Sexy Science User Interfaces

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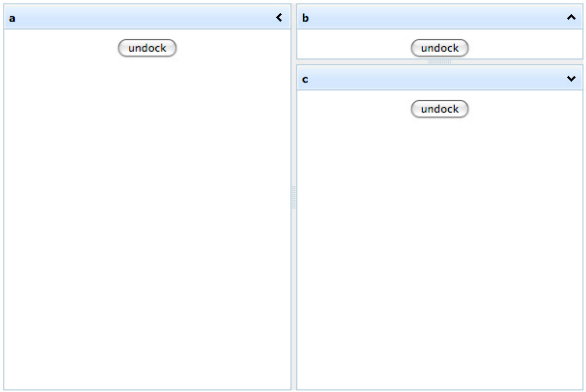
Javascript GUIs

- Love it or hate it
  - Javascript is the world's most popular language
  - Javascript is the world's most unpopular language

- Javascript is the language of the web
  - Browsers have become essentially Javascript engines
  - There are dozens of (free) libraries and frameworks that provide arguably the most extensive set of GUI capabilities in the world

Example: DHTMLX Layout



Source

```
<link rel="stylesheet" type="text/css" href="../../codebase/dhtmlxlayout.css">
<link rel="stylesheet" type="text/css" href="../../codebase/skins/dhtmlxlayout_dhx_skyblue.css">
<script src="../../codebase/dhtmlxcommon.js"></script>
<script src="../../codebase/dhtmlxlayout.js"></script>
<link rel="stylesheet" type="text/css" href="../../../dhtmlxWindows/codebase/dhtmlxwindows.css">
<link rel="stylesheet" type="text/css" href="../../../dhtmlxWindows/codebase/skins/dhtmlxwindows_dhx_skyblue.css">
<script src="../../../dhtmlxWindows/codebase/dhtmlxwindows.js"></script>
<script src="../../../dhtmlxWindows/codebase/engine/dhtmlxwindows_enginedhx.js"></script>
<script src="../../codebase/dhtmlxcontainer.js"></script>

<div id="winVP" style="position: relative; height: 500px; margin: 10px;">
    <div id="parentId" style="position: relative; top: 10px; left: 10px; width: 600px; height: 400px; aborder: #B5CDE4 1px solid;"></div>
</div>
<div id="log" style="position: relative; margin-top: 40px; margin-left: 20px; width: 600px; height: 120px; border: #909090 1px solid; overflow-y: scroll; font-family: Tahoma; font-size: 11px;">
</div>
<div id="objA" style="text-align: center; padding-top: 10px;"><input type="button" value="undock" onclick="dhxLayout.cells('a').undock();"></div>
<div id="objB" style="text-align: center; padding-top: 10px;"><input type="button" value="undock" onclick="dhxLayout.cells('b').undock();"></div>
<div id="objC" style="text-align: center; padding-top: 10px;"><input type="button" value="undock" onclick="dhxLayout.cells('c').undock();"></div>
<script>

var dhxLayout;
function doOnLoad() {
    dhxLayout = new dhtmlXLayoutObject("parentId", "3L");
    dhxLayout.dhxWins.enableAutoViewport(false);
    dhxLayout.dhxWins.attachViewportTo("winVP");
    dhxLayout.attachEvent("onDock", doOnDock);
    dhxLayout.attachEvent("onUnDock", doOnUnDock);
    dhxLayout.cells("a").attachObject("objA");
    dhxLayout.cells("b").attachObject("objB");
    dhxLayout.cells("c").attachObject("objC");
}
function doOnDock(itemId) {
    document.getElementById("log").innerHTML += "<b>onDock</b> event called, item id is <b>" + itemId + "</b><br>";
}
function doOnUnDock(itemId) {
    document.getElementById("log").innerHTML += "<b>onUnDock</b> event called, item id is <b>" + itemId + "</b><br>";
    dhxLayout.dhxWins.window(itemId).keepInViewport(true);
}

</script>
```

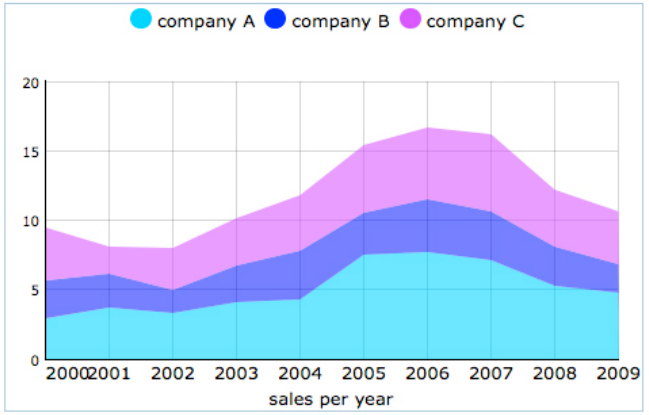
Example: DHTMLX Layout (2)

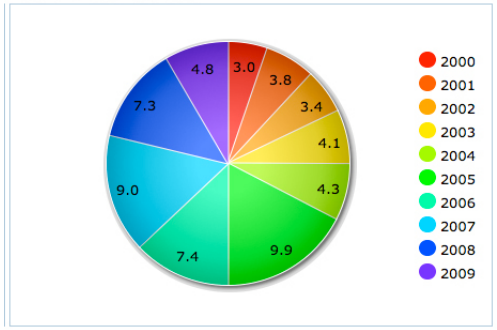
But We are Science Nerds

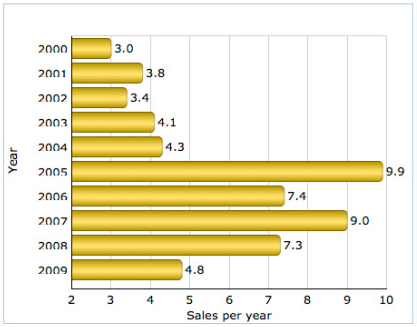
- Computer guys may get off on GUIs but we love *data*
  - Images
  - Plots
  - Tables
- … Lots of it
  - Billion record tables
  - Multi-Gigabyte images
- … And poking things
  - Which object is that?
  - Sort this, subset that

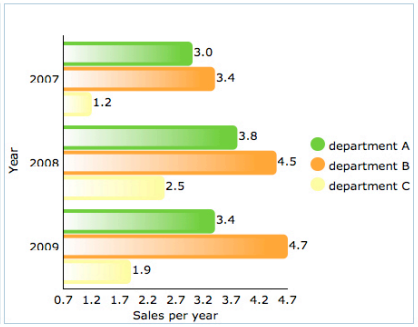
Web Plotting Tools

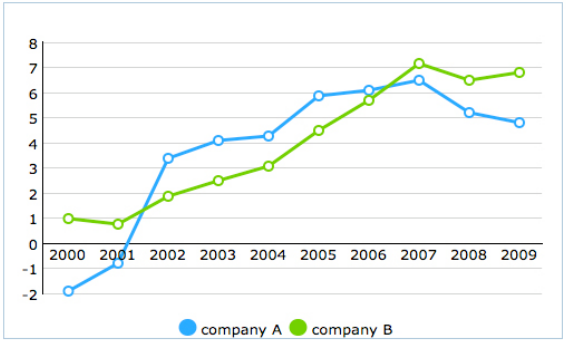
- Cute and OK for *managers*
- But totally inadequate for *real* data











