

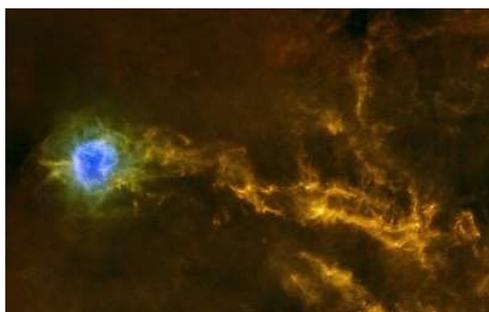
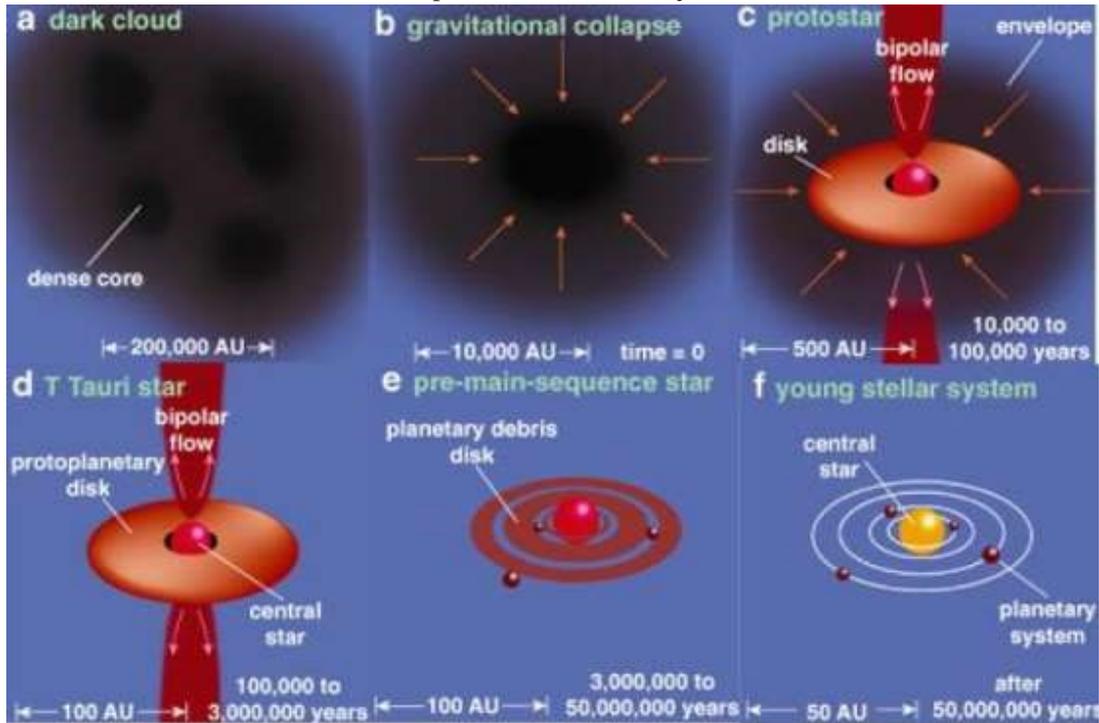
Main Event: “The Hoys-Caps Citizen Science Project: Hunting Outbursting Young Stars” by Alexander Sholtz

Aleks Sholtz is a lecturer at degree and masters level at the School of Physics and Astronomy in St. Andrews. He is also a researcher and observational astronomer working with colleagues with problems in star and planetary formation.

Aleks’ talk was about how we can help with a citizen science project which aims to find out about some of the outstanding issues of star and planet formation. This, in essence, is through simple technology which involves photographing these protostars and involves collaboration between academics and groups (mostly astronomy societies) across the UK and talking to all the astronomy societies who are interested.

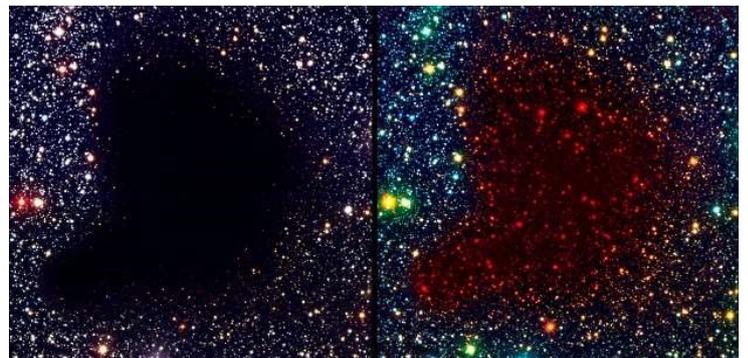
Caps is the “Centre for AstroPhysics in Planetary Science” and Hoys stands for “Hunting Outbursting Young Stars” – this is the science bit.

