

**LVK COMMUNICATION AND OUTREACH
STRATEGIC MEETING**

SOCIAL MEDIA

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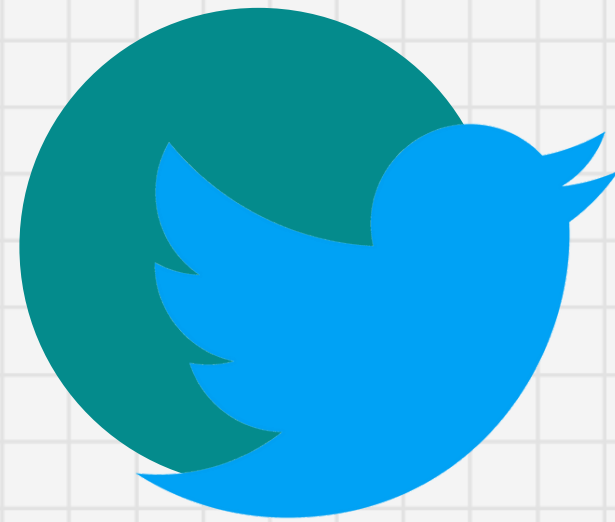


Current social media accounts



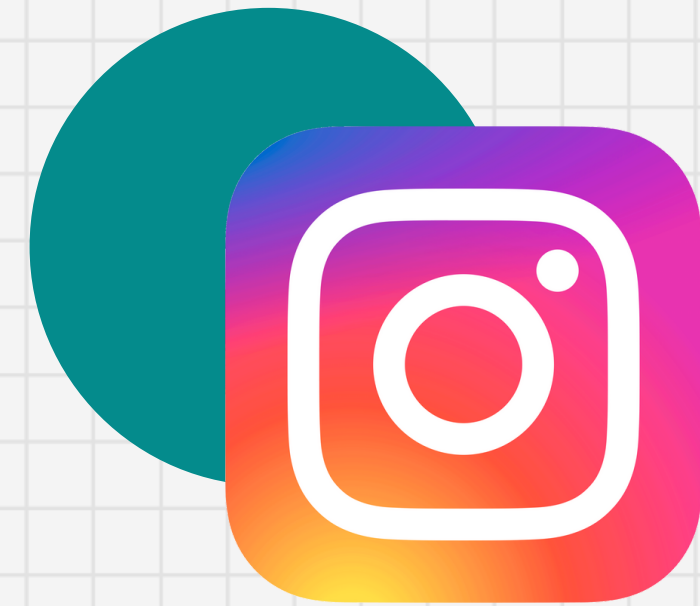
Facebook

**EGO & the Virgo
Collaboration**



Twitter

@EGO_Virgo



Instagram

@ligo_virgo

Followers vs. Engagement vs. Reach (vs. the Algorithm)

Followers

- = Reaching a new audience, in some way
- Something that worked in the past to gain followers will not necessarily work again
- It says nothing about what your current audience thinks of your posts*
- It is also a reflection of the real life world



EGO - Virgo
@ego_virgo

Virgo is a Gravitational Wave detector, hosted by the European Gravitational Observatory (EGO), near Pisa, Italy.

Header credits: Massimo D'Andrea

Science & Technology Cascina, Toscana virgo-gw.eu
Born June 27, 1994 Joined October 2014

405 Following 12K Followers



LIGO
@LIGO Follows you

Official Twitter of the LIGO Scientific Collaboration. We detect gravitational waves!

Email: questions@ligo.org

Livingston, LA and Hanford, WA ligo.org Joined June 2008

322 Following 111.9K Followers

Engagement

- = What your audience thinks of your posts
- It's made of likes, shares, comments etc.
- It's inherently different for different social media
- It's a propagation factor of posts, just as relevant as the follower pool in defining the final audience

LIGO @LIGO · Dec 15, 2021
New @LIGO @ego_virgo @KAGRA_PR paper on the @arxiv today! "Tests of General Relativity with #GWTC3" presents our most comprehensive tests of @AlbertEinstein's theory to date. More details at ligo.org/news.php and read the science summary at ligo.org/science/Public...



DOES EINSTEIN'S THEORY OF GRAVITY HOLD UP TO THE LATEST LIGO/VIRGO/KAGRA OBSERVATIONS?

