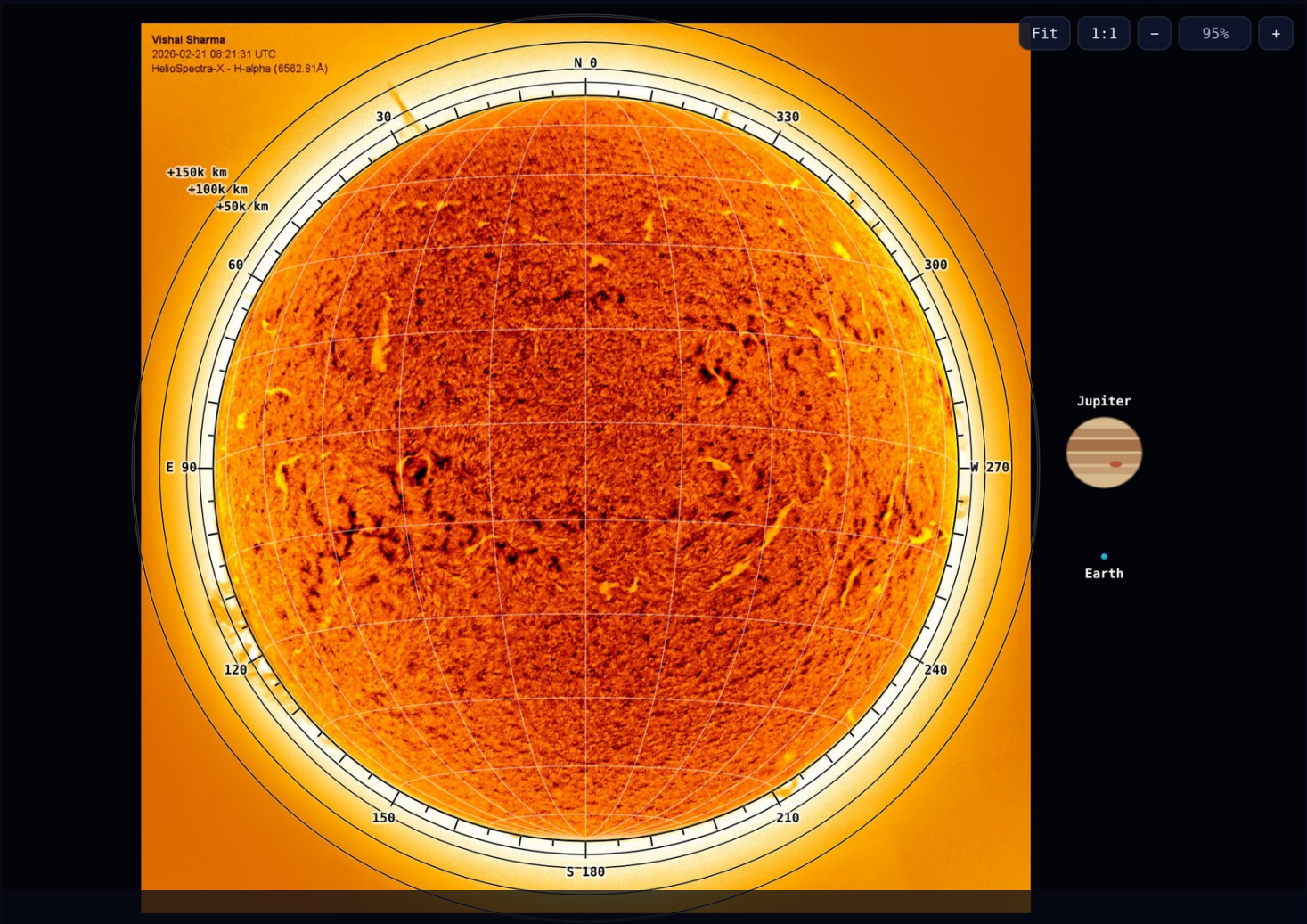


STARDUST ASTRONOMY

Solar Lab

A step-by-step guide to measuring your own Sun images

Every tool, what it shows and how to read it — written for beginners.
For H-alpha, Calcium and white-light images taken with your own telescope.
Vishal Sharma · stardustastronomy.com/solar-lab · November 2026

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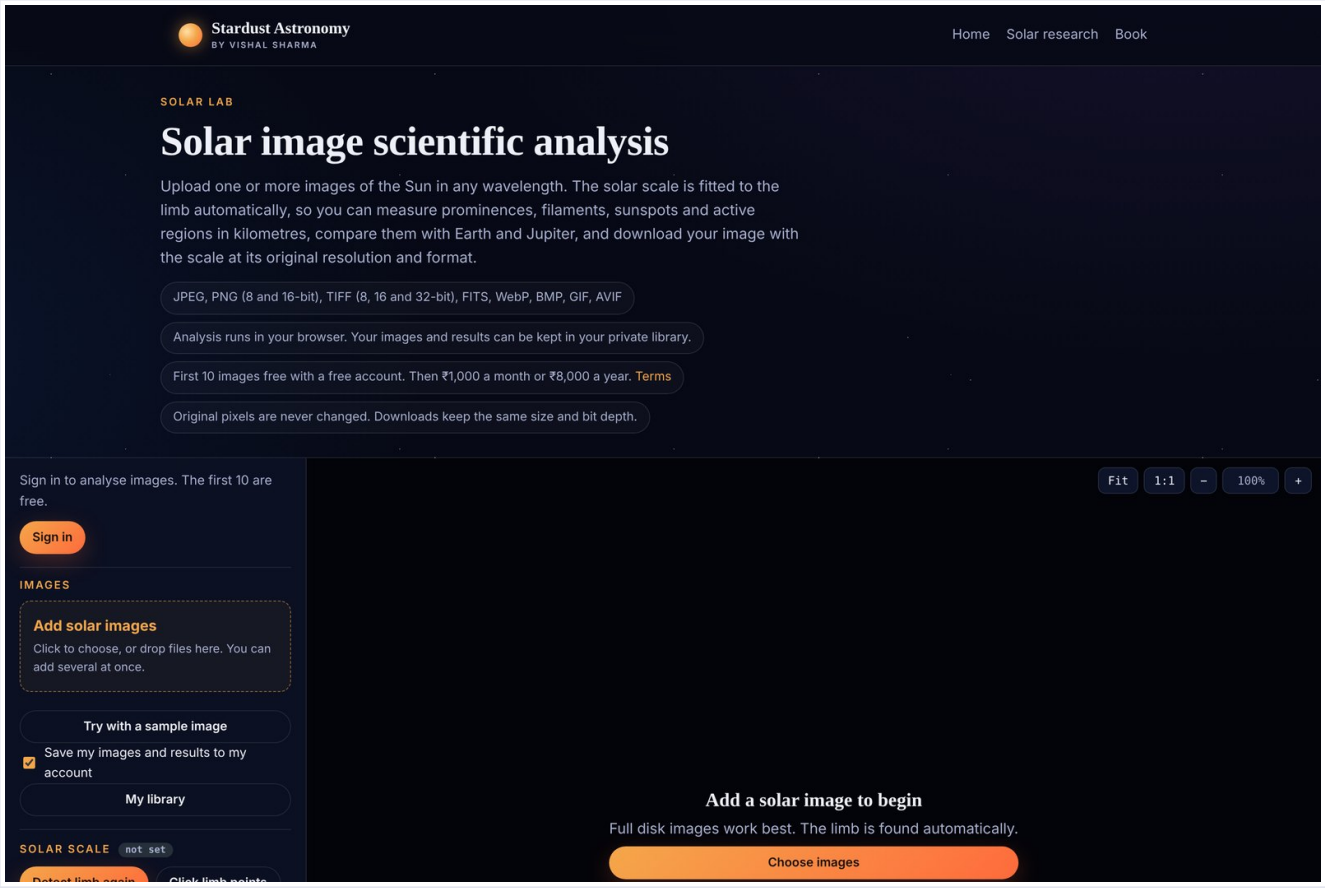
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1. What the Solar Lab is

The Solar Lab is a free tool on **stardustastronomy.com/solar-lab** that turns a photo of the Sun you took with your own telescope into a **measured, scientific image**. You add your picture and the Lab:

- finds the edge of the Sun (the **limb**) by itself, and from it works out how many kilometres one pixel of your picture covers;
- draws an accurate scale on top: the limb, compass directions around the Sun, height rings above the edge and a latitude–longitude grid on the disk;
- finds the **prominences** (glowing clouds standing above the edge) and measures how tall and wide they are;
- finds **dark and bright features** on the disk — filaments, sunspots and bright plage — and measures their true size;
- lets you measure anything yourself in kilometres — length, width, height and area — and put **Earth and Jupiter** beside a feature at exactly the right size;
- gives you graphs, specially processed scientific images and downloads, all at the full resolution of your original file.

Your picture itself is never changed. The scale is drawn on a copy, and downloads keep the same width, height, format and bit depth as your file.



The Solar Lab page. Left: the tool panel. Middle: your image with the scale drawn on it. Below: results in four tabs.

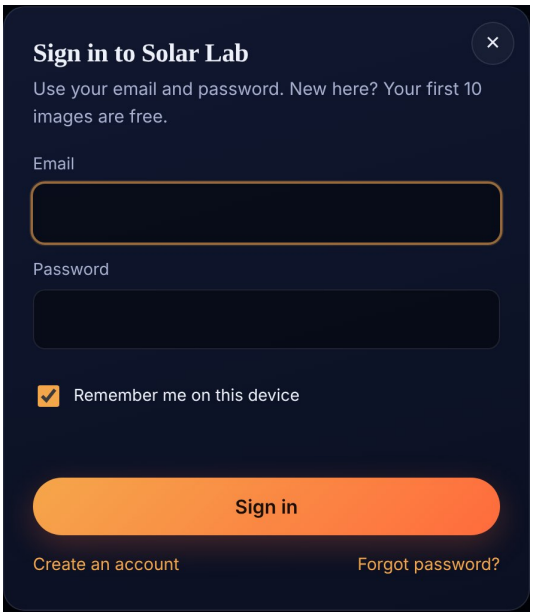
> **Good to know:** All the analysis runs inside your web browser on your own computer or phone, so it is fast and works with very large files (16-bit TIFF and FITS included).

What you need

- A picture of the Sun: the whole disk, or a part of it with some of the edge visible. H-alpha, Calcium H/K, white light, spectroheliograph images — colour or black and white.
- Any common format: JPEG, PNG (8 or 16-bit), TIFF (8, 16 or 32-bit, compressed or not), FITS, WebP, BMP, GIF or AVIF.
- The date and time the picture was taken, in your own local time (for example IST), and the place. The Lab suggests the time from the camera data; you confirm or correct it.
- A free account (email and password). Each email address may analyse 10 different images free. After that a subscription is needed.

