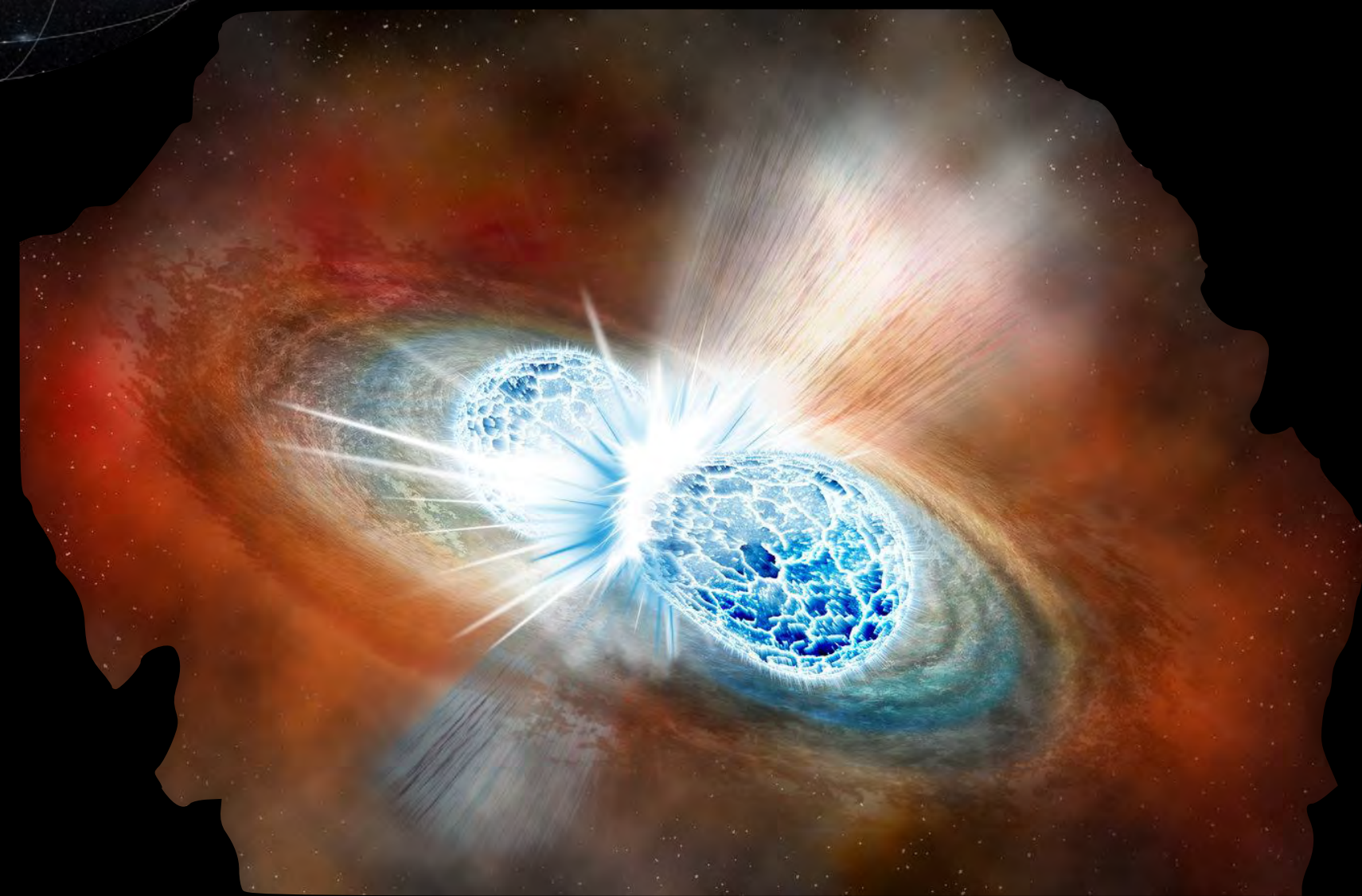


THE NEXT GENERATION SCHEDULING, TRIGGERING, AND DATA SHARING FOR MULTIMESSENGER ASTROPHYSICS



Case Study: neutron star merger
GW170817

Andy Howell
Las Cumbres Observatory
University of California, Santa
Barbara

Member of NSF SCIMMA Working
Group (Scalable Cyberinfrastructure for
Multimessenger Astrophysics)

