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Multi-scale fracture mechanisms in snow

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Depending on the scale of observation, many engineered and natural materials show different mechanical behaviour. Thus, size effect theories, based on a multiscale approach, analyse the intrinsic (due to microstructural constraints, e.g., grain size) and extrinsic effects (caused by dimensional constraints), in order to improve the knowledge in materials science and applied mechanics (Bazant and Planas 1997). Nevertheless, several problems regarding Solid Mechanics and Materials Science cannot be solved by conventional approaches, because of the complexity and uncertainty of materials proprieties, especially at different scales. It is sufficient to think, for instance, to the concept of void nucleation, or to localisation of deformations at microscopic level produced by the non-linear phenomena occurring at mesoscopic level (Collini, 2010).

For this reason, a simple model, capable of predicting fracture mechanisms in brittle and quasi-brittle materials has been developed. This model is based on the Golden Ratio. Intimately interconnected with the Fibonacci sequence (1, 2, 3, 5, 8, 13, . . .), this number controls growth in Nature and recurs in many disciplines, such as art, architecture, design, medicine, etc ... This paper presents the case of fracture toughness of snow, in which the irrational number 1.61803 recurs when the geometrical dimensions vary. This aspect is confirmed by the results of experimental campaigns performed on snow samples.