2. Getting started: your account

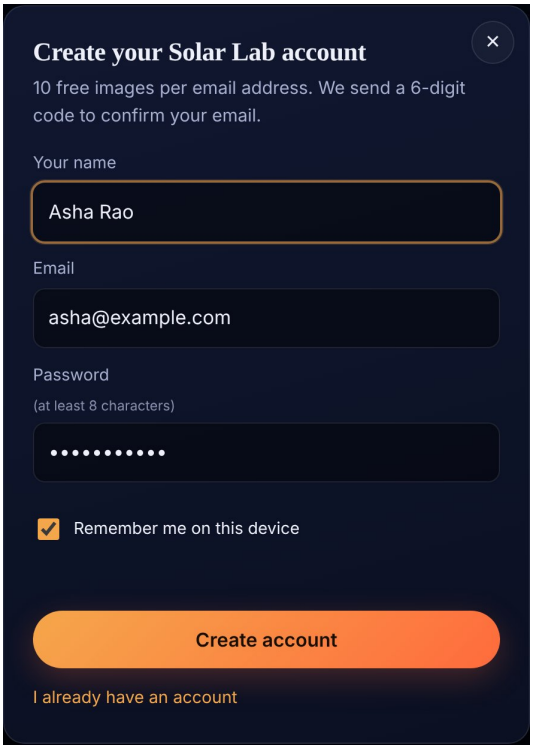
Step 1 — Sign in or create an account



Click **Sign in** at the top of the tool panel, or simply click **Add solar images** — the sign-in window opens by itself.

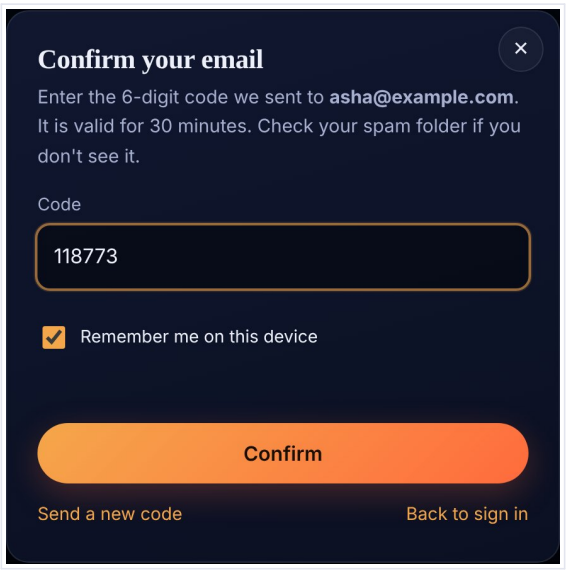
- **Email** and **Password**: your login.
- **Remember me on this device**: keeps you signed in for 30 days, so next time you go straight in. Your browser may also offer to save the password.
- **Create an account**: for first-time users.
- **Forgot password?** sends a 6-digit code to your email so you can set a new password.

Step 2 — Create an account and confirm your email



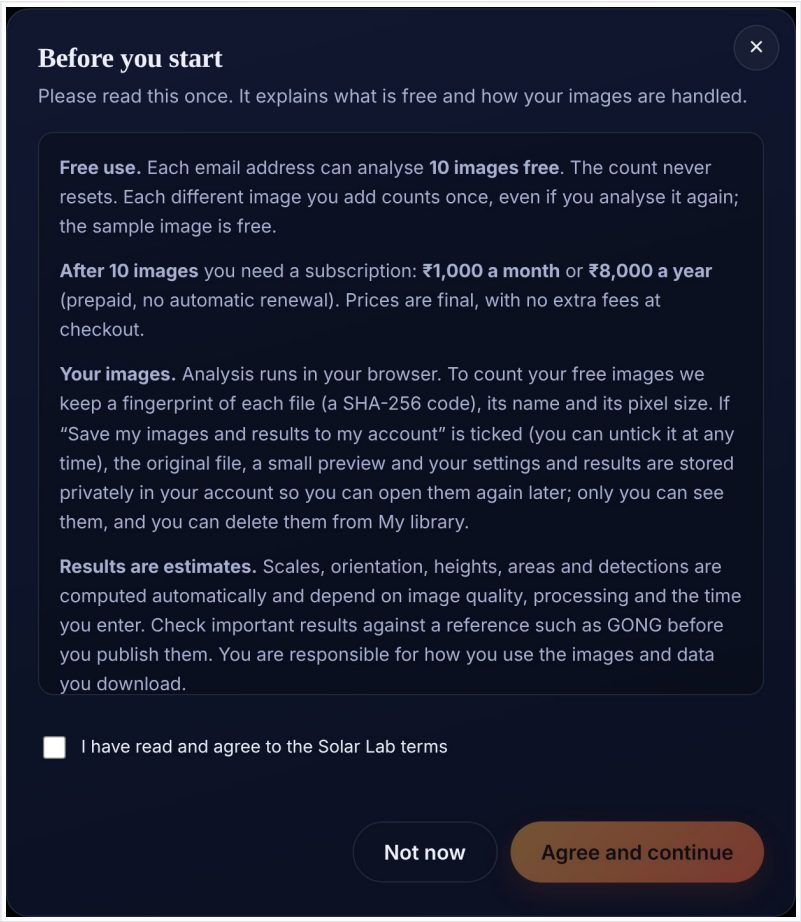
Type your name, email and a password of at least 8 characters, then press **Create account**.

A 6-digit code is emailed to you (check your spam folder if you do not see it within a minute). Type it in the next window and press **Confirm**. You are now signed in.



The code window. “Send a new code” emails a fresh code if the first one did not arrive.

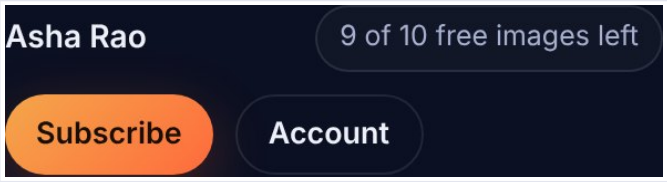
Step 3 — Read and accept the terms (once)



Shown before your first image. Tick “I have read and agree” and press “Agree and continue”.

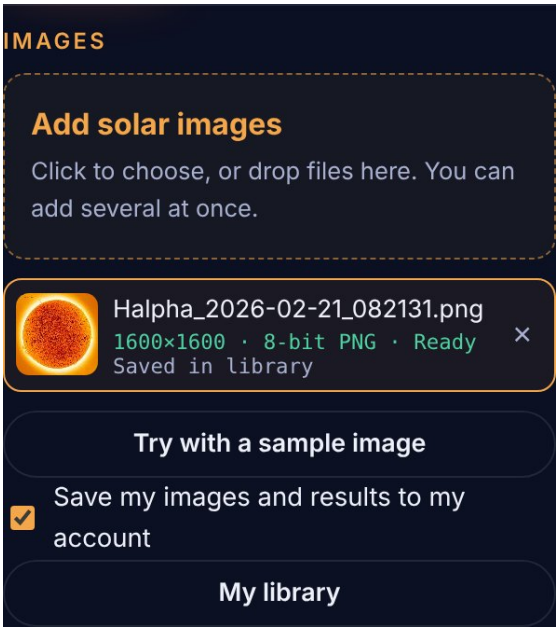
The terms explain, in plain words: the 10 free images, the prices after that (₹1,000 a month or ₹8,000 a year), how your images are stored, that all results are careful estimates, and the cancellation rule.

The account bar



Top of the tool panel: your name, how many free images are left (or your plan), and the Subscribe and Account buttons.

3. Adding images



Add solar images

Click the box and pick one or several files, or drag files from your computer onto the box or onto the big image area.

The image list

Each image appears as a small card: name, size in pixels, bit depth, format and its status — Reading, Finding limb, Analysing, then **Ready**. Click a card to show that image and its results. The × removes it from the page (it does not delete your file).

Try with a sample image

Loads one of Vishal's H-alpha images so you can explore every tool. It does not use up a free image.

Save my images and results to my account

When ticked, each image is also kept privately in **My library** together with your settings, measurements and results, so you can open it again any time from any device (chapter 12).

My library

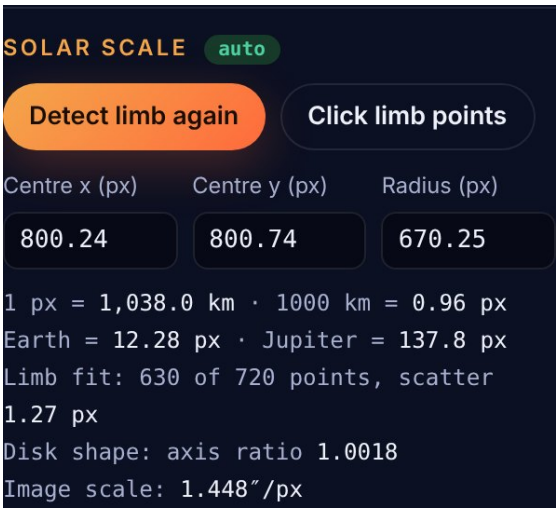
Opens the list of your saved images.

Good to know: Every image is analysed on its own. When an upload finishes, the Lab switches to it, and the results below always belong to the image named at the top of the Scientific data tab. Nothing is mixed between images.

Tip: You can add many images at once — for example the best frames of a session — and then use the Compare tab to pick the sharpest.

4. The solar scale: how the Lab knows the size of the Sun

Everything in kilometres starts from one fact: the Sun's radius is **695,700 km** (the international standard value). When the Lab knows how many pixels the Sun's radius is in your picture, it knows how many km each pixel covers. That is why finding the edge accurately matters so much.



auto / fitted / manual

The small label tells you how the edge was found: **auto** (by the Lab), **fitted** (from points you clicked) or **manual** (numbers you typed).

Detect limb again

Runs the automatic edge finder again (for example after you changed something).

Click limb points

For difficult images: click 8 to 12 points spread around the edge of the Sun; a circle is fitted through them. Press the button again to finish.

Centre x, Centre y, Radius

The fitted circle in pixels. You may type exact values if you know them.

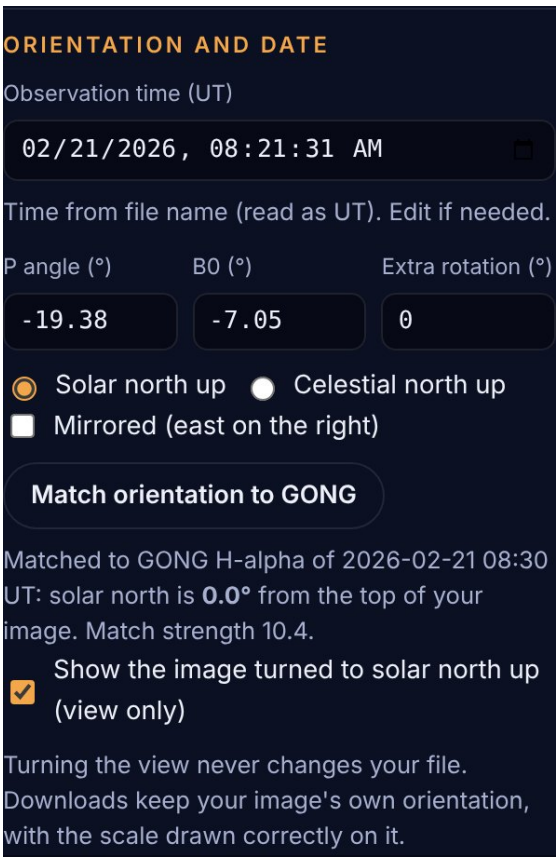
What the numbers under the boxes mean

Line	Meaning	Example
1 px = … km	Kilometres on the Sun covered by one pixel of your picture.	1 px = 1,038 km
1000 km = … px	The same, the other way round.	0.96 px
Earth = … px, Jupiter = … px	How big Earth and Jupiter are in your picture, in pixels across.	Earth 12.3 px
Limb fit: n points, scatter	How many edge points were used and how closely they sit on the circle. A scatter below about 1–2 px is very good.	scatter 1.27 px
Disk shape: axis ratio	Round disk = 1.000. Above 1.01 means the image is stretched (e.g. a spectroheliograph scan speed or tilt problem).	1.0018
Image scale ″/px	Arcseconds of sky per pixel, from the date. Useful for comparing telescopes and cameras.	1.448″/px

The edge finder handles dark, bright, grey and coloured backgrounds, inverted images, a Sun cut off by the frame and partial or annular eclipses (the Moon's edge is recognised and ignored). If only part of the edge is visible, a warning tells you the scale is less certain.

