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Imaging and Spectroscopy of Merging Galaxies

Abstract:
The purpose of these observations would be to collect the images and spectra of interacting galaxies. The end goal is to gain a better understanding of how the merging of different kinds of galaxies affects star formation, and how star formation is affected in different stages of the merger.

Scientific Justification:
Different galaxies have different star formation rates, often indicated by the type of galaxy they are. However, in nearly all cases of galaxies undergoing mergers, star formation rates are extremely high. This results from molecular clouds that are rapidly falling to the center of the galaxy and creating shockwaves that allow gas to condense into new stars.

The process of galaxy merger is the central phenomena that drives galaxy evolution. Elliptical galaxies are those with very little star formation are believed to be end products of major galaxy mergers in which gas was quickly used up to create stars during the merger. It would be of interest to observe galaxies of different types undergoing different kinds of merger events, and observe these phenomena at various points in the merger timeline and determine how such events affect the star formation within the galaxy.

Imaging can show what types of galaxies are interacting (spiral, elliptical, lenticular) which would serve as an indicator of their age and star formation rate pre-merger. Spectroscopy can give a better indicator of galaxy type as well as show indicators of star formation rates and the differences between galaxies at different stages of the merger. Wet mergers occur between gas-rich "blue" galaxies, typically produce large amount of star formation, and transform disk galaxies into elliptical galaxies. A dry merger occurs between gas-poor "red" galaxies. These mergers do not greatly change star formation rates. Damp/Mixed merger occurs between a red and blue galaxy, causes significant star formation.

Experimental Design:
The goal is to observe 9 different merging galaxies which will reach high altitudes and be visible at night for the duration of the observing time on March 17th-March 19th. These objects should also be visible with the Moon present, which would rise at 2:30am, 3:00am 4:00 am on those days. The Moon shouldn't be a significant barrier since it will only reach altitude of 33o at its highest point at 7am with altitude of 13 o at 4am.

As an indicator of the star formation rate of the galaxies, it will require the emission line of [OII] doublet at 3726-3729 Å, which the FAST Spectrograph is capable of observing. Additionally, the strength of the Hα Balmer line of hydrogen at 6562.8 Å is a good indicator of star formation. The line's intensity can be related to the ionizing photon rate as discussed in Calzetti (2012, p.14) and Kennicutt (1998).

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Object	Right Ascension	Declination	Highest Altitude (24hr local time)	Exposure Times (s)	S/N
M51	+13h 29m 52.70s	+47º 11' 42.9"	01:55:46	102	5000
NGC 4013	+11h 58m 31.42s	+43º 56' 49.3"	23:38:00	39.7	1000
NGC 5907	+15h 15m 53.69s	+56º 19' 43.9"	03:47:37	62.7	2000
M87	+12h 30m 49.42s	+12º 23' 28.0"	01:01:03	60	3280
NGC 4302	+12h 21m 42.48s	+14º 35' 51.9"	00:46:40	120	798
NGC 4676	+12h 46m 10.18s	+30º 43' 53.7"	01:15:27	200	744
NGC 3921	+11h 51m 6.87s	+55º 4' 43.4"	00:17:52	200	1032
Arp 302	+14h 57m 0.41s	+24º 36' 43.9"	03:32:14	200	677
NGC 2623	+8h 38m 24.02s	+25º 45' 16.3"	21:09:16	200	783