INTRODUCTION

Gravitational waves are produced by non-uniformly accelerating masses that carry information about their sources, and are often thought of as ripples in the curvature of spacetime. Einstein's theory of General Relativity (GR) predicts measurable properties of gravitational waves. According to GR, these waves travel at the speed of light, and the speed of propagation is independent of the frequency of the wave. It predicts the waves to have two independent modes of polarization referred to as 'plus' and 'cross'. Further, GR makes predictions for the dynamics of spacetime that lead to the generation of gravitational waves, for instance, in the case of collisions of black holes and/or neutron stars. The gravitational-wave detections from merging binaries consisting of black holes and neutron stars by the advanced LIGO/Virgo detector network hence provide a unique opportunity to verify the predictions of GR and thereby search for any beyond-GR physics.

With the most recent gravitational wave transient catalog GWTC-3, the LIGO/Virgo detectors have detected about 90 compact binary mergers, including binary black holes, binary neutron stars, and neutron star-black hole pairs. Among the 90 events, 35 compact binary mergers from the second half of the third observing run (O3b) were reported for the first time. In this paper, we combine the new observational data with the older data to seek possible departures from GR.

Every experiment makes measurements in the presence of noise and gravitational wave detectors are no exception. When we search for deviations from GR, certain types of noise that are present in the detector can mimic them, creating a risk that we incorrectly claim a deviation when there isn't any. Hence, we restrict our analysis to "loud" events only, whose signals could be expected to resemble detector noise only once in 1000 years or higher. This gives us 15 events to be analyzed from O3b and we carry out nine different tests that look for deviations from GR. A summary of the results is described below.

CONSISTENCY TESTS

Overall consistency of the signal with the data: the residual test

We use GR waveforms to detect and interpret gravitational-wave events. The most straightforward test of GR we can perform is subtracting from the observed data the GR waveform that fits the data the best. The residual left behind by this procedure should be consistent with noise, if GR is correct. For all the events studied, we find the residual is consistent with the detector noise providing evidence for the consistency of the data with the predictions of GR.

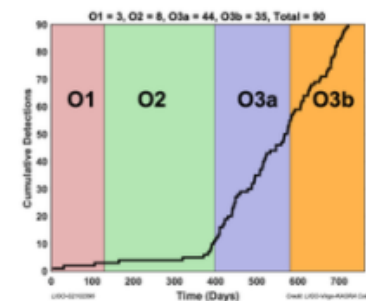


Figure 1: Durations of the first three observing runs of the advanced LIGO and advanced Virgo detectors and the cumulative number of detections made. However, as mentioned in the main text, not all of these binaries were analyzed to test GR in this study.

Self-consistency of the waveform: the inspiral-merger-ringdown consistency test

Gravitational waves from mergers of neutron stars and black holes have three phases of evolution: the slow inspiral of the two bodies toward each other, the merger of the two bodies into one, and the ringdown of the remnant compact object. An important consistency check can be performed by asking whether the waveform from the inspiral is consistent with the waveform from the post-inspiral. The final mass and spin of the remnant black hole can be inferred from both parts of