5. Orientation and date: which way is solar north?

To give positions on the Sun (latitude, longitude, compass directions) the Lab must know which way the Sun's north pole points in your picture. This depends on your telescope, camera and processing, and on the date.



Date and time the image was taken

Required. Filled from the camera data when the file has it; check it, correct it if needed (your local time), then press Confirm date and time. Nothing runs before you confirm.

Latitude and longitude

Filled from your phone’s location (allow it when asked) or typed by hand for the place of capture. The Lab shows how high the Sun was.

P angle

How far the Sun's north pole is tilted from celestial north, as seen from Earth on that date (between −26° and +26°).

B0

How much the Sun's north pole is tipped towards (+) or away from (−) us (between −7.25° and +7.25°). It shifts the latitude lines.

Extra rotation

Any further turn of your image, in degrees.

Solar north up / Celestial north up

Choose “Solar north up” for processed images that already have solar north at the top; “Celestial north up” for raw frames — then the P angle is applied for you.

Mirrored

Tick if east is on the right (diagonals and some spectroheliographs mirror the image).

Match orientation to GONG

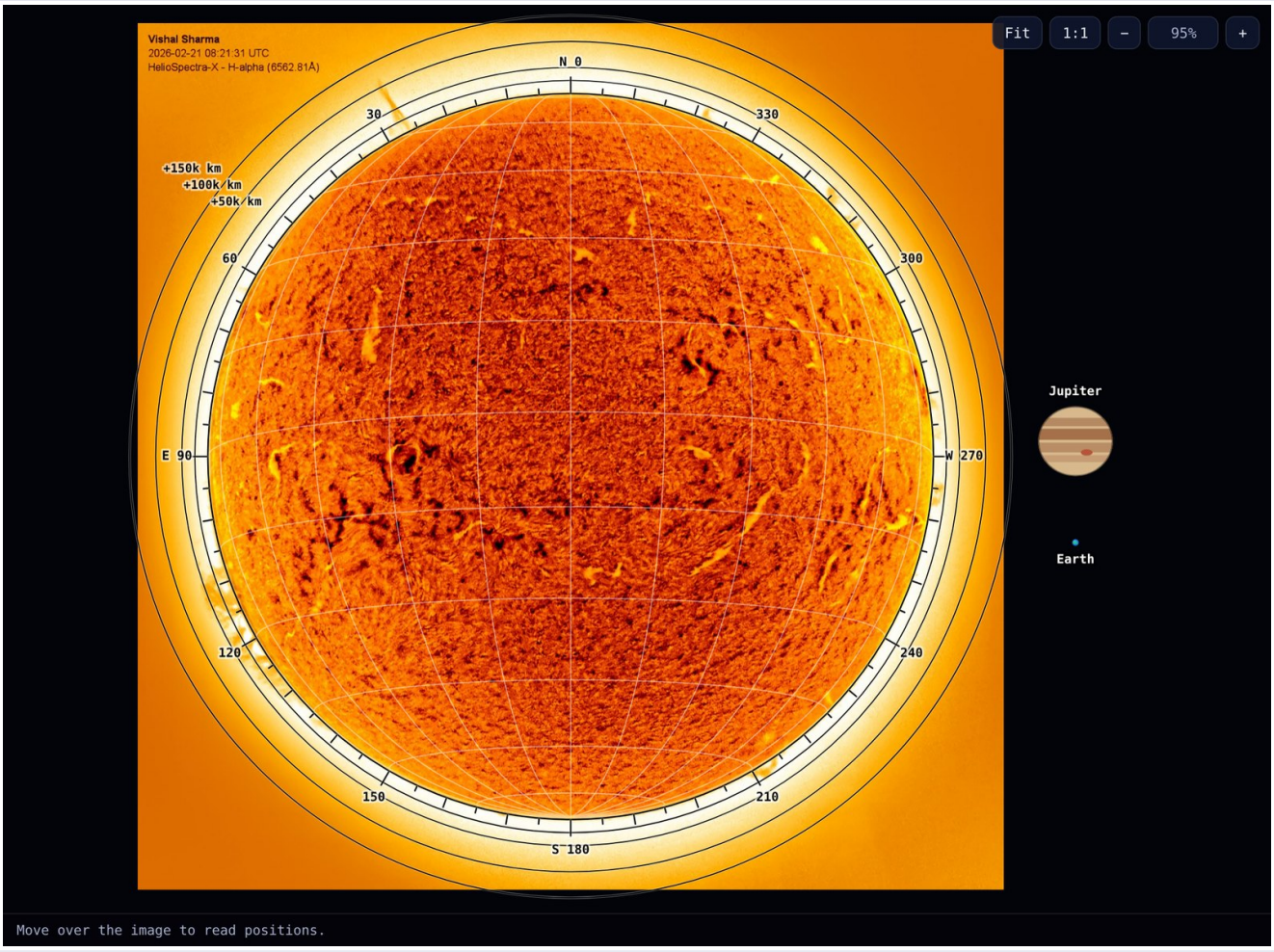
Runs after you confirm the time. Compares your image with the full GONG H-alpha images (with prominences) of each station near that time and uses the clearest match (strength 2+). Or set it by hand with the arrow, turn and flip buttons.

Turn my image to solar north up

On by default: after a match, your image is shown and downloaded turned like GONG (north up, east left), in a larger frame so all rings and labels fit.

Good to know: GONG is a worldwide network of solar telescopes run by the US National Solar Observatory. Its full-disk H-alpha images are taken every minute and are the usual reference for orientation.

6. Your image with the scale: what every line means



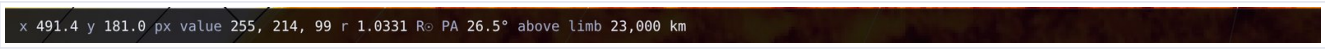
An H-alpha image with the scale drawn by the Lab. Earth and Jupiter wait beside the image (they only go into downloads when you drag them onto it).

On the image	What it is	How to read it
Limb circle	The fitted edge of the Sun.	It should sit exactly on the edge all the way round.
Position-angle ticks and numbers (N 0, E 90, S 180, W 270, 30, 60…)	Directions around the Sun, measured from solar north (0°) through east (90°).	A prominence “at PA 30” is 30° from north towards east. Long ticks every 30°, medium every 10°, short every 5°.
Height rings	Circles 25,000, 50,000, 100,000 and 150,000 km above the edge.	Read a prominence's height by the ring its top reaches.
Height values (+50k km…)	The labels of the rings, stacked in an empty part of the sky.	+50k km = 50,000 km above the surface.
Latitude–longitude grid	Lines every 15° on the Sun, tilted by B0 and turned by the P angle.	Gives the position of a sunspot or filament on the Sun.
Earth and Jupiter	Both planets at exactly the right size for this image.	See chapter 8.
Measurements (green)	Your own measurements with their labels.	See chapter 7.

Moving around the image

- **Drag** to move; **scroll the mouse wheel** or **pinch** to zoom.
- **Fit** shows the whole image; **1:1** shows real pixels; **−** and **+** zoom out and in; the percentage shows the zoom.

The reading bar under the image



Move the pointer over the image to read the exact position under it.

Item	Meaning
x, y px	Pixel position in your file.
value	The original pixel values (red, green, blue, or one value for black-and-white), unchanged.
r R☉	Distance from the Sun's centre in solar radii: 1.0000 is the edge, 1.05 is 5% above it.
PA	Position angle of that point.
S8.2° E29.9°	On the disk: solar latitude (N/S) and longitude east or west of the centre line.
μ	On the disk: 1 at the centre, 0 at the edge (how face-on you see that spot).
above limb … km	Off the disk: height above the edge.
segment … km	While measuring: the length of the line you are drawing.

7. Measuring things yourself

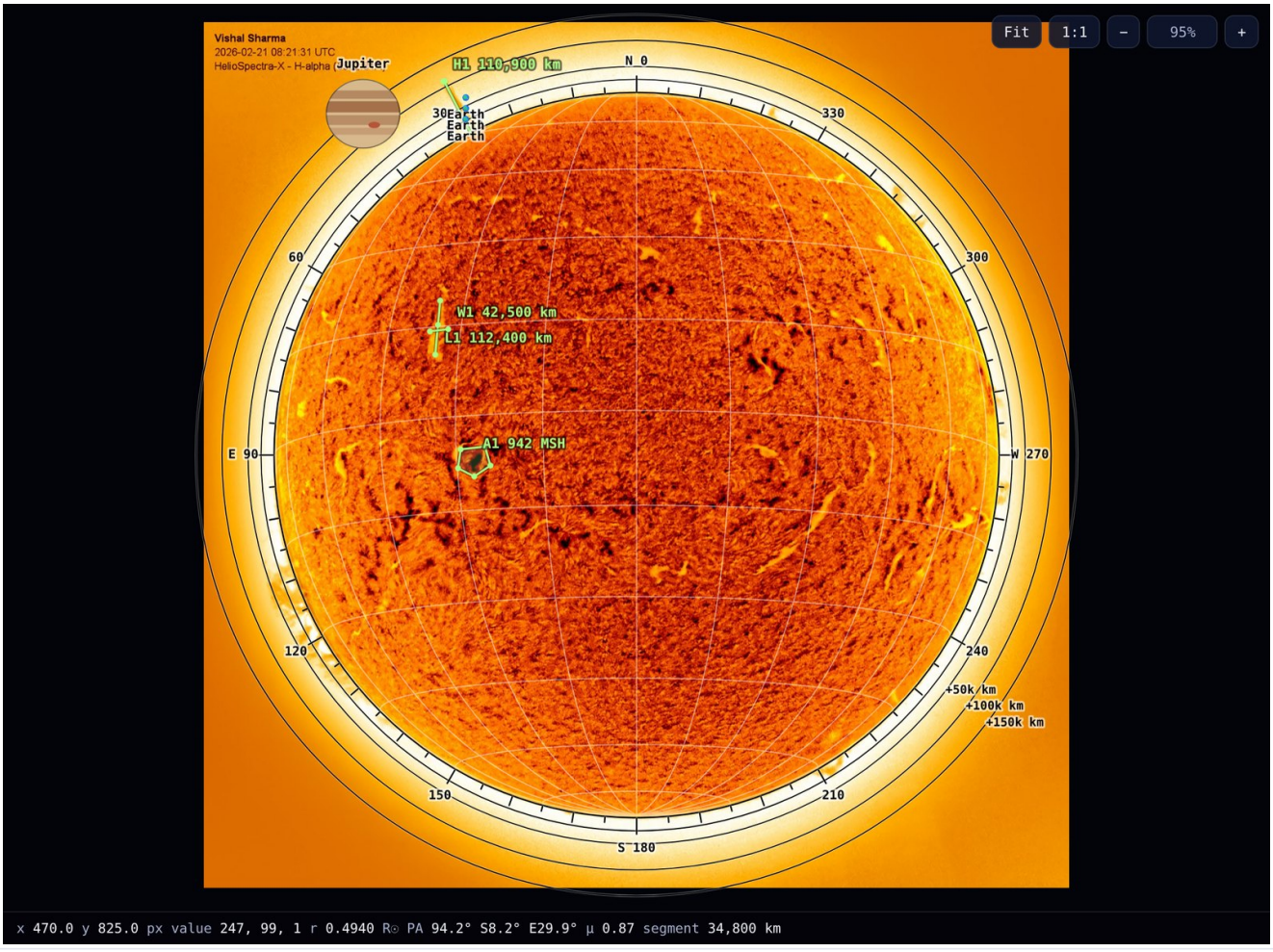


The five tool buttons

- **Pan** — normal mode: move the image, drag Earth and Jupiter.
- **Length** — click along a feature (a filament can be curved: click several points). Double-click, press Enter or Finish to end.
- **Width** — click the two edges of a feature.
- **Height** — click the top of a prominence; the height is measured straight out from the edge.
- **Area** — click around a sunspot or region, then Finish.

