Gaseous disks and star formation in S0 galaxies

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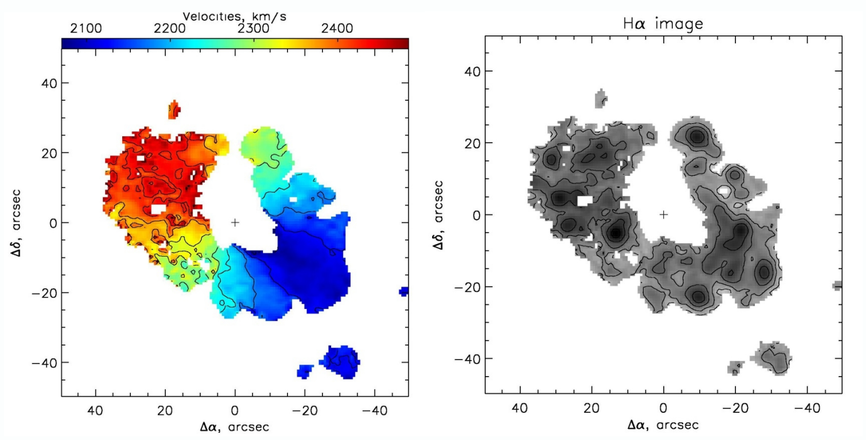
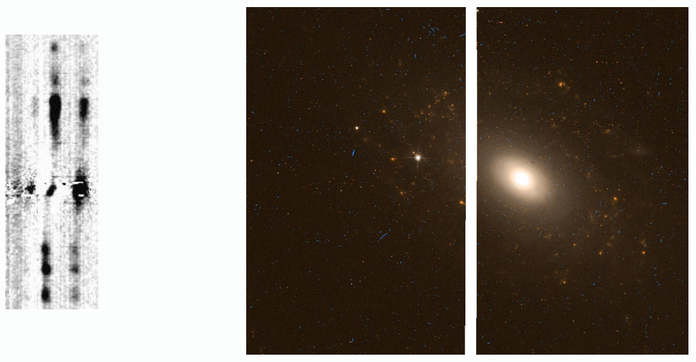
Though lenticular galaxies are thought to be `red and dead', really they often possess extended gaseous disks where current star formation can be noticed. By observing spectrally a sample of the nearby S0s with extended ultraviolet disks or rings, we have found warm-gas emission lines in several spectra which excitation betrays the presence of massive young stars in the outer rings of these galaxies. However sometimes the star formation does not proceed despite the large amount of the cold gas, and in these cases the peculiar kinematics of the gaseous disks can be often noted. We discuss the possible origin of the extended gaseous disks in S0 galaxies and try to reveal necessary conditions to ignite star formation through their large-scale disks.

