17225 - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Cycle: 30, Proposal Category: GO
(UV Initiative)
(Availability Mode: SUPPORTED)

INVESTIGATORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Daniela Calzetti (PI) (Contact)</td>
<td>University of Massachusetts - Amherst</td>
</tr>
<tr>
<td>Dr. Andrew J. Battisti (CoI)</td>
<td>Australian National University</td>
</tr>
<tr>
<td>Dr. Irene Shivaei (CoI)</td>
<td>University of Arizona</td>
</tr>
<tr>
<td>Dr. Linda J. Smith (CoI)</td>
<td>Space Telescope Science Institute</td>
</tr>
<tr>
<td>Dr. Elena Sabbi (CoI)</td>
<td>Space Telescope Science Institute</td>
</tr>
<tr>
<td>Dr. Sean Linden (CoI)</td>
<td>University of Massachusetts - Amherst</td>
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VISITS

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<tr>
<th>Visit</th>
<th>Targets used in Visit</th>
<th>Configurations used in Visit</th>
<th>Orbits Used</th>
<th>Last Orbit Planner Run</th>
<th>OP Current with Visit?</th>
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ABSTRACT
While dust constitutes a small fraction of a galaxy's interstellar medium, it has an outsized impact on its spectral energy distribution (SED) by reddening and attenuating the light from stars. The effects of dust are degenerate with those of the galaxy's star formation history, because stellar populations of different ages can be subject to different levels of attenuation in the presence of patchy dust. We propose to separate the variations of the ultraviolet-to-nearIR (UV-to-NIR) dust attenuation from those of the star formation history in star-forming galaxies, by leveraging the multi-wavelength and high resolution capabilities of HST. We will complement archival HST data with new ACS and WFC3 broad and narrow-band imaging to probe the SEDs of the stars and the hydrogen recombination lines of H-alpha and Pa-beta to model the spatially-resolved stellar populations, gas emission, and dust in five nearby galaxies hosting central starbursts. The five starbursts are selected based on their global far-infrared and UV emission properties, which deviate from those of typical starbursts in the local Universe, making them puzzling outliers. FUV (1600 Angstrom) to NIR (~1.6 micron) SEDs of individual star clusters and HII regions will provide necessary constraints to separate variations of stellar ages in patchy dust from variations of the shape and normalization of the dust attenuation curve. Our study will provide a benchmark for dust attenuation corrections directly applied to UV-to-NIR SEDs. This will remain the only viable option to derive physical parameters for the large high-redshift galaxy surveys produced by the JWST, Roman, Euclid, and ELTs.

OBSERVING DESCRIPTION
Target Selection:
Our targets are selected to be starbursts with IRX values 2 sigma or more below those of the IRX-beta relation marked by the SB curve and to span a range in beta, to probe the attenuation curve along the locus marked by the SMC curve. We impose a distance limit of 10 Mpc to achieve spatial resolution better than 5 pc with HST.

Observational Set-Up and Exposure Times.
Instrument/filter combinations are chosen to complete the archival datasets and cover the full FUV-H range for each target. Our template source is a 5000 M_sun, 4 Myr old star cluster with a conservative A_V=1.5~mag (F(1600)=2.5x10^-1 ~erg/s/cm^2/AA and Sigma(Pa-beta)=2x10^-16
ACS/SBC 2x2 mosaics in F150LP are planned for NGC4214 and NGC5236 to cover the UV--emitting starburst regions, while one pointing only is required for NGC3351. S/N=5 is expected to be achieved for the above template cluster in 600 s per mosaic tile in NGC4214 and NGC5236 and in 2,400 s for NGC3351 (located at twice the distance of the other two galaxies).

WFC3/UVIS observations for NGC3351 (F218W), NGC4214 and NGC5236 (F275W), and NGC5253 (F657N+F547M) will be obtained with S/N>=10 for our template cluster in 2,500 s (F218W), 2,000 s (F275W), 2,000 s (F657N). WFC3/IR observations will be obtained for NGC5474 in F110W, F128N, F160W, with S/N>=10 in 900 s, 2300 s, and 900 s, respectively. F547M and F110W are observed with S/N>20 to ensure that the subtraction of the stellar continuum from the narrow-band filter does not dominate the noise budget.