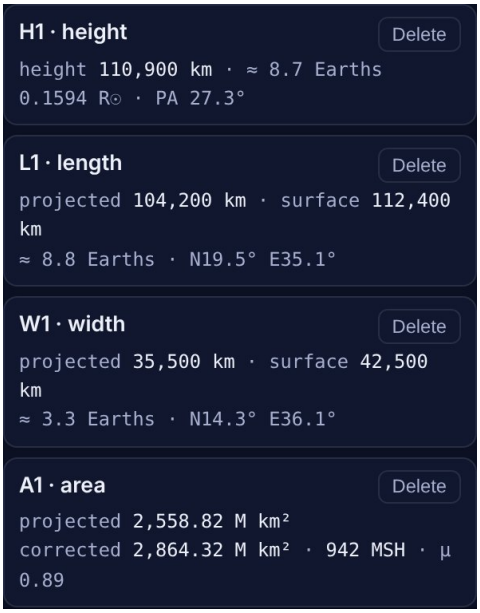
Finish, Undo, Clear

Finish ends a Length or Area; Undo removes the last point (or the last measurement); Clear removes all measurements of this image.



Examples: H1 = height of the tall north-east prominence (110,900 km); L1 = length of a filament (112,400 km); W1 = its width; A1 = area of a region (942 MSH). Earths and Jupiter placed beside the prominence for comparison.

How to read your measurement list



- **projected**: the length as it looks in the image.
- **surface**: on the disk, the true length along the curved surface of the Sun (features near the edge are foreshortened, so this is longer).
- **≈ Earths**: how many Earths would fit along it.
- **height**, **R☉** and **PA**: height above the edge in km and in solar radii, and the direction.
- **MSH** (millionths of the solar hemisphere): the true area, corrected for viewing angle — the standard unit used by observatories for sunspots.

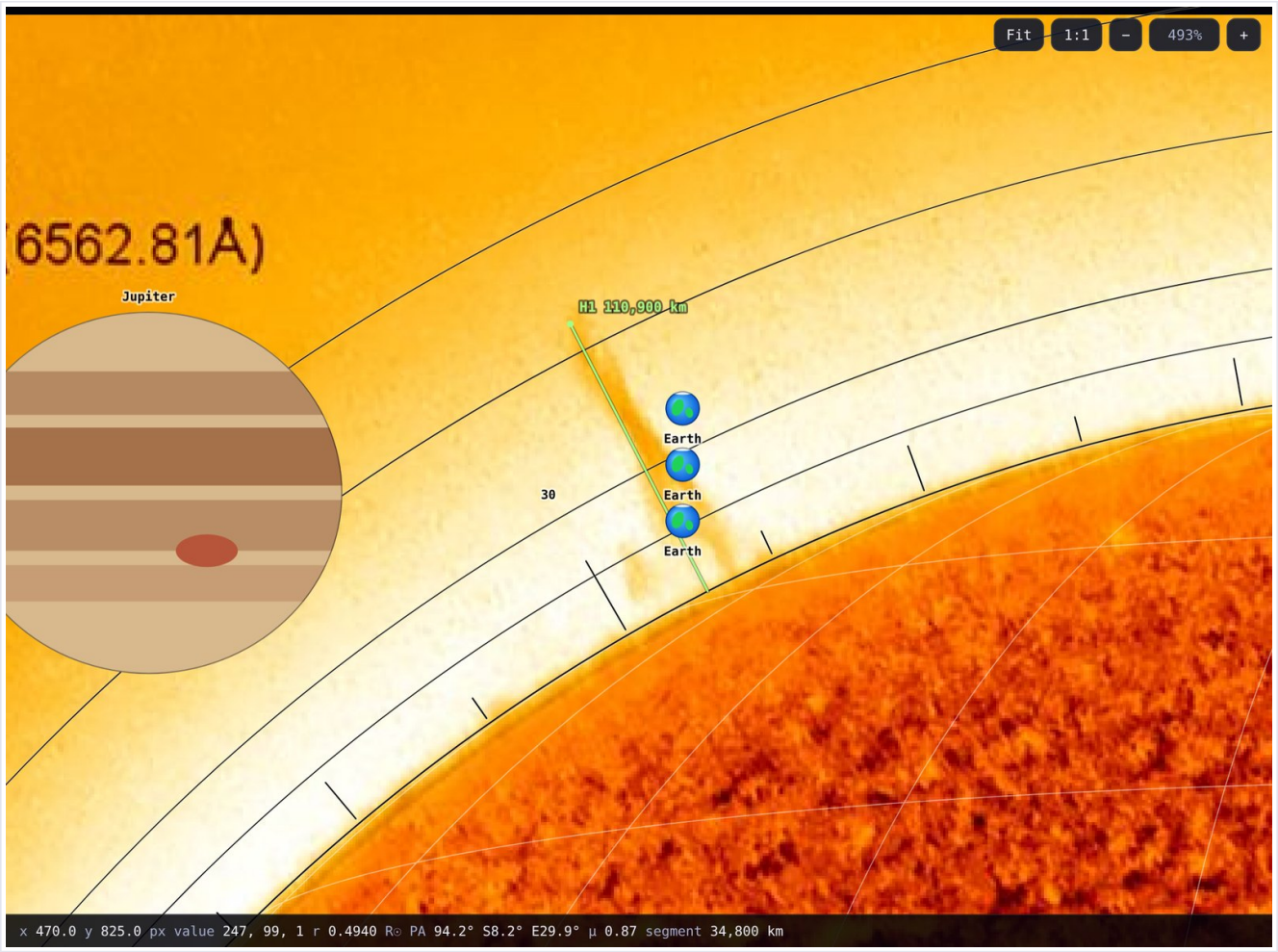
Each measurement has a Delete button. Measurements are drawn into the downloads and saved in My library.

Tip: Zoom in (scroll wheel) before clicking the ends of a small feature: the more you zoom, the more precise your clicks.

8. Earth and Jupiter at true size

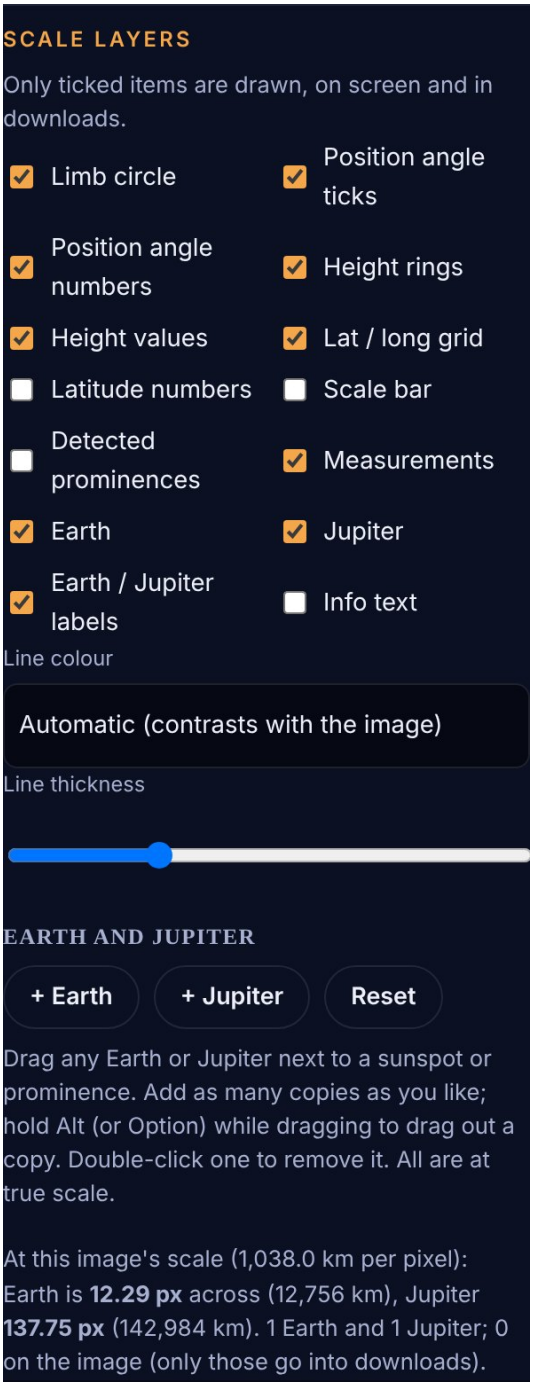
Earth (12,756 km across at the equator) and Jupiter (142,984 km) are drawn from the same km-per-pixel as the Sun in **this** image, so their size is exact for every picture you add. Jupiter is drawn slightly flattened, as it really is (its poles are 6.5% closer together). The tool panel shows their sizes in pixels for your image.

1. They start **just outside the right edge of your image**, so they are not in your downloads unless you want them.
2. Make sure **Pan** is selected, then **drag** Earth or Jupiter onto the image and drop it next to a prominence, sunspot or filament.
3. For more copies press **+ Earth** or **+ Jupiter** (Scale layers → Earth and Jupiter). Each press adds one more beside the last. Or hold **Alt** (Option on a Mac) while dragging an Earth or Jupiter to pull out a copy.
4. **Double-click** a copy to remove it. **Reset** puts back the original pair outside the image.
5. Only the copies that are on the image go into downloads, exactly where you put them.



Three Earths stacked beside the 110,900 km prominence, with Jupiter for comparison: about 9 Earths tall.

9. Scale layers and downloads



Every item of the scale can be switched on or off. Only ticked items are drawn — on screen and in downloads.

- Limb circle, Position angle ticks, Position angle numbers
- Height rings, Height values
- Lat / long grid, Latitude numbers
- Scale bar (a kilometre bar; off by default)
- Detected prominences (marks and labels P1, P2…)
- Measurements
- Earth, Jupiter, and their labels
- Info text (scale, time, P and B0 in a corner; off by default)

Line colour

Automatic picks black on bright backgrounds and white on dark ones. Or choose white, light grey, dark grey, black, cyan or yellow.