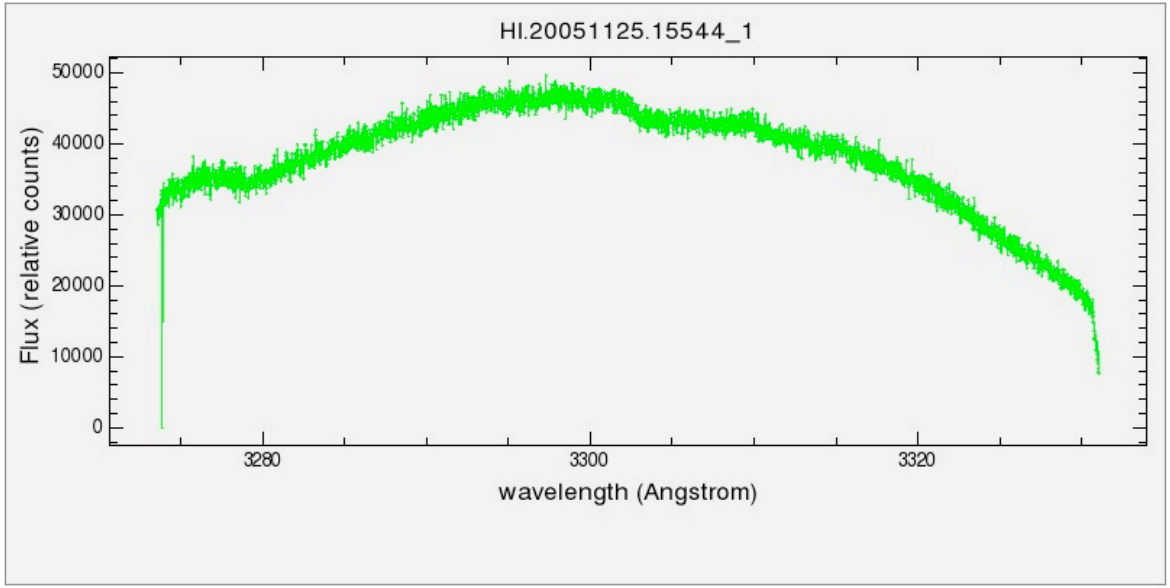
Working at Scale

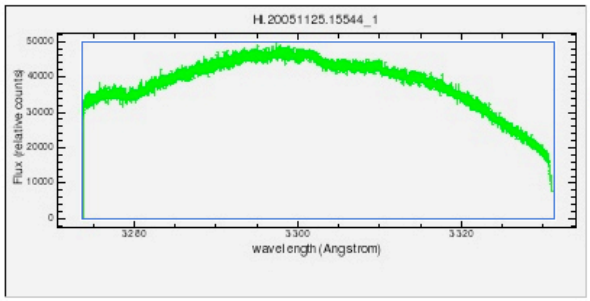
- Data is better left on the back end
  - Tabular data in a database (*e.g.* SQLite file) which allows fast, full SQL, manipulation
  - Images processed through a toolkit that provides science grade resampling, cutouts, and rendering (*e.g.* Montage)

- And served in bits and pieces
  - You may want to "explore" a 10-million record table but in fact will only actually interactively look at a few thousand records total
  - Screens have a million or so pixels, so why transfer 100 million?

Plots and Tables

- Basic interactive plotting requires nothing more than adding positional event handling to existing JPEG plot generation





Zoom In | Zoom Out | Reset Zoom

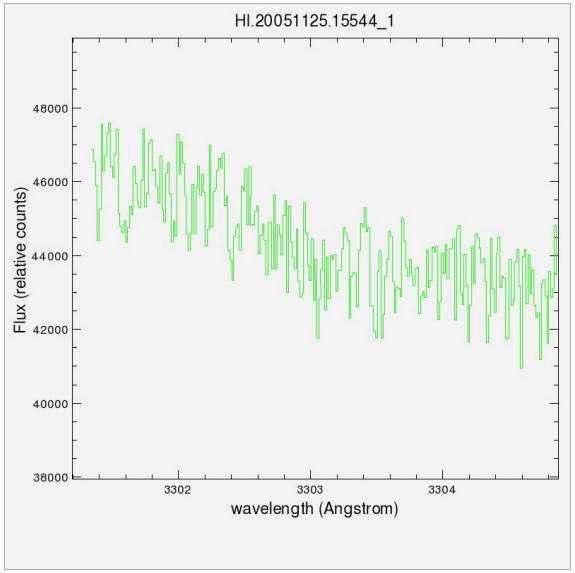
Show Table | Plot Controls

Plot Coordinate Feedback Off

Click plot to print coordinates here.

Plots and Tables (2)

- Which can be augmented with control panels to make use of all the underlying plotting capabilities

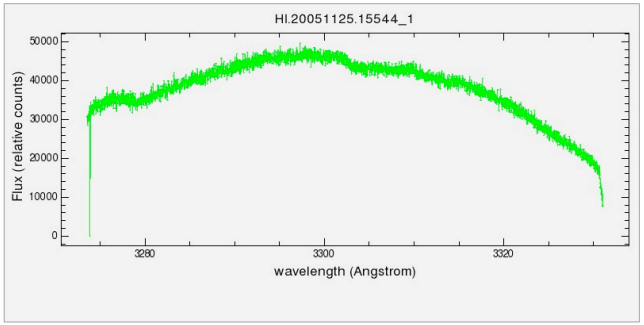


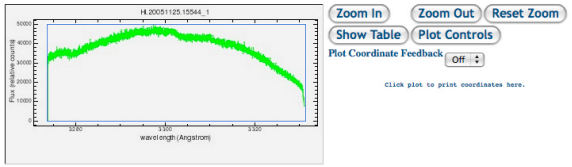
Plot Controls | Overplot Fields

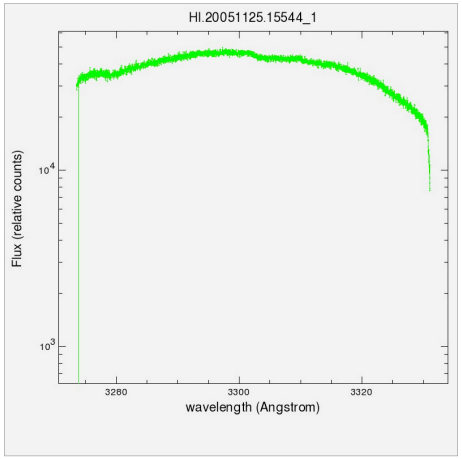
Table File	HI.20051125.15544_1_01_flux.tbl	Npts *	4056
Xaxis *	wave	Yaxis *	Flux
Xlabel	wavelength (Angstrom)	Ylabel	Flux (relative counts)
Plot Width	800	Plot Height	400
Xdatamin	3273.538300	Ydatamin	0.000000
Xdatamax	3331.056100	Ydatamax	49698.996000
X autoscale	Yes	Y autoscale	Yes
X flip	No	Y flip	No
Xmin		Ymin	
Xmax		Ymax	
Xscaling	Linear	Yscaling	Linear
Histogram Style	off	Label Color	Black
Axes Color	Black	Background Color	f0f0f0
Pt Color *	Green	Ln Color *	Green
Pt Type *	Dot	Ln Type *	Solid
Pt Size *	1.0	Ln Width *	1

Update Plot

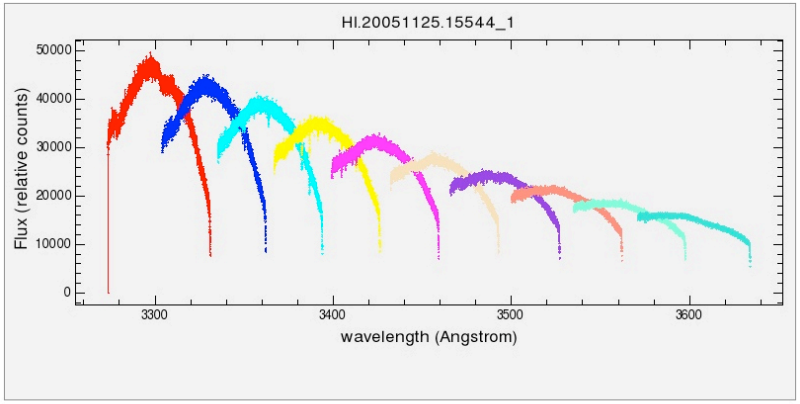
Note 1: The parameters in the asterisk (*) fields do not apply to the over plots. Overplot parameters should be set with the 'Overplot Fields' interface.
Note 2: The tick marks on Log scale plot only appear on the integer number (i.e. 10, 100 etc.). If the plot range is less than one order of magnitude, there might be no tick mark at all.



