13321 - COS Spectroscopy of the Stephan's Quintet Giant Shock

Cycle: 21, Proposal Category: GO
(UV Initiative)
(Availability Mode: SUPPORTED)

INVESTIGATORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>E-Mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Pierre Guillard (PI) (ESA Member) (Contact)</td>
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<tr>
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<tr>
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</tr>
<tr>
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<td>The University of Western Ontario</td>
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</tr>
<tr>
<td>Mr. Konstantin Fedotov (Col)</td>
<td>The University of Western Ontario</td>
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<tr>
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<td><a href="mailto:guillaume.pineaudesforets@ias.u-psud.fr">guillaume.pineaudesforets@ias.u-psud.fr</a></td>
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<tr>
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<td>Ecole Normale Superieure</td>
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<tr>
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<td>California Institute of Technology</td>
<td><a href="mailto:cxu@ipac.caltech.edu">cxu@ipac.caltech.edu</a></td>
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VISITS

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<tr>
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<th>Targets used in Visit</th>
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ABSTRACT
Stephan's Quintet, the most studied compact group, is an ideal laboratory to study how kinetic energy is dissipated, how gas cools, and how star formation is triggered in galaxy interactions. It hosts a dramatic 30 kpc X-ray emitting shocked region, triggered by a 1000 km/s galaxy collision. Our Spitzer and Herschel spectroscopy has revealed that H2, C+ and OI are important coolants in the shock, with luminosities exceeding that of X-rays. However, nothing is known about UV line cooling. Our models of the collision show that the kinetic energy is dissipated through a turbulent cascade, with a large range of shock velocities (from 600 down to 10 km/s in the H2 gas), with shock-excited UV emission lines possibly dominating the energy budget at intermediate velocities. Thus, we propose to observe the brightest ones (Lyα, CIV, OVI) with COS by targeting different environments in the shock. Our key science goals are to (1) quantify the contribution of the UV lines to the total gas cooling, (2) understand why, despite large H2 masses, the star formation efficiency in the shock is very low, and (3) determine the origin of the diffuse UV emission detected with GALEX in the shock (is it continuum or line emission?). These observations are crucial to determine the dissipation rate and physical state of the gas and to understand the star formation efficiency. This problem is relevant to many other active phases of galaxy evolution, ranging from shocks in infrared luminous galaxies and AGN feedback, to gas cooling and formation of the first galaxies at high z.

OBSERVING DESCRIPTION
The project aims to explore the importance of key UV emission lines in the cooling side of the energy budget of the giant intergalactic shock structure in the Stephan's Quintet group. Previous observations with Spitzer and Herschel have shown that this huge intergroup structure shows powerful line cooling through pure rotational molecular lines in the mid-IR and almost as much cooling from the [CII] and [OI] far-IR fine-structure
lines. Preliminary modeling suggests that energy from a galaxy collision is being dissipated through various cooling pathways, however nothing is known about the UV cooling. The COS spectroscopy is targeted at specific regions in the giant filament where we might expect powerful UV cooling from Lyman-alpha, CIV, OVI and other lines. The observations will allow us to 1) determine how important UV line cooling is as energy is progressively funneled by turbulence to smaller and smaller scales, 2) use the spectra to help understand the kinematics of warmer gas and its connection to the turbulent molecular gas already detected and specifically to look for mechanisms that might suppress star formation (negative feedback), and finally 3) to determine how much of the UV emission detected by GALEX across the shock-structure is attributed to line emission rather than diffuse continuum emission from faint massive stars. We request observations at moderate resolution using the G130M and G160M settings for the seven positions in the shock structure. In order to achieve continuous spectral coverage and minimize fixed pattern noise, observations in each grating will be made at two central wavelengths for G130M and G160M. We will use central wavelengths settings at 1096A and 1222A for G130M, and the 1611A and 1623A for G160M.
### Proposal 13321 - Target 1 (02) - COS Spectroscopy of the Stephan’s Quintet Giant Shock

#### Visit

- **Scientific Instruments:** COS/NUV, COS/FUV
- **Special Requirements:** (none)

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### Exposures

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Proposal 13321 - Target 3 (04) - COS Spectroscopy of the Stephan's Quintet Giant Shock

**Visit**

- Proposal 13321, Target 3 (04), implementation
- Diagnostic Status: Warning
- Scientific Instruments: COS/NUV, COS/FUV
- Special Requirements: (none)

**Diagnostics**

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**Exposures**

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Proposal 13321 - Target 3 (04) - COS Spectroscopy of the Stephan's Quintet Giant Shock
### Proposal 13321 - Target 5 (05) - COS Spectroscopy of the Stephan's Quintet Giant Shock