Line thickness

Drag to make the lines thinner or bolder.

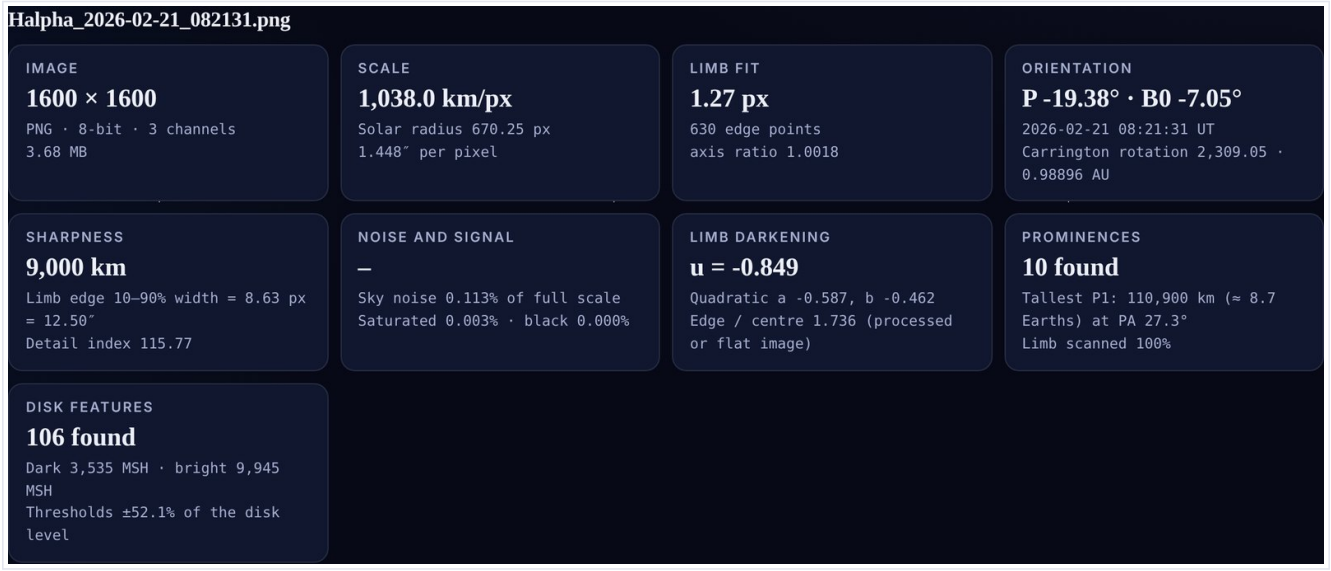
Download this image



- **Image with scale**: your picture with the ticked scale items drawn on it — same format, same width and height, same bit depth.
- **Transparent overlay PNG**: only the scale, on a transparent background, to lay over your image in any editor.
- **Data CSV**: all numbers in a spreadsheet file.
- **Report JSON**: all numbers in a structured file for programs.
- The **Compare** tab also has one ZIP with everything for all images.

> **Good to know:** JPEG is saved at the highest quality. Formats a browser cannot write (GIF, AVIF, HEIC) are saved as lossless PNG at the same size.

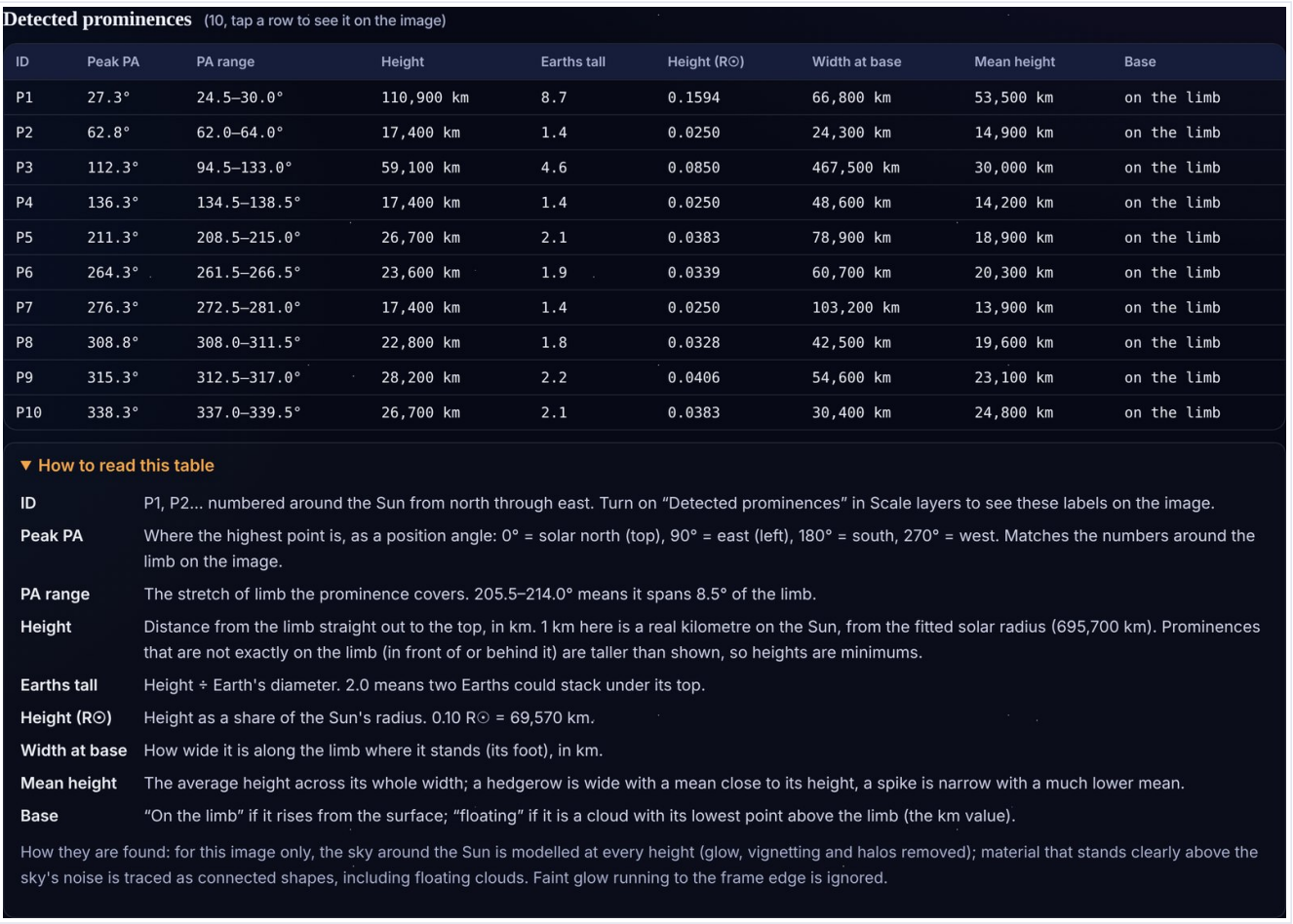
10. Results: the Scientific data tab



Summary cards at the top of the Scientific data tab.

Card	What it tells you
Image	Size, format, bit depth of your file.
Scale	km per pixel and arcseconds per pixel.
Limb fit	How well the edge was found (scatter in pixels).
Orientation	Time, P angle, B0, Carrington rotation number and the Sun–Earth distance on that date.
Sharpness	How sharp the disk is, and the width of the edge in km (10%–90% brightness). Smaller edge width = better seeing and focus.
Noise and signal	Noise in the sky, signal-to-noise ratio, how many pixels are saturated (pure white) or pure black.
Limb darkening	How much darker the edge is than the centre (coefficient u). Real images ≈ 0.5–0.8 in white light; very low values mean the image was flattened in processing.
Prominences	How many were found and the tallest one.
Disk features	How many dark and bright features, with their total area in MSH.

Detected prominences table



Detected prominences (10, tap a row to see it on the image)

ID	Peak PA	PA range	Height	Earths tall	Height (R⊙)	Width at base	Mean height	Base
P1	27.3°	24.5–30.0°	110,900 km	8.7	0.1594	66,800 km	53,500 km	on the limb
P2	62.8°	62.0–64.0°	17,400 km	1.4	0.0250	24,300 km	14,900 km	on the limb
P3	112.3°	94.5–133.0°	59,100 km	4.6	0.0850	467,500 km	30,000 km	on the limb
P4	136.3°	134.5–138.5°	17,400 km	1.4	0.0250	48,600 km	14,200 km	on the limb
P5	211.3°	208.5–215.0°	26,700 km	2.1	0.0383	78,900 km	18,900 km	on the limb
P6	264.3°	261.5–266.5°	23,600 km	1.9	0.0339	60,700 km	20,300 km	on the limb
P7	276.3°	272.5–281.0°	17,400 km	1.4	0.0250	103,200 km	13,900 km	on the limb
P8	308.8°	308.0–311.5°	22,800 km	1.8	0.0328	42,500 km	19,600 km	on the limb
P9	315.3°	312.5–317.0°	28,200 km	2.2	0.0406	54,600 km	23,100 km	on the limb
P10	338.3°	337.0–339.5°	26,700 km	2.1	0.0383	30,400 km	24,800 km	on the limb

▼ How to read this table

ID	P1, P2… numbered around the Sun from north through east. Turn on “Detected prominences” in Scale layers to see these labels on the image.
Peak PA	Where the highest point is, as a position angle: 0° = solar north (top), 90° = east (left), 180° = south, 270° = west. Matches the numbers around the limb on the image.
PA range	The stretch of limb the prominence covers. 205.5–214.0° means it spans 8.5° of the limb.
Height	Distance from the limb straight out to the top, in km. 1 km here is a real kilometre on the Sun, from the fitted solar radius (695,700 km). Prominences that are not exactly on the limb (in front of or behind it) are taller than shown, so heights are minimums.
Earths tall	Height ÷ Earth's diameter. 2.0 means two Earths could stack under its top.
Height (R⊙)	Height as a share of the Sun's radius. 0.10 R⊙ = 69,570 km.
Width at base	How wide it is along the limb where it stands (its foot), in km.
Mean height	The average height across its whole width; a hedgerow is wide with a mean close to its height, a spike is narrow with a much lower mean.
Base	“On the limb” if it rises from the surface; “floating” if it is a cloud with its lowest point above the limb (the km value).

How they are found: for this image only, the sky around the Sun is modelled at every height (glow, vignetting and halos removed); material that stands clearly above the sky's noise is traced as connected shapes, including floating clouds. Faint glow running to the frame edge is ignored.

Tap any row to jump to that prominence on the image. “How to read this table” opens the explanation shown here.

Column	Meaning	How to read it
ID	P1, P2… numbered around the Sun from north through east.	Tick “Detected prominences” in Scale layers to see the labels on the image.
Peak PA	Direction of the highest point (0° north, 90° east, 180° south, 270° west).	Matches the numbers around the edge of the image.
PA range	The stretch of the edge it covers.	205.5–214.0° = it spans 8.5° of the limb.
Height	Distance from the edge straight out to the top, in km.	A minimum: a prominence slightly in front of or behind the edge is really taller.
Earths tall	Height ÷ Earth's diameter (12,742 km).	9.3 = nine Earths stacked would reach its top.
Height (R☉)	Height as a share of the Sun's radius.	0.10 R☉ = 69,570 km.
Width at base	How wide its foot is along the edge.	Narrow foot + tall = spike or jet; wide foot = hedgerow.
Mean height	Average height across its whole width.	Close to the height → hedgerow; much lower → spike.
Base	“on the limb” or “floating, X km up”.	Floating clouds are detached from the surface.