MMA FOLLOW-UP TODAY

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TITLE: GCN CIRCULAR
NUMBER: 21505
SUBJECT: LIGO/Virgo G298048: Fermi GBM trigger 524666471/170817529: LIGO/Virgo Id
DATE: 17/08/17 13:21:42 GMT
FROM: Reed Clasey Essick at MIT <ressick@mit.edu>

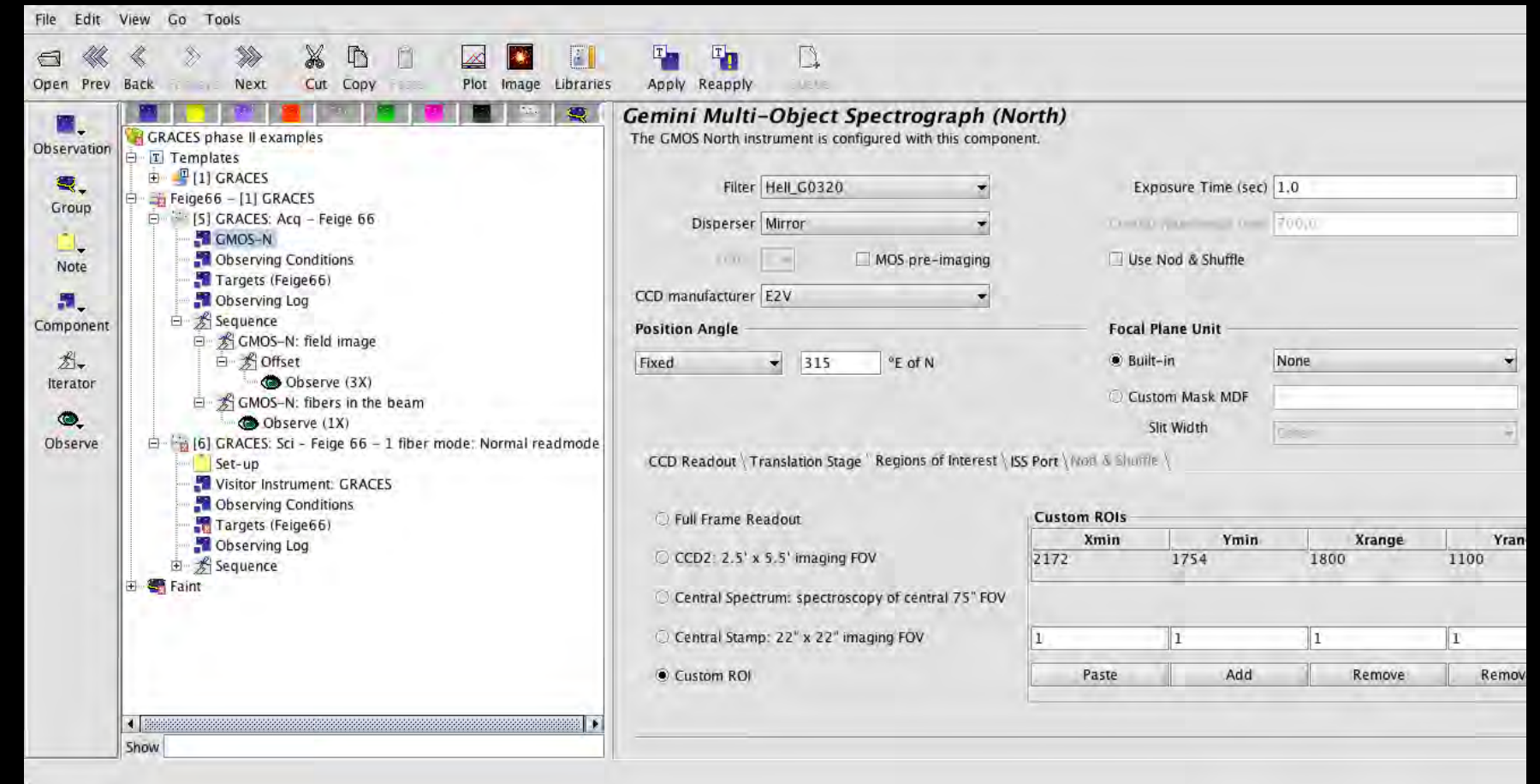
The LIGO Scientific Collaboration and the Virgo Collaboration report:

The online CBC pipeline (gstlal) has made a preliminary
identification of a GW candidate associated with the time
of Fermi GBM trigger 524666471/170817529 at gps time 1187008884.47
(Thu Aug 17 12:41:06 GMT 2017) with RA=186.62deg Dec=-48.84deg and an error radiu

The candidate is consistent with a neutron star binary coalescence with
False Alarm Rate of ~1/10,000 years.

An offline analysis is ongoing. Any significant updates will be provided
by a new Circular.

[GCN OPS NOTE(17aug17): Per author's request, the LIGO/VIRGO ID
was added to the beginning of the Subject-line.]
    
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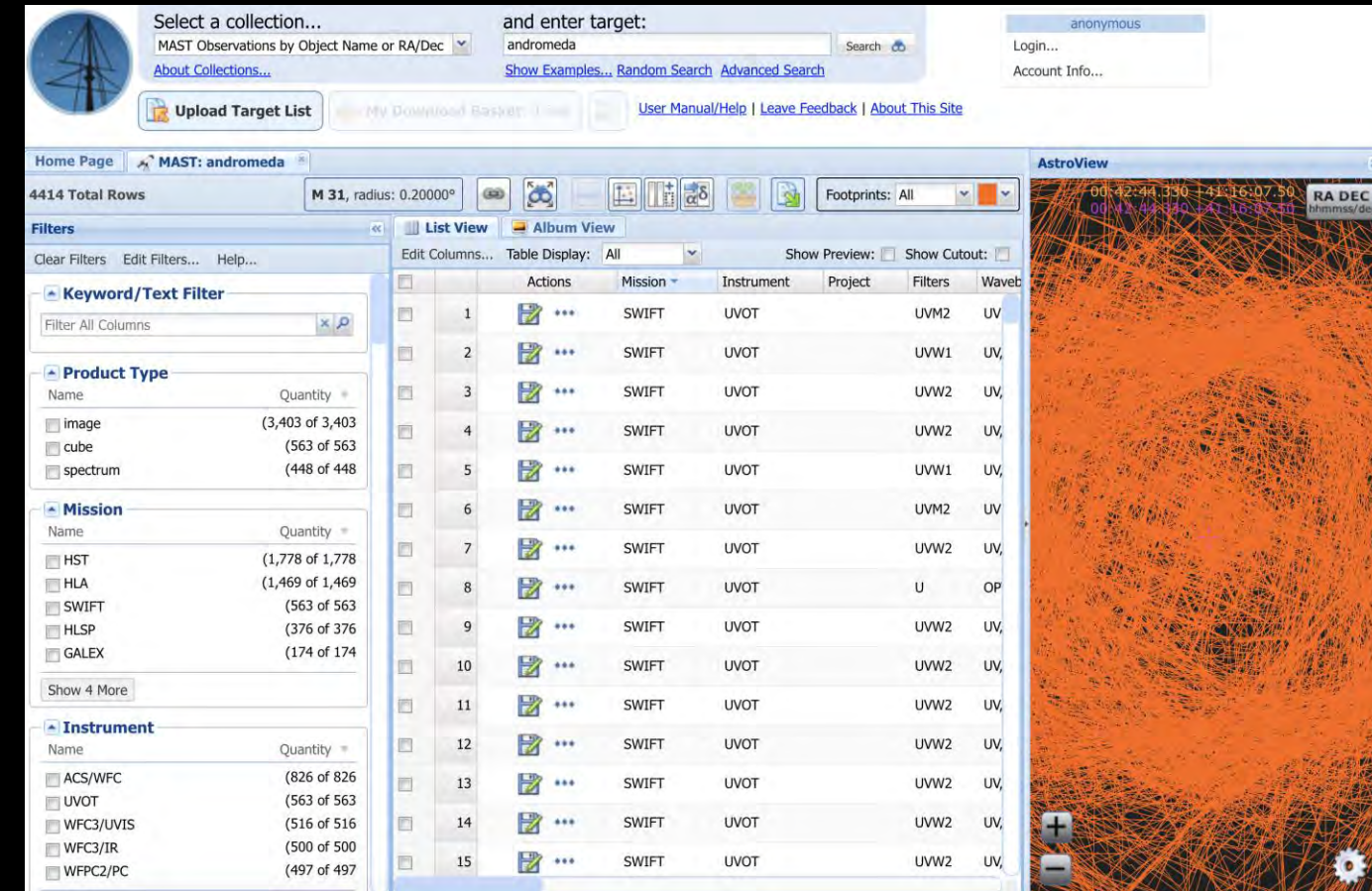


