Age Estimation from Broad H-alpha in star-forming regions

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The highly resolved spectra of H-alpha lines from shocks in star-forming regions, including the ultraluminous supernova remnants and Balmer dominated supernova remnants, often show the narrow component (~80km/s) superposed on the broad component (~250 km/s) of H-alpha line. The broad component is known to be formed by the charge exchange process in the shock front. At younger stage, the ionization is thought to be dominated by the photoionization by O-type stars while shock-ionization due to the explosion of B-type stars is dominant at later stages. Therefore, the age of the star-forming regions can be estimated using the flux ratio between the narrow and the broad components. We present a preliminary result of evolutionary variations in synthesized spectra of star-forming regions by using the Starburst99. We consider three types of star-formation models: instantaneous starburst, continuous starburst, and starburst during a limited duration. It turns out that the broad component arising from shock-ionized regions is dominant when the age of the star-forming region is about 10 million years. A number of H-alpha profiles of nearby starburst galaxies show the broad components, indicating relatively young ages. Some galaxies show both components, and the others show only the narrow components. This shapes of the profiles vary even in one galaxy: this means that the ages of the star-forming regions in one galaxy could have substantial variation. We argue that the H-alpha profile could become another probe of star formation activities in galaxies.