

Evaluation of Two Transit Algorithms



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Supported by the Donald A. Cowan institute

Outline

- Planetary Transits
- Similar Research
- Our Research
- Equipment
- Algorithms
- Results

Planetary Transits

- Transit method of detection
- Distinguish curve from binary stars
 - Shape
 - Depth

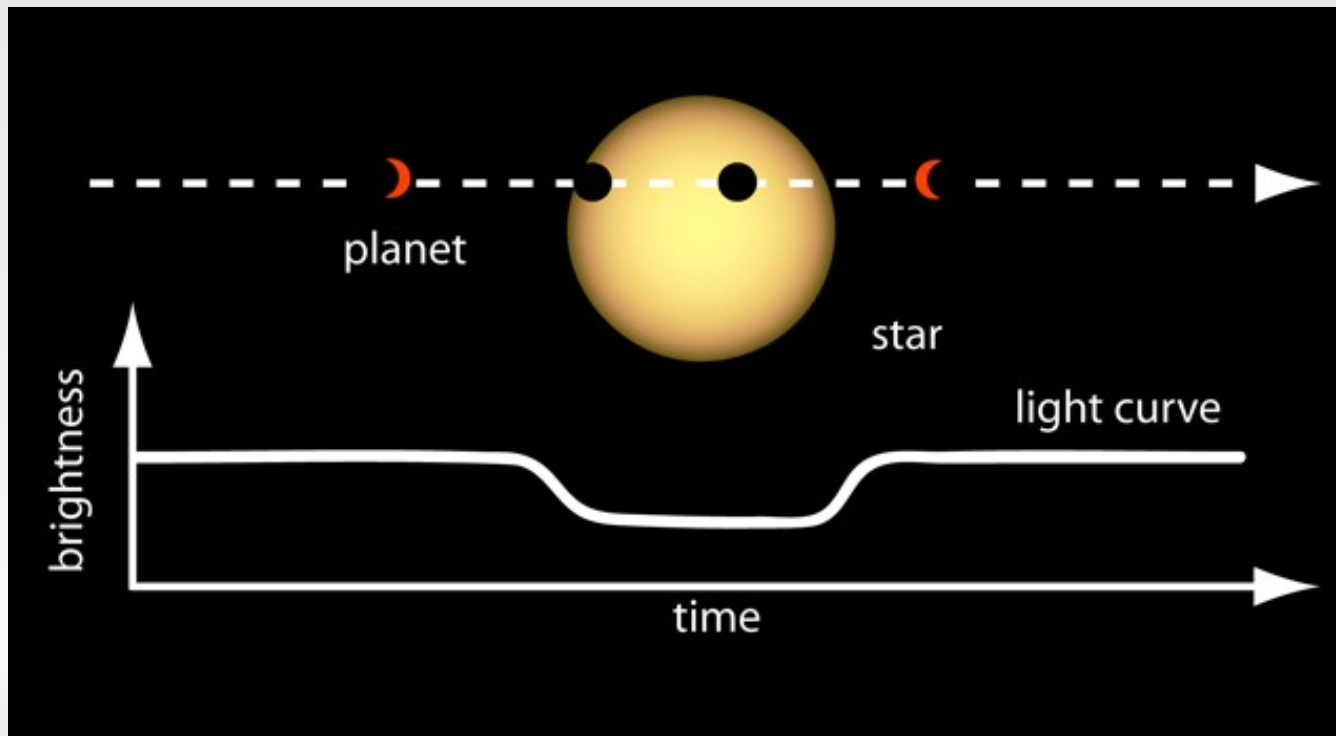


Image courtesy of: jpl.nasa.gov

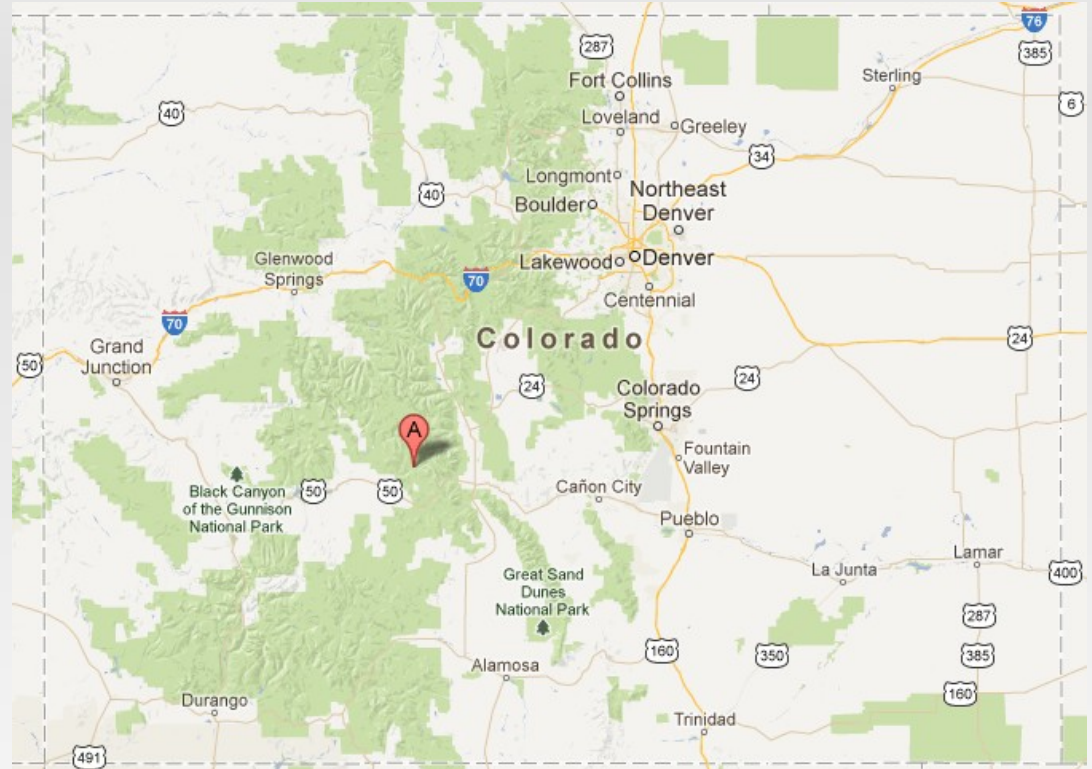
Similar Research

- Kepler
 - Looking for other earth-like planets
 - Spacebased
 - 3.5 years
 - 105 sq. deg.



