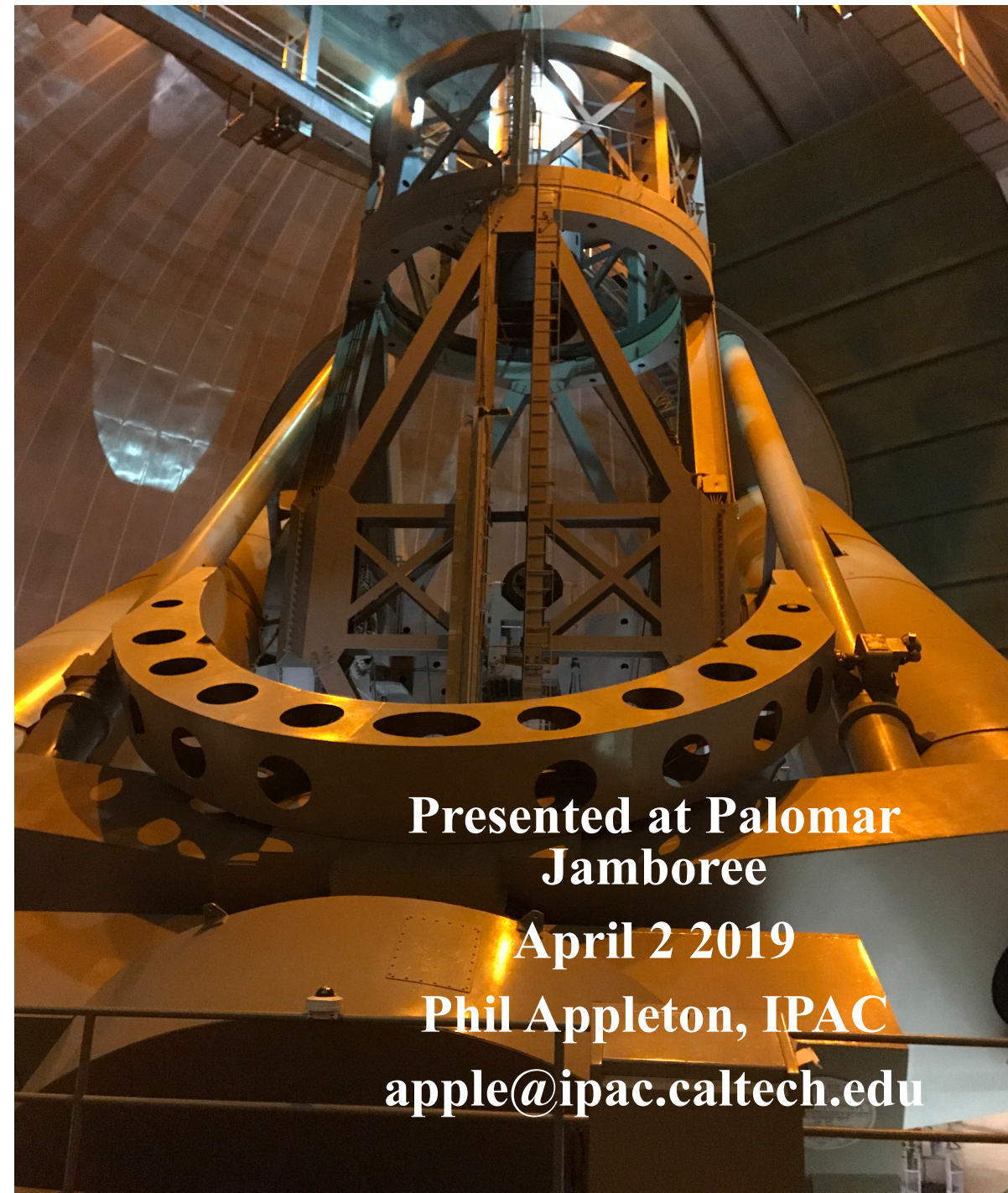
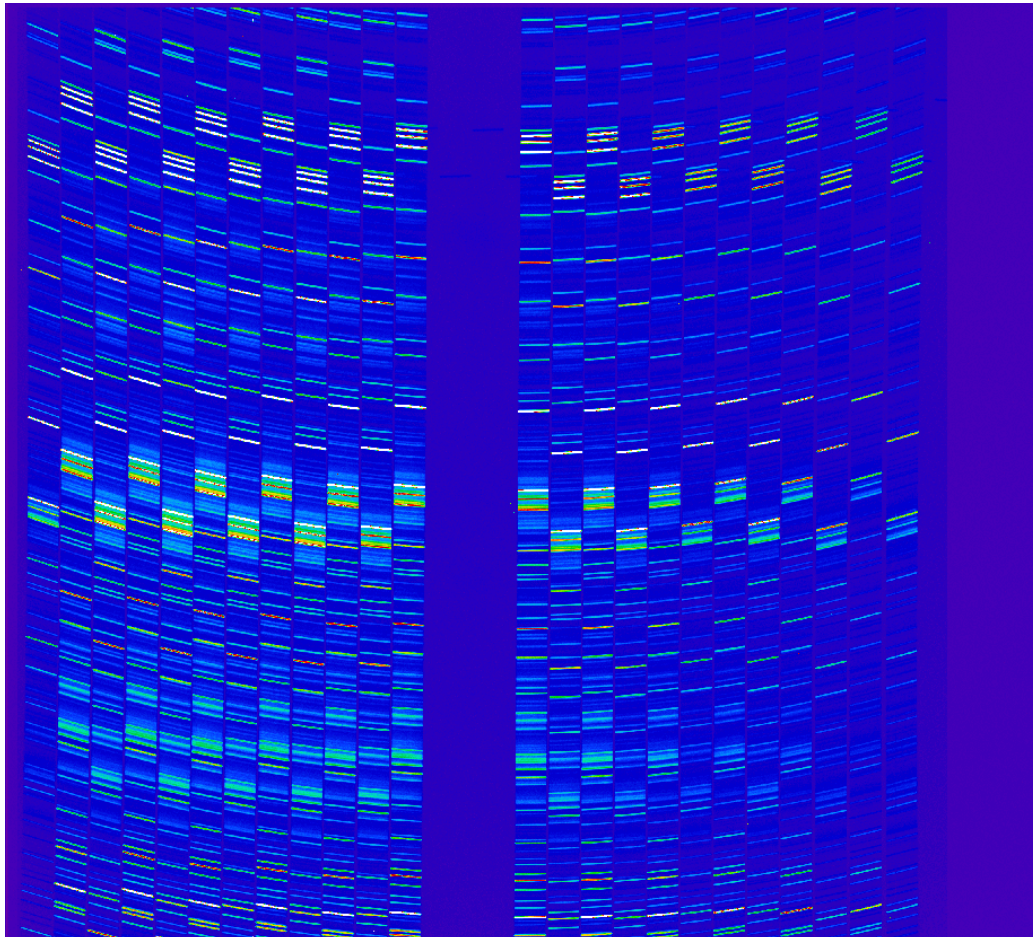