1. Receive alert via GCN or automatic listener.

2. Panic

3. Trigger approved resources by filling out Phase II forms

Telescope Schedule												
2019A telescope schedule												
Select schedule for: Both Tels Year: 2019 Month: January 3 00												
January 2019 - Both Tels												
DOW	Date	Dark	Tel#	Principal	Observers	Location	Instr/Acc	Institution	OA	SA	NA	ProjCode
Tue	Jan-01	80	1	Masters	Masters, (CIT), J. Cohen, (CIT), Hermschek, (CIT), Stanford, (UCB)	CIT/UCB	LRIS-ADC(9)	NASA	JA	ARoc		N044
Tue	Jan-01	80	2	G. Fuller	K. Rubin, (UCSD), Coli, (UCSD), Vaught, (UCSD), Burchett, (UCSC)	UCSD/UCSC	KCW(8)	UCSD	JR	LR		U090
Wed	Jan-02	88	1	Crystal, Martin	Crystal, Martin, (UCSB)	UCSB	LRIS-ADC(1)	UCSB	JA/CW	JW	SJ	U136
Wed	Jan-02	88	2	G. Fuller	K. Rubin, (UCSD), Coli, (UCSD), Vaught, (UCSD), Burchett, (UCSC)	UCSD/UCSC	KCW(8)	UCSD	JR	LRoc	SJ	U090
Thu	Jan-03	96	1	S. Kulkarni	Burdge	HQ	LRIS-ADC(2)	CIT	CW	JW	SJ	C323
Thu	Jan-03	96	2	J. Cohen	J. Cohen, (CIT), Hermschek, (CIT)	CIT	ESI(1)	CIT	JR/JP	RC	SJ	C253
Fri	Jan-04	100	1	PrinceRavi	Burdge/Burdge	HQ	LRIS-ADC(3/3)	CIT	CW	JW	SJ	C322/C327
Fri	Jan-04	100	2	J. Cohen	J. Cohen, (CIT), Hermschek, (CIT)	CIT	ESI(1)	CIT	JP	RCoc	SJ	C253
Sat	Jan-05	100	1	J. Cooke	Foran, (Swin), Pritchard, Mestric, J. Cooke, S. Webb	SwinHQ	LRIS-ADC(4)	Swinburne	CW	JW	SJ/JLP	W247
Sat	Jan-05	100	2	Fassnacht	Fassnacht, (UCD), G. Chen, (UCD)	UCD	ESI(2)	UCD	JP	JL	SJ/JLP	U122
Sun	Jan-06	98	1	Dressing	Isaacson, (UCB), Pelgura, (CIT)	UCB/CIT	HRES(1)	UCB	CW/TR/AAR	GD	JLP	U096
Sun	Jan-06	98	2	Ono	Ono, Itoh	HQ	DEIMOS(4)	Subaru	JP	AR	JLP	S347
Mon	Jan-07	90	1	Dressing	Isaacson, (UCB), Pelgura, (CIT)	UCB/CIT	HRES(1)	UCB	TR (AAR)	GDoc	JLP/TKC	U096
Mon	Jan-07	90	2	Hu, L. Cowie	Hu, L. Cowie	HQ	DEIMOS(5)	UH	JP/HH	AR	JLP/TKC	H239
Tue	Jan-08	83	1	Redfield	Farrin, Swen, Redfield	HQ	HRES(7)	NASA	TR (AAR)	GD	JLP/TKC	N192
Tue	Jan-08	83	2	Mawet/Hu	Mawet, (CIT), Echevert, (CIT), S. Ragland/Hu, L. Cowie	CIT/HQ	NIRSPAC-NGS+HIRC2-NGS(SV-DEIMOS(5))	CIT/UH	HH/AH	CA	JLP/TKC	C315H239
Wed	Jan-09	76	1	M. White	Khee-Gan, Lee, Ata	HQ	LRIS-ADC(5)	UCB	TR (AAR)	JW	TKC	U095
Wed	Jan-09	76	2	Skemer/Hillenbrand	Salum, (UCSC)/Hillenbrand, Omopoc	UCSC/HQ	NIRC2-NGS(8)/NIRSPEC(4)	UCSC/CIT	HH (AH)	CA	TKC	U128/C272
Thu	Jan-10	69	1	S. Valenti/M. White	Bostrom, (UCD)/Khee-Gan, Lee, Ata	UCD/HQ	LRIS-ADC(6)	UCD/UCB	TR/CJ (AAR)	JW	TKC	U099/U095
Thu	Jan-10	69	2	Skemer/M. Cooper	Salum, (UCSC)/M. Cooper, (UCI), Fillingham, (UCI), Wimberly, (UCI), Baxter, (UCI)	UCSC/UCI	NIRC2-NGS(8)/DEIMOS(6)	UCSC/UCI	HH (AH)	CA	TKC	U128/U053



