

Getting Sparks from Water with Lord Kelvin's Thunderstorm

[Originalartikel](#)

[Backup](#)

```
<html> <p>In the comments to our recent <a
href=„http://hackaday.com/2017/03/03/how-wimshurst-machines-work-high-voltage-from-the-
gods/“>article about Wimshurst machines</a>, we saw&#160;that some hackers had never heard of
them, reminding us that we all have different backgrounds and much to share. Well here&#8217;s
one I&#8217;m guessing even fewer will have heard of. It&#8217;s never even shown up in a single
Hackaday article, something that was also pointed out in a comment to that&#160;Wimshurst article.
It is the Lord Kelvin&#8217;s Water Dropper aka Lord&#160;Kelvin&#8217;s Thunderstorm, <a
href=„https://books.google.ca/books?id=2lgwAAAAIAAJ&amp;pg=PA391&amp;lpg=PA391&amp;redir_
esc=y#v=onepage&amp;q&amp;f=false“ target=„_blank“>invented in the 1860s</a> by <a
href=„https://en.wikipedia.org/wiki/William_Thomson,_1st_Baron_Kelvin“ target=„_blank“>William
Thomson, 1st Baron Kelvin</a>, the same fellow for whom the Kelvin temperature scale is named.
&#160;It&#8217;s a device that produces a high voltage and sparks from falling drops of water.</p>
<p/> <h2>A Brief Overview</h2> <div class=„tiled-gallery type-rectangular tiled-gallery-unresized“
data-original-width=„800“ data-carousel-
extra=„{&quot;blog_id&quot;;:4779443,&quot;permalink&quot;;&quot;http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-
thunderstorm/&quot;;&quot;likes_blog_id&quot;;:4779443}&quot;> <div class=„gallery-row“ style=„width:
800px; height: 257px;“ data-original-width=„800“ data-original-height=„257“> <div class=„gallery-
group images-1“ style=„width: 476px; height: 257px;“ data-original-width=„476“ data-original-
height=„257“> <div class=„tiled-gallery-item tiled-gallery-item-large“ itemprop=„associatedMedia“
itemscope=„“ itemtype=„http://schema.org/ImageObject“> <a
href=„http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-thunderstorm/kelv
in_water_dropper_parts/“ border=„0“ itemprop=„url“> <meta itemprop=„width“
content=„472“/><meta itemprop=„height“ content=„253“/><img data-attachment-id=„249557“
data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/kelvin_water_dropper_parts.png“
data-orig-size=„981,526“ data-comments-opened=„1“ data-image-
meta=„{&quot;aperture&quot;;&quot;0&quot;;&quot;credit&quot;;&quot;&quot;;&quot;camera&quot;;
&quot;&quot;;&quot;caption&quot;;&quot;&quot;;&quot;created_timestamp&quot;;&quot;0&quot;;&
quot;copyright&quot;;&quot;&quot;;&quot;focal_length&quot;;&quot;0&quot;;&quot;iso&quot;;&quot;0
&quot;;&quot;shutter_speed&quot;;&quot;0&quot;;&quot;title&quot;;&quot;&quot;;&quot;orientation&
quot;;&quot;0&quot;;}&quot; data-image-title=„Kelvin water dropper parts“ data-image-description=„“
data-
medium-file=„https://hackadaycom.files.wordpress.com/2017/03/kelvin_water_dropper_parts.png?w=
400“
data-
large-
file=„https://hackadaycom.files.wordpress.com/2017/03/kelvin_water_dropper_parts.png?w=800“
src=„http://i2.wp.com/hackadaycom.files.wordpress.com/2017/03/kelvin_water_dropper_parts.png?w
=472&amp;h=253&amp;crop&amp;ssl=1“ width=„472“ height=„253“ data-original-width=„472“
data-original-height=„253“ itemprop=„http://schema.org/image“ title=„Kelvin water dropper parts“
alt=„Kelvin water dropper parts“ style=„width: 472px; height: 253px;“/></a> <div class=„tiled-
gallery-caption“ itemprop=„caption description“> Kelvin water dropper parts </div> </div> </div>
<!-- close group --> <div class=„gallery-group images-1“ style=„width: 324px; height: 257px;“ data-
original-width=„324“ data-original-height=„257“> <div class=„tiled-gallery-item tiled-gallery-item-
```

