The low-ionization nuclear emission-line region (LINER) has been known as a kind of representative AGN population, which especially dominates in low-luminosity regime. However, LINER has been thought to have several physical origins for now: LL-AGN, fast shock, old stars, fraction of their active nuclei. In the AGN context, therefore, it should be noted that many kinds of ‘fake AGNs’ are included in this population.

Unfortunately, there are no definitive diagnostic schemes for the LINER origins. Some recent SDSS studies noted that most of LINERs may originate from old stars(Cid Fernandes+2011). These models, however, have a big problem: “Why the ‘retired’ LINERs are different from the red Quiescent ETGs?” Therefore, we were motivated to examine some UV properties by utilizing the GALEX database and search unknown ionizing UV sources, the answer to this question and the appropriate diagnostics of LINERs.

4. ANALYSES & RESULTS

4-1. Classification result

![Graph showing classification results](image1)

Number of SDSS(DR7)-GALEX(GR6) matched sample:
- Active: Hβ, [OIII], 5007, Hα, [NII] 6584 are ≥ 3σ.
- Semi-Active: These 1~3 emission lines are ≥ 3σ.
- Quiescent: Hβ, [OIII], 5007, Hα, [NII] 6584 are < 3σ.

4-2. NUV-r' Color vs. Stellar Mass

(1) About half of LINERs have NUV-r'≥5.0 mag(Fig.3):
We showed a UV color-mass diagram in Fig.3. In this plot, we adopted the color threshold of NUV-r'=5.0 mag which separates all ETGs into ‘blue’ or ‘red’ ETGs. This is because the M89(a strong UV-galaxy) shows NUV-r'=5.0 mag and FUV-NUV=1.0 mag. From Fig.3, we can see about half of LINERs are red, suggesting that an amount of young OB stars in host galaxy is very small. On the other hand, there are bluer half of LINERs, suggesting that they have some UV sources, i.e., young OB stars and/or LL-AGN.

4-3. FUV-NUV Color vs. NUV-r' Color

(2) Most of the bluer half of LINERs show the UV color distribution similar to that of SFs(Fig.4):
We showed a UV color-color diagram in Fig.4. In this plot, we adopted the color threshold of FUV-NUV=1.0 mag which separates all ETGs into ‘UVX’ or ‘no UVX’ ETGs. Most of the aforementioned ‘blue’ LINERs distribute in the UVX region and their distribution isn’t different from that of SFs. Therefore, we speculated that the origin of ‘blue’ and ‘UVX’ LINERs could be more likely to be weak star formation(i.e. young OB stars) than LL-AGN(cf. Salim+2012, Fang+2012). In addition, Fig.5 shows that the luminosity of [OIII] 5007 doesn’t correlate well with the UV magnitudes, possibly suggesting that LL-AGN isn’t a ionizing UV source of LINERs.

(3) The LINERs with a strong UV-upturn feature are rather rare (Fig.4):
Most of the Quiescents are included in the red subclass and their NUV-r' color is almost constant in Figs.3-4. Their FUV-NUV color, however, does change significantly in Fig.4. This sequence means that they have a wide range of UV-upturn strength(note: bluer FUV-NUV color corresponds to stronger UV-upturn). If the UV-upturn activity links closely to the LINER activity, we would expect that LINERs distribute preferentially around the UV-upturn region. In the case of the aforementioned ‘red’ LINERs, however, although they showed a wide range of the strength, it seems that they tend to favor the no UVX region(ref. of UV-upturn: Brown+2000, Yi+2011, Ree+2012).

5. DISCUSSION & SUMMARY

(1) Old stars photoionization(‘retired’ LINER): Firstly, we presented the ‘red’ LINERs which show little evidence of young OB stars and/or LL-AGN. If these LINERs don’t have a central X-ray source neither, old stars(e.g. Post-AGBs) are promising ionizing sources of the LINERs.

(2) Possible UV contribution from OB stars: Secondly, we presented the ‘blue’ and ‘UVX’ LINERs which show clear sign of UV sources. If the sources are OB stars, young-to-total mass fraction is estimated to F(1-Gyr) = 10^3(Kauffmann+2007). Given this mass fraction, OB stars are expected to be stronger ionizing UV sources than old stars(Cid Fernandes+2011). Although the geometry between gas and ionizing source still remains uncertain, we felt it would be necessary to consider a hybrid photoionization model by young and old stars.

(3) UV-upturn and ‘retired’ LINER: Finally, we presented the ‘red’ and ‘UVX’ LINERs which show the UV-upturn feature. We showed that these LINERs are rather minority in the ‘red’ LINERs, in other words, the UV-upturn activity doesn’t tend to induce the LINER activity. Because the UV-upturn activity also has been thought to originate from old stars(i.e. ZAHBs, AGB-Manquéts, PE-AGBs, Post-AGBs), this result might suggest that an amount of ionized gas plays a critical role to differentiate between LINERs and Quiescents, or (b)the ‘retired’ LINERs require some additional ionizing sources other than old stars.