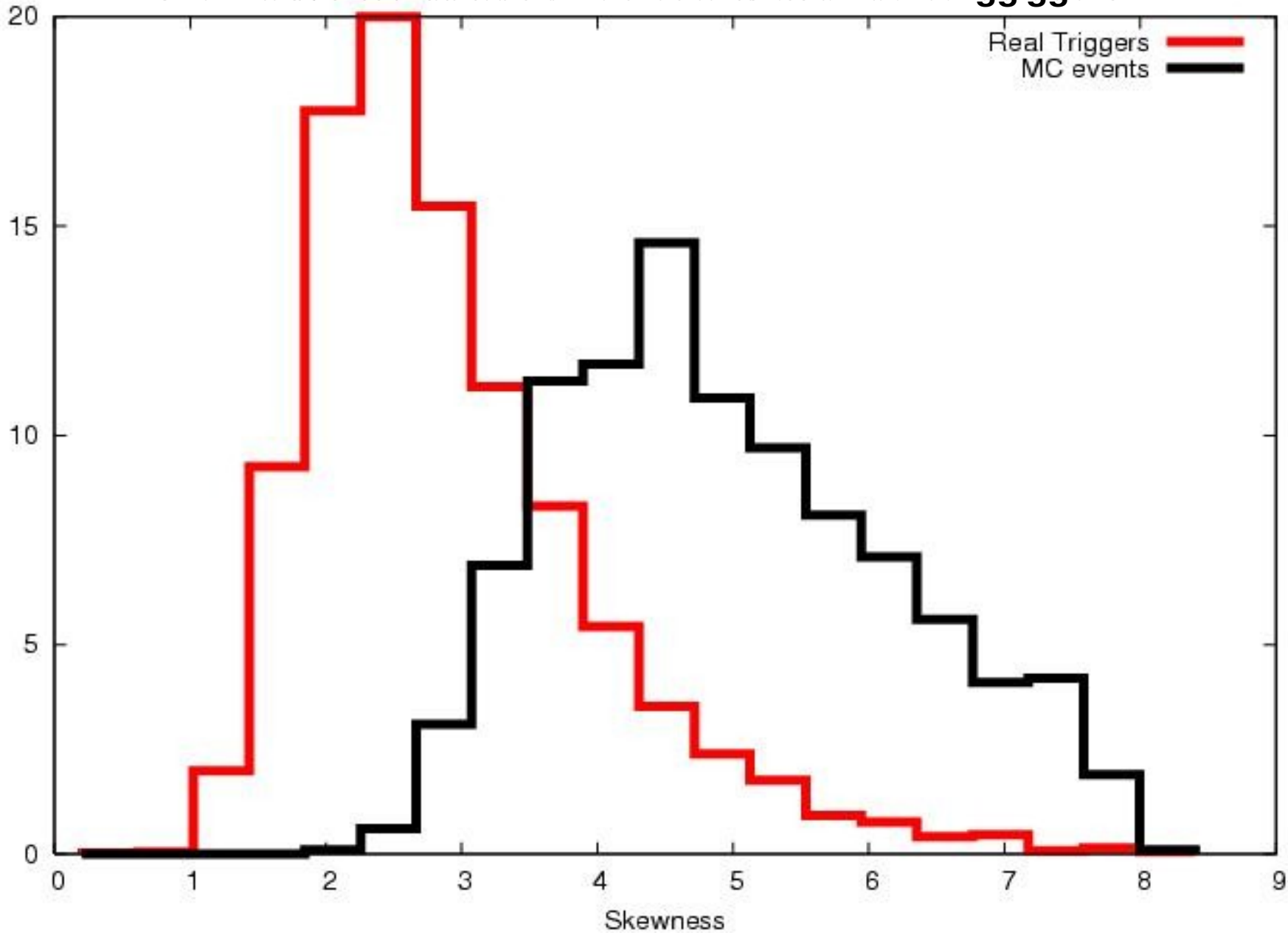


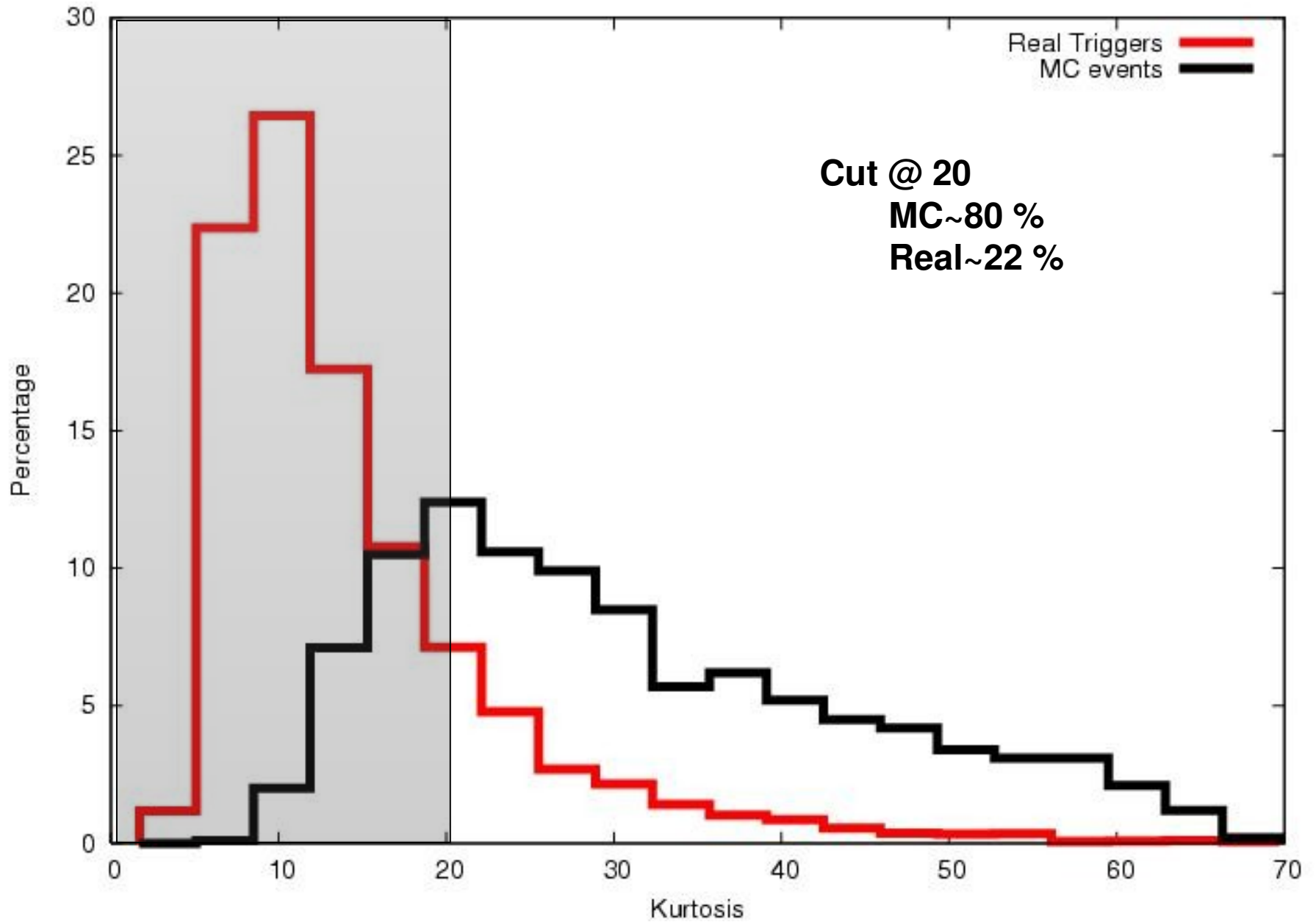
Kurtosis/Skewness of Power Spectrum

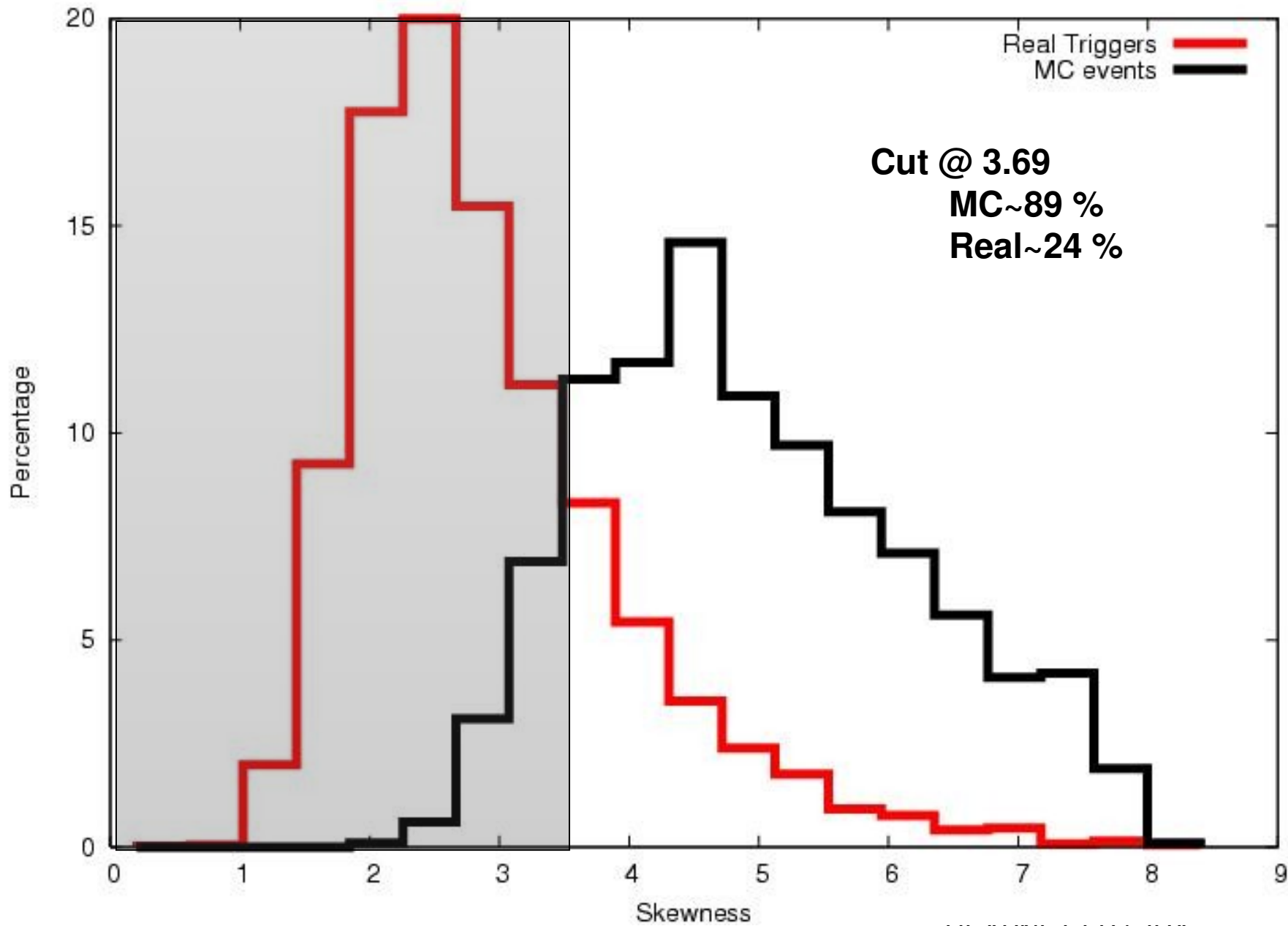
1. Take fast fourier transform of 128 samples centred around trigger
2. Calculate the kurtosis & skewness of the resultant Power Spectrum
3. Plot skewness/kurtosis distribution for each data set

(Done for both real triggers from the triggers pulled out by reduction code and a sample simulated neutrino-induced pulses with noise added)