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TITLE: GCN CIRCULAR
NUMBER: 21538
SUBJECT: LIGO/Virgo G298048: Las Cumbres Observatory Detection of The Possible Optical Counterpart in NGC 4993
DATE: 17/08/18 04:06:31 GMT
FROM: Iair Arcavi at LCOGT <iarcavi@lcogt.net>

I. Arcavi, D. A. Howell, C. McCully, G. Hosseinzadeh, S. Vasylyev (UCSB/Las Cumbres Obs), M. Zalzman, D. Poznanski (TAU), L.P. Singer (NASA/GSFC), S. Valenti (UC Davis), T. Piran (HUJI), D. Kasen, J. Barnes (UC Berkeley) and W.-f. Fong (UA) report an independent detection of the possible optical counterpart reported by Coulter et al. (LVC GCN 21529), Chornock et al. (LVC GCN 21530), Valenti et al. (LVC GCN 21531) and Melandri et al. (LVC GCN 21532).

In the course of Las Cumbres Observatory galaxy-targeted LIGO followup we observed NGC 4993 from one of our 1-meter telescopes at the Cerro Tololo Inter-American Observatory in Chile. An imaging 5-minute exposure starting at 2017-08-18 00:15:23 UT in the w (=g+r+i) filter clearly shows the candidate.