Palomar Jamboree—Tuesday Program

			HEAVIER EMPHASIS ON INSTRUMENTATION = INSTRUMENT CAPABILITIES,						
Tuesday, April 2 at IPAC			OBSERVATION PLANNING, DATA REDUCTION.						
	2 hours								start
noon-2:00pm, Rm. 410		Werner		INTRO				5min	12.00
Keith Spalding Bldg.		Phil Appleton		CWI				15 min	12.05
		Dave Ciardi		P3K+PHARO				15 min	12.20
		Rob Zellem		NESSI				10 min	12.30
		Joe Simon		DBSP				15 min	12.45
		Fede Marocco		3-SPEC				15 min	13.00
		Shreya V.		WIRC Pol+Spec				15 min	13.15
		Gautam Vasisht		PARVI				10 min	13.25
		Werner		WaSP				5 min	13.30

Cosmic Web Imager (P)CWI

An Integral field Spectrometer for Palomar Hale



Presented at Palomar
Jamboree

April 2 2019

Phil Appleton, IPAC

apple@ipac.caltech.edu

What is CWI?

- CWI is Integral Field Spectrometer operated at the prime focus of the 200-inch operating in visible light: *It is a **Semi-private instrument***

Contact Chris Martin (cmartin@srl.caltech.edu) if you are interested

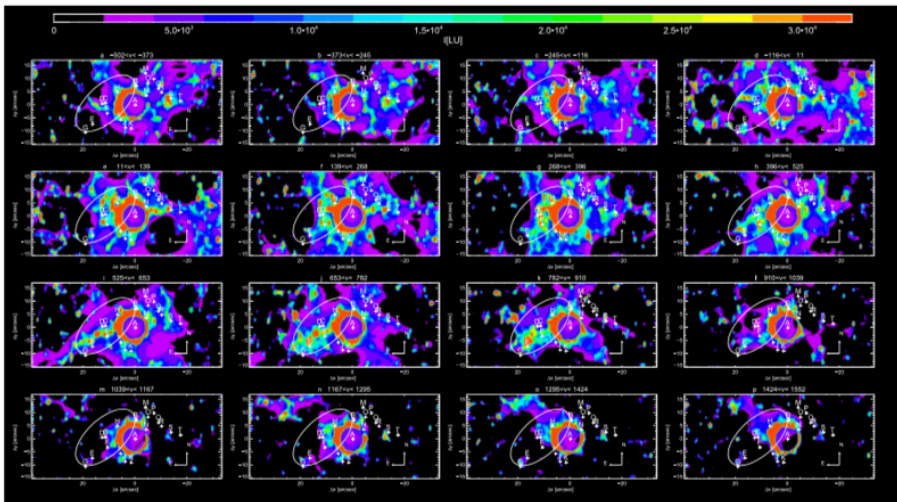
- It has a $\sim 4K \times 4K$ CCD with an **60 x 40 arcsec field of view**
 - **Pixel scale is $2.5 \times 1 \text{ arcsec}^2$ pixels** (24 mirrors image $24 \times [2.5'' \times 40'']$ slits on sky)
 - **Spectral resolution $R (\Delta\lambda/\lambda) = 5000$ (60 km/s)**
 - **Grating coverage**
 - **Blue: $4600 < \lambda(\text{\AA}) < 5500$** G' and r' filters
Instantaneous bandwidth $\Delta\lambda_{\text{bw}} = 450\text{\AA}$ (120\AA)
 - **Yellow: $5560 < \lambda(\text{\AA}) < 6900$** r' filter $\Delta\lambda_{\text{bw}} = 500\text{\AA}$ (140\AA)
 - **Red: $6460 < \lambda(\text{\AA}) < 6900$** r' filter $\Delta\lambda_{\text{bw}} = 570\text{\AA}$ (170\AA)
 - **Red : $6900 < \lambda(\text{\AA}) < 7700$** i' filter $\Delta\lambda_{\text{bw}} = 570\text{\AA}$ (170\AA)

