



FIG. 2: (Color online) The variations of \bar{S} and f_{GCC} during the removal of weak ties first and strong ties first, respectively. f_r is the fraction of removed ties.

nected cluster (GCC), denoted by f_{GCC} , shows different dynamics between the removals of weak ties first and strong ties first. We denote the critical fractions of the removed ties at the phase transition point by f_c . It is interesting to note that $f_c = 0.753$ for YouTube and $f_c = 0.890$ for Facebook when \bar{S} reaches the submit, which are very close to the case when $f_{GCC} \approx 0$.

In the percolation theory, the existence of the above phase transition means that the network is collapsed, while the network is just shrinking if there is no phase transition when removing the ties [19]. So the above experiments tell us that weak ties play a special role in the structure of online social networks, which is different from the one strong ties play. In fact, they act as the important bridges that connect isolated communities. In what follows, we build a model that associates the weak ties with the information diffusion, to discuss the coupled dynamics of the structure and the information diffusion.

IV. DIFFUSING ROLE OF WEAK TIES

The information diffusing in online social networks includes blogs, photos, messages, comments, multimedia files, states, etc. Because of the privacy control and other features of online social sites, the mechanism of the in-

formation diffusion in online social networks is different from traditional models, such as SIS, SIR and random walk. We start by discussing the procedure of information diffusion in online social networks.

A. The Procedure of Information Diffusion

The procedure of the diffusion in online social networks can be briefly described as follows:

- The user i publishes the information I , which may be a photo, a blog, etc.
- Friends of i will know I when they access the profile page of i or get some direct notifications from the online social site. We call this scheme as *push*.
- Some friends of i , may be one, many or none, will comment, cite or reprint I , because they think that it is interesting, funny or important. We call this behavior as *republish*.
- The above steps will be repeated with i replaced by each of those who have republished I .

It is easy to find that the key feature of the information diffusion in online social networks is that the information is pushed actively by the site and only part of