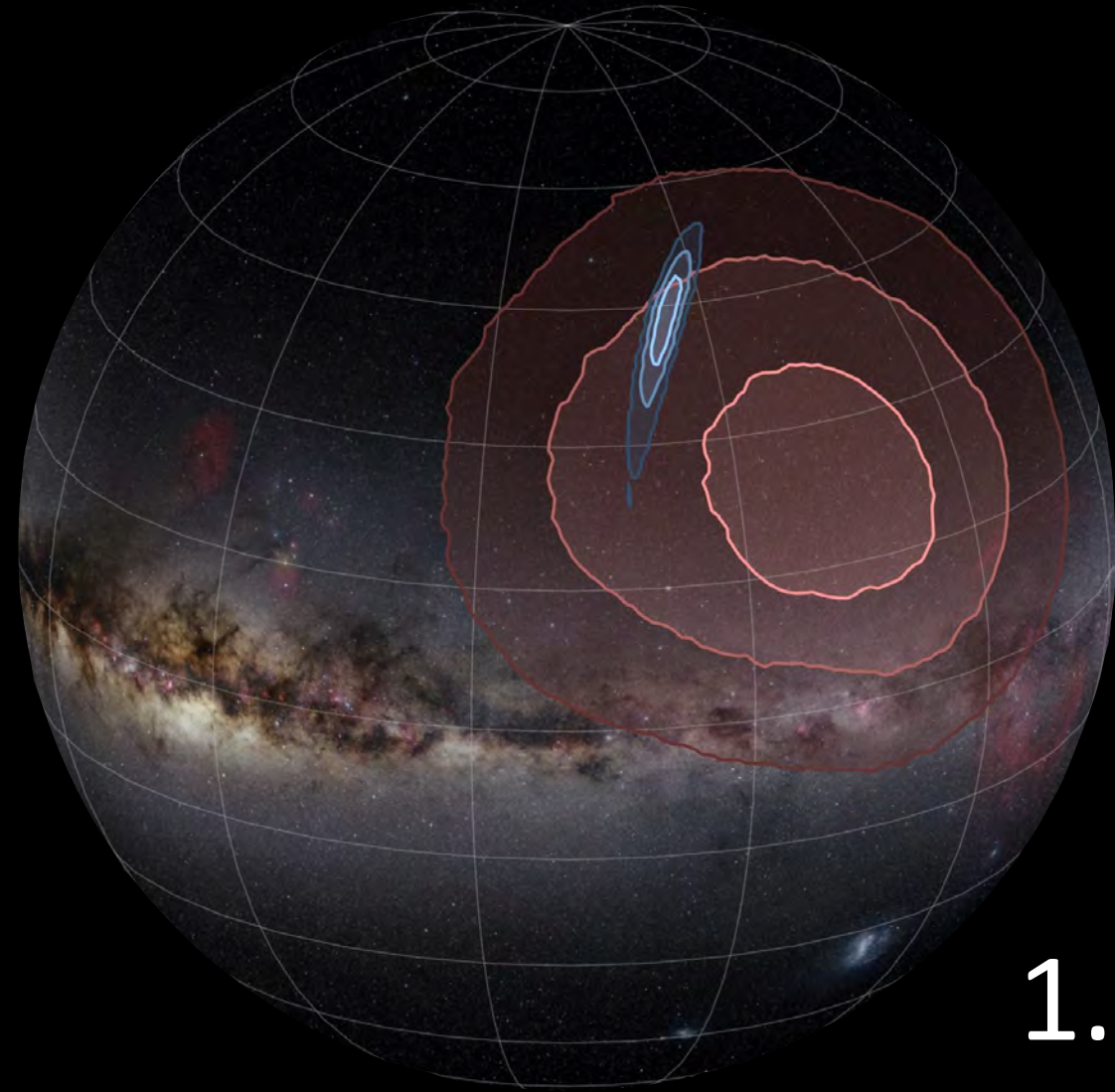
Analysis of the image is ongoing and followup is planned when the field becomes visible to our Siding Spring telescopes starting at 2017-08-18 08:32 UT.
    
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4. Look up other resources available. Beg, plead, cajole for time. Form collaborations.