Targeted Science Topics

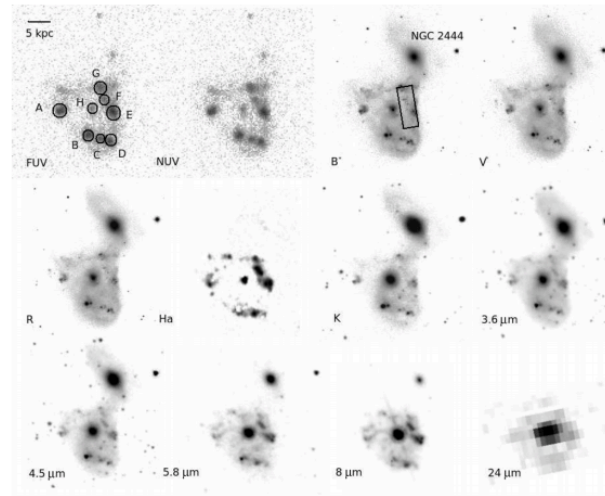
- Lyman Alpha imaging of cosmic web
- 2-d velocity fields of large objects (galaxies, superspirals, nebulae)
- Spatially resolved emission-line diagnostic diagrams (AGN,LINER,SF) galaxies

THE ASTROPHYSICAL JOURNAL LETTERS, 824:L5 (7pp), 2016 June 10

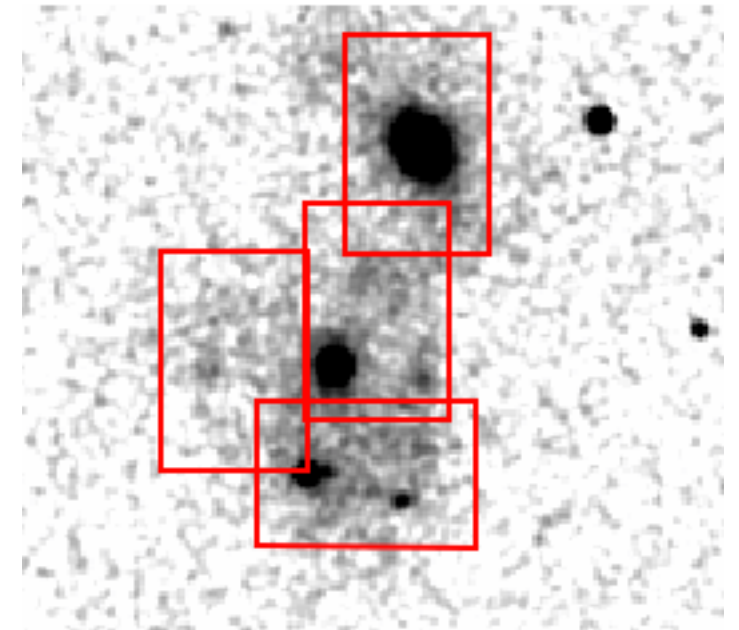
MARTIN ET AL.



Lyman-Alpha in $z=2.8$ QSO field –protogalaxy disk and filaments
Martin+16.