**Visit**

Proposal 13321, Target 5 (05), implementation  
Diagnostic Status: Warning  
Scientific Instruments: COS/NUV, COS/FUV  
Special Requirements: (none)

**Diagnostics**

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Dec: +33 58 21.89 (33.97275d)  
Equinox: J2000 | V=17.42+/-0.1  
Reference Frame: ICRS |                  |

# Exposures

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1096 A | FP-POS=ALL;  
BUFFER-TIME=84  
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1222 A | FP-POS=ALL;  
BUFFER-TIME=13  
210 |  |  | 350 Secs (1360 Secs) | [1] |
| 4 | T5-G160M-1611 (513465) | HCG92-5 | COS/FUV, TIME-TAG, PSA | G160M  
1611 A | BUFFER-TIME=22  
260;  
FP-POS=ALL |  |  | 900 Secs (3180 Secs) | [2] |
| 5 | T5-G160M-1623 (513468) | HCG92-5 | COS/FUV, TIME-TAG, PSA | G160M  
1623 A | FP-POS=ALL;  
BUFFER-TIME=22  
303 |  |  | 900 Secs (3671 Secs) | [3] |
Proposal 13321 - Target 5 (05) - COS Spectroscopy of the Stephan's Quintet Giant Shock

**Orbit 3**

- GS Reacq
- Exp. 4, split 3
- Exp. 4, split 4
- Exp. 5, split 1
- Occultation
- Unused Visibility = 2

**Orbit 4**

- GS Reacq
- Exp. 5, split 2
- Exp. 5, split 3
- Exp. 5, split 4
- Home
- Unused Visibility = 0

Server Version: 20130919
Visit

Proposal 13321, Target 7 (06), implementation

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Target 7 (06)) Warning (Orbit Planner): NO PLATE ID SPECIFIED FOR FIXED TARGET
(Target 7 (06)) Warning (Orbit Planner): NO PLATE ID SPECIFIED FOR FIXED TARGET
(Target 7 (06)) Warning (Orbit Planner): NO PLATE ID SPECIFIED FOR FIXED TARGET
(Target 7 (06)) Warning (Orbit Planner): NO PLATE ID SPECIFIED FOR FIXED TARGET

Fixed Targets

<table>
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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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</thead>
<tbody>
<tr>
<td>(7)</td>
<td>HCG92-7</td>
<td>Offset from ACQ-STAR2</td>
<td>RA Offset: -0.372 Secs Dec Offset: 13.2 Arcsec</td>
<td>V=13.1+/-0.2</td>
<td>Offset Position (HCG92-7)</td>
</tr>
<tr>
<td>(9)</td>
<td>ACQ-STAR2</td>
<td>RA: 22 35 59.3250 (338.9971875d) Dec: +33 58 36.76 (33.97688d)</td>
<td>V=18.5+/-0.5</td>
<td>Reference Frame: ICRS</td>
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Exposures

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<tbody>
<tr>
<td>1</td>
<td>T7 Acquisition (534407)</td>
<td>(9) ACQ-STAR2</td>
<td>COS/NUV, ACQ/IMAGE, PSA</td>
<td>MIRRORA</td>
<td></td>
<td></td>
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<td>116 Secs (116 Secs)</td>
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<td>2</td>
<td>T7-G130M-1096 (512167)</td>
<td>(7) HCG92-7</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G130M 1096 A</td>
<td>FP-POS=ALL; BUFFER-TIME=84 75</td>
<td></td>
<td></td>
<td>150 Secs (600 Secs)</td>
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<td>3</td>
<td>T7-G130M-1222 (512167)</td>
<td>(7) HCG92-7</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G130M 1222 A</td>
<td>FP-POS=ALL; BUFFER-TIME=13 210</td>
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<td>150 Secs (600 Secs)</td>
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<td>4</td>
<td>T7-G160M-1611 (512190)</td>
<td>(7) HCG92-7</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1611 A</td>
<td>BUFFER-TIME=22 260; FP-POS=ALL</td>
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<td>350 Secs (1103 Secs)</td>
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<td>5</td>
<td>T7-G160M-1623 (512191)</td>
<td>(7) HCG92-7</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1623 A</td>
<td>FP-POS=ALL; BUFFER-TIME=22 303</td>
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<td>350 Secs (1304 Secs)</td>
<td>[2]</td>
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</table>
Proposal 13321 - Target 7 (06) - COS Spectroscopy of the Stephan's Quintet Giant Shock

Orbit 1

Pointing Maneuver

Exp. 2, split 1
Exp. 2, split 2
Exp. 2, split 3
Exp. 2, split 4
Exp. 3, split 1
Exp. 3, split 2
Exp. 3, split 3
Exp. 3, split 4
Exp. 4, split 1

GS Acq
Exp. 1

Unused Visibility = 0
Occultation

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.