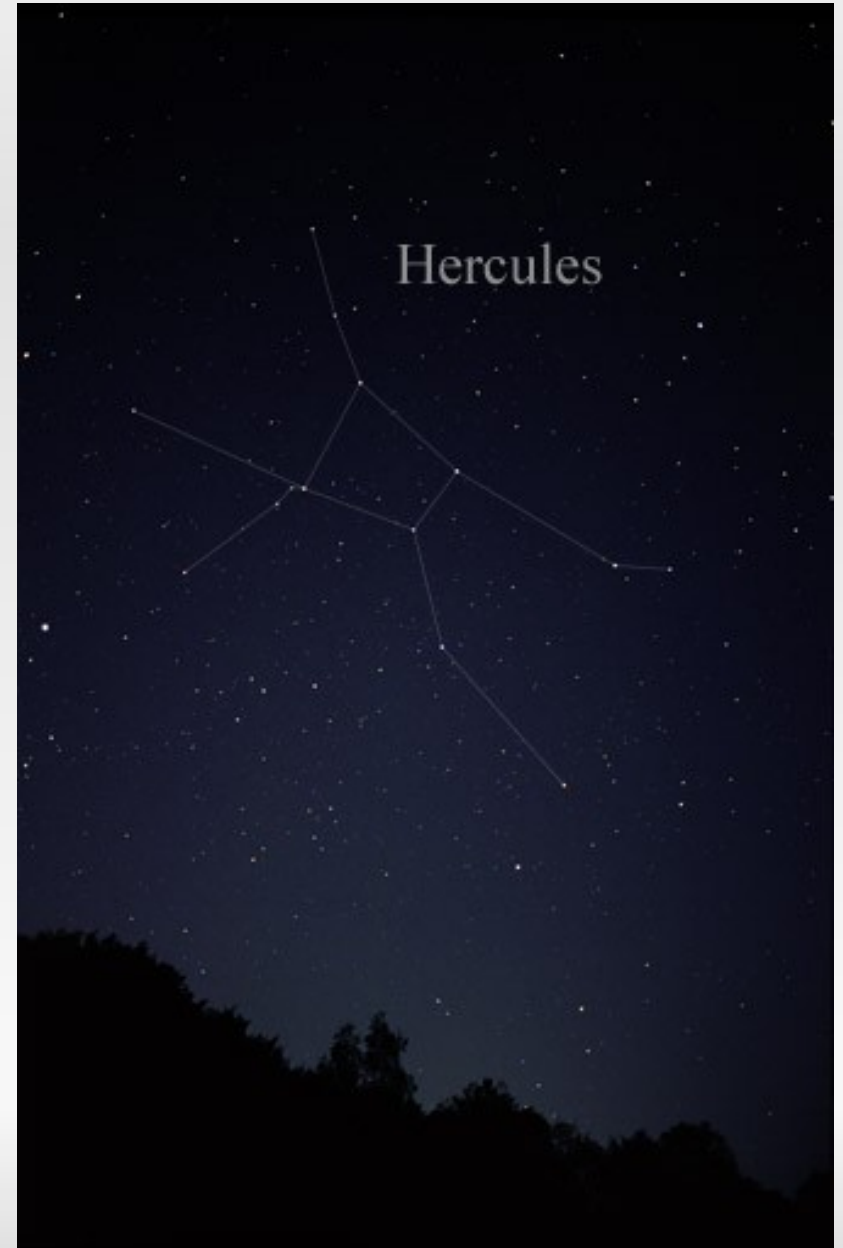
Research

- Summer 2012
- Pitkin, CO
 - 9216 ft (2809m)
- 37 nights
- 8535 images
- 60s integration time