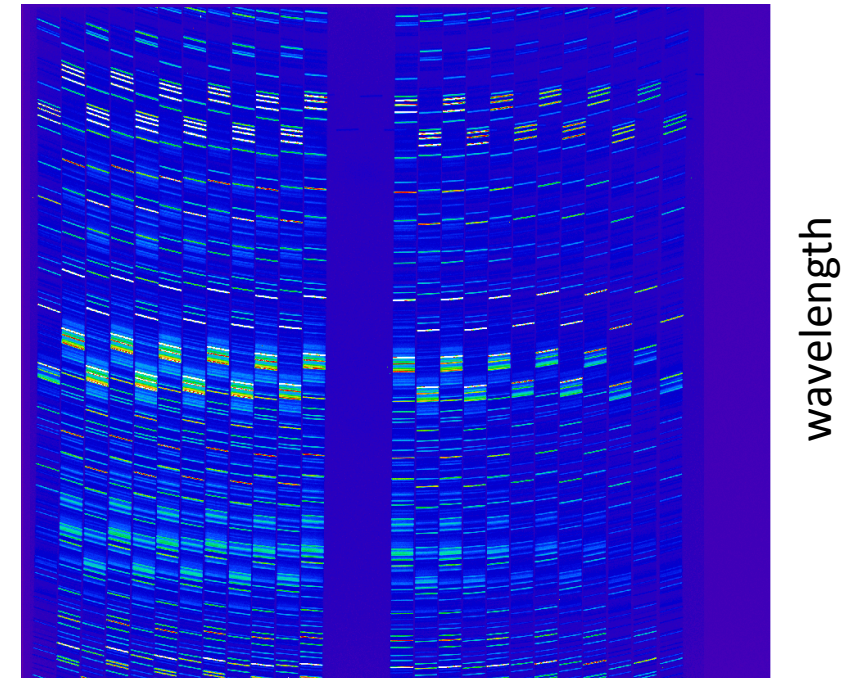
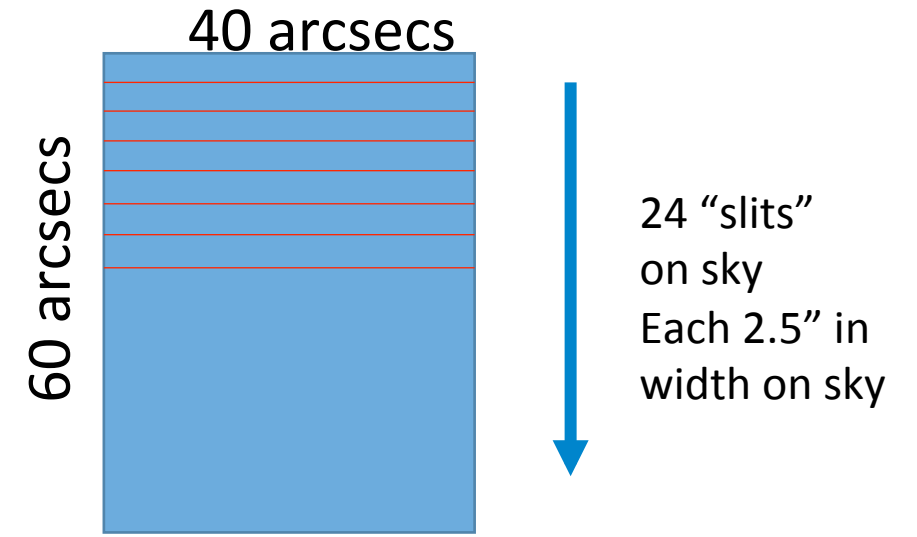
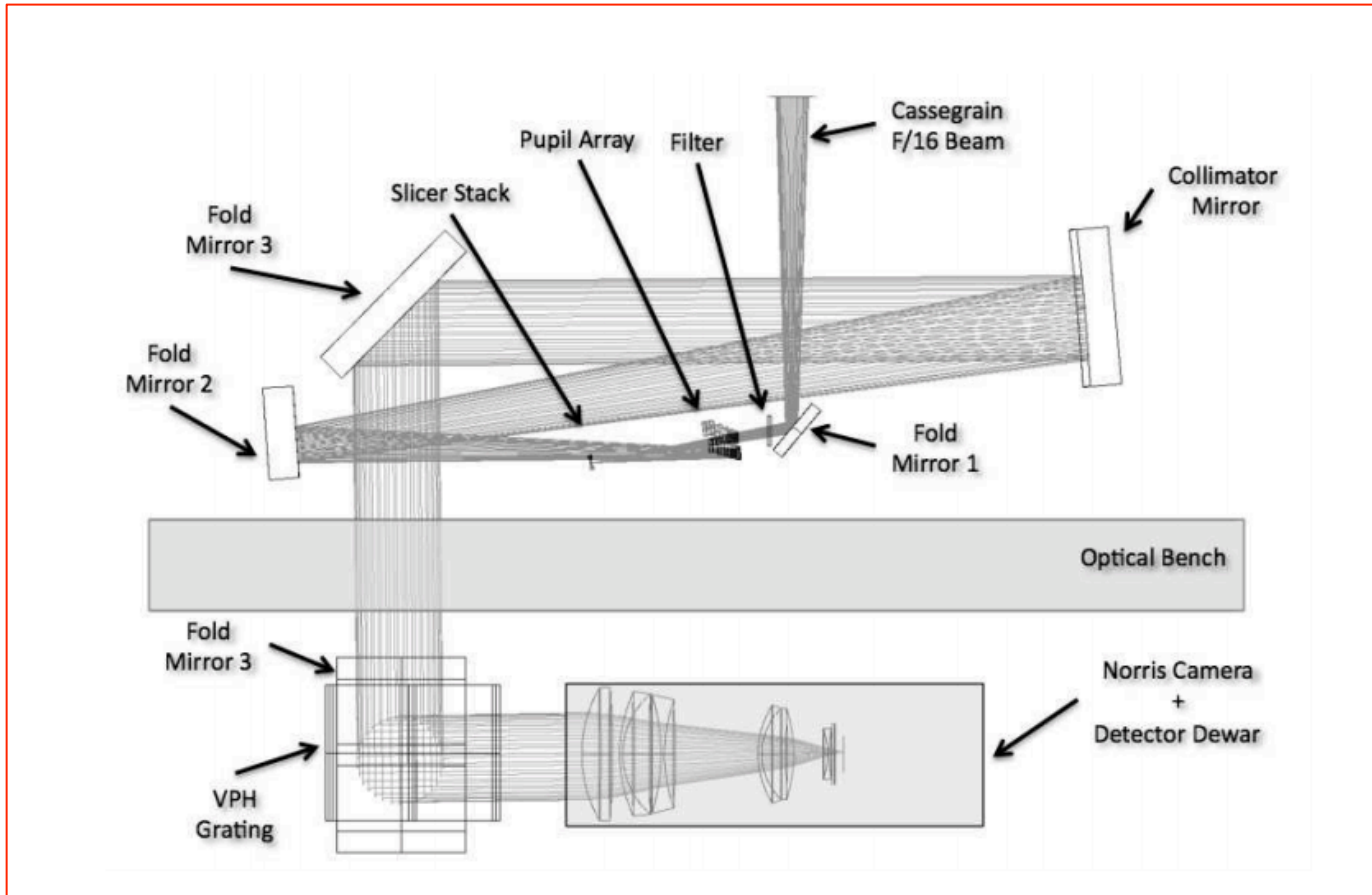


