LABORATORI NAZIONALI DEL GRAN SASSO

SEMINAR ANNOUNCEMENT

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"From the core to L'Aquila earthquake: the Earth viewed by the LNGS geodetic interferometers"

Two crossed 90-m long laser extensometers are operating at LNGS since several years. They measure temporal changes in length of two 90-m-long baselines, which are about parallel and perpendicular to the local trend of the Apennines respectively. Because of their stability, sensitivity (now about 0.3 picostrain) and underground location (1400 m under the free surface) these instruments provide strain records showing high S/N ratio from tens of milliseconds to years. The most important scientific results obtained till now regard various geophysical phenomena, from the Earth core (through the diurnal resonance of the solid tide), to the fundamental thoroidal free oscillations, and to slow earthquakes. Before, during and after the 6 April 2009 L'Aquila earthquake they continuously maintained optical alignment, and have produced a clear record of preseismic and postseismic strain. The analysis of the data related to the first few days after the event show that strain after about 1.5 days is fully consistent with afterslip on a stationary region of the earthquake causative fault. Very recently, this afterslip has been confirmed by satellite (SAR) techniques. The preceding few-hour-long transient (whose seismic moment history is quasi-exponential) is fully consistent with unilateral diffusive slip propagation toward the shallower part of the same fault. The propagation path ends where later afterslip probably occurred. Slip propagation similar to heat diffusion has been suggested in the past to explain the observed scaling law between amplitude and duration of slow earthquakes, but this is the first observational evidence of the role and details of slow rupture propagation. As regards pre-seismic strain, no anomalous signal larger than a few tens of nanostrains is visible during the two years before the event, thus limiting the volume of the possible earthquake preparation zone to less than 100 km^3; moreover, earth tidal response is stable within 0.5% in amplitude and 0.5° in phase. Thus, reality of large-scale precursory phenomena seems unlikely. During the last few days, there is some evidence of dilatancy of satured rock over the earthquake causative fault, maybe related to the foreshocks. Seconds before the event, strain is stable at the picostrain level and prerupture nucleation slip in the hypocentral region is constrained to have a moment less than 0.00005\% of the main shock seismic moment.

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