Research

- 3 degree field
- 3000-4000 stars in field
- Constellation Hercules
- SAO 85182



Research



Photo Taken: June 25, 2012 23:06 MDT

Equipment

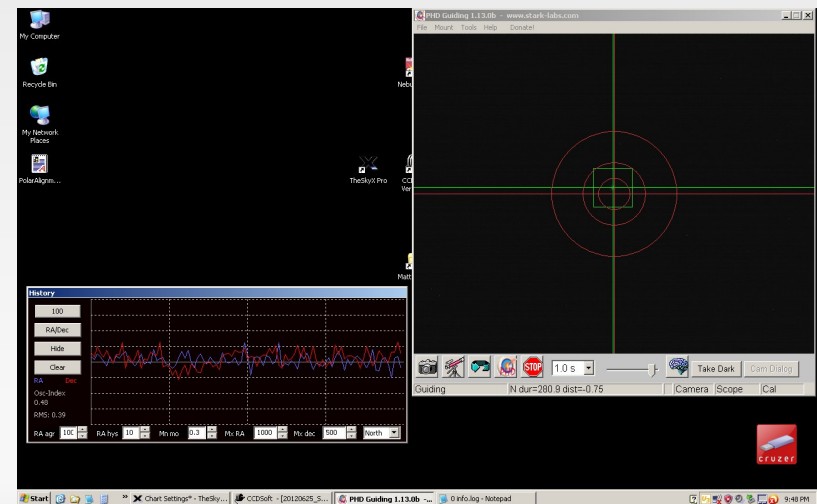
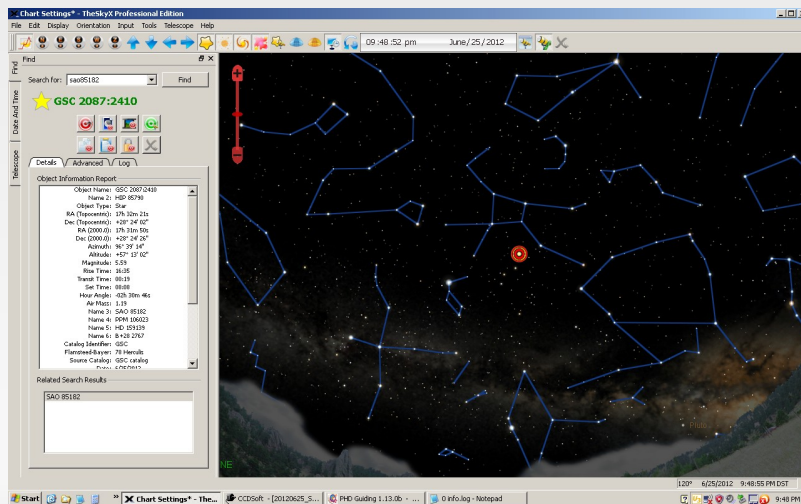
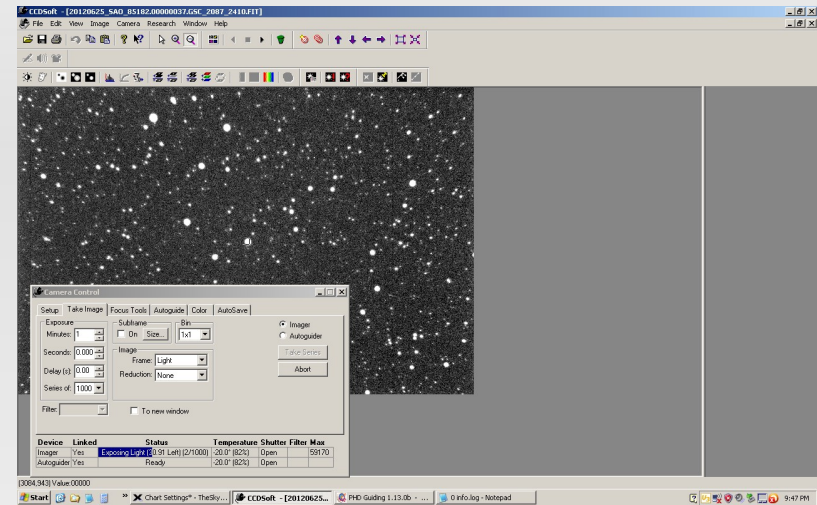
- Astrograph
 - f/1.5 stopped down to f/2.8
 - 6in / 200mm
 - R-Band Filter
- Guide scope
 - 80mm diameter
- 2 CCD's
 - SBIG-ST10
 - 3.2 megapixel



- 2 Heaters
- USB Hub
- Power Supply

Equipment

- CCD Soft
- The Sky X
- PHD Guiding



Algorithms

- EEELS
- Box-fitting Least Squares algorithm
- Kovács
- FORTRAN '77 subroutine

```
FILE * fp;
char str[80];
strcpy(str, "eeels-");
strcat(str, argv[1]);

fp = fopen(str, "w");
fprintf(fp, "Star,bper,bpow,depth,qtran,in1,in2,T,IP,EP\n");
#pragma omp parallel for num_threads(8)
for(i = 0; i < numStars; i++){
    eeels(numReadings, timeStamps, dataValues[i], u, v, numFreqPts,
        freqMin, freqStep, numBins, qMin, qMax,
        /* Output variables */ p, &bper, &bpow, &depth, &qtran, &in1, &in2);

    double T = 2.0*bper*qtran;
    double dummy;
    fprintf(fp, "%s,%f,%f,%f,%f,%d,%d,%f,%f,%f\n",
        starNames[i], bper, bpow, depth, qtran, in1, in2,
        T, modf(in1 * tot / numBins / T, &dummy), modf(in2 * tot / numBins / T, &dummy));
}
fclose(fp);
```

Algorithms

- QATS
- Quasiperiodic Automated Transit Search algorithm
- Eric Agol
- Kepler instrument
- C++

Algorithms

- Differences
 - QATS
 - Designed for Kepler
 - Very Few Data Gaps
 - Cadences
 - EEELS
 - Designed for earth based projects
 - Gaps for daylight time and cloud cover
- Similarities
 - box-fit