Beira&Appleton+09



CWI footprint on near-IR image of
Arp 143—Collisional system at $z = 0.01$

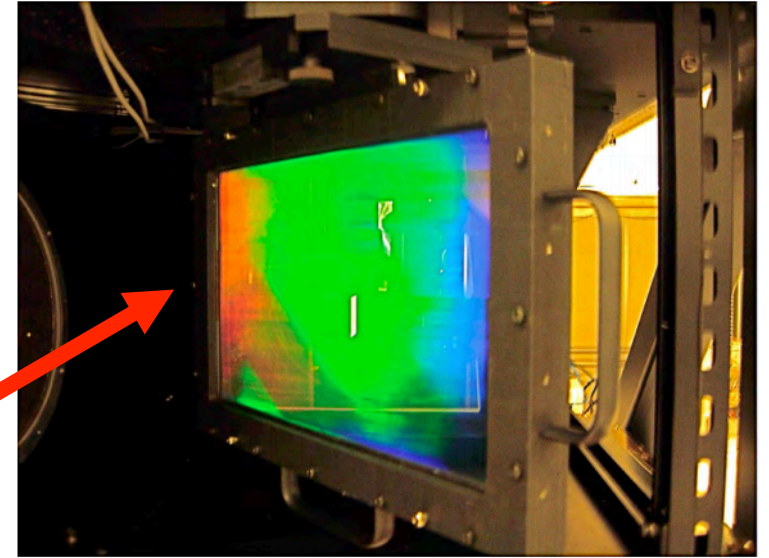
24 pupil mirrors slice image into 24 “slits” projected on sky then passed through grating to CCD



24 Subslits each spatial 40” length

CWI – Key Characteristics

- Detector – 4Kx4K E2V CCD231-84
- Pixel Size - 15 um square
- Field of View - 60 x 40 arcsecs²
- Read noise ~ 2e-
- Full Well 120k electrons? (keep below 60k)
- Readout time ~ 30 s
- Gratings (e. g. Blue grating 3050 lines/mm) linear dispersion $\sim 7.5 \text{ \AA} / \text{mm}$ ($R \geq 5000$)
- Limiting Sensitivity $\sim 10^{18} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ arcsecs}^{-2}$



CWI – Things you might need to know about observing and data reduction

<http://www.astro.caltech.edu/palomar/observer/P200observers.html#instruments>

Before the run:

Need to specify—in advance (green sheet)—the Grating (e. g. B, Y or R), central wavelength, filter and Nod/Shuffle in or out

Best guide is a document called “cwi-

e. g. Y-grating centered at 6300Ang, r' filter nod and shuffle OUT (giving broader instantaneous bandwidth)

A special file is created by the Palomar staff which allows the instrument to move to the correct position and grating tilt.

You should specify this for each night and for different targets.

Observing is relatively straight forwards: Three main tasks

—1) check that the grating setup looks correct and is centered on the required wavelength

Run an IDL code that displays arcs and compares the measured with expected profiles

---2) Center a star in the center of the central slit using a special mask (compbars) which allows you to determine where your

star is in the cross-dispersion and dispersion direction. This works well and the software calculates

the offsets which you give to the TO. For the Y-grating—need an especially long compbars exposure (200s)

---3) Observe a good spectrophotometric standard—even if conditions are not photometric—this is for bandpass calibration

Data Reduction: PDERP Pipeline (*Talk to me, Jeff Rich, Carnegie, or Lee Armus's GOALS team for code*)

There is a mature pipeline (IDL) which works well. A 1 night of data will take about 1-2 hr of work to reduce to fully calibrated data cubes.

Three projects I am working on with CWI

Excitation of Ionized Gas in Hickson Compact Groups (Follow-on from McDonald Observatory VIRUS-P IFU data/Spitzer/Herschel/ALMA/NOEMA)—part of L. Armus GOALS project**

Shock-interaction of Radio Jets with Host Galaxy ISM (NGC 4258 and NGC 7479)**

(SOFIA [CII]158 μ m follow up-; CWI published as part of Appleton et al. 2018 (ApJ 869, 61)

Weather has hampered full mapping

Kinematics of Super Spiral Galaxies at $z = 0.15-0.25$ ** March 2019—TOTALLY WEATHERED OUT

Superspirals are huge spiral galaxies (20-35 arcsecs in extent—hundreds of kpc in size)

-They fall OFF the Baryonic Fisher-Tully relation—

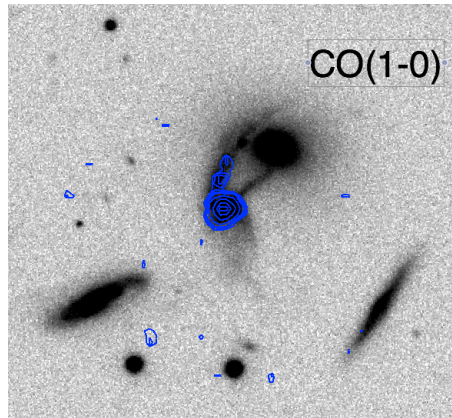
rotating too fast for their baryonic mass—Why?

-non-circular motions

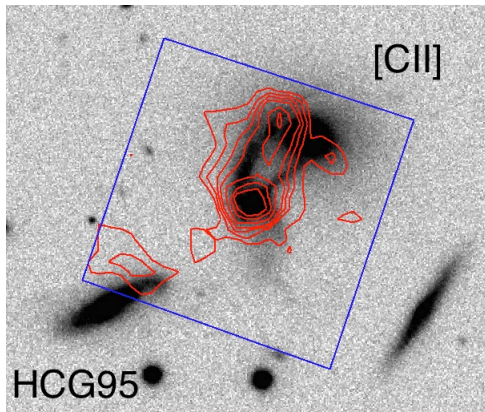
-major mergers of 2 spirals? (some have double nuclei)