Star formation starts with a dark cloud of mostly hydrogen and 1% dust, the cloud collapses (notice this cloud is spherical in the diagram) and in the centre a small dense and compact which eventually becomes a star.



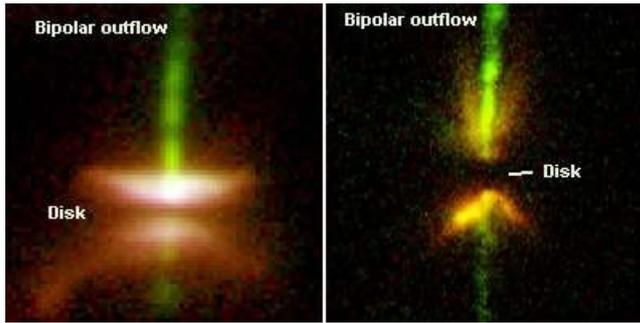
In real life, there are molecular clouds of different shapes, the one to the left is the Cocoon Nebula photographed by the infrared telescope, Herschel, which allows us to see protostars and the gas from which they are born. Here we can see a blob and an elongated structure; they are more beautiful and complicated in real life.

Barnard 68 (right) is a dark nebula and looks like a dark cloud because the dust within hides the stars behind but when viewed in infrared, we can see the light from those stars coming through. The dust dims and reddens starlight as blue light is scattered away so starlight changes colour as it passes through dust and the way it changes colour tells us something about the dust. Planets, of course, grow through colliding dust particles.



Returning to the star formation picture above, it shows material raining down onto the protostar from an accretion disc and it's within the accretion disc that planets form which is why planets tend to be in the same plane.

How protostars gain mass and how planets form are some of the most fundamental problems.

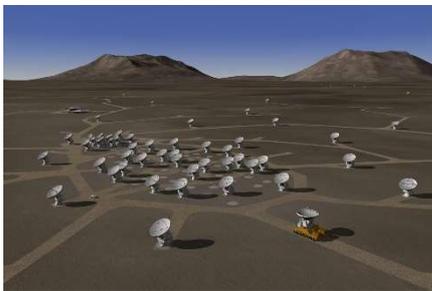


When protostars gain mass by being fed by the disc, they will eject matter in the form of bipolar outflows (green). In the picture below it can be seen that the outflows are lumpy and it seems that the process of growth is in bursts.

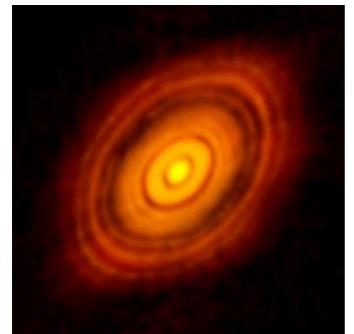


We want to be able to see this in action so by observing protostars we can see when material falls onto the protostar because they brighten. A model of star formation suggests that they should grow in bursts, e.g. 1000 years of growth and then perhaps 10,000 years of nothing.

The question is, do all stars grow in bursts? If so this could cause a problem with planet formation and suggests they need to form between bursts or perhaps after the protostar has stopped growing. In addition, how long do the bursts last and how often do they occur?