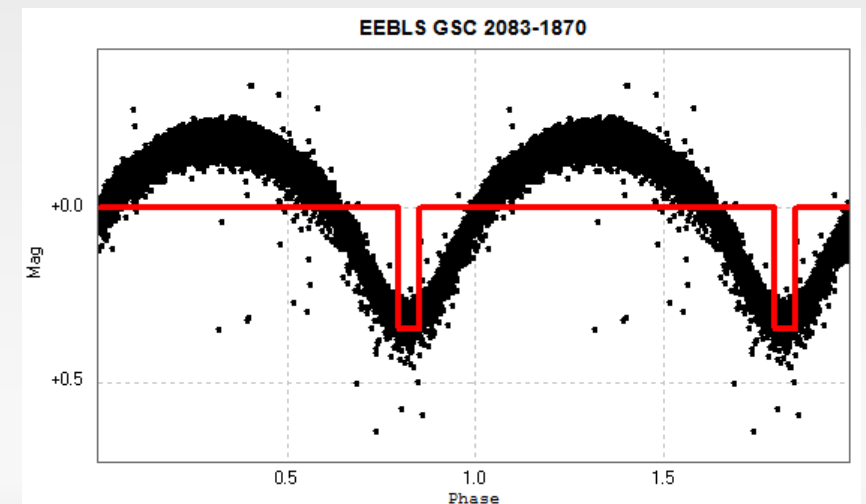
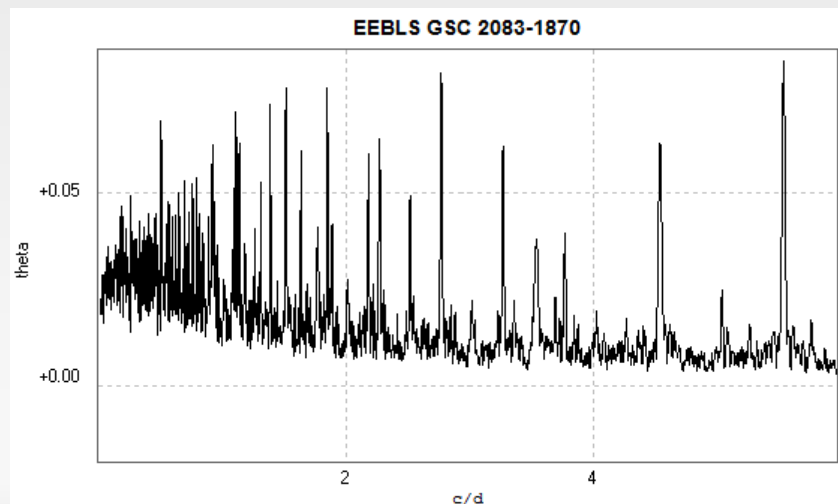
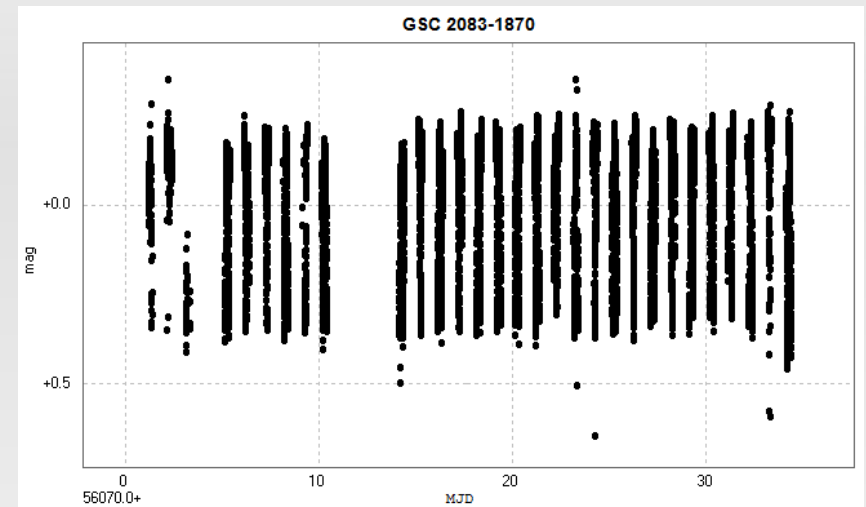
Results