large" itemprop=„associatedMedia“ itemscope=„“ itemtype=„<http://schema.org/ImageObject>“> <meta itemprop=„width“ content=„320“/><meta itemprop=„height“ content=„253“/><img data-attachment-id=„249555“ data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/continuous_water_and_drops.png“ data-orig-size=„716,566“ data-comments-opened=„1“ data-image-meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“ data-image-title=„Continuous water and drops“ data-image-description=„“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/continuous_water_and_drops.png?w=400“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/continuous_water_and_drops.png?w=716“ src=„http://i1.wp.com/hackadaycom.files.wordpress.com/2017/03/continuous_water_and_drops.png?w=320&h=253&crop&ssl=1“ width=„320“ height=„253“ data-original-width=„320“ data-original-height=„253“ itemprop=„<http://schema.org/image>“ title=„Continuous water and drops“ alt=„Continuous water and drops“ style=„width: 320px; height: 253px;“/> <div class=„tiled-gallery-caption“ itemprop=„caption description“> Continuous water and drops </div> </div> </div> <!-- close group -> </div> <!-- close row -> </div> <p>Lord Kelvin’s Thunderstorm is build around the concept of water droplets falling through inductors. Two streams of water fall from small holes in reservoirs at the top. Those streams fall through two metal cylinders, called inductors, not making contact with them. A stream of falling water will change from a continuous stream into individual drops at some point, if it falls far enough.</p> <p>The inductors are vertically positioned such that this change from continuous stream to individual drops happens as the water is falling through the inductors. To see these drops, the photo on the right, above, was taken with a fast shutter speed. Finally, the drops fall into metal cans, called receivers, at the bottom.</p> <p>The receiver on the left is electrically connected to the inductor on the right, and the receiver on the right is electrically connected to the inductor on the left. You can see this in the photo above in the form of the crossing yellow and red wires.</p> <p>Also, a wire is connected to each receiver and goes to either side of a spark gap. Every now and then, a spark crosses the gap. Magic. Or is it?</p> <h2>How It Works</h2> <li style=„clear:both;padding-top:1em;“><img data-attachment-id=„249561“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=400&h=159“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=800“ data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png“ data-orig-size=„845,336“ data-comments-opened=„1“ data-image-meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“ data-image-title=„Step 1. Starting“ data-image-description=„“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=400&h=159“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=800“

class=„alignright wp-image-249561 size-medium“
src=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=400&h=159“
alt=„Step 1. Starting“ width=„400“ height=„159“
srcset=„https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=400&h=159
400w, https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=800&h=318
800w, https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=250&h=99
250w, https://hackadaycom.files.wordpress.com/2017/03/step_1_starting.png?w=768&h=305
768w“ sizes=„(max-width: 400px) 100vw, 400px“/>To begin, there has to be some excess
electric charge somewhere, either positive or negative. And there usually is. Let's
say that the right receiver has a slight net negative charge. Since it's wired to
the left inductor, the left inductor also has a slight negative charge. <li
style=„clear:both;padding-top:1em;“><a
href=„https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png“
target=„_blank“><img data-attachment-id=„249562“
data-
permalink=„http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-thunderstorm/step_2_charging_water/“
data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png“ data-
orig-size=„845,566“ data-comments-opened=„1“ data-image-
meta=„{"aperture":"0","credit":"","camera":
:","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0
","shutter_speed":"0","title":"","orientation":
":"0"}" data-image-title=„Step 2 Charging water“ data-image-description=„“ data-
medium-file=„[https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400
&h=268](https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400&h=268)“
data-
large-file=„https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=800“
class=„alignright wp-image-249562 size-medium“
src=„[https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400&h
=268](https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400&h=268)“ alt=„Step 2 Charging water“ width=„400“ height=„268“
srcset=„[https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400&h
;h=268](https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=400&h=268) 400w,
https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=800&h=536
800w,
https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=250&h=167
250w,
https://hackadaycom.files.wordpress.com/2017/03/step_2_charging_water1.png?w=768&h=514
768w“ sizes=„(max-width: 400px) 100vw, 400px“/>Here is where the real magic happens.
Remember that the inductor is vertically positioned where the continuous stream breaks up
into drops. Since the left inductor is negatively charged, it repels negative charge in the
water. The continuous water stream from the reservoir to the inductor acts like a wire and that
negative charge is repelled up that stream to the reservoir. But that leaves the drops
falling below the inductor with a net positive charge. And since they are individual drops, they
stay positive, all the way to the left receiver below them. <li style=„clear:both;padding-
top:1em;“><a
href=„[https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_induct
or1.png](https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png)“ target=„_blank“><img data-attachment-id=„249563“
data-
permalink=„http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-thunderstorm/step_3_charging_other_receiver_and_inductor/“