**** Partially observed and/or published**

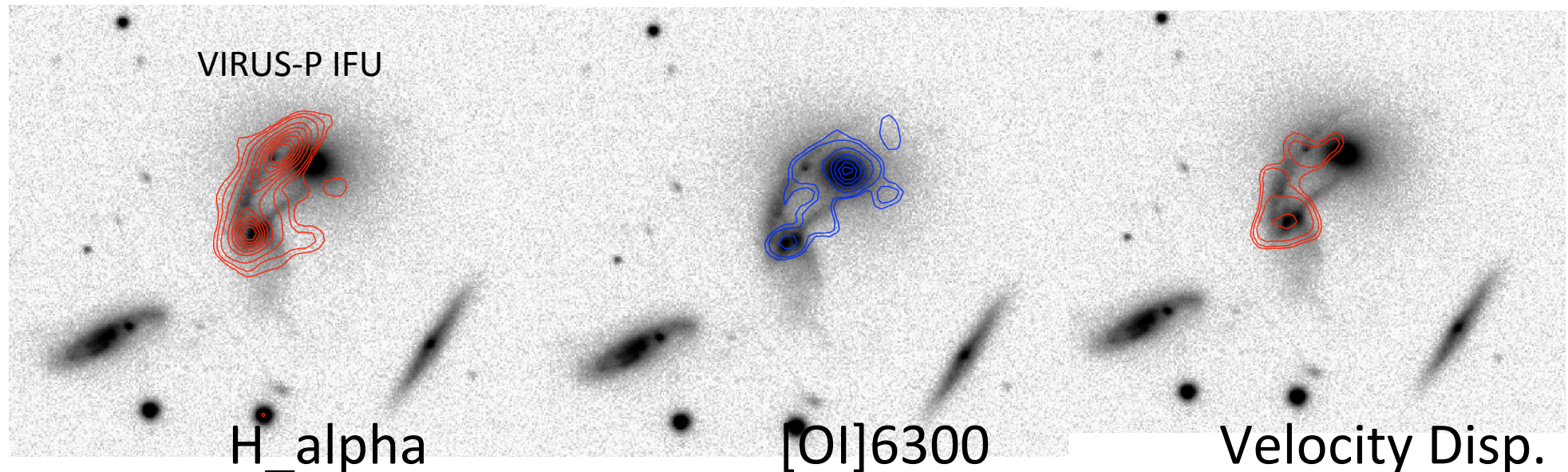
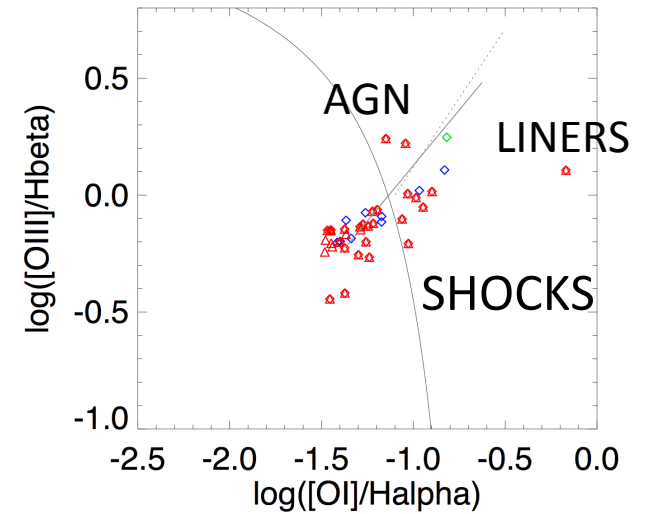
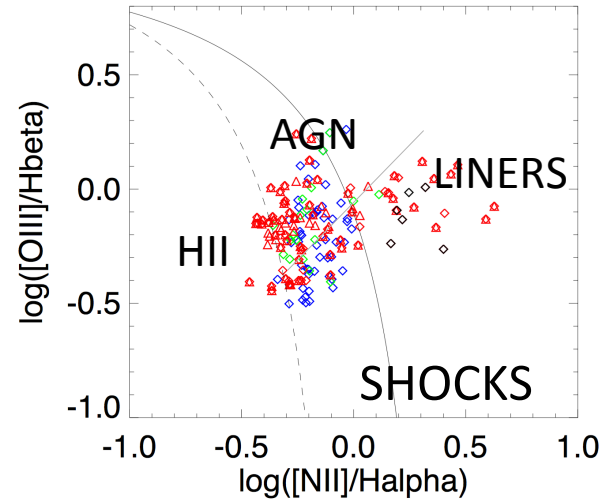
Compact Groups: HCG95C – Example of what can be done: Multiwavelength study (Data from CARMA/HERSCHEL/McDonald)



