# Report on the FCT MDC

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# Goals of the FCT MDC (May 2001)

- FCT MDC consisted of a purely functional test rather than a scientific test, to verify functionality and stability of the FCT dynamically-loaded shared object (DSO) and the LDAS pipeline including it.
- Initial goal was to get a full FCT pipeline working from end-to-end, using simple implementations of some functionality: more sophisticated processing can easily be added later.

# Pre-MDC Development

- FCT is a self-contained library independent of LAL. This was incorporated into LAL and modified to comply with LAL specifications and interfaces.
- Parallelization was achieved by folding LAL FCT interface into a DSO which can be loaded by the LDAS wrapper API and run on multiple nodes of a Beowulf system (Wen).

# Outline of the FCT Pipeline

- Search options such as dimensionality of parameter space and range over which each parameter is defined are specified in an LDAS script.
- Frame API obtains data from frame files and passes it to data conditioning API.
- “Conditioned” data is passed to all nodes of the Beowulf system (currently, no conditioning is done - data is just passed through). Identical data is propagated to all nodes.

# Outline of the FCT Pipeline (Cont.)

- Parallel FCT is performed on the Beowulf with specified parameters – each process is an instance of the FCT DSO, which performs an FCT on the same data but over a different part of parameter space.
- Trivial event detection currently used. An event is deemed to have occurred if FCT power for some choice of chirp parameters exceeds a threshold.
- Output from FCT DSO is either no products (if no events are found) or a list of events and corresponding parameters.
- Events are then inserted into the database.

# Testing of FCT performed in the MDC

- Simulated data was generated using Matlab and written in Frame format from Matlab using Sam Finn's mkframe MEX-file in LIGOtools.
- Test frames contained a single channel at a sampling rate of 2048 Hz representing a gravity wave channel already down sampled from 16384 Hz.
- Data consisted of Gaussian noise with zero mean and unit variance, plus three 2-PN chirps with known coalescence time. The mass parameters chosen were 1.4/1.4, 3.0/1.4 and 3.0/3.0.

# List of Tests Performed

- Verify FCT DSO in the "standalone" wrapper ie. not as part of LDAS.
- Verify that FCT DSO rejects invalid parameters and that the LDAS pipeline correctly logs the errors.
- Verify that FCT DSO successfully completes with a variety of valid parameters and data eg. data lengths of 2^10, 2^16 and 2^22, and 2, 3 or 4 chirp parameters.
- Verify that FCT DSO works correctly on different numbers of processors and that execution time scales inversely with number of processors.

# Tests Performed (Cont.)

- Verify detection:

  Basic test to show that chirps can be detected in white noise with correct chirp parameters and that correct entries are inserted into the database.

- Verify long-term stability of pipeline:

  Consisted of reading 12 hours of data in a looped LDAS job and checking that LDAS and the FCT DSO did not crash or leak; all appropriate results were inserted into the database.

# Future Activities

- FCT engine
  - Improving performance and memory usage
- Parallel search code
  - Realistic inputs including whitened data, response function, LIGO noise model
  - More sophisticated event detection
  - Changing parallel model
- Hierarchical search methods (Hua Fang, Tinto)
- Approximate representation of chirp phase at different PN orders (Jeff Edlund, Yi Pan, Tinto)