- Sample output from EEBLS

	A	B	C	D	E	F	G	H
1	Star	<u>bper</u>	<u>bpow</u>	depth	<u>qtran</u>	T	IP	EP
2	UD17.595704+26.626751	33.201714	1.743014	-8.244696	0.046893	3.113877	0.106625	0.63975
3	GSC 2087-0323	11.611849	0.227872	-1.86007	0.01524	0.353937	0.673937	0.488144
4	GSC 2087-0108	22.666009	0.229341	-1.858042	0.015475	0.701504	0.244795	0.611263
5	GSC 2605-1636	14.467817	0.043933	-0.442313	0.009965	0.288339	0.544496	0.544496
6	GSC 2083-1870	1.983659	0.069403	-0.241622	0.090739	0.359989	0.456091	0.300688
7	GSC 2087-1908	7.805248	0.05145	-0.216802	0.059906	0.935166	0.520855	0.296033
8	GSC 2083-1636	4.461917	0.045424	-0.179866	0.068464	0.610964	0.908882	0.082611
9	GSC 2087-1579	7.805248	0.038312	-0.161439	0.059906	0.935166	0.520855	0.296033
10	GSC 2083-0661	10.296654	0.040188	-0.160804	0.06694	1.37852	0.576157	0.298708
11	GSC 2087-0343	7.805248	0.034396	-0.144938	0.059906	0.935166	0.520855	0.296033
12	GSC 2088-0814	15.596019	0.037547	-0.143876	0.073505	2.292779	0.737719	0.027339
13	GSC 2087-0469	19.952542	0.041417	-0.138202	0.099766	3.981152	0.504219	0.921205
14	GSC 2088-0134	10.191714	0.022895	-0.106419	0.048652	0.991691	0.361182	0.035178
15	GSC 2088-0560	11.478562	0.025331	-0.090608	0.085463	1.961986	0.7997	0.645825
16	UD17.612972+27.116050	10.191714	0.018063	-0.083958	0.048652	0.991691	0.361182	0.035178
17	GSC 2087-1127	10.403778	0.019959	-0.083195	0.061313	1.275774	0.42421	0.204952
18	GSC 2087-0218	11.3483	0.015447	-0.079637	0.039156	0.888706	0.99724	0.744433
19	GSC 2605-1950	10.191714	0.015428	-0.07171	0.048652	0.991691	0.361182	0.035178
20	GSC 2083-2131	31.134291	0.020389	0.078072	0.073623	4.584369	0.434542	0.796661
21	GSC 2087-0790	13.67635	0.016277	0.078699	0.044783	1.224939	0.79467	0.336766
22	GSC 2087-2090	31.134291	0.020781	0.079572	0.073623	4.584369	0.434542	0.796661