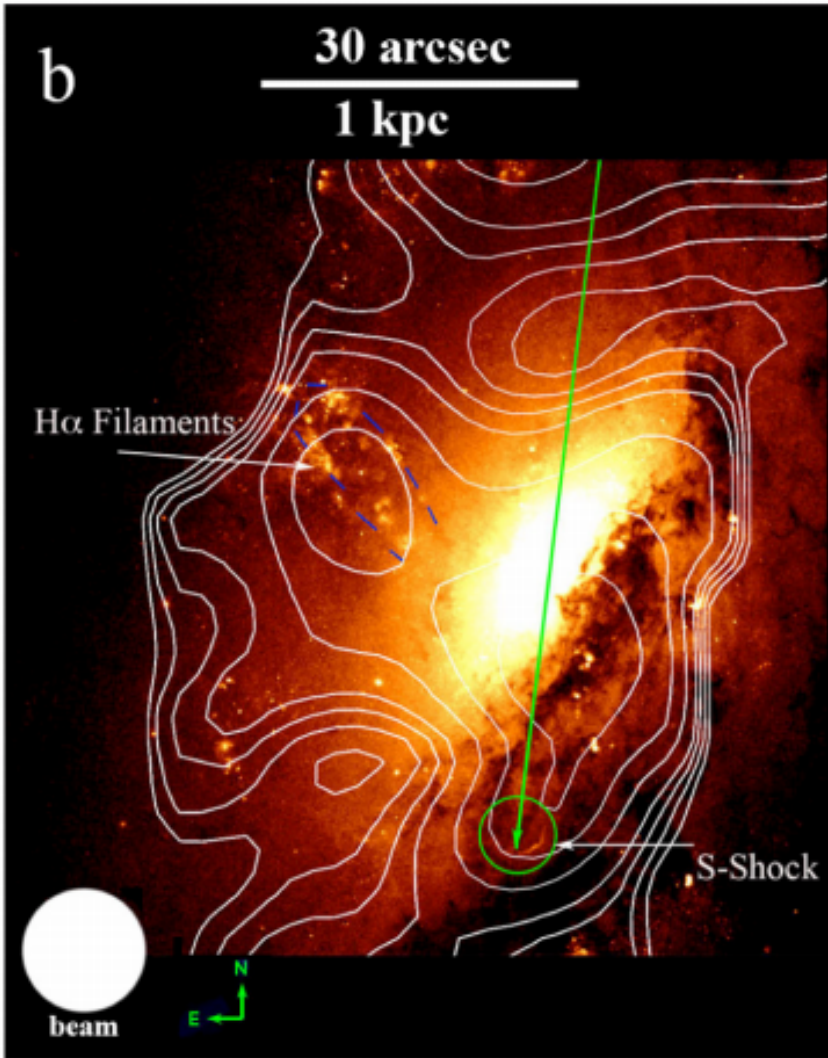
CARMA
CO data



Herschel
[CII] data

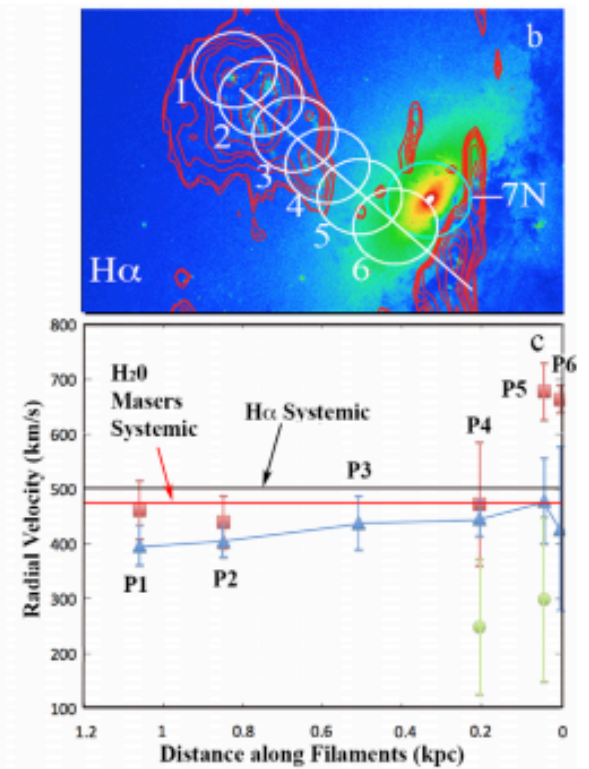
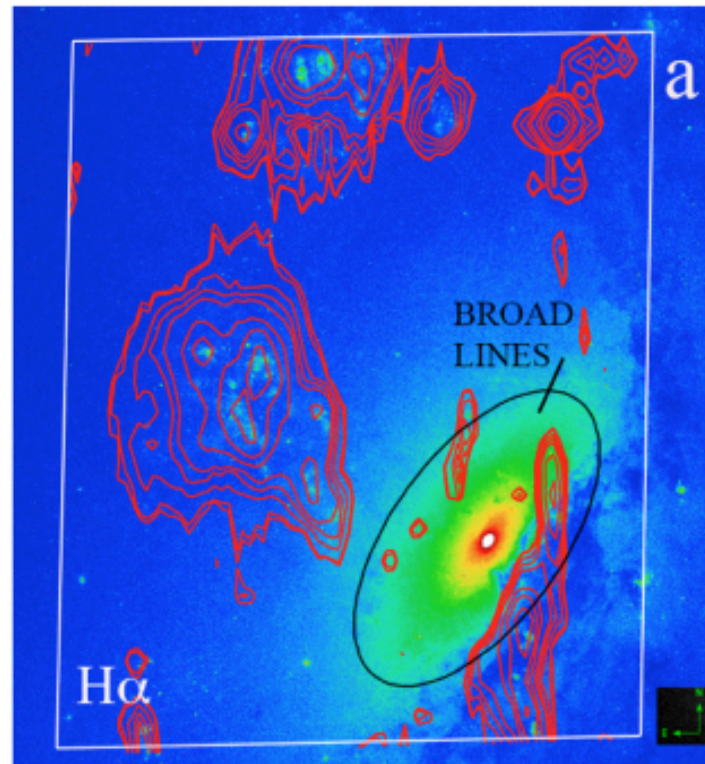


NGC 4258 SOFIA and PCWI (Appleton+18)