How they are found: for this image only, the sky around the Sun is modelled at every height (glow, vignetting and bright halos are removed). Anything standing clearly above the sky's noise is traced as a connected shape, including floating clouds. Faint glow running to the image

edge is ignored. In tests with five known prominences — a spike, an arch, a 40° hedgerow, a floating cloud and a small one — heights came out within 1%.

Disk features table



Dark features (D) and bright features (B), largest first. Every feature found is listed; scroll inside the table to see them all. Tap a row to see it on the image.

Column	Meaning	How to read it
ID	D = dark, B = bright, numbered from the largest.	
Type	Filament: long and thin (length > 3 × width). Sunspot: very dark core (> 45% darker). Dark spot: darker patch without a deep core. Bright region (plage): brighter areas around active regions.	In H-alpha, filaments are prominences seen from above against the disk.
Position	Latitude N/S and longitude E/W of the centre line.	S16.8° W70.7° = 16.8° south, 70.7° towards the west edge.
μ	1 at disk centre, 0 at the edge.	Below 0.2 (marked *) the area is uncertain.

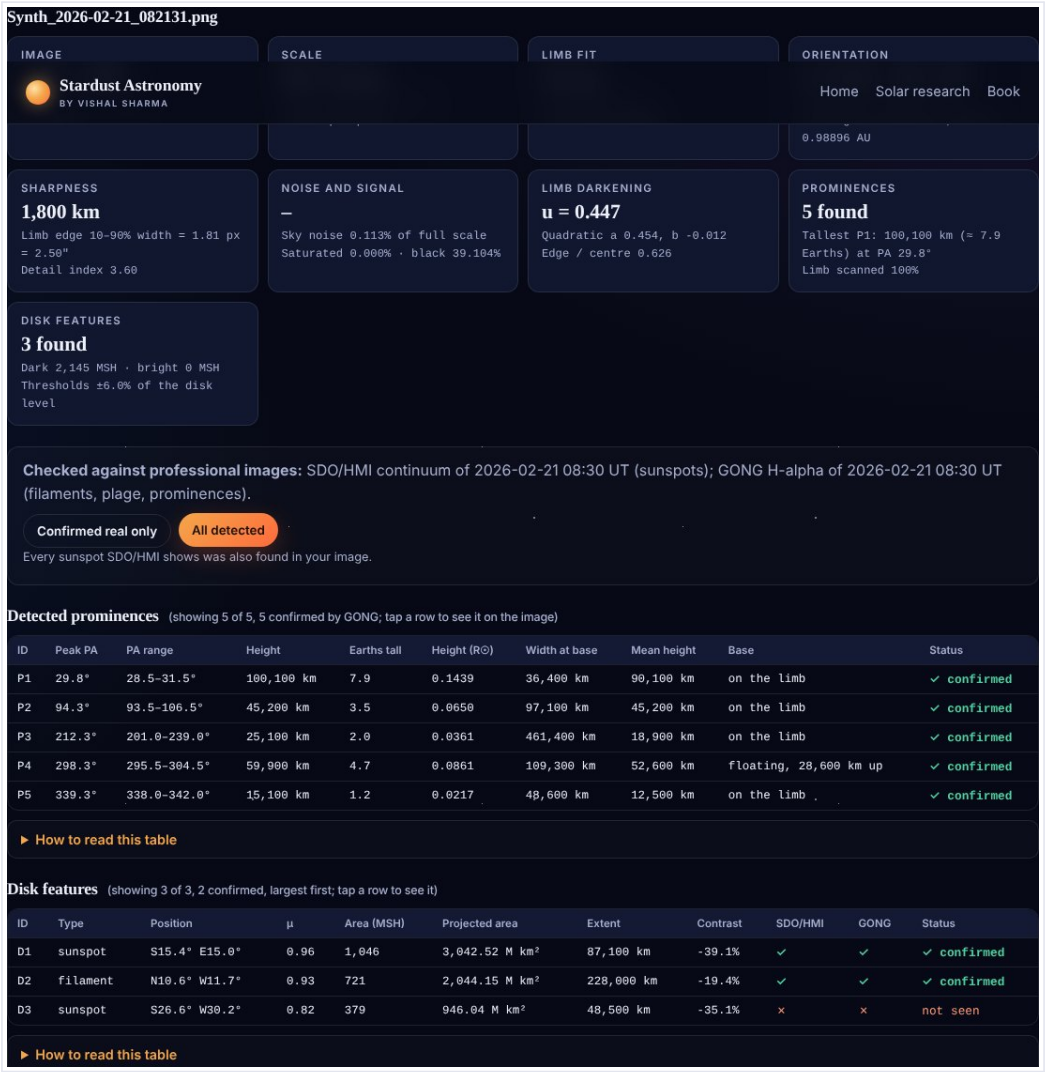
Column	Meaning	How to read it
Area (MSH)	True area in millionths of the visible hemisphere, corrected for viewing angle. 1 MSH ≈ 3 million km².	A big sunspot group: a few hundred MSH. Earth's disk: about 169 MSH.
Projected area	Area as it appears in the image, before correction.	Million km².
Extent	Longest size across.	km.
Contrast	Brightness compared with the disk around it.	−33% = a third darker; +35% = a third brighter.

Good to know: Inverted images (sky brighter than the disk, often used to show prominences) are recognised: filaments then look bright in the picture, but the table still calls them filaments, as they really are on the Sun.

Confirmed with SDO and GONG

To make sure only **real** solar features are listed, the Lab loads the professional images taken nearest your observation time — **SDO/HMI continuum** from NASA's Solar Dynamics Observatory (best for sunspots) and **GONG H-alpha** (filaments, plage and prominences) — and analyses them the same way. A feature in your image is **confirmed** when the professional image shows the same kind of feature at the same place on the Sun, after allowing for the Sun's rotation between the two times. This runs by itself once the orientation has been matched to GONG; you can also press **Check features with SDO and GONG** in the Orientation panel.

- **Confirmed real only** (shown by default after checking) lists just the confirmed features; **All detected** shows everything the Lab found, with ✓ or ✗ in the **SDO/HMI** and **GONG** columns.
- **Status**: “✓ confirmed”, “not seen” (no matching feature in the professional images — usually noise, a processing artefact or seeing), or “no reference” (no professional image available for that time).
- Sunspots that SDO sees but that were not found in your image are listed above the tables (usually too small for your resolution).
- Both tables show every feature found, however many; scroll inside the table to see them all.



Example (a test image): one sunspot that is not in the professional image is marked “not seen” and hidden from the confirmed list.

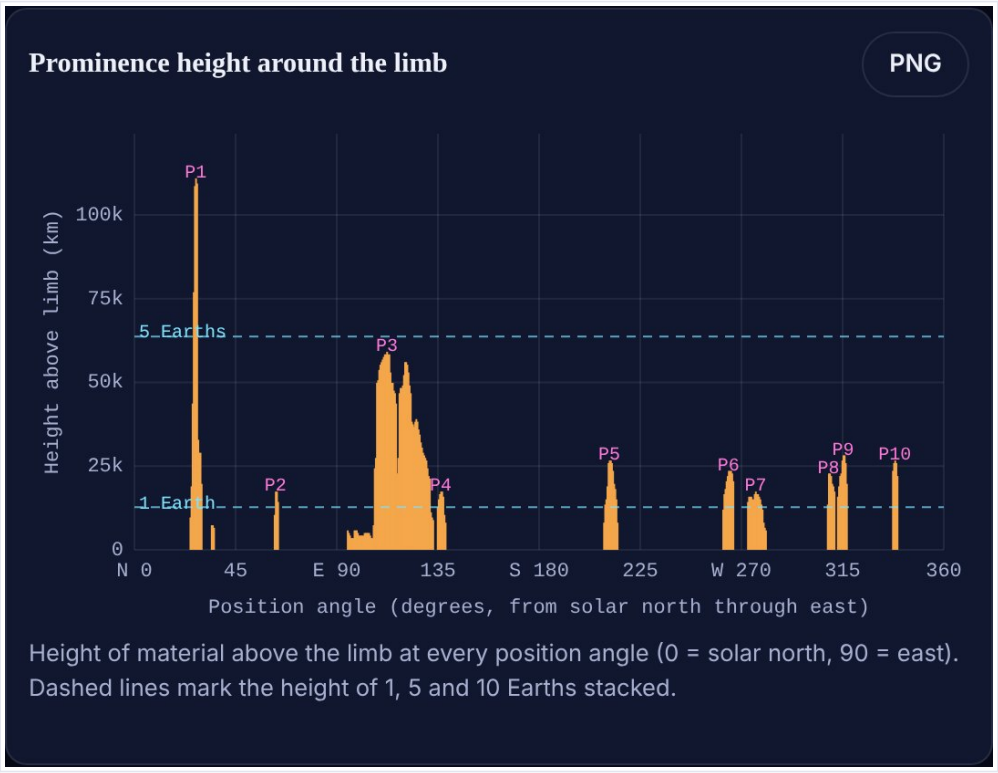
> **Good to know:** The check needs the observation time and an internet connection to the GONG and SDO archives (through Helioviewer). Features are matched within a few degrees on the Sun, so the orientation must be right — match it to GONG first.

Jump to a feature

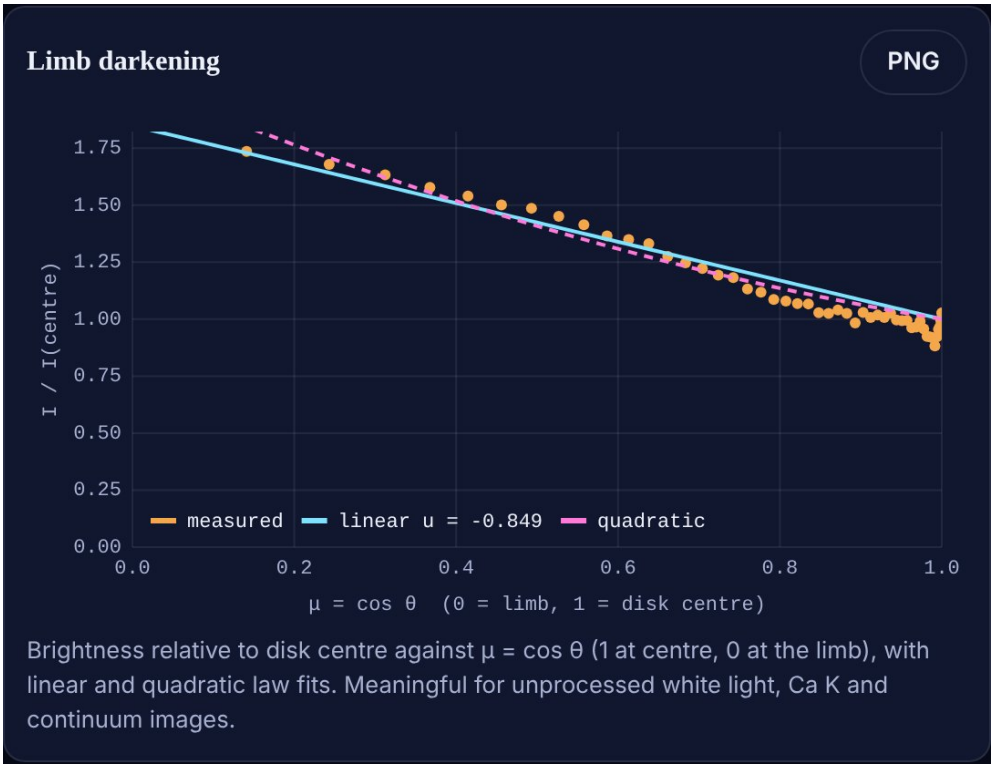
Tap any row in either table: the image scrolls into view, zooms onto that prominence or feature and marks it with a pulsing ring and its ID for a few seconds.

