



## WSL Institute for Snow and Avalanche Research SLF

The WSL Institute for Snow and Avalanche Research SLF is part of the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and thus of the ETH Domain. WSL focuses on the sustainable use and protection of the environment and on the handling of natural hazards. WSL employs approximately 600 people, of whom 180 work at SLF in Davos. The Research Unit Snow Avalanches and Prevention studies the formation and dynamics of avalanches, develops warning systems for alpine natural hazards and issues the Swiss Avalanche Bulletin. Its research group Avalanche Formation and Dynamics is calling for applications for a

# Master Thesis: Scaling laws in snow fracture toughness

Snow is a complex material from a mechanical point of view. It has temperature and strain rate dependent properties and a complex microstructure. In order to further improve avalanche forecasting, detailed knowledge of the material properties of snow and, especially of weak layers is required. One property of particular interest is fracture toughness, as the release of slab avalanches is governed by fracture mechanical processes. However, current fracture toughness experiments (e.g. tilted PSTs) require large sample sizes and are therefore limited to field experiments and specialized setups. Smaller sample sizes would allow more data to be collected in the field and even allow experiments to be conducted in the controlled environment of a cold laboratory.

The aim of this thesis is therefore to evaluate the feasibility of downscaling fracture toughness experiments and to quantify the scaling of material properties with sample size. To this end, a series of field and laboratory experiments will be carried out to collect multiaxial (mode I & II) fracture toughness data. Digital image correlation will allow strain within the weak layer to be derived and finite element simulations will help to validate results and improve the experimental setup.

You are studying physics, engineering, materials science or a similar subject. We are looking for a student with a solid background in mechanics, some practical experience with finite element analysis and good programming skills (Python). Ideally, you will have some experience in fracture mechanics or have attended a lecture on the subject. For field work, you must have appropriate (backcountry) skiing experience and be prepared to work in harsh winter conditions. You should have good oral and written communication skills, especially in English, be well organized, motivated to work in an interdisciplinary and international team and keen to transfer your research into practice.

As some experiments depend on the presence of natural weak layers, the project will start in November 2024. We offer free accommodation in a shared flat in Davos for the duration of the thesis. Please contact Jakob Schöttner ([jakob.schoettner@slf.ch](mailto:jakob.schoettner@slf.ch)) for further information. To apply, please send your CV, a current transcript of records and a short motivation letter by email by **15.08.2024**.