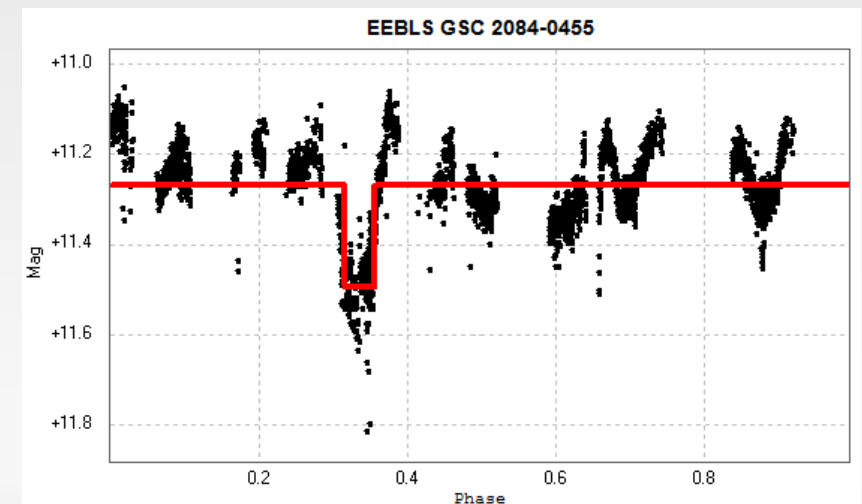
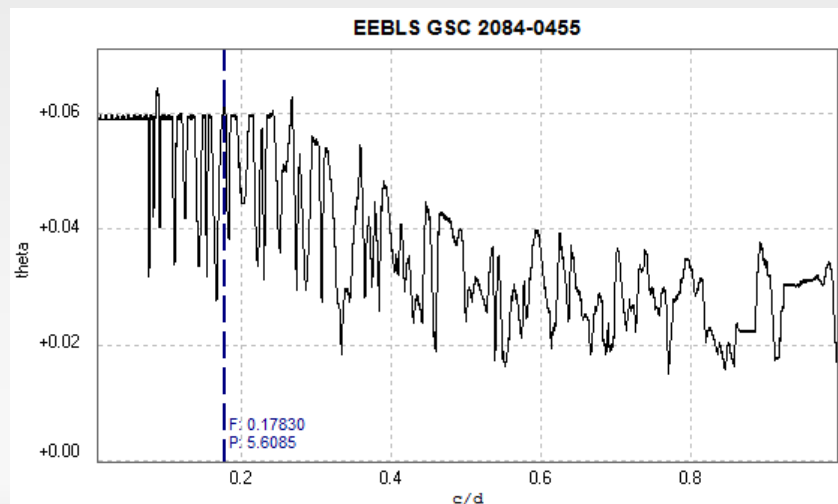
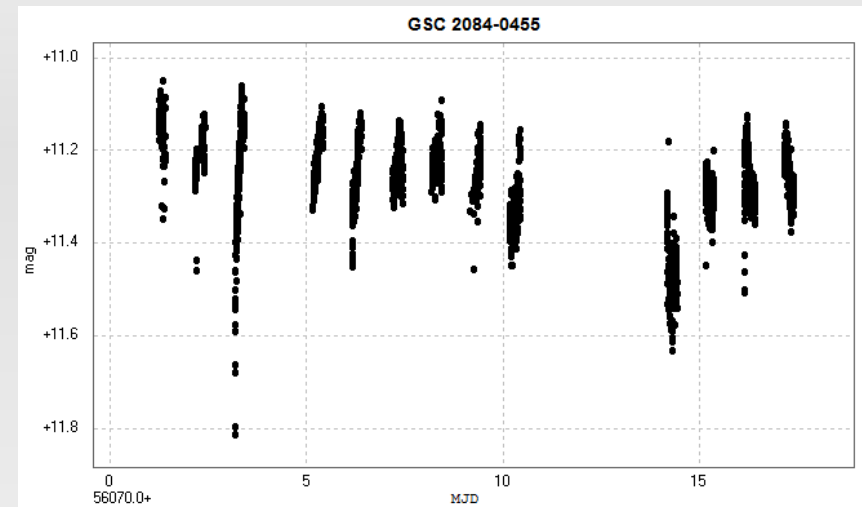
Results