11. Graphs, scientific images and comparing images

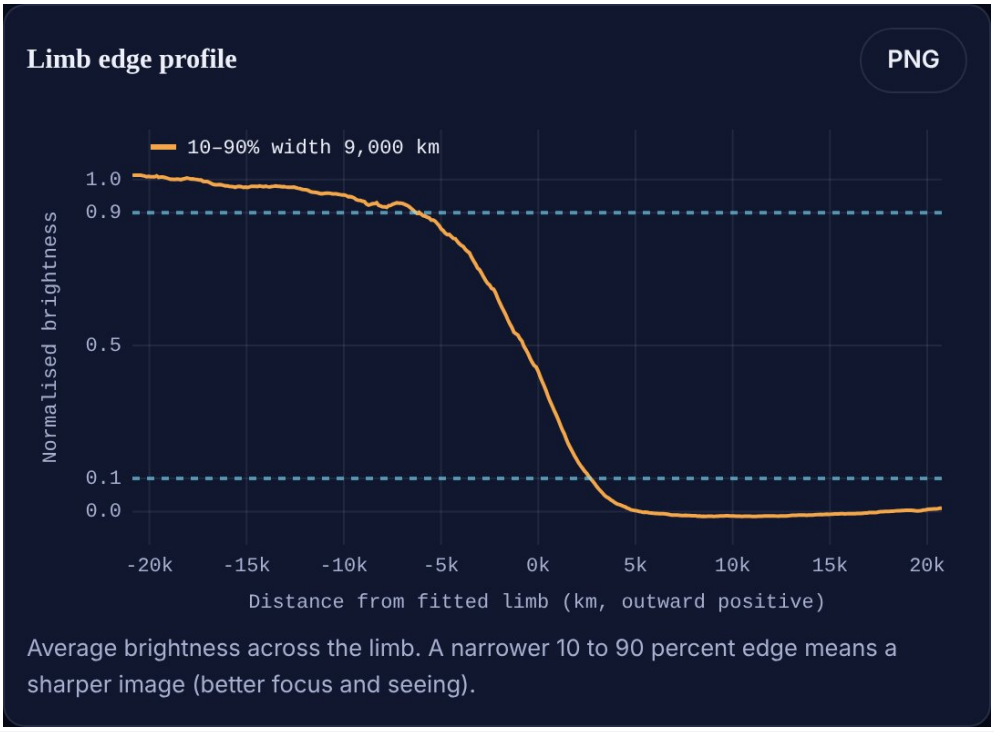
Graphs tab



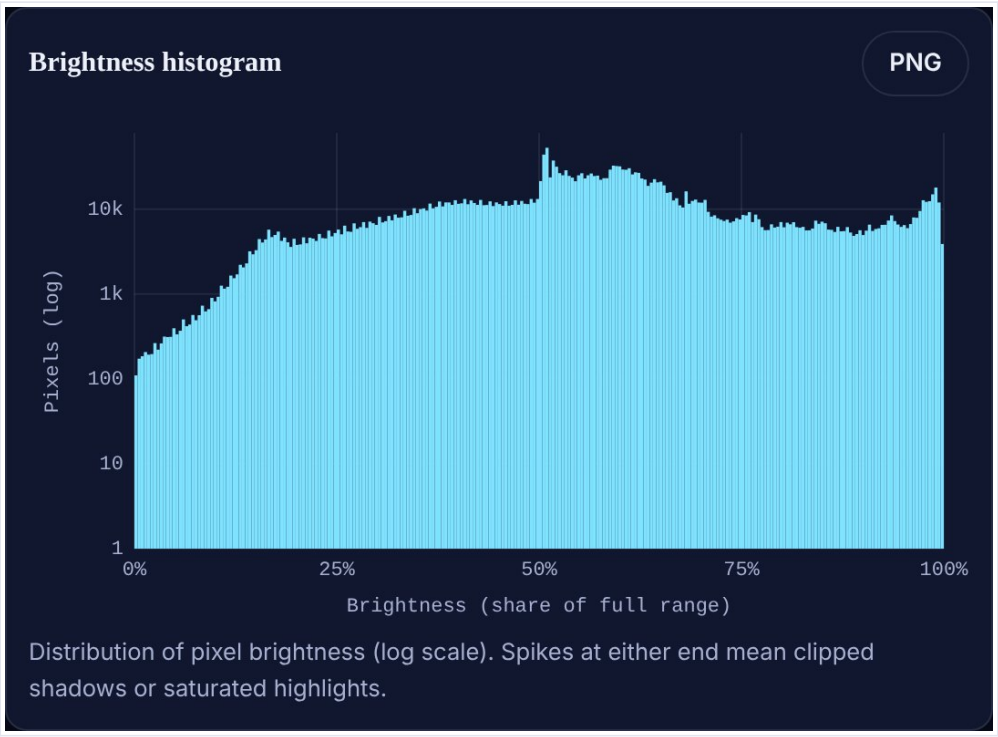
Prominence height around the limb. *Across: position angle from north through east. Up: height in km. Each orange bar is material above the edge; dashed lines show 1, 5 and 10 Earths. Grey bands: parts of the edge outside your picture.*



Limb darkening. *Brightness from the centre (right, μ = 1) to the edge (left, μ = 0). Dots: measured; lines: fitted laws. Compare the coefficient u between filters and nights.*



Limb edge profile. *How quickly brightness drops across the edge, in km. A steep drop (narrow 10–90% width) means good seeing and focus.*

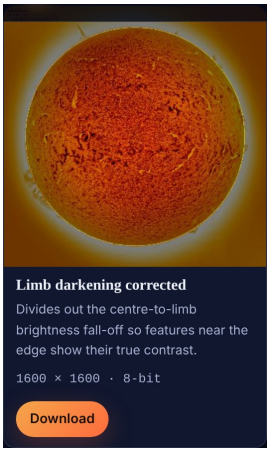


Brightness histogram. *How many pixels have each brightness. A spike at the right end means saturated (burned-out) pixels; a spike at the left means clipped black.*

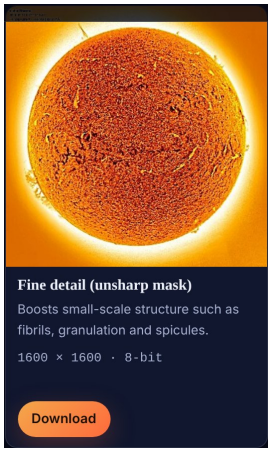
Each graph has a PNG button to save it.

Scientific images tab

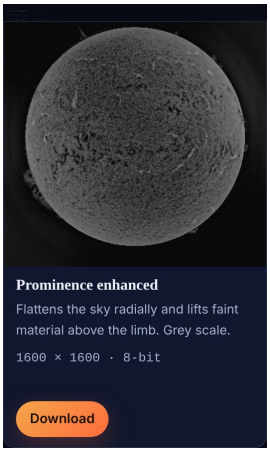
Press **Create** on a card (or **Create all**) to make a processed version of your image at full resolution, then **Download**.



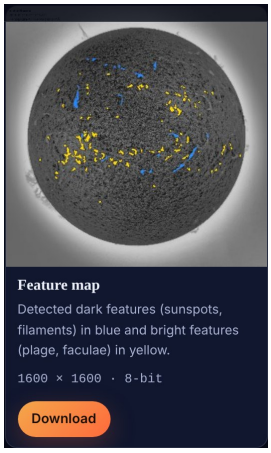
Limb darkening corrected
Removes the darkening towards the edge, so features near the limb show their true contrast.



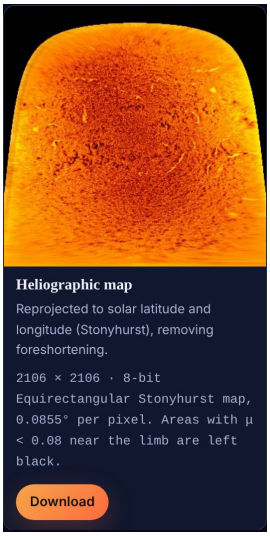
Fine detail
Sharpens small structures: fibrils, granulation, spicules.



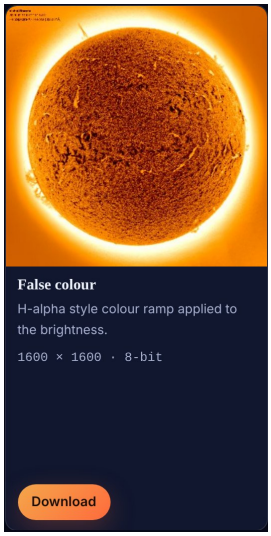
Prominence enhanced
Flattens the sky and lifts faint material above the edge (grey scale).



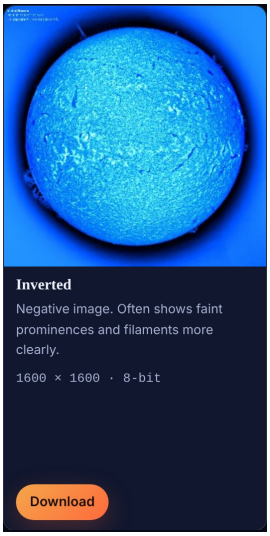
Feature map
Detected dark features in blue, bright features in yellow.



Heliographic map
The disk re-projected to a flat map of solar latitude and longitude, removing foreshortening.



False colour
An H-alpha-style colour scale applied to the brightness.

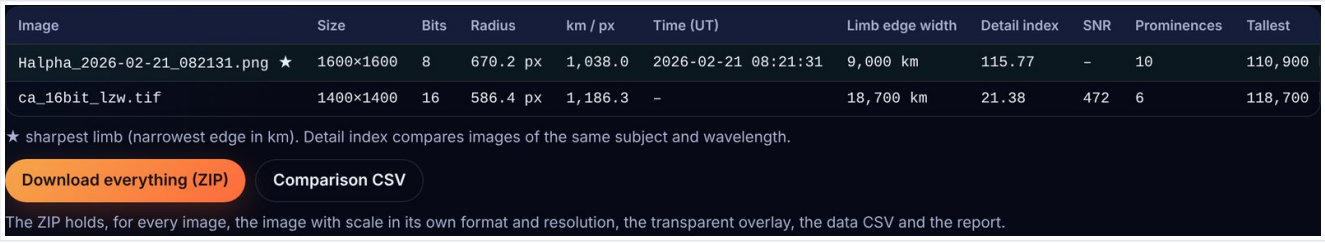


Inverted
A negative; often shows faint prominences and filaments more clearly.