5. Download data from different archives and reduce it.

6. Communicate information to the community, via text

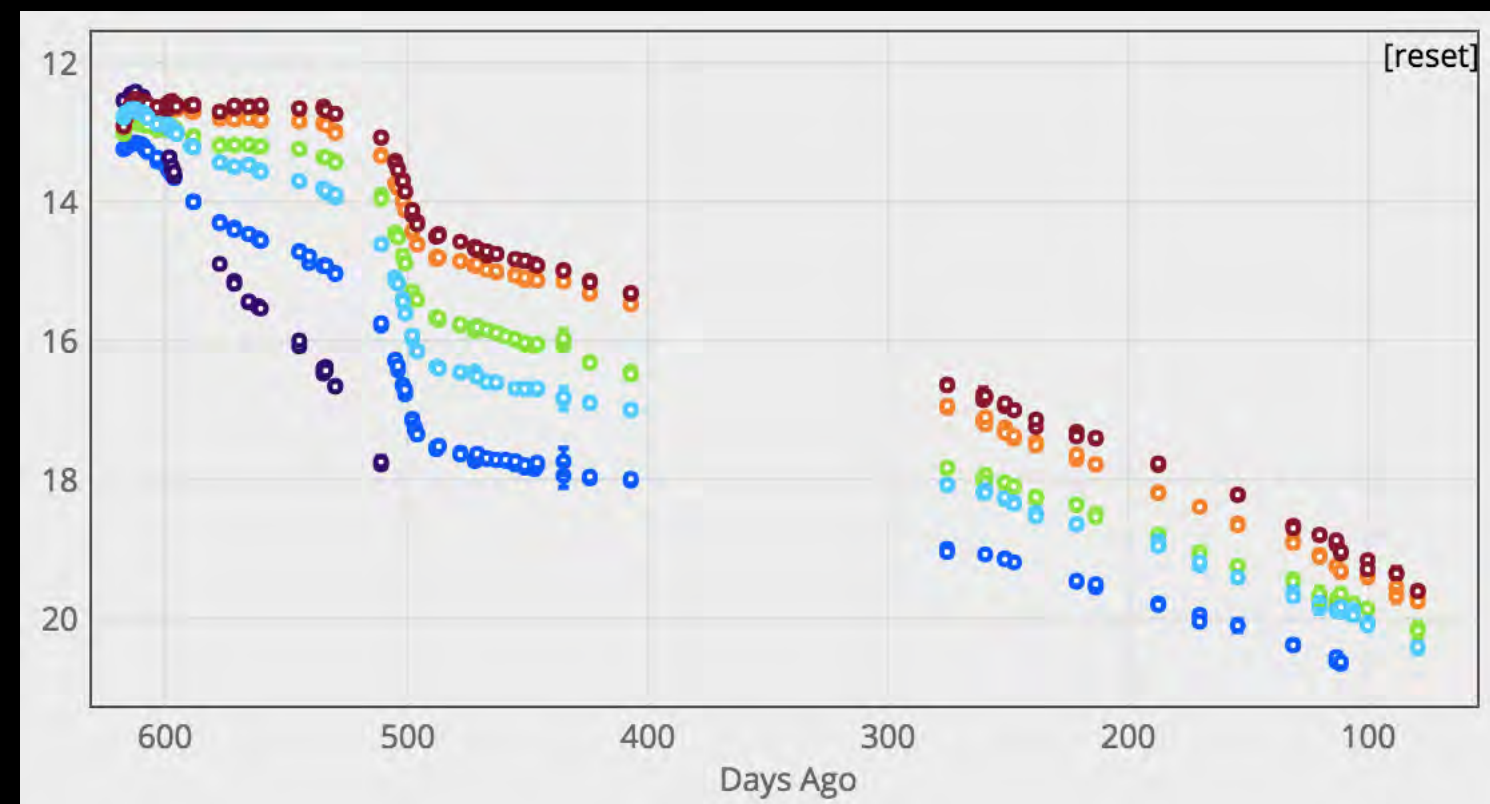
VISION FOR TOMORROW



1. Receive alert



2. Telescopes automatically observes target, negotiates priorities, data access



3. Data are automatically reduced, instantly made available to community

$$p_{\text{dist}}(\text{R.A.}, \text{decl.}, D) = N_{\text{dist}}(\text{R.A.}, \text{decl.}) \cdot e^{-\frac{[D - \mu_{\text{dist}}(\text{R.A.}, \text{decl.})]^2}{2\sigma_{\text{dist}}^2(\text{R.A.}, \text{decl.})}}$$