Each WFC3 exposure is divided into 3-4 dither patterns to remove CRs and fill the chip gap. The WFC3 UV/U and H-alpha exposures include 20 s post--flash. The S/N in the FUV is sufficient to discriminate between individual attenuation slopes to >5 sigma; the combination of SBC/F150LP, WFC3/F218W (or F225W) and F275W separates mean UV slopes from effects of the 2175 A bump to >10 sigma.
Proposal 17225 - NGC-3351-SBC (01) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit

Proposal 17225, NGC-3351-SBC (01), completed
Diagnostic Status: No Diagnostics
Scientific Instruments: ACS/SBC
Special Requirements: (none)

Patterns

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Fixed Targets

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<tr>
<th>#</th>
<th>Name</th>
<th>Target Coordinates</th>
<th>Targ. Coord. Corrections</th>
<th>Fluxes</th>
<th>Miscellaneous</th>
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<td></td>
<td></td>
<td>Dec: +11 42 13.24 (11.70368d)</td>
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<td>Equinox: J2000</td>
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Comments: This object was generated by the targetselector and retrieved from the NED database. Coordinates slightly (<0.5") updated using HST imaging.

Category=GALAXY
Description=[SPIRAL, STARBURST]

Exposures

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<td>(1) NGC-3351</td>
<td>ACS/SBC, ACCUM, SBC-FIX</td>
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<td>625 Secs (2500 Secs)</td>
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Comments: Extrapolated from the F275W WFC3/UVIS filter, using the brightest pixel of the brightest and bluest source, which has flux 1.03E-16 erg/s/cm²/A. Extrapolation from F275W to F150LP uses most unfavorable case that source has a Lambda^(-2) spectral shape.

Orbit 1

Server Version: 20220630

Orbit Structure

GS Acq Exp. 1 Exp. 1 Exp. 1 Exp. 1 Exp. 1

Pointing Maneuver Pointing Maneuver Pointing Maneuver Pointing Maneuver

Unused Orbital Visibility = 5 Occultation
### Proposal 17225 - NGC-3351-WFC3 (02) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

**Visit**
- Proposal 17225, NGC-3351-WFC3 (02), failed
- **Diagnostic Status:** No Diagnostics
- **Scientific Instruments:** WFC3/UVIS
- **Special Requirements:** (none)

#### Patterns
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<th>Target Coordinates</th>
<th>Targ. Coord. Corrections</th>
<th>Fluxes</th>
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### Comments
- This object was generated by the targetselector and retrieved from the NED database. Coordinates slightly (<0.5") updated using HST imaging.
- **Category**: GALAXY
- **Description** = [SPIRAL, STARBURST]

#### Exposures

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<td>585 Secs (2340 Secs)</td>
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Proposal 17225 - NGC-3351-WFC3 (02) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies
## Proposal 17225 - NGC-3351-WFC3 (52) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

**Visit**

Proposal 17225, NGC-3351-WFC3 (52), failed

**Diagnostic Status:** No Diagnostics

**Scientific Instruments:** WFC3/UVIS

**Special Requirements:** (none)

**Comments:** HOPR copy of visit 2

### Patterns

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**Comments:** This object was generated by the targetselector and retrieved from the NED database. Coordinates slightly (<0.5") updated using HST imaging.

**Category:** GALAXY

**Descriptions:** [SPIRAL, STARBURST]

### Exposures

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Proposal 17225 - NGC-3351-WFC3 (53) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit 17225, NGC-3351-WFC3 (53), scheduling
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/UVIS
Special Requirements: (none)
Comments: HOPR copy of visit 52

Patterns

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Category=GALAXY
Descriptions=[SPIRAL, STARBURST]

Exposures

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Proposal 17225 - NGC-5236-SBC (03) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit
Proposal 17225, NGC-5236-SBC (03), completed
Diagnostic Status: No Diagnostics
Scientific Instruments: ACS/SBC
Special Requirements: ORIENT 60D TO 85 D; ORIENT 240D TO 265 D

Patterns
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Fixed Targets
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<td>V=7.52</td>
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Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL, STARBURST]

Exposures
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Comments: The bright area in this galaxy has been already observed in SBC/F125LP (HST-GO-11579). Brightest pixel has flux: 3.615E-16 erg/s/cm²/Å.