Limb strip. *The whole edge of the Sun unrolled into one line: north, through east, south and west, back to north. Up is height above the edge, at the same km scale both ways. The preview shows only the traced prominences on a smooth grey-black sky. “Download” gives the true data; “Labelled preview” gives this picture.*

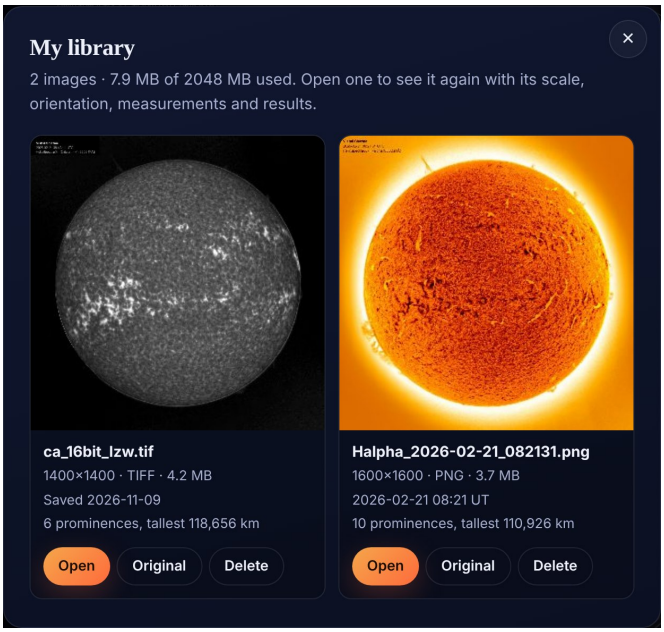
Compare images tab



All your images side by side: scale, time, edge sharpness, noise, prominences and dark area. The star (★) marks the sharpest image. “Download everything” makes one ZIP.

12. My library, your account and subscription

My library

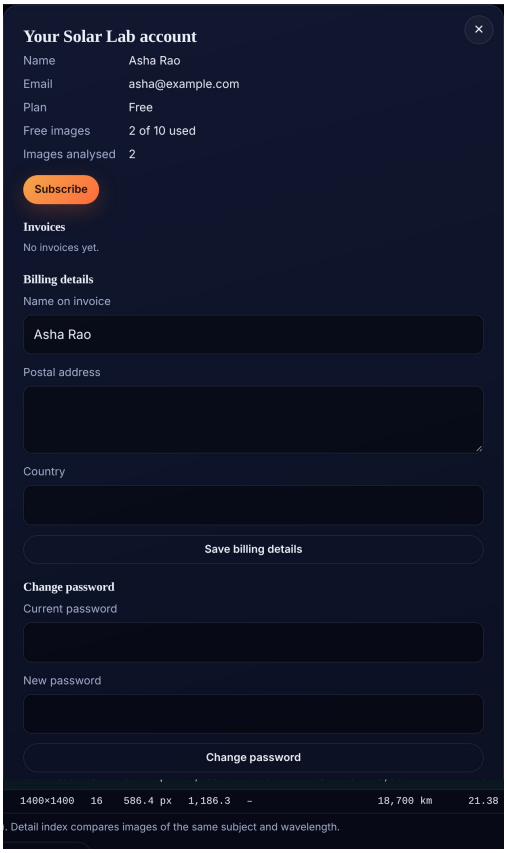


Everything you analysed while “Save my images and results to my account” was ticked. Only you can see it.

- **Open**: loads the image again with its scale, orientation, measurements and Earth/Jupiter exactly as you left them. It does not use a free image.
- **Original**: downloads your original file.
- **Delete**: removes it for good (press twice).

Changes you make later (new measurements, moved planets, orientation) are saved automatically.

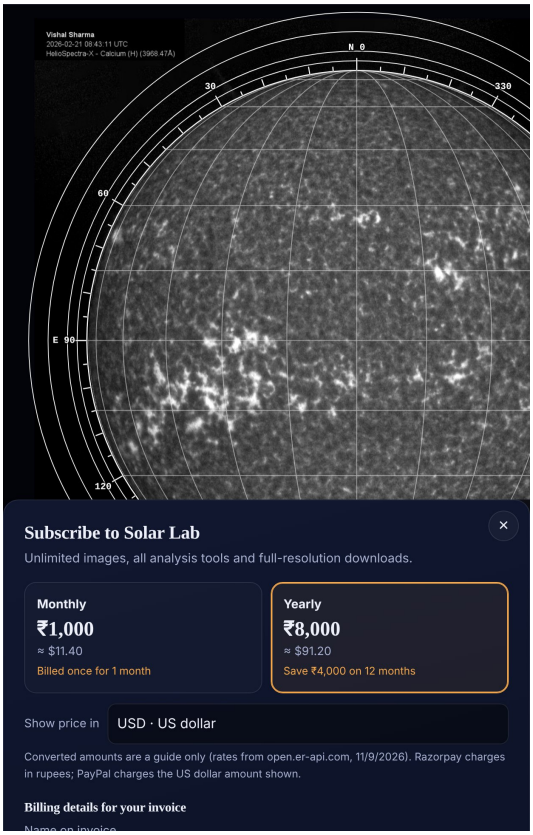
Your account



Open with the **Account** button.

- Plan and end date, free images used, total images analysed.
- **Invoices**: download each PDF bill.
- **Billing details**: the name (yours or your business) and postal address printed on invoices.
- **Change password** and **Sign out**.

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- Monthly **₹1,000** or Yearly **₹8,000**. Prepaid, no automatic renewal; a reminder is emailed 3 days before the end.
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- **Pay with PayPal**: for payments from abroad, final amount in US dollars.
- Prices are final — no extra fees at checkout. A PDF invoice is emailed after payment.

13. Science you can do from your own backyard

Professional observatories measure the same things the Solar Lab measures. With a small solar telescope and regular observing you can do real, useful work. Here are ten projects, from easy to more advanced.

1. How tall is that prominence?

Add your H-alpha image, open the Detected prominences table, tap the tallest one, and drag a few Earths next to it. Post the picture with “P1 reached 111,000 km — about 9 Earths”.

What you learn: Prominence heights, comparison with Earth.

2. Watch a prominence change

Take an image every 10–30 minutes for a few hours. Add them all and note the height of the same prominence (same PA) each time. Plot height against time in the CSV. Eruptions can rise at tens to hundreds of km per second.

What you learn: Growth, eruption speed (height change ÷ time).

3. Count and measure sunspots

With a white-light or Calcium image, use the Disk features table (sunspots and dark spots) or the Area tool around each group. Record the MSH every clear day.

What you learn: Sunspot areas in MSH, like official observatories.

4. The Sun's rotation

Image the same sunspot or filament on 2–3 days at the same hour. Note its longitude (Position column) each day. The change ÷ days gives the rotation rate (about 13–14° per day near the equator, slower near the poles — the Sun does not rotate like a solid ball).

What you learn: Synodic rotation rate, differential rotation.

5. Filament lengths and life

Measure filaments with the Length tool (surface length) over several days. Long filaments can reach several hundred thousand km and may suddenly disappear (“disparition brusque”).

What you learn: Filament length, evolution, eruptions.

6. Limb darkening

From an unprocessed white-light image, read the limb darkening coefficient u. Compare with the textbook value (about 0.6 in visible light) and with different filters.

What you learn: How the Sun's atmosphere gets cooler with height.

7. Choose your best frame

Add all frames from a session; in Compare, the sharpest (narrowest limb edge) gets the ★. Use it as your master image.

What you learn: Seeing and focus quality.

8. Check your equipment

The axis ratio shows if your spectroheliograph or camera stretches the disk; the arcseconds per pixel tell you your true image scale.

What you learn: Instrument calibration.

9. Activity over a season

Keep every image in My library. Every week, write down the number of prominences, the tallest one and the dark area. Over months you will see solar activity rise and fall.

What you learn: Solar cycle tracking.

10. Eclipse measurements

During a partial or annular eclipse the Lab still finds the Sun's edge and recognises the Moon. Compare the Moon's size with the Sun's (shown in the Solar scale panel).

What you learn: Apparent sizes of Moon and Sun.

> **Tip:** Always write down the exact time of each image: it makes orientation, latitude, longitude and rotation measurements possible.

14. Tips for best results and solving problems

If…	Do this
the limb circle does not sit on the edge	Press “Detect limb again”. If still wrong, use “Click limb points” and click 8–12 points evenly around the edge (zoom in for accuracy).
only part of the Sun is in the picture	It still works if a good part of the edge is visible; read the warning about scale certainty.
the grid or positions look turned	Enter the correct time, press “Match orientation to GONG”, or set rotation and mirroring by hand.
east is on the right	Tick “Mirrored”.
no time was found	Type it in “Observation time (UT)”. Include seconds if you know them.
a prominence is missing in the table	It may be too faint compared with the sky noise. Stack more frames, or use the Height tool to measure it yourself.
lines are hard to see	Line colour → Automatic, or choose a colour; increase Line thickness.
the free images are used up	Subscribe (chapter 12). Opening images from My library never uses a free image.

For the most accurate measurements

- Use the original 16-bit TIFF or FITS when you can (not a reduced JPEG).
- Keep the whole disk in the frame with a little sky around it.
- Avoid over-sharpening and heavy halos when processing images you want to measure.
- Note down the local date and time of each capture, so you can enter it in the Lab.
- Remember that heights are minimums and areas near the edge (μ below 0.2) are less certain.

15. Glossary

Word	Meaning
Limb	The visible edge of the Sun's disk.
Prominence	A cloud of cooler, denser gas held above the surface by magnetic fields; bright against the dark sky at the edge.
Filament	A prominence seen from above, against the bright disk; it looks like a dark thread in H-alpha.
Sunspot	A cooler, darker area where strong magnetic fields block heat from below.
Plage	Bright regions in the chromosphere around active regions.
H-alpha (656.28 nm)	Red light from hydrogen; shows the chromosphere, prominences and filaments.
Calcium H / K	Violet light from calcium; shows plage and the chromospheric network brightly.
Position angle (PA)	Direction around the Sun from solar north (0°) through east (90°).
P angle	Tilt of the Sun's north pole relative to celestial north, seen from Earth.
B0	Tilt of the Sun's north pole towards or away from Earth.
Heliographic latitude / longitude	Position on the Sun, like latitude and longitude on Earth (longitude measured from the centre line of the disk).
μ (mu)	How face-on a point on the disk is: 1 at the centre, 0 at the edge.
MSH	Millionths of the solar hemisphere: the standard unit of sunspot area (about 3 million km²).
R☉	One solar radius = 695,700 km.
Limb darkening	The Sun looks darker towards its edge because we see higher, cooler layers there.
Seeing	Blurring by Earth's atmosphere; it widens the limb edge.
Bit depth	8-bit = 256 brightness levels; 16-bit = 65,536 levels (better for measuring).
GONG	Global Oscillation Network Group: professional solar telescopes around the world, used as the orientation reference.

Questions? Contact Vishal Sharma at stardustastronomy.com · WhatsApp +91 99996 92985.