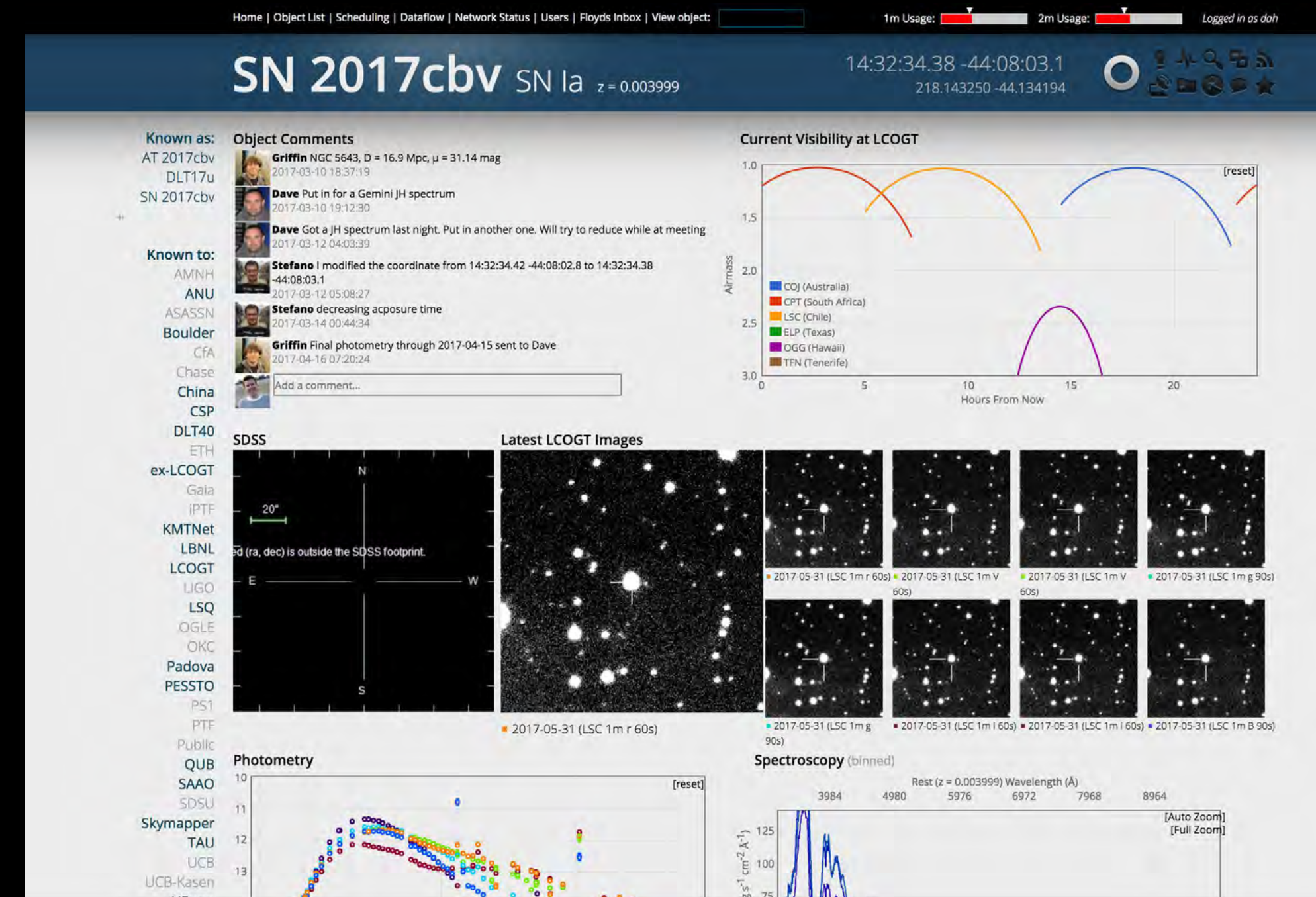
4. Machines and humans make inferences based on all available data, repeat

NEW / PLANNED TOOLS FOR MMA FOLLOW-UP

1. Treasure Map: Replace Text-based GCNs with visualizations of areas searched, actual data.



2. AEON Network: Telescopes communicating, coordinating via APIs.



3. Automated, flexible telescope scheduling

4. TOM Toolkit: tools for controlling telescopes, reducing and sharing data, coordinating observations, communicating results.