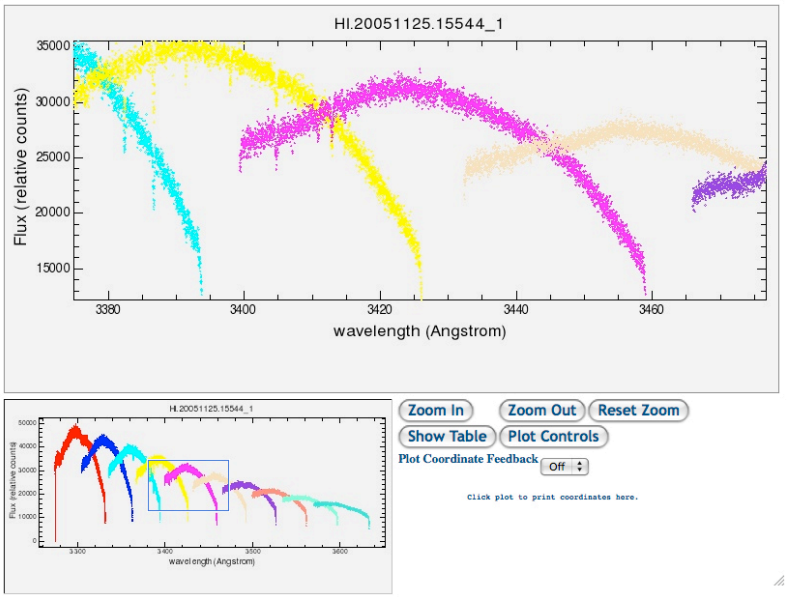




Plots and Tables (3)

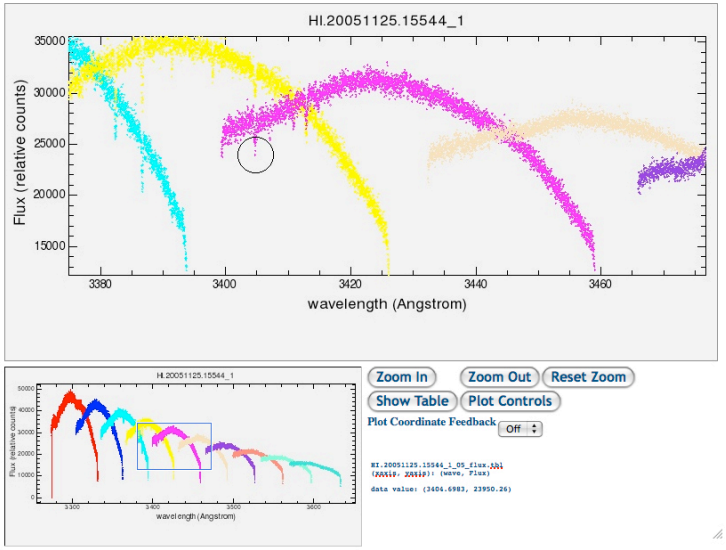


- Including overplotting
- Basic region selection is all you need to support zooming



Plots and Tables (4)

- And point selection (across multiple input tables)



HI.20051125.15544_1_03_flux | HI.20051125.15544_1_04_flux | **HI.20051125.15544_1_05_flux** | HI.20051125.15544_1_06_flux | HI.20051125.15544_1_07_flux | HI.20051125.15544_1_08_flux | HI.20051125.15544_1_09_flux | HI.20051125.15544_1_10_flux

rowid	wave	Flux	col	row	raw_col	raw_row	Error	Background	Sig_to_Noise	Flat	Arc_Lamp	S
333	3404.5727	25706.85000000000	332.00	170.89	828.11	332.00	209.89522000000	806.27667000000	122.47468000000	37.08152400000	40.58284000000	25677.
334	3404.5884	25419.13500000000	333.00	170.91	828.09	333.00	209.53956000000	802.55035000000	121.30948000000	37.03052900000	47.42594900000	25421.
335	3404.6041	26659.76800000000	334.00	170.94	828.06	334.00	219.80356000000	806.02802000000	121.28906000000	37.00269300000	47.32078600000	26669.
336	3404.6198	25367.75200000000	335.00	170.96	828.04	335.00	207.32121000000	788.05042000000	122.35965000000	36.75735900000	45.39485900000	25333.
337	3404.6355	25259.10200000000	336.00	170.98	828.02	336.00	252.68815000000	792.13660000000	99.96156000000	36.65465500000	35.25205200000	25005.
338	3404.6512	25937.82600000000	337.00	171.01	827.99	337.00	213.06753000000	775.44092000000	121.73524000000	36.83299300000	26.43696600000	25937.
339	3404.6669	26434.25000000000	338.00	171.03	827.97	338.00	266.56972000000	782.09546000000	99.16449000000	36.96255900000	23.08805300000	24843.
340	3404.6826	25520.64600000000	339.00	171.05	827.95	339.00	237.40450000000	781.04114000000	107.49858000000	36.96527100000	21.23436500000	24410.
341	3404.6983	23950.26000000000	340.00	171.08	827.92	340.00	199.44746000000	778.03644000000	120.08305000000	37.30862000000	26.00442700000	23963.
342	3404.7140	25071.49400000000	341.00	171.10	827.90	341.00	236.73777000000	767.25574000000	105.90408000000	37.42094400000	29.23185500000	23341.
343	3404.7297	24835.30500000000	342.00	171.12	827.88	342.00	263.98227000000	769.36957000000	94.07944100000	37.51257300000	29.25476100000	23405.
344	3404.7454	24346.62500000000	343.00	171.15	827.85	343.00	226.00759000000	777.84515000000	107.72481000000	37.57808700000	27.77919800000	23188.
345	3404.7611	25479.87900000000	344.00	171.17	827.83	344.00	220.44836000000	790.60687000000	115.58207000000	37.52487900000	29.03269600000	25460.
346	3404.7768	27312.26200000000	345.00	171.19	827.81	345.00	246.39761000000	790.14026000000	110.84629000000	37.68965500000	24.87517400000	26247.
347	3404.7925	26132.29300000000	346.00	171.22	827.78	346.00	213.25350000000	783.48145000000	122.54098000000	37.70566900000	21.25655700000	26140.
348	3404.8082	26304.26400000000	347.00	171.24	827.76	347.00	231.19760000000	781.38483000000	113.77395000000	37.60050200000	17.44860100000	26124.
349	3404.8239	25180.68900000000	348.00	171.26	827.74	348.00	221.90528000000	792.22986000000	113.47495000000	37.69902400000	16.89607600000	25277.
350	3404.8396	25741.09600000000	349.00	171.29	827.71	349.00	207.93081000000	791.64343000000	123.79645000000	37.79680600000	15.69287400000	25725.
351	3404.8553	25682.61700000000	350.00	171.31	827.69	350.00	228.18695000000	784.35974000000	112.55077000000	37.85920000000	17.95749300000	25917.
352	3404.8710	25813.24400000000	351.00	171.33	827.67	351.00	208.99427000000	781.65961000000	123.51173000000	37.87246700000	16.98431600000	25840.

331 of 4056 records

Reset

Table Manipulation

- Tables are linked to a server-side SQLite database
  - This allows data transfer to be minimized (intelligent paging is built into the DHTMLX table tool)
  - Sorting, filtering, etc. can use full SQL syntax (e.g. you can say that the "flux1" column needs to be "> flux2")
- Table cell content can have complex rendering and adornment
- All sorts of functions and links can be attached to the data, header, *etc*.