Orbit Structure

Universe

Orbit 1

GS Acq Exp 1 Exp 1 Exp 1 Exp 1 Exp 1 Exp 1

Pointing Maneuver

Unused Orbital Visibility = 19

Server Version: 20220630
Proposal 17225 - NGC-5236-WFC3 (04) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit
Proposal 17225, NGC-5236-WFC3 (04), completed
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/UVIS
Special Requirements: (none)

Patterns

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<td>Purpose=DITHER</td>
<td>Pattern Orientation=23.884</td>
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Fixed Targets

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<th>Fluxes</th>
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<td>(2)</td>
<td>NGC-5236</td>
<td>RA: 13 37 0.2924 (204.2512183d) Dec: -29 51 55.18 (-29.86533d) Equinox: J2000</td>
<td>Proper Motion RA: -3.9360555658684066E-5 sec of time/yr</td>
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Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL, STARBURST]

Exposures

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Orbit 1

Server Version: 20220630
Proposal 17225 - NGC-4214-SBC (05) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit
Proposal 17225, NGC-4214-SBC (05), failed
Diagnostic Status: No Diagnostics
Scientific Instruments: ACS/SBC
Special Requirements: ORIENT 345D TO 30 D; ORIENT 165D TO 210 D; ORIENT 70D TO 90 D; ORIENT 250D TO 270 D

Patterns

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Fixed Targets

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Exposures

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Comments: The bright area in this galaxy has been already observed in SBC/F150LP (HST-GO-11579). Brightest pixel has flux: 8.092E-16 erg/s/cm^2/A.
Proposal 17225 - NGC-4214-SBC (54) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

Visit 17225, NGC-4214-SBC (54)
Diagnostic Status: No Diagnostics
Scientific Instruments: ACS/SBC
Special Requirements: ORIENT 345D TO 30 D; ORIENT 165D TO 210 D; ORIENT 70D TO 90 D; ORIENT 250D TO 270 D
Comments: HOPR copy of visit 5

Patterns

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Fixed Targets

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Exposures

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Comments: The bright area in this galaxy has been already observed in SBC/F125LP (HST-GO-11579). Brightest pixel has flux: 8.092E-16 erg/cm^2/A.
### Proposal 17225 - NGC-4214-WFC3 (06) - The (Ir)regularities of Dust Attenuation in Star Forming Galaxies

**Visit**

Proposal 17225, NGC-4214-WFC3 (06), completed

**Diagnostic Status:** No Diagnostics

**Scientific Instruments:** WFC3/UVIS

**Special Requirements:** (none)

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#### Patterns

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#### Fixed Targets

- **NGC-4214**
  - RA: 12 15 40.4200 (183.9184167d)
  - Dec: +36 19 27.68 (36.32436d)
  - Equinox: J2000

*Comments: This object was generated by the targetselector and retrieved from the NED database.*

*Category:* GALAXY

*Description:* [MAGELLANIC IRREGULAR, STARBURST]

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#### Exposures

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### Fixed Targets

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</table>
| (4) | NGC-5253 | RA: 13 39 55.9632 (204.9831800d)  
Dec: -31 38 30.40 (-31.64178d)  
Equinox: J2000 | V=10.09 | Reference Frame: NED |

**Comments:** This object was generated by the targetselector and retrieved from the NED database.

**Category=** GALAXY

**Description=** [AMORPHOUS IRREGULAR, STARBURST]

### Exposures

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<td>F657N</td>
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<td>390 Secs (390 Secs)</td>
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<td>WFC3/UVIS, ACCUM, UVIS1</td>
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## Proposal 17225 - NGC-5474-WFC3/IR (08) - The (Ir)Regularities of Dust Attenuation in Star Forming Galaxies

#### Visit
- **Diagnostic Status:** No Diagnostics
- **Scientific Instruments:** WFC3/IR
- **Special Requirements:** (none)

#### Patterns
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Comments: This object was generated by the targetselector and retrieved from the NED database.
Category: GALAXY
Description: [SPIRAL, STARBURST]

#### Exposures

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