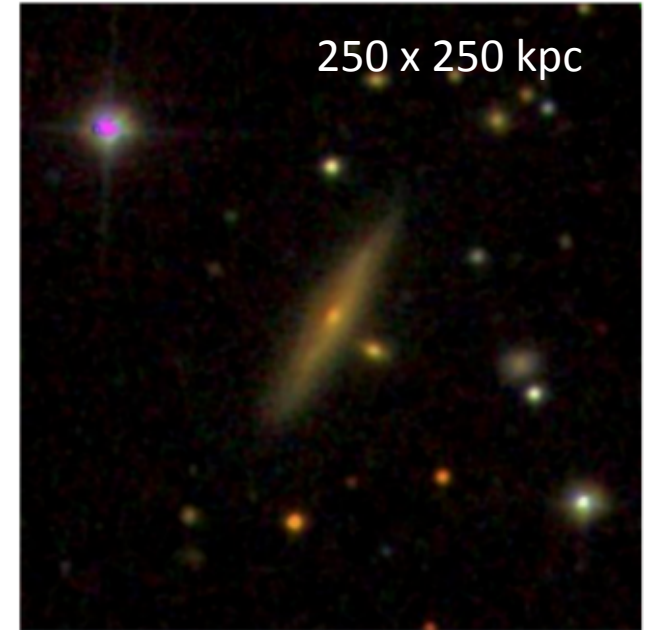
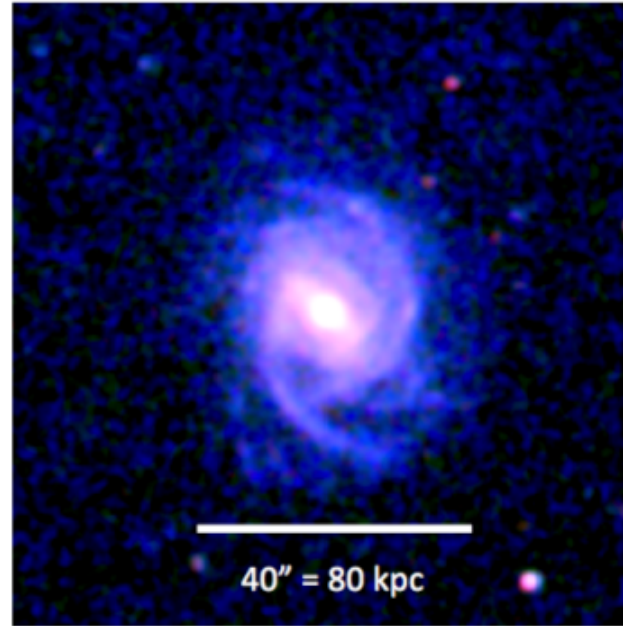
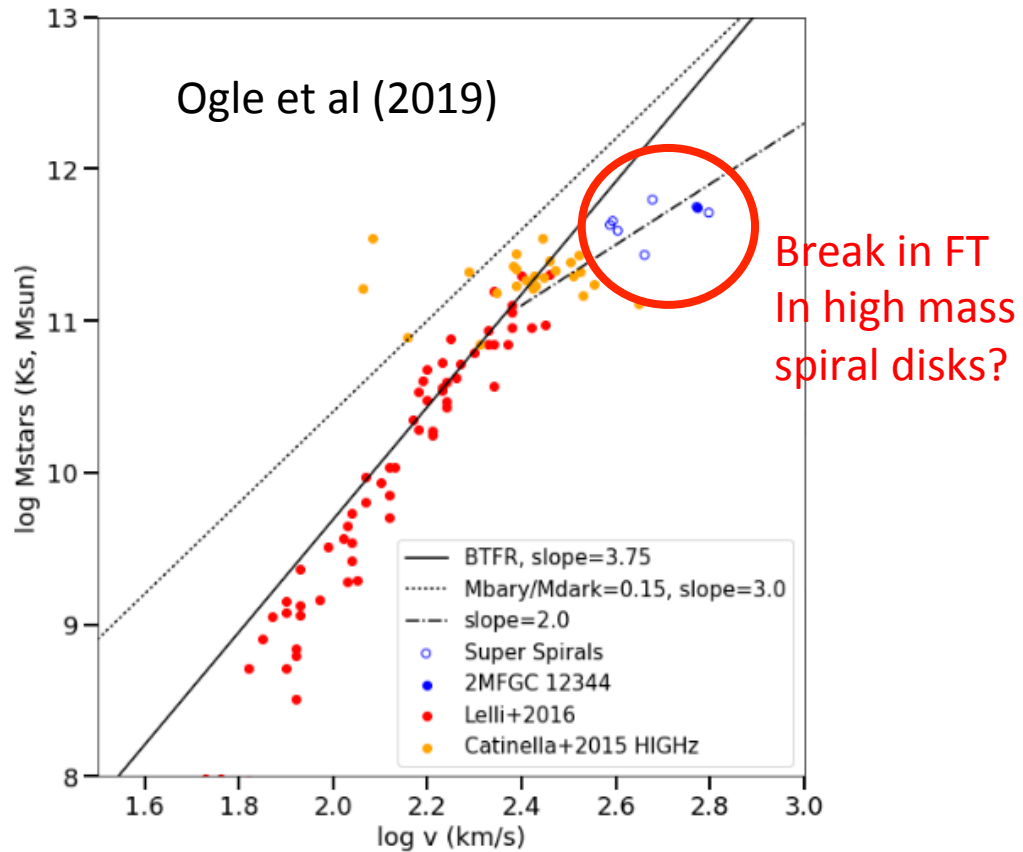
CWI to the rescue for kinematics of minor-axis filament showing dominant component is blueshifted wrt AGN.

THE ASTROPHYSICAL JOURNAL, 869:61 (17pp), 2018 December 10



Appl

Superspirals (Ogle et al. 2017;2019)



Obtaining 2-d kinematics of sample of SSs will allow us to test different models of their dynamics