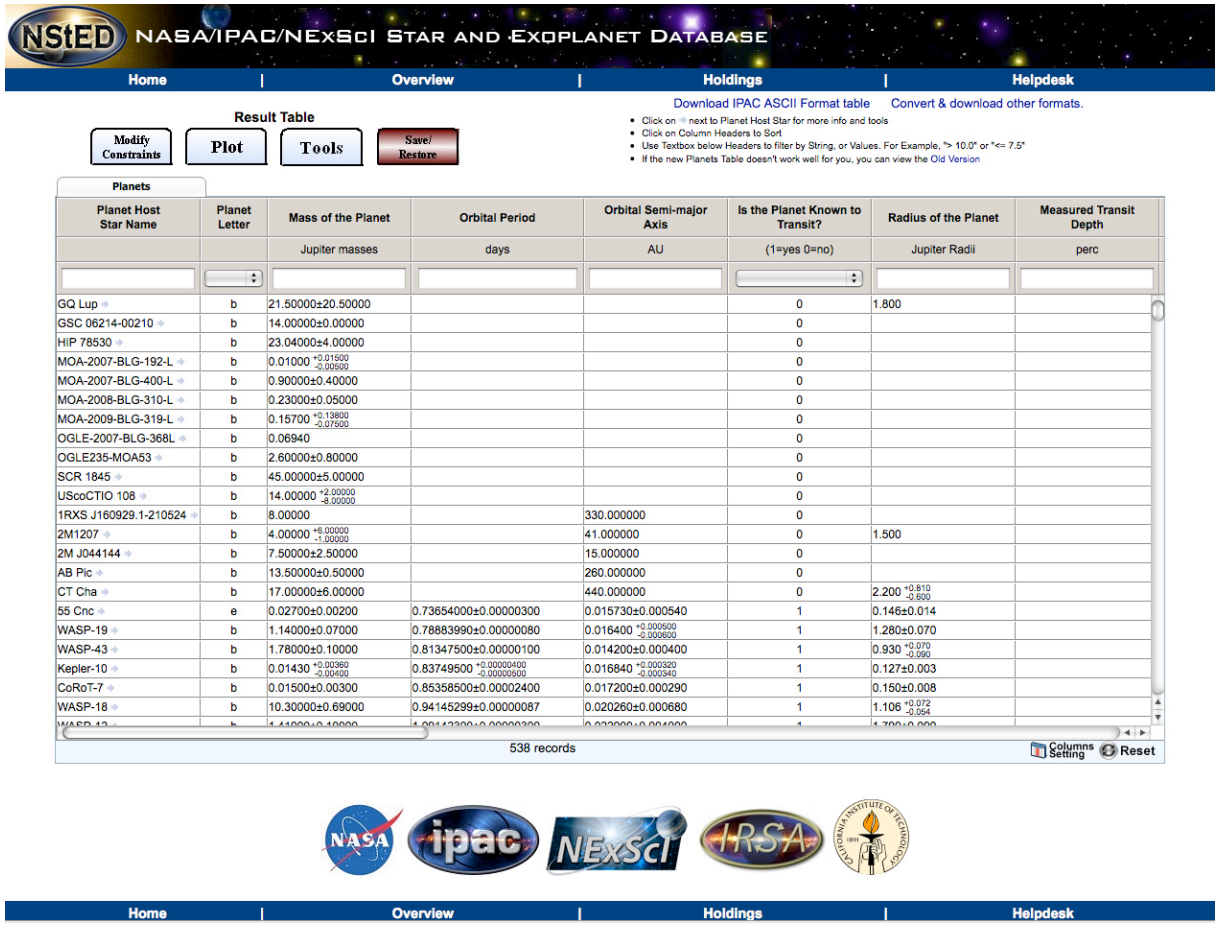


Table Manipulation (2)

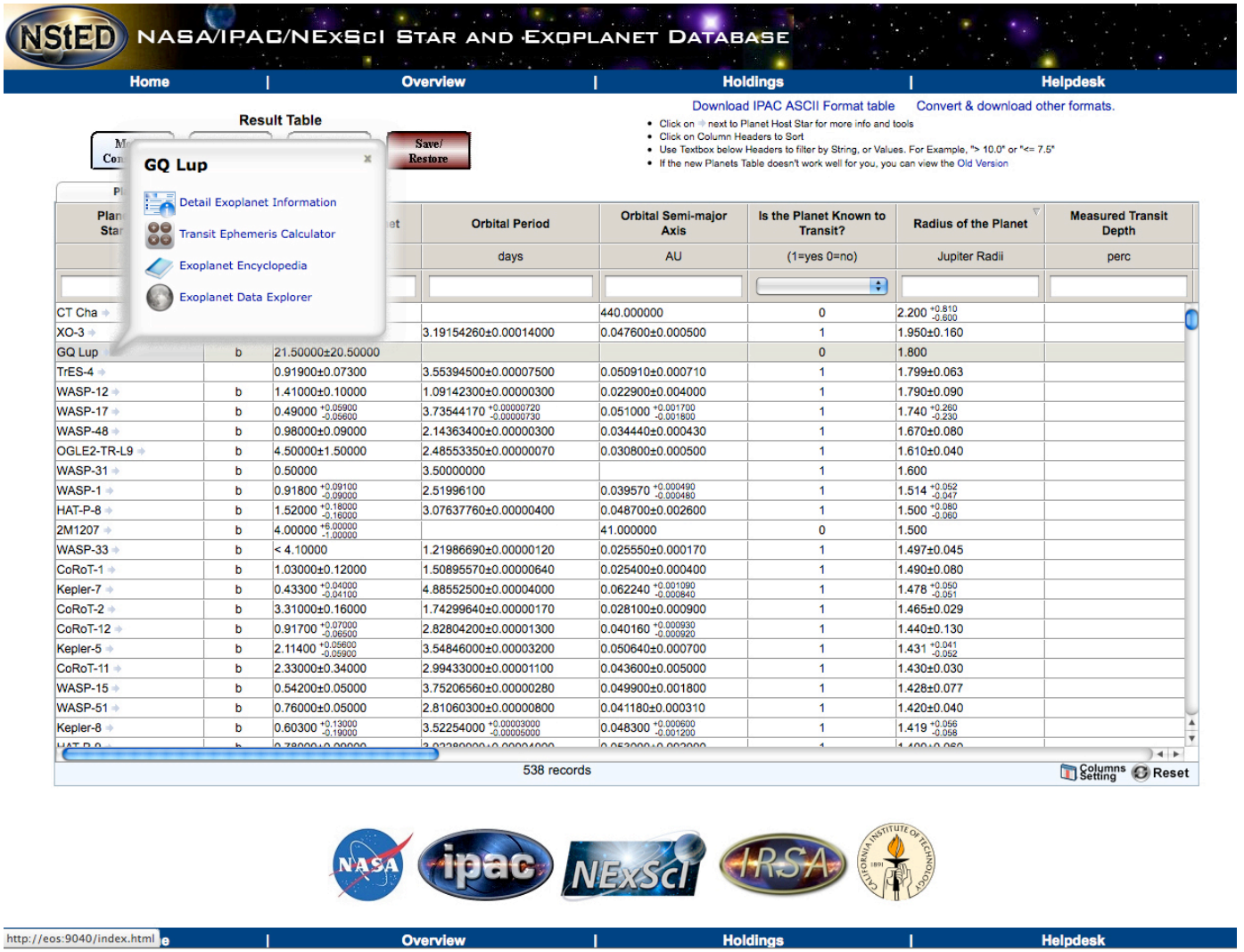
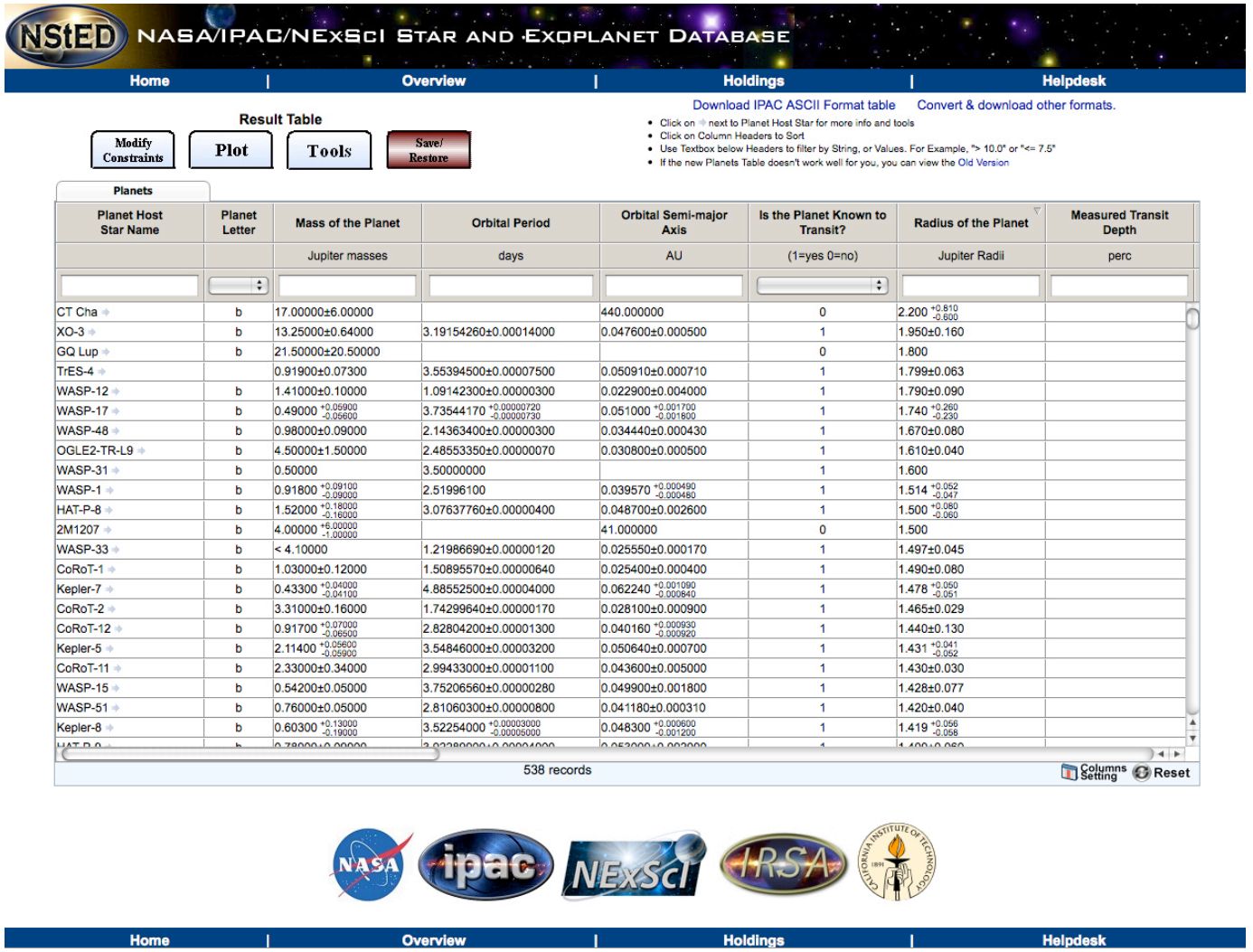