data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png“ data-orig-size=„846,342“ data-comments-opened=„1“ data-image-meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“ data-image-title=„Step. 3 Charging other receiver and inductor“ data-image-description=„“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=400&h=162“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=800“ class=„alignright wp-image-249563 size-medium“ src=„https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=400&h=162“ alt=„Step. 3 Charging other receiver and inductor“ width=„400“ height=„162“ srcset=„https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=400&h=162 400w,
https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=800&h=324 800w,
https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=250&h=101 250w,
https://hackadaycom.files.wordpress.com/2017/03/step_3_charging_other_receiver_and_inductor1.png?w=768&h=310 768w“ sizes=„(max-width: 400px) 100vw, 400px“/>The left receiver is a metal can and is in electrical contact with the water in it, and so the left receiver is made positive by those positively charged drops.But the left receiver is wired to the right inductor. That means the right inductor also becomes positively charged. <li style=„clear:both;padding-top:1em;“><img data-attachment-id=„249564“ data-permalink=„http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-thunderstorm/step_4_charging_water/“ data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png“ data-orig-size=„845,566“ data-comments-opened=„1“ data-image-meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“ data-image-title=„Step 4. Charging water“ data-image-description=„“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=400&h=268“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=800“ class=„alignright wp-image-249564 size-medium“ src=„https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=400&h=268“

=268" alt="Step 4. Charging water" width="400" height="268"
 srcset="https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=400&h=268 400w,
 https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=800&h=536 800w,
 https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=250&h=167 250w,
 https://hackadaycom.files.wordpress.com/2017/03/step_4_charging_water1.png?w=768&h=514 768w" sizes="(max-width: 400px) 100vw, 400px"/>That right inductor also has a stream of continuous water entering it from above and drops leaving it below. Since the inductor is positively charged, it repels positive charge up the solid water stream to the reservoir above. Meanwhile, the drops leaving it are left with a net negative charge and fall into the receiver below them. <li style="clear:both;padding-top:1em;">If you recall from step 1, the right reservoir was the one we started with, and was slightly negative. Now, as a result of the negatively charged drops falling into it, that receiver becomes even more negative. And since that right receiver is wired to the left inductor, that makes the left inductor more negative, which repels negative charge up the left stream, while the drops below it are made positive, and fall into the left receiver, making the left receiver more positive, and so on. <li style="clear:both;padding-top:1em;"><img data-attachment-id="249566" data-permalink="http://hackaday.com/2017/03/27/getting-sparks-from-water-with-lord-kelvins-thunderstorm/step_6_charging_the_spark_gap/"

data-

orig-file=„https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png“

data-orig-size=„845,426“ data-comments-opened=„1“ data-image-

meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“ data-image-title=„Step 6. Charging the spark gap“ data-image-description=„“

data-

medium-file=„https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=400&h=202“

data-

large-

file=„https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=800“ class=„alignright wp-image-249566 size-medium“

src=„https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=400&h=202“ alt=„Step 6. Charging the spark gap“ width=„400“ height=„202“

srcset=„https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=400&h=202 400w,

https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=800&h=404 800w,

https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=250&h=126 250w,

https://hackadaycom.files.wordpress.com/2017/03/step_6_charging_the_spark_gap1.png?w=768&h=387 768w“ sizes=„(max-width: 400px) 100vw, 400px“/>So the right receiver becomes

more and more negative while the left receiver becomes more and more positive. But remember, the two receivers are wired up to opposite sides of a spark gap. The electrodes at the spark gap also become more and more negative and positive. That is, until the voltage across the spark gap becomes so strong that it breaks down the air between them, and a spark crosses the gap, discharging the whole thing. But of course a little net charge is left somewhere and the whole process repeats.