NGC 2551

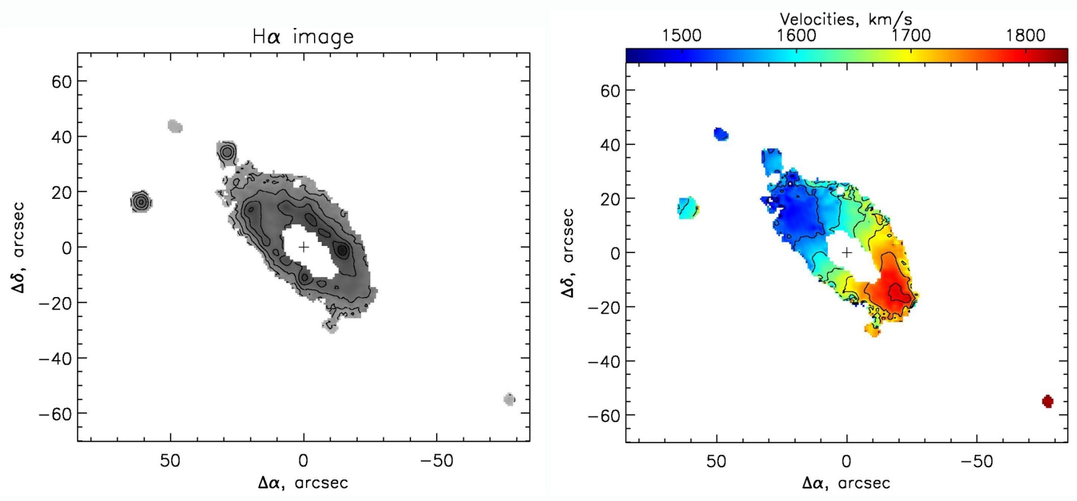




NGC 2551 possesses several starforming, UV-bright rings which are well seen in the portion of the long-slit spectrum with the continuum subtracted; the spectral range presented is 6500-6600 A. These rings are resolved as a lot of separate small HII regions in the narrow-band, H-alpha centered HST-image (thanks to Hubble Legacy Archive WEB-site). The smoothed Fabry-Perot H-alpha velocity field shows regular rotation in the plane of the galaxy.

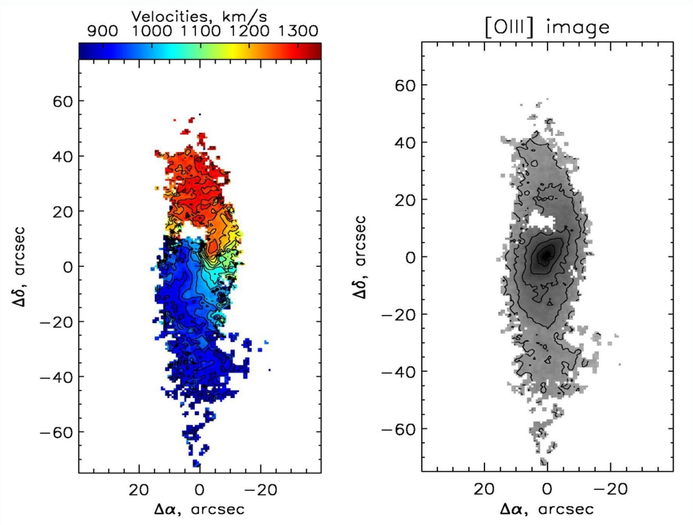
A sample of nearby S0 galaxies with extended gaseous disks was investigated. Two modes of spectral observations provided by the focal reducer SCORPIO-2 (Afanasiev and Moiseev 2011) of the Russian 6-meter telescope were used. We get deep long-slit spectra in the full optical range, 3700--7200 A, with a spectral resolution of 5 A, to obtain emission-line intensity ratios and absorption-line Lick indices. The former are used to determine gas excitation nature and oxygen abundances, the latters -- to restrict stellar population ages and chemistry. Also we get full gaseous velocity fields by exploring the scanning Fabry-Perot interferometer working in narrow spectral range near the strong emission lines H-alpha or [OIII]5007. Some examples of the data obtained are shown below.

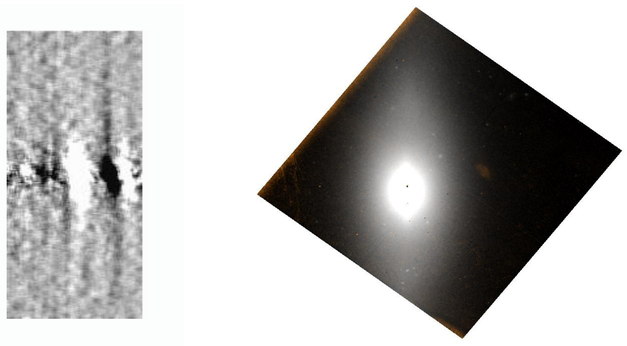
NGC 4324



NGC 4324 demonstrates a blue starforming ring at the radius of some 25 arcsec (2.5 kpc) even in the SDSS-image. This ring emits strong H-alpha and [NII]6583 lines, with the intensity ratios typical for gas excitation by young massive stars. The gas rotation looks regular, with possible slow (subsonic) radial expansion.