Table Manipulation (3)



NSTED NASA/IPAC/NExScI Star and Exoplanet Database

Home | Overview | Holdings | Helpdesk

Result Table

Modify Constraints | Plot | Tools | Save/ Restore

Download IPAC ASCII Format table Convert & download other formats.

- Click on next to Planet Host Star for more info and tools
- Click on Column Headers to Sort
- Use Textbox below Headers to filter by String, or Values. For Example, "> 10.0" or "<= 7.5"
- If the new Planets Table doesn't work well for you, you can view the Old Version

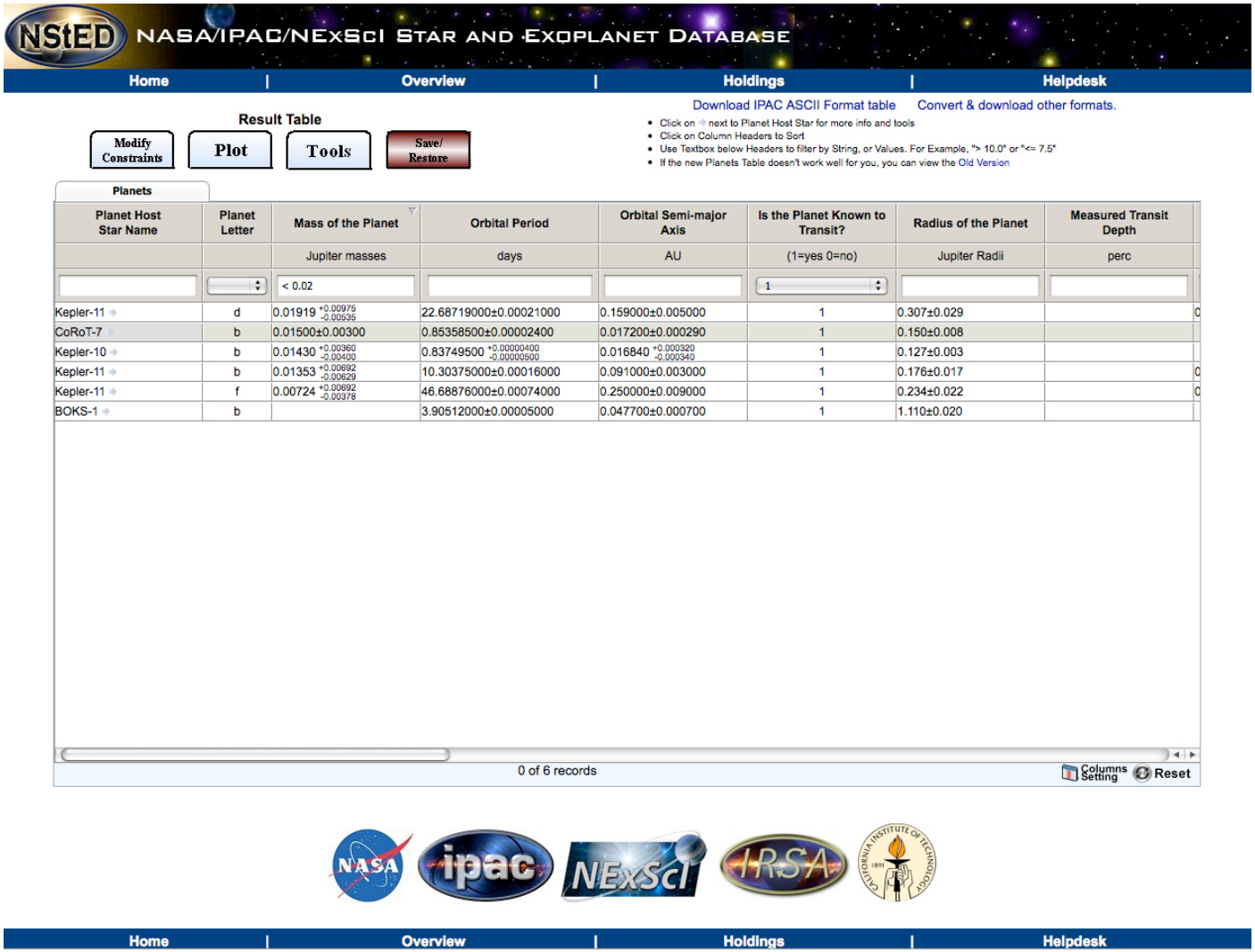
Planets

Planet Host Star Name	Planet Letter	Mass of the Planet	Orbital Period	Orbital Semi-major Axis	Is the Planet Known to Transit?	Radius of the Planet	Measured Transit Depth
		Jupiter masses	days	AU	(1=yes 0=no)	Jupiter Radii	perc
CT Cha	b	17.00000±6.00000		440.000000	0	2.200 +0.810 -0.600	
XO-3	b	13.25000±0.64000	3.19154260±0.00014000	0.047600±0.000500	1	1.950±0.160	
GQ Lup	b	21.50000±20.50000			0	1.800	
TrES-4		0.91900±0.07300	3.55394500±0.00007500	0.050910±0.000710	1	1.799±0.063	
WASP-12	b	1.41000±0.10000	1.09142300±0.00000300	0.022900±0.004000	1	1.790±0.090	
WASP-17	b	0.49000 +0.05900 -0.05600	3.73544170 +0.00000720 -0.00000730	0.051000 +0.001700 -0.001800	1	1.740 +0.260 -0.230	
WASP-48	b	0.98000±0.09000	2.14363400±0.00000300	0.034440±0.000430	1	1.670±0.080	
OGLE2-TR-L9	b	4.50000±1.50000	2.48553350±0.00000070	0.030800±0.000500	1	1.610±0.040	
WASP-31	b	0.50000	3.50000000		1	1.600	
WASP-1	b	0.91800 +0.09100 -0.09000	2.51996100	0.039570 +0.000490 -0.000480	1	1.514 +0.052 -0.047	
HAT-P-8	b	1.52000 +0.18000 -0.16000	3.07637760±0.00000400	0.048700±0.002600	1	1.500 +0.080 -0.060	
2M1207	b	4.00000 +6.00000 -1.00000		41.000000	0	1.500	
WASP-33	b	< 4.10000	1.21986690±0.00000120	0.025550±0.000170	1	1.497±0.045	
CoRoT-1	b	1.03000±0.12000	1.50895570±0.00000640	0.025400±0.000400	1	1.490±0.080	
Kepler-7	b	0.43300 +0.04000 -0.04100	4.88552500±0.00004000	0.062240 +0.001090 -0.000840	1	1.478 +0.050 -0.051	
CoRoT-2	b	3.31000±0.16000	1.74299640±0.00000170	0.028100±0.000900	1	1.465±0.029	
CoRoT-12	b	0.91700 +0.07000 -0.06500	2.82804200±0.00001300	0.040160 +0.000930 -0.000920	1	1.440±0.130	
Kepler-5	b	2.11400 +0.05600 -0.05900	3.54846000±0.00003200	0.050640±0.000700	1	1.431 +0.041 -0.052	
CoRoT-11	b	2.33000±0.34000	2.99433000±0.00001100	0.043600±0.005000	1	1.430±0.030	
WASP-15	b	0.54200±0.05000	3.75206560±0.00000280	0.049900±0.001800	1	1.428±0.077	
WASP-51	b	0.76000±0.05000	2.81060300±0.00000800	0.041180±0.000310	1	1.420±0.040	
Kepler-8	b	0.60300 +0.13000 -0.19000	3.52254000 +0.00003000 -0.00005000	0.048300 +0.000600 -0.001200	1	1.419 +0.056 -0.058	