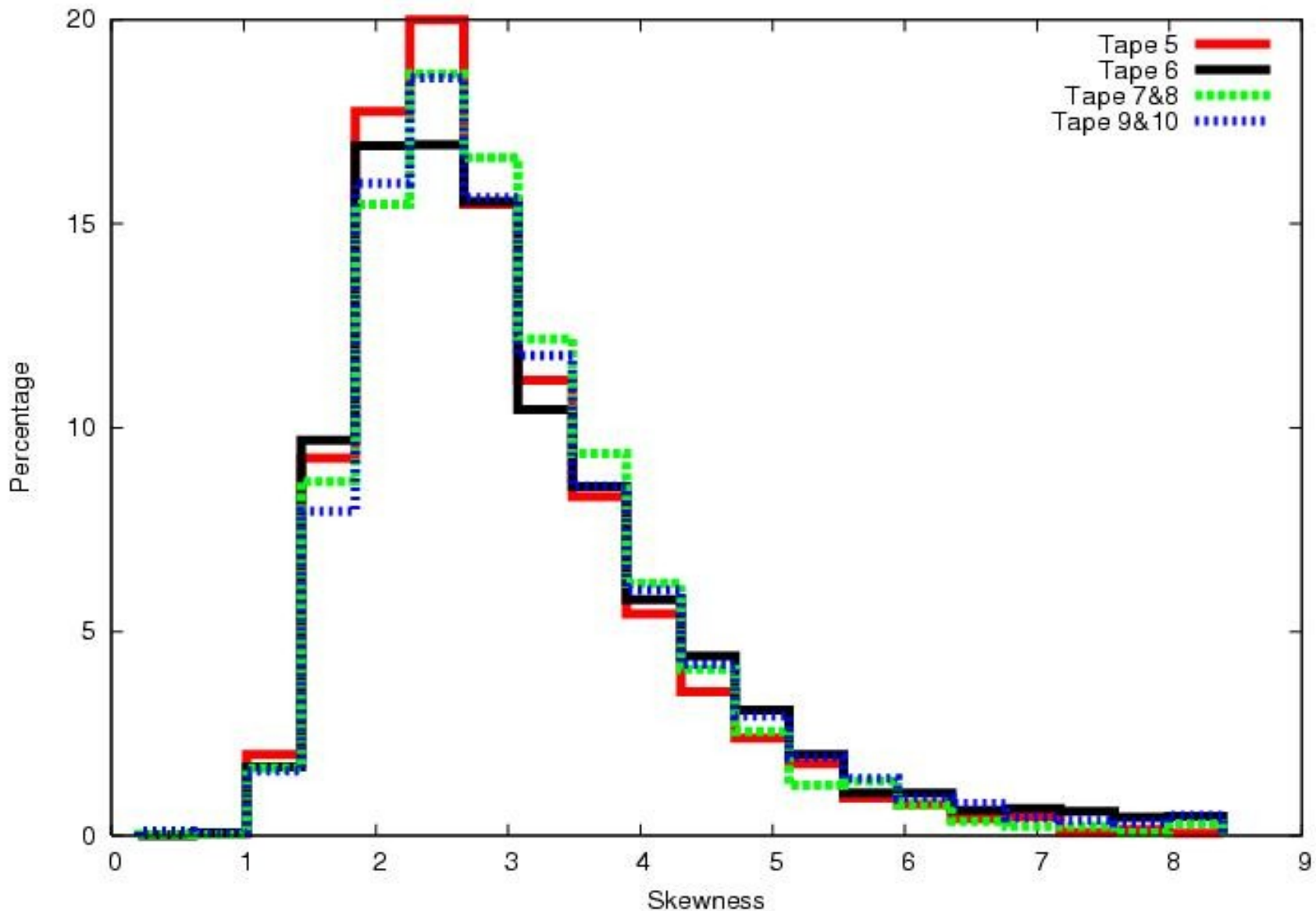
Skewness Distribution of MCMC Centers and Real Triggers







FFT Window	Type	Efficiency MC	Efficiency Real
128	Kurtosis	80 %	22 %
128	Skewness	89 %	24 %
256	Kurtosis	73 %	29%
256	Skewness	89 %	24 %



Discrimination Power of Kurtosis & Skewness is independent of Sea State conditions

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In Closing...

- Plenty of Rona data taken so far (116 days over 7 hydrophones)
- Parallel avenues explored for data analysis
 - Signal Processing based
 - Particle Physics based
- **Kurtosis** & **Skewness** are powerful bipolar pulse discriminators
- Studies extended to other possible discriminators (including neural networks to give weights to discriminators as opposed to arbitrary values)
- Both techniques will be applied to the data taken during our recent trip to Rona as discussed in Omar's talk