Fanning Drops And Electroscopes

Besides watching the sparks, there are some additional fun ways to observe this repeated charging and discharging. One such way is to watch the drops fanning out as they fall, and then suddenly falling straight again.

thunderstorm/","likes_blog_id":4779443}"> <div class=„gallery-row“ style=„width: 800px; height: 352px;“ data-original-width=„800“ data-original-height=„352“> <div class=„gallery-group images-1“ style=„width: 313px; height: 352px;“ data-original-width=„313“ data-original-height=„352“> <div class=„tilted-gallery-item tiled-gallery-item-large“ itemprop=„associatedMedia“

itemscope=„“ itemType=„<http://schema.org/ImageObject>“> <meta itemprop=„width“ content=„309“/><meta itemprop=„height“ content=„348“/><img data-attachment-id=„249539“

data-orig-file=„https://hackadaycom.files.wordpress.com/2017/03/fanning_water_for_gif.gif“ data-orig-size=„368,415“ data-comments-opened=„1“ data-image-

meta=„{"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}"“

“"aperture":"0","credit":"","camera":"","caption":"","created_timestamp":"0","copyright":"","focal_length":"0","iso":"0","shutter_speed":"0","title":"","orientation":"0"}" data-image-title=„Water fanning out. The camera speed was too slow to show individual drops.“ data-image-description=„“ data-medium-file=„https://hackadaycom.files.wordpress.com/2017/03/fanning_water_for_gif.gif?w=355“ data-large-file=„https://hackadaycom.files.wordpress.com/2017/03/fanning_water_for_gif.gif?w=368“ src=„http://i0.wp.com/hackadaycom.files.wordpress.com/2017/03/fanning_water_for_gif.gif?w=309&h=348&crop&ssl=1“ width=„309“ height=„348“ data-original-width=„309“ data-original-height=„348“ itemprop=„http://schema.org/image“ title=„Water fanning out. The camera speed was too slow to show individual drops.“ alt=„Water fanning out. The camera speed was too slow to show individual drops.“ style=„width: 309px; height: 348px;“> <div class=„tiled-gallery-caption“ itemprop=„caption description“> Water fanning out. Camera’s too slow for drops. </div> </div> </div> <!-- close group -> <div class=„gallery-group images-1“ style=„width: 487px; height: 352px;“ data-original-width=„487“ data-original-height=„352“> <div class=„tiled-gallery-item tiled-gallery-item-large“ itemprop=„associatedMedia“ itemscope=„“ itemType=„http://schema.org/ImageObject“> <meta itemprop=„width“ content=„483“><meta itemprop=„height“ content=„348“> <div class=„tiled-gallery-caption“ itemprop=„caption description“> Electroscope </div> </div> </div> <!-- close group -> </div> <!-- close row -> </div>

<p>Why does this fanning-out happen? The drops coming out of the inductors have the opposite charge of the inductors. For example, the drops falling below the left inductor are positive, while the left inductor is negative. Note also that the bottom lip of the inductor is to one side of the drops. Since unlike-charges attract, there’s a horizontal attraction between the inductors and the drops falling below them that imparts some sideways movement to the drops.</p> <p>The result is a visible fanning-out of the drops. This fanning-out gets wider and wider as the inductor becomes more and more charged. That is, until the spark occurs and discharges everything. At that time the drops fall straight down again only to start fanning out as the charge builds back up.</p> <p>Another fun way of observing the charging and discharging in action is to place the terminal of an electroscope near an inductor or receiver. As the charge builds up, the electroscope leafs will spread apart. But when the spark occurs, the leafs fall back together</p>

<p>Rather than have just one stream falling through each inductor, some builders use something like a shower head to have multiple streams fall through. Below is a video from science YouTube channel, Veritasium, showing a large and very sci-fi looking Lord Kelvin water dropper that uses shower heads.</p> <p>It also has a pump to keep the water flowing continuously. You might wonder what would happen if you did use a pump, since you’d be electrically connecting the two receivers. To avoid that, the

receivers are just meshes through which the water drops fall. As the drops falls through, the mesh takes their charge. So I guess you can say these receivers receive the charge but not the water.

`</p> <p><iframe class=„youtube-player“ type=„text/html“ width=„800“ height=„480“ src=„http://www.youtube.com/embed/rv4MjaF_wow?version=3&rel=1&fs=1&autoplay=2&showsearch=0&showinfo=1&iv_load_policy=1&wmode=transparent“ allowfullscreen=„true“ style=„border:0;“>[embedded content]</iframe></p> </html>`

From:

<https://schnipsl.qgelm.de/> - Qgelm

Permanent link:

<https://schnipsl.qgelm.de/doku.php?id=wallabag:getting-sparks-from-water-with-lord-kelvins-thunderstorm>

Last update: **2021/12/06 15:24**

