20.10.2022, 10:30, Building A42 room 129/130

Dr. Geoffrey D. Reeves
Los Alamos National Laboratory, Intelligence and Space Research Division

"Space Weather, Solar Storms, and You"

Space Physics refers to the study of physical processes from the Sun to the edges of our solar system. Often it involves measurements of the charged particles and electromagnetic fields that make up space plasmas. Plasmas behave as a coupled, nonlinear fluid and control the flow of energy and momentum in space. Space Weather refers to the application of the scientific discipline of space physics to the practical needs of society. The goals of space weather are to understand, specify, and predict severe conditions in space that can adversely affect essentially all technological systems that have links to space - including satellites, human space flight, terrestrial power systems, communications, etc.

Both fundamental (space physics) and applied (space weather) research pre-date the modern space era. Studies of the sun, sunspots, and solar flares date back to the time of Galileo. Studies of the aurora borealis date back to the earliest times that humans migrated far enough north to observe them. Space weather effects were interrupting and damaging technological systems long before people understood their causes. Now, both the number and severity of space weather effects is increasing in unprecedented ways as the barriers to space come down like never before and as our ground-based technologies are increasingly connected with our space-based ones.

I will discuss what we mean when we talk about space weather, some of its history, the physical processes that produce it, and what it means to us here on Earth.

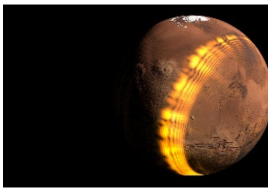
Geoff Reeves is the Chief Scientist for Intelligence and Space Research at Los Alamos National Laboratory (LANL) in New Mexico, USA. He is a fellow of both LANL and the American Geophysical Union where he currently serves as president for Space Physics and Aeronomy. Geoff's research concentrates on understanding the near-Earth space environment, space weather effects on commercial and military satellite systems, and radiation hazards from nuclear explosions in space. He has been active on a number of NASA, DoE, and European satellite systems including GPS, Polar, Cluster, MMS, and the Van Allen Probes. He has published over 500 papers on geomagnetic storms and substorms, radiation belt dynamics, energetic neutral atom imaging, the effects of nuclear explosions in space, and active space experiments including the use of space-based electron beams to study wave-particle interactions.

28.10.2022, 10:00, Building H – rooms VR1-3

Dr. Simon Stähler:
ETH Zürich, Dept. of Earth Sciences, Seismology and Geodynamics

"The big Marsquake of May 4 2022 - InSight's grand finale"

InSight has been the first successful seismic observatory on planet Mars since November 2018. During this time, it allowed to investigate the structure of the crust, mantle and core and give insight into the way surface tectonics work on single-plate terrestrial planet.



And just as the mission was coming to a close due to diminishing solar power, a magnitude 4.8 quake struck the planet and provides the community with an exciting new dataset, including surface waves.

12.01.2023, 10:00, Building H - large lecture hall

Prof. Satoshi Ide
School of Science, University of Tokyo, Dept. of Earth and Planetary Environmental Science

"Physics of Fast and Slow Earthquakes"

Slow earthquakes have different names, such as low frequency earthquakes (LFEs), tectonic tremors, very low frequency earthquakes (VLFEs), and slow slip events (SSEs), but these events can be considered as different manifestations of a single slow deformation process. Recent observations have proved that VLFEs radiate very broadband seismic waves, from 0.01 to 10 Hz and the moment release of SSEs is synchronized well with the temporal change of tremor/LFE activity. These observations are consistent with a Brownian slow earthquake model, in which tiny stochastic fluctuations (tremors/LFEs) produce large-scale continuous deformation (SSEs). Assuming that a cluster of tremor/LFE represents a small SSE, we may define almost all size of slow earthquakes with different time constant, or duration T, from 0.1 s to years. The compilation of recent catalogs of slow earthquakes shows that the maximum seismic moment M_o at a given duration T is proportional to T, i.e., $M_o \leq cT$ ($c \sim 10^{12}\mathrm{Nm/s}$), which is the updated interpretation of the scaling relation of Ide et al. (2007).

For fast earthquakes, both the maximum and minimum of seismic moment at a given duration are strictly limited by the duration, as $M_o \propto T^3$. Rupture process of earthquakes are almost self-similar, with scale invariant stress drop and scaled energy. The self-similarity continues from the very beginning of the rupture initiation, and it is almost impossible to predict the final size of an earthquake at the initial stage of rupture. Despite complexity in each rupture process, the dynamic rupture is controlled by some structural heterogeneity, and the isolated heterogeneity produces repeating or imperfectly repeating earthquakes. Therefore, the dynamic rupture process of fast earthquakes can be modeled by multiscale patch model with fractal fracture energy distribution. In such a model, rupture continue to propagate for wide scale range, at changing propagation speed, which is of significant fraction (~70%) of shear wave speed. Rupture cannot propagate slowly, for example at 10% of shear wave speed, because the dynamic rupture is a coupled process between seismic wave propagation and fracture.

The most fundamental difference between fast and slow earthquakes is the governing equation coupled with friction/fracture equation: wave equation and diffusion equation, respectively. Diffusional mechanisms are various, and dependent on regional environmental conditions. Therefore, slow earthquakes appear diverse. On the other hand, fast earthquakes are rather unique, a special type of deformation mode.