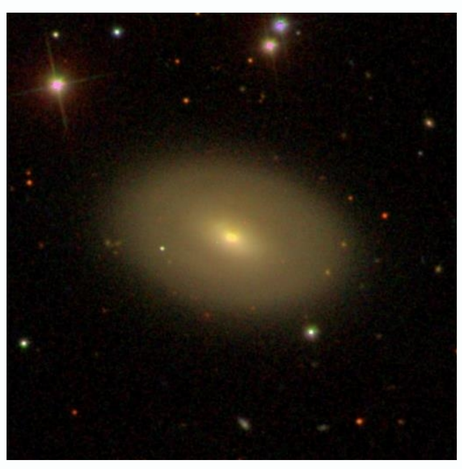
NGC 4026

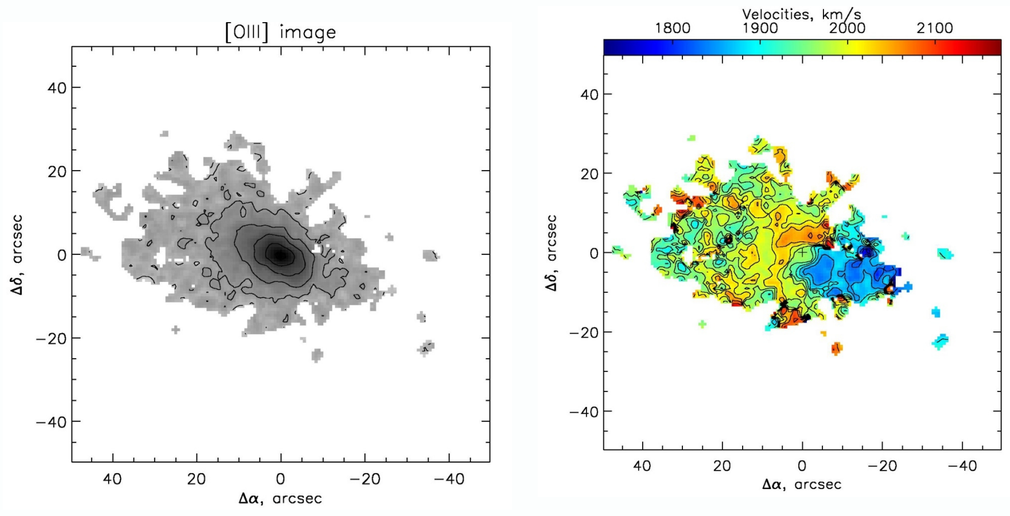




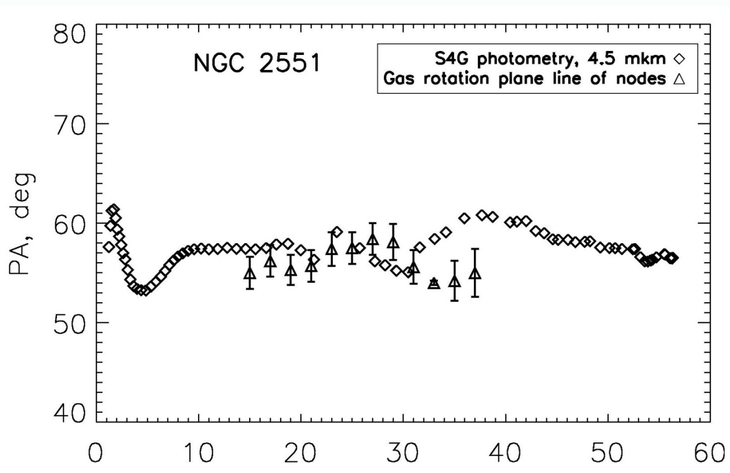
NGC 4026 is an edge-on lenticular galaxy in dense group environment. The hydrogen emission IS ABSENT in the long-slit spectra (the spectral range shown is 6500-6600 A) and in the Paschen-alpha centered narrow-band HST image (thanks to the Hubble Legacy Survey WEB-site). However an extended gaseous disk is traced in the [OIII]5007 emission line with our scanning Fabry-Perot. In the outer part it rotates together with stars, and in the very central kiloparsec it warps beyong the stellar disk seen edge-on. Polar central accretion of HI is detected in NGC 4026 in the 21cm line by Serra et al. (2012).