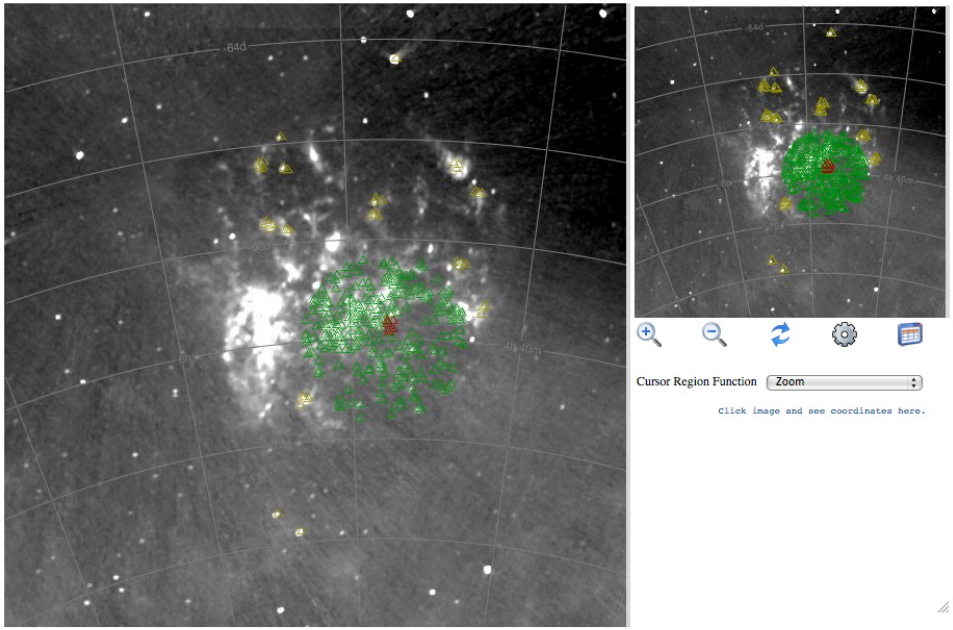
538 records Columns Setting Reset

Home | Overview | Holdings | Helpdesk

Table Manipulation (4)



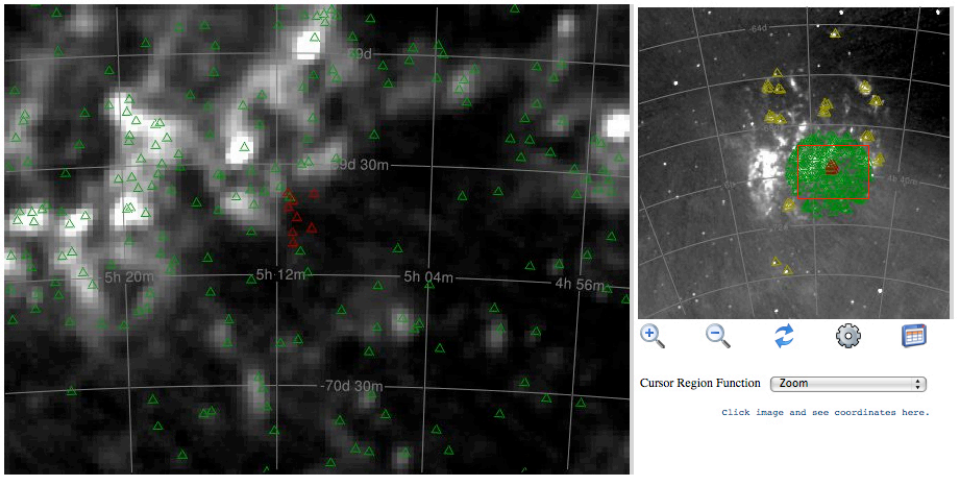
Images



The main image area allows for pick image points by clicking or defining zoom areas by dragging a box shape. Coarse zoom steps are also available via the buttons above. If the data table window has been activated, selected points will be highlighted there also and selecting table records will cause the image picked point to change in response.

- The same interaction functionality can be applied to images
  - Region zooming
  - Point selection from overlay tables