- GSC 2083-1870



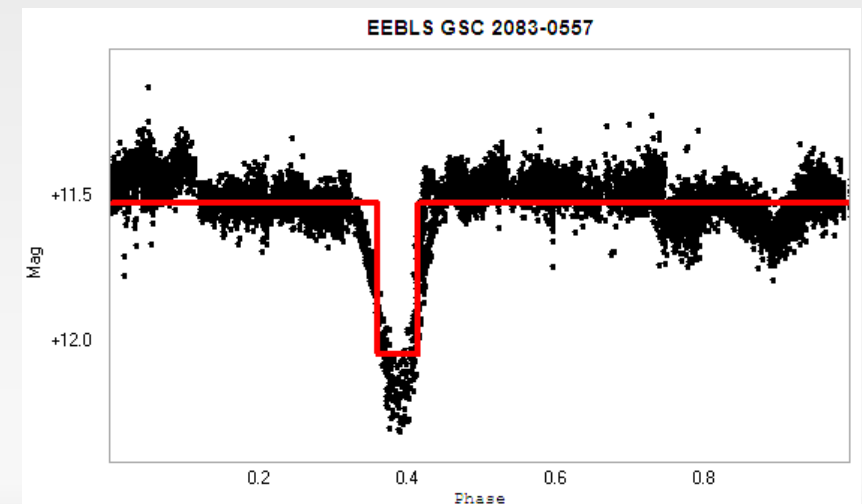
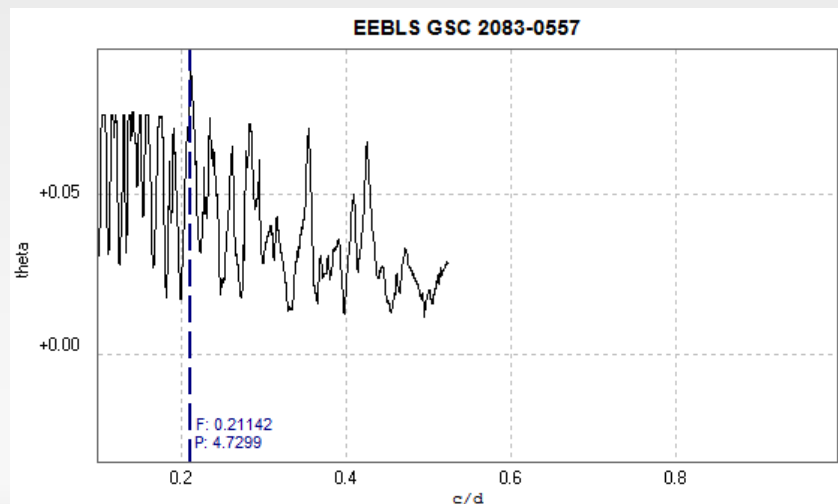
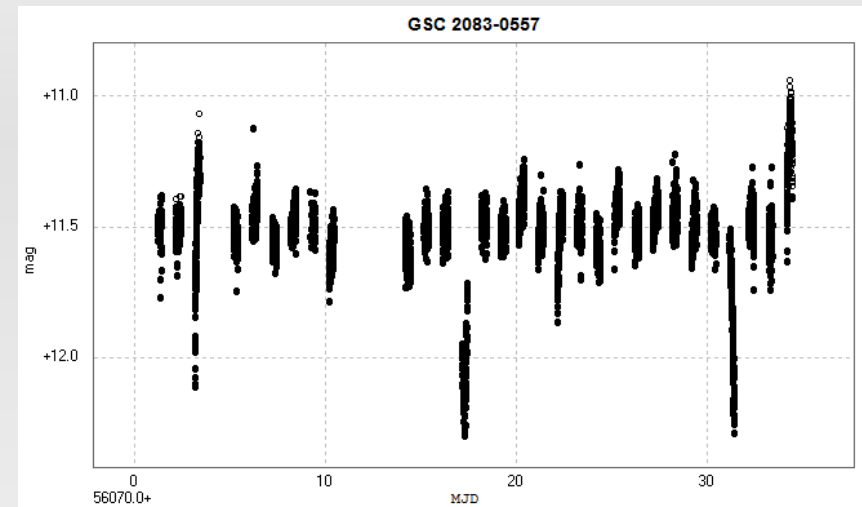
Results

- GSC 2084-0455



Results

- GSC 2083-0557



Conclusion

- Learned how to take and analyze scientific data
- EebIs is useful as a guide
- Insufficient results with QATS

References

- A box-fitting algorithm in the search for periodic transits
Kovács, G.; Zucker, S.; Mazeh, T.
Astronomy and Astrophysics, v.391, p.369-377 (2002)
- The Quasiperiodic Automated Transit Search Algorithm
Joshua A. Carter, Eric Agol
arXiv:1210.5136 [astro-ph.EP]

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