Virgo Status

B. Mours (LAPP Annecy)
For the Virgo Collaboration

- Detector Status
- Computing
- Data Analysis status and Plans
Recent history

- Sept 01 - July 02: Central ITF (CITF) commissioning
  - 5 Engineering RUN (Sept 01 - July 02)
- Aug
  - ...
- July
  - ...

Graph showing frequency against displacement sensitivity.
Alignment status (Now)

- **North AND West arms aligned**
North Arm Cavity

- First lock: October 28
- Easily reproducible
- Stable for a few hours
First Virgo Commissioning Run: C1

- November 14-17
- North Cavity + Output Mode Cleaner

![Graph showing noise components](image)

- Shot noise
- Frequency noise
- Control noise?
- Electronic noise (ADC)

**Sensitivity (m/sqrt(Hz))**

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
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<tbody>
<tr>
<td>Start</td>
<td>753113780.00</td>
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<tr>
<td>Avg Lvl</td>
<td>1.135e-11</td>
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<tr>
<td>RMS</td>
<td>2.631e-09</td>
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</tbody>
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Local (this site) T0: 17/11/03 14:16:39
C1: Duty cycle

- 3km cavity Transmitted power

**Pr_B7_DC_mean** TIME

- Lock Losses
- Quadrant Alignment
- $\theta_x$ excitation
- Large Seismic Noise
- earthquake

Locking tests

2 hours without operation

Channel not present

752857200.0000 : Nov 14 2003 14:59:47 UTC
Next steps

- **North Cavity**
  - Linear alignment (work in progress)
  - Laser frequency stabilization (work in progress)

- **West cavity:**
  - Locked on Monday (Dec 15)

- **Recombined Michelson:**
  - Start work on January 2004

- **First science run: fall 2004??**
On site (Cascina) Computing

- **Purpose:**
  - Online/On-time analysis
  - Commissioning support

- **Storage**
  - 20 TB available
    - 10TB for the raw data circular buffer (1 month)
  - Additional 50 TB almost installed

- **Data analysis computing**
  - 16 Bi-pro Linux PC available
  - 2004: add a '300 Gflops machine' (450 KEuros)

- **Network:**
  - 34 Mbits/s now
  - Upgraded to 155 Mbits/s in 2004
Off site Computing

- **2 National Computing centers:**
  - Bologna (+ Italian lab using Grid) and Lyon
  - Ressources shared with other HEP experiments

- **To be used for:**
  - Data archiving and distribution for the runs:
    - Medium term (‘One year on disk’): Bologna
    - Long term: Lyon
  - Simulation
  - Offline analysis

- **Request for 2004:**
  - 46000kSPECINT2000.day (about 150 CPU*365days)
  - 8 time 2003 use
  - 80% requested by periodic searches
Data Analysis Organization

• **Commissioning activities**
  - investigations with E. run data
    - Calibration, control performances, detector noises, lines studies, glitches identifications...
    → Driven by Engineering runs

• **Data Analysis working groups**
  - Calibration/Reconstruction (coordinator: F. Marion)
  - Noises studies (coordinator: JY. Vinet)
  - Periodic searches (coordinator: S. Frasca)
  - Burst searches (P. Hello)
  - Binary coalescence searches (A. Viceré)
  - Stochastique (G. Cella)
  → Up to now, mainly driven by Mock Data Challanges
  3 MDC’s in 2003 (March, June, October)
CITF Analysis: Example I

- E4 Sensitivity curve understanding

Internal noise + electronic & shot noises

Laser frequency noise +

Internal noise + electronic & shot noises
CITF Analysis: $h(t)$ reconstruction

- Build $h(t)$ in the time domain
  - Build a set of ARMA filters
  - Follow optical gain
  - High pass filter

- E4 data:

- Practice whitening on E4 data
- Full characterization of filters using ROC (efficiency vs false alarm rate) diagrams

- Bursts filters running during MDCs: implementation using the Parallel code (Merlino) for Coalescing Binaries

- Implementation of Damped Sine correlator to be tested during next MDC

- Characterization of network strategies (coherent analysis vs coincidence) using ROCs done

- Improvement of coincidence analysis under study (see Fabien Cavalier’s talk on Friday)
MDC: Example for Bursts

- Inject ZM events in 9 hours of E4 noise
  - Non stationarity for MDC3
  - Lock segment for MDC3
- Produce
  - Calibrated channel
  - Whitened channel
- Run different algorithms:
  - Mean Filter (MF),
  - Slope filter (ALF),
  - Peak Correlator (PC)
  - Generalized Delta Filter (GDF)
- Get:
  - Event list, efficiency, SNR ratio, ...

![Graph showing ALF cut at 40]

![Graph showing detection performance with GDF order vs. detection probability]
- Code for grid generation available
  - high and low Minimal Match
- A chain using the Merlino framework available
  - MPI based
  - tested during the MDCs on the Cascina cluster
- Code using the Multi Band method available
  - see Frederique Marion’s presentation
- Two prototypes of the event manager available
  - Collecte the output of many filters
- Ongoing activity on network, vetos...
  - See Giancarlo Cella, Gianluca Guidi, Andrea Viceré talks
MDC: Example for Binary

- **Inject events with:**
  - Different masses, SNR, models

- **Run different analysis:**
  - Merlino: Parallel flat search
    - MPI based
  - Multi-Band Template Analysis

- **Get:**
  - Speed,
  - Event list,
  - Efficiency, false alarms
  - SNR ratio...

The Horizon follows the non-stationarity

Computational time ≈ 1h 10m
Periodic sources

- Hierarchical method available
- Develop the tool for distributed computing
- Large test made using GRID
  - Frequency band of 2hZ, 2 spin down parameters
  - Compared coherent vs incoherent approaches
  - Tune the code
  - Measure performances

- New ideas to improve performances
  - See Sergio Frasca’s talk
- Binary periodic source: first version available
  - Tested on E4 data
Stochastic search

- Activity recently started
- On going software developments
- Possible collaboration with Bar detectors
Summary

- Full Virgo commissioning started
- Data Analysis integration through MDC's

Coming up Data
- Commissioning runs:
  - C2: Jan 16-19 (N or W arms) with linear alignment
- MDC4: January 04
  - run part of the online pipeline
  - Some data conditioning tests (like lines removal)

Goal: Be ready for the first Virgo science run
- Fall 2004 ??