- The following set of slides shows some of the underlying capabilities



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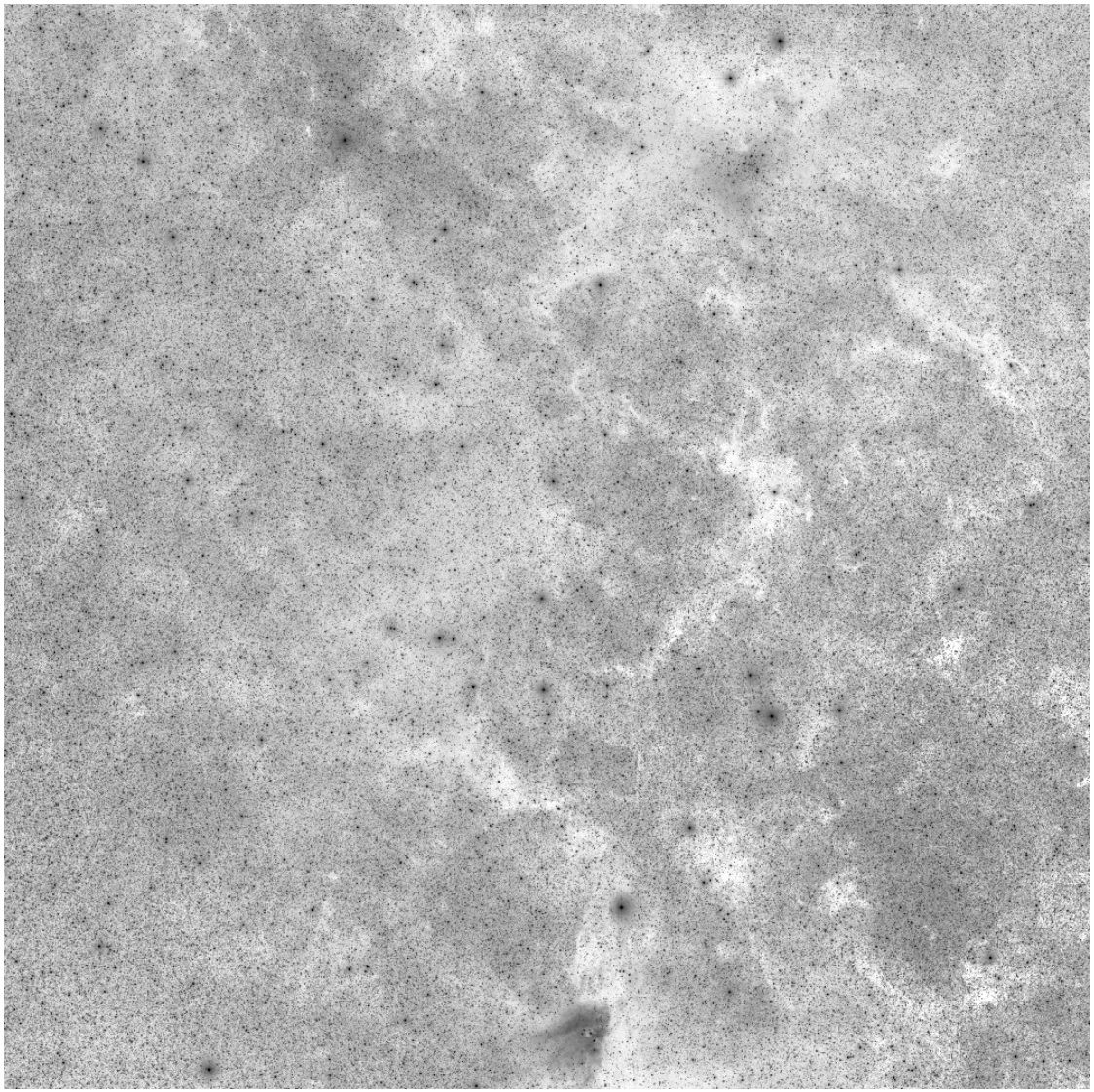
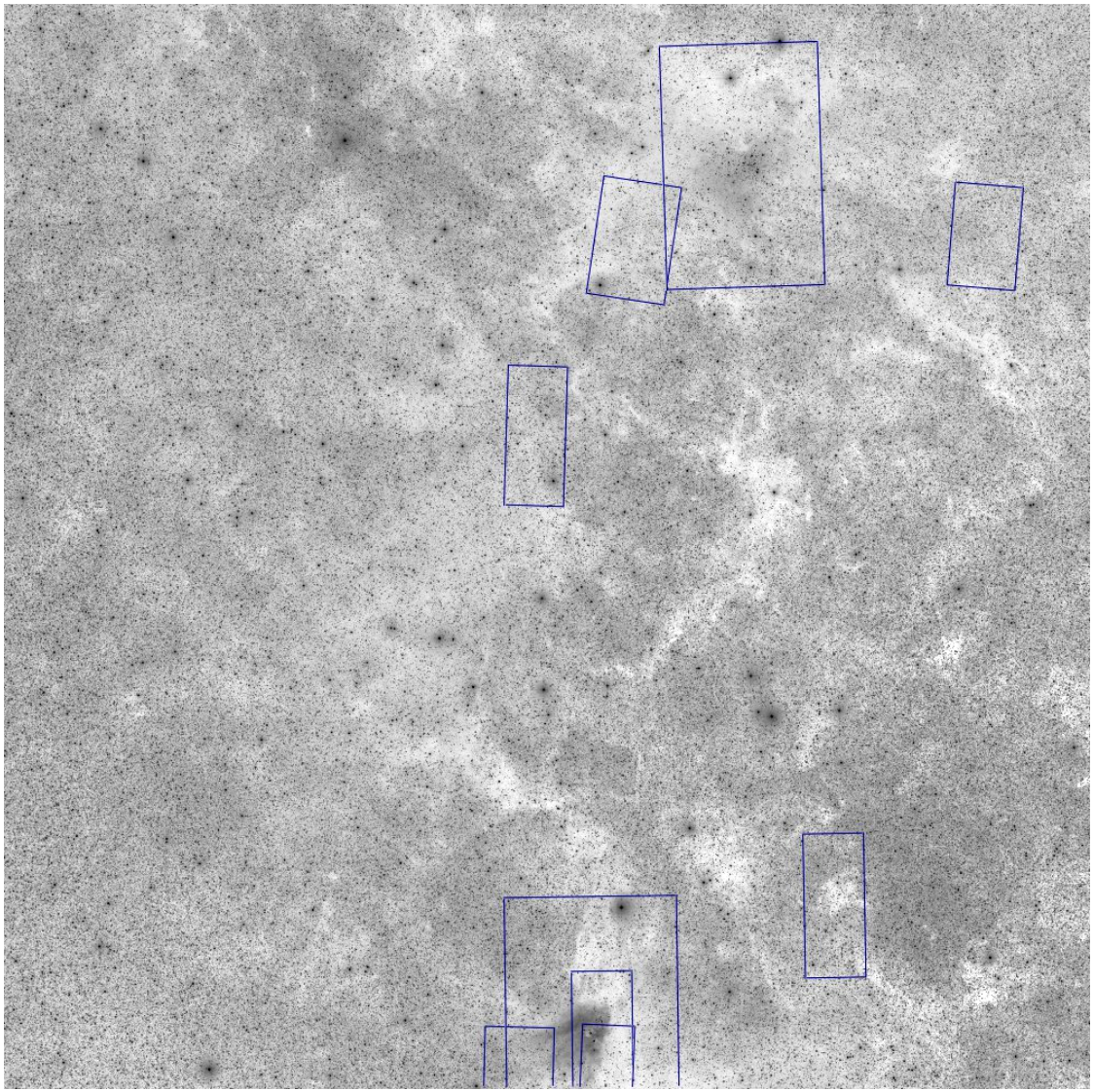
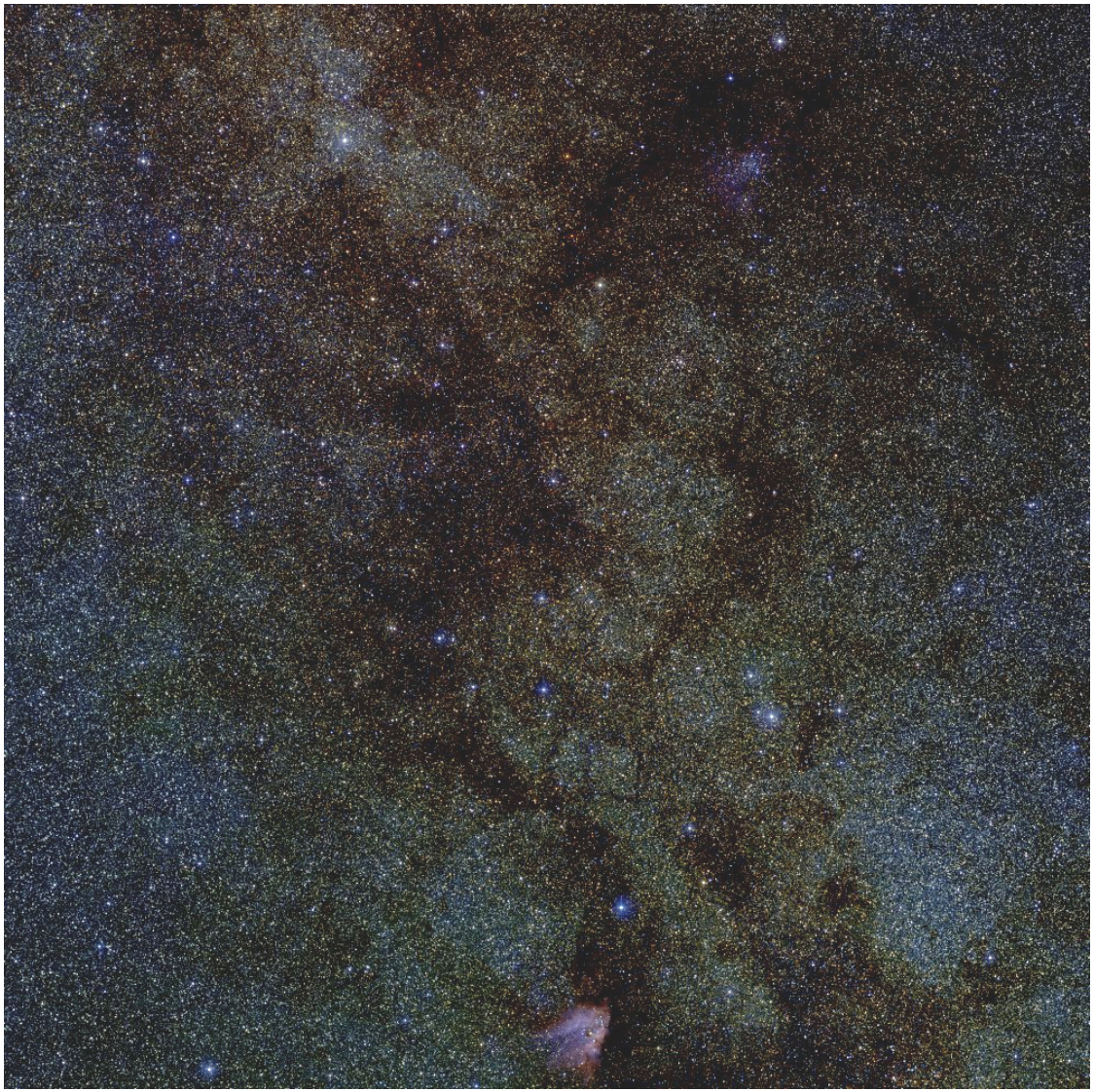
Images (2)