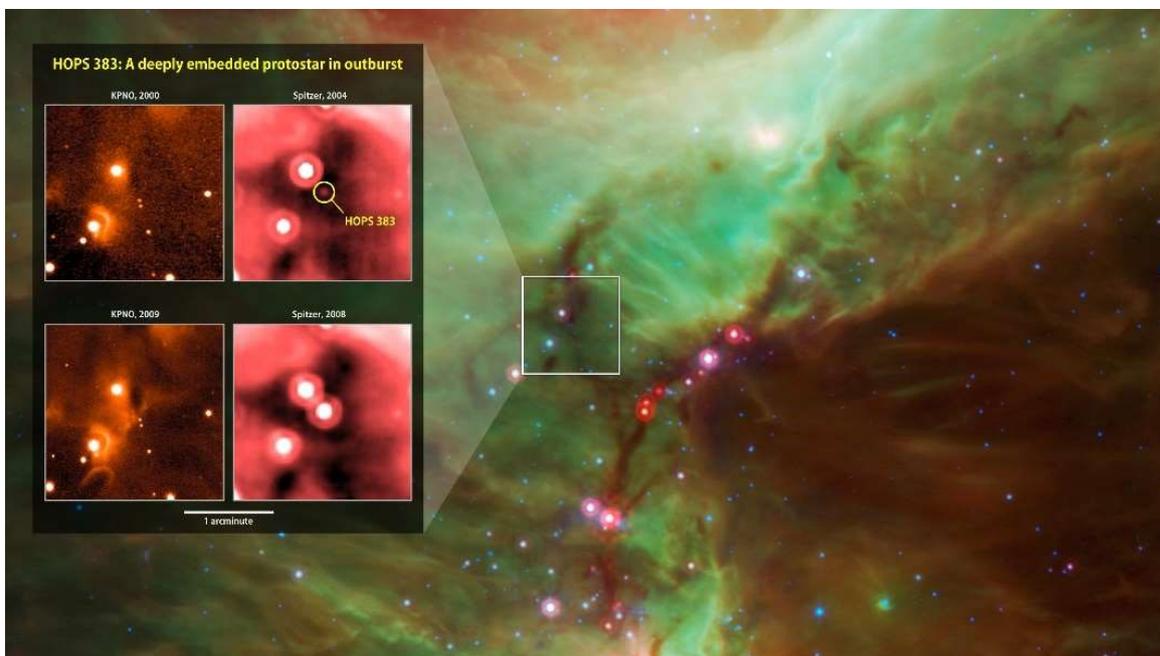
ALMA, an interferometer telescope (left), is able to image an accretion disc (right) showing dark lanes where it is thought planets might be forming. Unfortunately, it is not possible to get the resolution required to resolve dark lanes where a planet in the position of Earth might lie. The best that can be achieved is a resolution of a distance between the Sun and Jupiter.



The size of the Moon in the sky is half a degree and corresponds to seeing the separation of car head lights at a few kilometres. With the best interferometry techniques car lights could be resolved at 12,000 km but that only gives us the Jupiter – Sun distance within an accretion disc. However, by waiting until something, like the accretion disc to pass in front of the star (to eclipse it), can attain a resolution that would allow the detection of planets at the distance of Earth from the Sun and is comparable to seeing car lights on Mars. The star should dim and it's this dimming that tells us about the properties, colours and size of the disc.

Basically, it's all about monitoring young stars, waiting for something to happen; perhaps a burst episode or an eclipse by the accretion disc. The technical term for this monitoring is 'long term, high cadence multi-wavelength optical monitoring'. St Andrew's use the 37" James Gregory Telescope, the largest operational telescope in Scotland for their observations.

It is important to monitor the young stars in multiple places because of the weather so if it is cloudy in one place it might be clear elsewhere allowing someone to observe. It is then possible to generate large numbers of observations through photography, taking numerous pictures of these stars over periods of time.



HOPS 383 in Orion shows a protostar in outburst. Main image by Spitzer, inset from an infrared telescope, Kitt Peak

Aleks showed us a number of diagrams, which I cannot find on the Internet, but one showed a number of variable stars identified by the project as young variable stars – these show outbursts which is similar to the picture above of HOPS 383 – and the idea is to monitor these to try to catch them producing bursts.

Another diagram showed the graph of an eclipse of a star which gets dimmer but the colour doesn't become redder as might be expected if this was due to dust from a disc around the star and thus suggests the material in the disc could be pebbles or larger which might indicate a planet forming.

A further diagram showed a variable young star with a regular period and from this it is possible to work out the size of the object doing the eclipsing and then to map planet forming discs. In fact, a lot of the results finds unrelated but very interesting information.

To participate, a target is selected from a choice of targets, the stars are observed and photographed and the data submitted. Once the data is in, if you are a contributor, your name will appear on a scientific paper!

Thank you, Aleks, for a well explained and fascinating insight into the formation of stars and telling us about the Hoys-Caps citizen science project, the results from which may help to answer those fundamental questions about star and planet formation.