INSIGHTS INTO EARTHQUAKE PHYSICS REVEALED BY SLOWNESS-ENHANCED BACK-PROJECTIONS

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An improved understanding of the earthquake physics relies on better knowledge of earthquake rupture processes (earthquake nucleation, its complex rupture propagation, and the final arrest). Currently, the greatest challenge in this field is that the observations are behind the modeling efforts, making testing and validations of the ever-increasing rupture models impossible. In this talk, I present our effort of improving the resolution and reducing the uncertainty of back-projection imaging which allows us to address the open questions of earthquake source dynamics. In the case study of the 2015 Mw 8.3 Chile earthquake, we observed splitting of rupture fronts around the rim of a large barrier. This encircling pattern is analogous to the double-pincer movement in military tactics. Such degree of complexity is previously only seen in simulations and it is observed for the first time in real earthquakes. In the 2018 Mw 7.5 Palu earthquake, we found sustained rupture velocity of 4.1 km/s from the rupture initiation to the end, despite large fault bends. The short or absent supershear transition distance can be caused by high initial shear stress or short critical slip-weakening distance, and promoted by fault roughness near the hypocenter. Steady rupture propagation at a unstable supershear speed lower than the Eshelby speed, could result from the presence of a damaged fault zone.