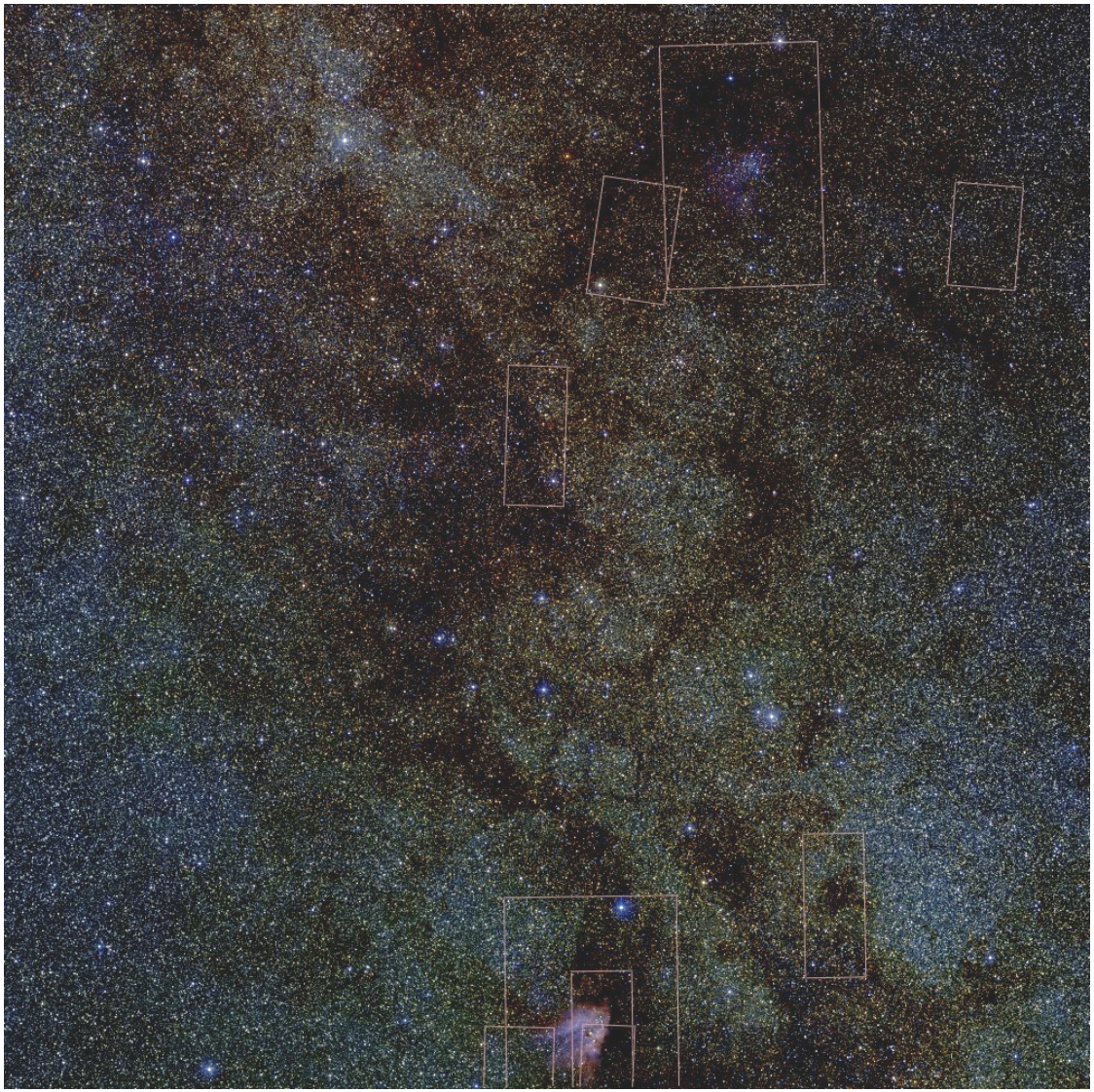
Images (3)



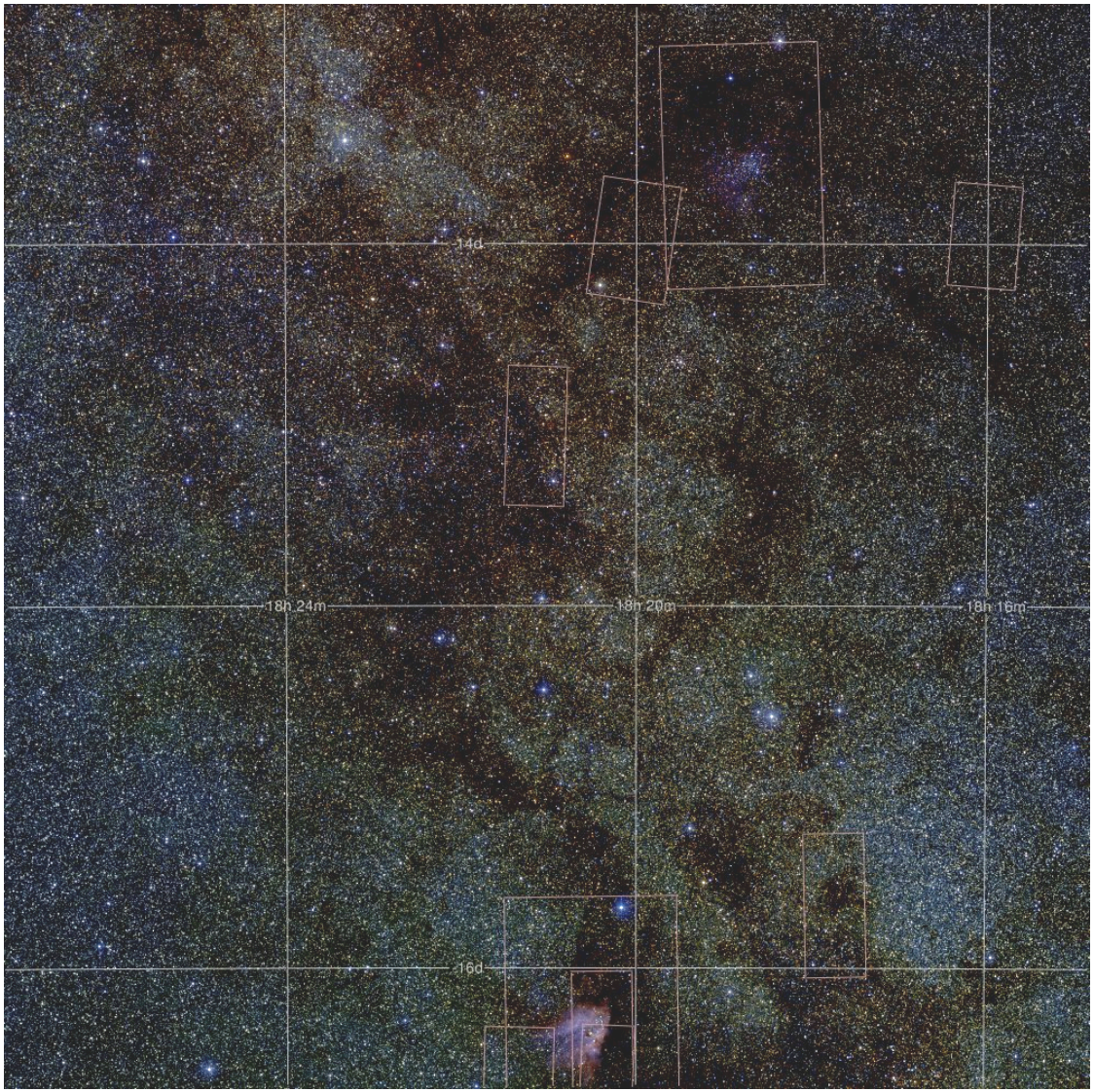
Images (4)



Images (5)



Images (6)



Images (7)

Images (8)

Closing Notes

- ICE components (our name for the tools described in this talk) fit into a page or pages in the same way as DHTMLX (or other) Javascript display objects. They can be intermixed.

- The server-side tools (SQLite-based dbLoad and dbSelect, jPlot, Montage manipulation and image rendering) can all be used in multiple modes:
  - From the command-line
  - From within pipelines and run by any scripting language
  - As the underpinnings for the tools shown here

- Server-side (and even remote computing such as on a cloud) is much higher performance than trying to shoehorn it into the client and allows the most effective/efficient languages to be used.

- Other backend components could just as easily be factored in
  - Instead of jPlot (an application built with the PlPlot library) on could instead use JPEGs generated by, for instance, a statistical analysis package
  - Very little of the client Javascript logic would have to change