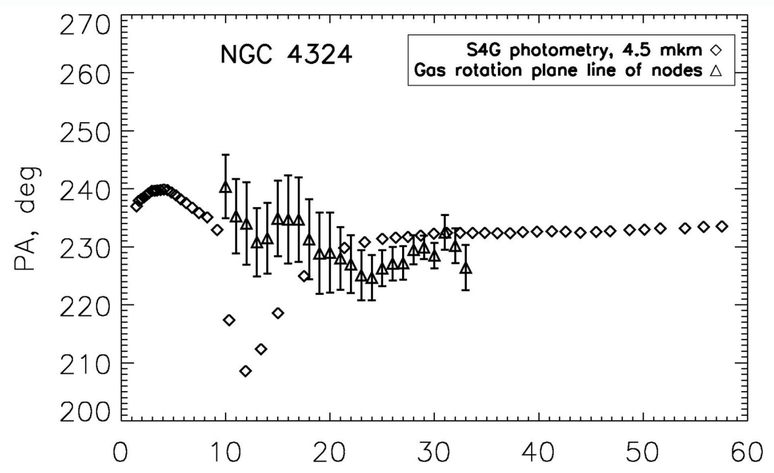
NGC 7280

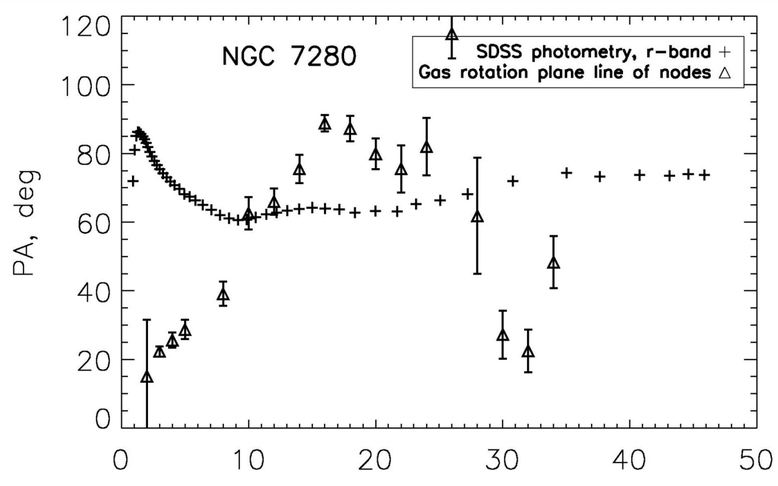




NGC 7280 is a lenticular galaxy with an irregular neighbor satellite rich in HI; subsequently accreting polar gas is detected in NGC 7280 by Serra et al. (2012). However star formation is absent in the extended gaseous disk of NGC 7280. We observed it with the scanning Fabry-Perot interferometer in the [OIII]5007 emission line. The gas velocity field reveals fast polar gas rotation in the very center and small-amplitude motions beyond the radius of 10 arcsec.







By analyzing the sample of lenticular galaxies with extended ionized-gas disks, we have noted that star formation can be met mostly in the gaseous disks/rings whose rotation plane coincides with the main plane of galactic stellar disks. The illustration of this fact is comparison of the isophote major axis orientation with that of the `kinematic major axis' -- the direction of the maximum rotation-velocity projection onto the line of sight. The coincidence of the stellar disk line of nodes with that of the gaseous disk provides favorable conditions for star formation, while polar gas accretion disturbs the cold gas and evidently prevents star formation.