Conference Call

Tuesday, March 01, 2011
10:25 AM

1:00PM EST to XXXXXXXX

866-524-3365

Me: 9466543#

All others: 7786875#

On the call:
- John
- Steve
- Stacy

Not on the call:
- Mike
- Debbie

TRIP to Pasadena August 2, 3, 4 with travel days on either side…. Confirmed. John will confirm with Luisa.

http://nsted.ipac.caltech.edu/index.html
Initial home site for all the data.

http://nsted.ipac.caltech.edu/applications/ETSS/Kepler_index.html
For analysis of star data.

Status of the proposal:
- Have a rough outline as a working document. Need to get going asap!

Steve launching into material:
- Read through the paper by Steve and Ciardi
- Figure 6 is the key to the project on page 8.
- We are into the dwarfs (Main Sequence) stars…. Luminosity class V.
- And Giants Lum Class III
- Stars evolve from the V to the III as they age.
- Concentrate on the class V dwarfs. We want to understand these 'cause they are like our star.
- Kepler Magnitude is like a Johnson V and R magnitude. Brighter on left and fainter on right.
- The Y axis is the variability of these stars in milli-magnitudes! Small variances. None of these visible from ground based scopes.
- Look at K and G dwarfs graphs….
- 1-10 mmag are the ones we are most interested in.
  - Some are periodic. Some not. We don't know, and we want to find out.
  - Important to characterize them: If we plot the quiet sun here… it would fall on the bottom… not all that variable at all.
  - What are those other stars doing? We want to characterize them. There are 150,000 of them.
  - We want to grab a sample between 11-14th magnitude from the bottom and top areas of those plots.
  - 300 or so stars in our sample.
  - Potentials for variability: Anything at all! Periodic (5%) or not periodic across entire light curve.
    - Ecl Bins
    - Pulsators
    - Stars Spots
    - Planets
  - Known stars: a few stars that are on the bottom sequence… known in a sense. Training set we have has a few in there that are well agreed upon periodic objects. Having objects from both populations helps if we all agree.
  - Also might look into others (not just K and G dwarfs). Maybe A dwarfs that vary? Maybe they vary differently?
  - The swooping set (population) along the grey line limit is just where stars with low (or no) variability hang out due to instrumental limitations.

Let's look at some light curves.
Go to: http://nsted.ipac.caltech.edu/index.html
Click on Kepler Public Data: http://nsted.ipac.caltech.edu/applications/ETSS/Kepler_index.html
Enter star IDs into the field to get returned data…
- Note all the other things you can search for data! LOTS of ways to do searches.

Once we get through today's exercise, Ciardi will put together a list of stars for us (200 or so). Otherwise we'd never know what to

choose. Another telecon will be had to discuss which ones to choose as a group: the how and the why… This will not be in the proposal…. This will be in May some time.

By the time we get to JPL: ALL these objects on the list will be "understood" through collected notes. We can't start on this in August. We need to be done by mid-July…. 40 stars each to work through, with some overlap.

Use this star:
5513861
It will bring up 2 data lists for you to choose from.
Lots of information here to look at: temp, gravity, size, etc...
The second one has 30 days of data. Choose to make a light curve from it (LC).
Look at the light curve first. Good way to go!

You'll see a sawtooth and argyle sock pattern here. The variations look like there is a beat to them, a pattern that is consistent looking. Bet it has a period to it. That's a good guess. Time is in Julian Days, about 30 days of it. Y-axis is a flux, brightness, in a true flux which is LINEAR not log like magnitudes. Electrons per cadence. When a photon hits the CCD, it kicks an electron free which is measured as data. Cadence is 30 minutes (LONG cadence = 30 minutes; short is 1 minute) for most of our data. How many electrons are collected from this star in one single 30 minute image session.
Can change all sorts of plot info: color, duration, etc…. Can even save the image of the plot.
Can also download the raw data to play with.

NOW Click on "Compute Periodogram" button to show a power spectrum of the star's data.
This creates a plot of POWER vs PERIOD in days.
POWER:
PERIOD:

THIS IS A GORGEOUS POWER SPECTRUM!
Strong Y axis power in the hundreds is good!
Narrow spike means period is found to a high level of accuracy: SKINNY tall peaks are GOOD.
Other peaks are miniature versions of the big peak: and these are period aliases. This means one is the real period and the others are just aliases.

Go down to the table underneath the plot.
Rank: highest to lowest powered rank of the found periods. The first one has the most power but is NOT always the right period.
Period: in DAYS.
Power is an arbitrary thing.
P-value is the value that tells you the probability that this period is caused by random noise. SMALL is GOOD.
The 6th one is not so good, but the top 5 are good looking. One of the first 4 is likely to be the best choice for the real period.

Phased light curve: Can I take all this data and fold it over itself to make one big coherent and useful light curve? If it is periodic and correct, the phased LC will be clean. If not, then it will be messy! Try another period.

Click on the "Phased Light Curve" for the highest ranked period. This is a PERFECT looking light curve with a period of 0.755272 day. Is an eclipsing binary star!

Try the second, 3rd and 4th ranked periods for periodograms: they are a mess: NOT GOOD. The first one wins. DONE.

TRY THIS STAR NOW: 7198959

Light curve as a dip around 85 days with some action at the bottom: looks almost bimodal. Modulation in the amplitude throughout the long period.

Compute its periodogram. Again a nice plot!
Try plotting a phased curve for the first ranked curve and you get a nice plot. Pulsating variable RR Lyrae.
Note the big spread of the values across the period! Hmmmm….
So, it is periodic but has amplitude modulation over that period. This is the Blasco Effect, a well known RR Lyr phenomenon.

TRY THIS STAR NOW: 8005468

The data are really GREAT! Not looking very periodic here! A mess but a very cool object to look at. At best, quasi-periodic. Both the shape and amplitude are changing.

Compute its periodogram. Ugly yes! Thick spikes…. Which one is right? Any of them? All longer end period with a broad thump at the end. The broad humps at the end of the periodogram is JUNK 90% of the time.

Try the highest ranked phase plot: Ugly. Not periodic looking.

What to do? Go back to the periodogram.
Try the other ranked periods…. They are all ugly and they get worse as we go down.

We can move on… maybe! since it is not periodic…. But IT IS DOING SOMETHING! This is non or quasi-periodic.

Look at the light curve again. Let's look at the other half of the data set. There are two distinct light curve shapes here.

54964.512228
54997.983349

Go back to the periodogram.....
On the right hand side we can mess with: type of periodogram (try these later. Read up on them!)....

We can change the input parameters to make it plot a periodogram for the first half of the data set:

Select Constraint as: MJD
54964 to start
54978 for the end
AND Make period range max shorter! Try 25

Click on submit
You will get a new phase plot with a thick broad and tall peak at about 6.42 day period...
Has a period though not all that well known...
Click on the highest power rank light curve: not bad, not perfect, but more or less periodic in the 6.4 day range. Not nailed down exactly.

Now in this phased plot window enter the range for the MJD constraint range
54979.000000
54997.000000
The new high rank is 9.5 day period! Different....
It seems to have switched periods during our data collection.
What does this mean?

What is find half of all our objects are like this?? And maybe they are all 6 and 9 hour period alternations? That would be COOL!
This is why we need to go deeper into every single star.

Another star:

12253350
Look at time series: SWEET periodic Pulsating with damped pulsations

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Look at:

10958931

Pick the last data set and plot time series. More or less a period with amplitude changes....

Go look at:
6425470
Light curve is a bit messy

Compute periodogram
Messy with lots of peaks.
Phased light curve is not that good. It is a huge spread. This is NOT periodic. It is just a changing flux level.
Try the 2nd ranked plot. Could be a sine curve, sort of...
Try the 3rd ranked plot.... Not great either....

The point here: what do we say???
Not enough data.
Given what we have, we can call this a pretty constant star....
Is this instrumental perhaps??? Kepler mag is 12.72 which is bright enough.
None of our tools can help us state what is happening here with this star.

Try this one;

8191672

What a beauty!

Constant looking light curve with narrow dips.
We CAN find these.

Look at the periodogram: Whole slew of aliases (several sets!) with one highest peak at 3.54 days.

The phased light curve at 3.54 days is a lovely eclipse.... Not very deep! SO IT IS A PLANET!!!!

The eclipse not being deep in brightness, and that they are U-shaped (Not V-shaped) is very indicative of a planet.