4 41 108

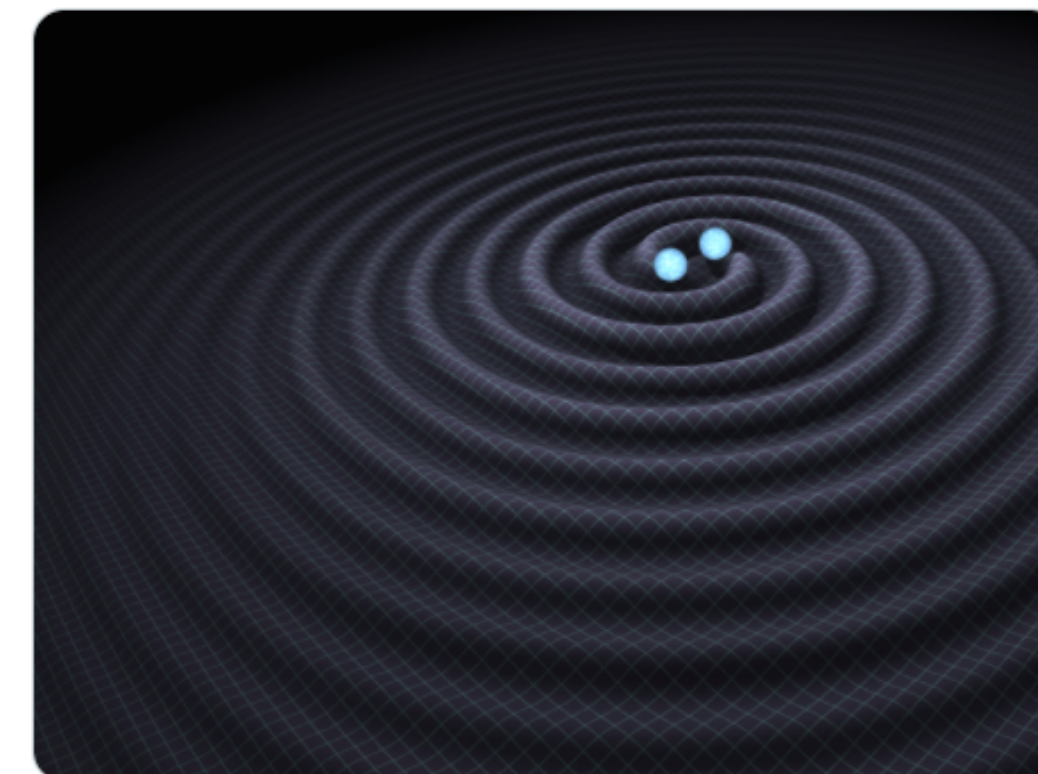
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3 37 117

EGO - Virgo EGO-Virgo @ego_virgo · Dec 15, 2021



Gravitational waves provide precious information about the theory of relativity and the nature of black holes. In a paper published yesterday, using all the data collected to date, the @LIGO - Virgo - @KAGRA_PR Collaboration has tested Einstein's equations of general relativity.

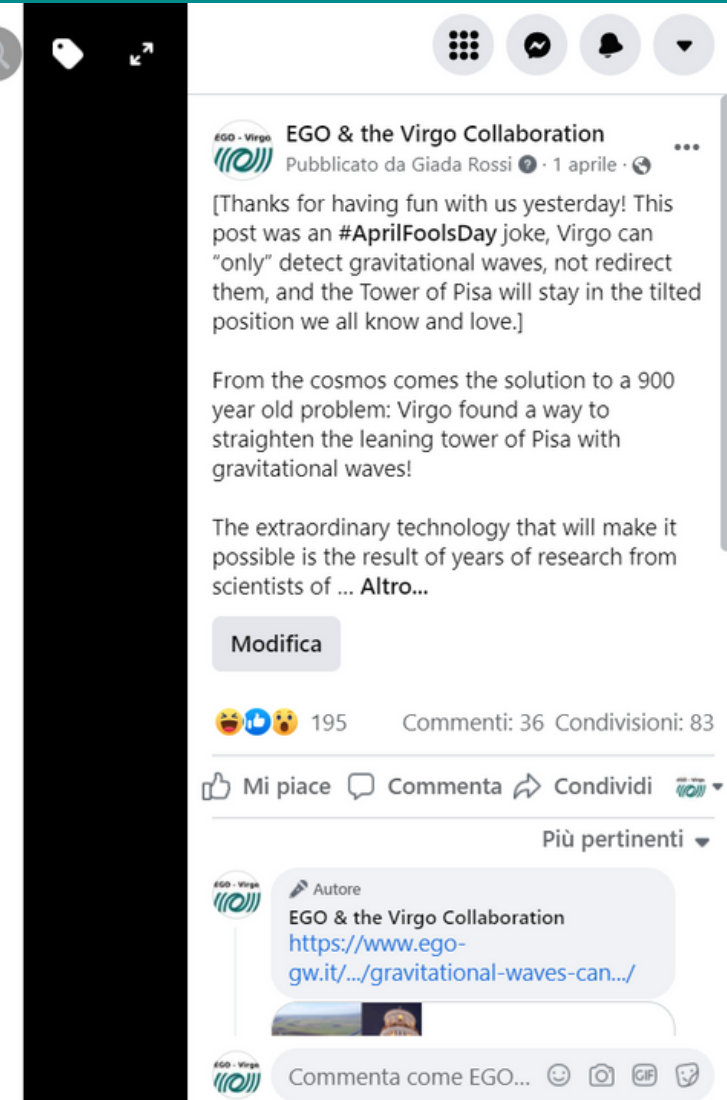
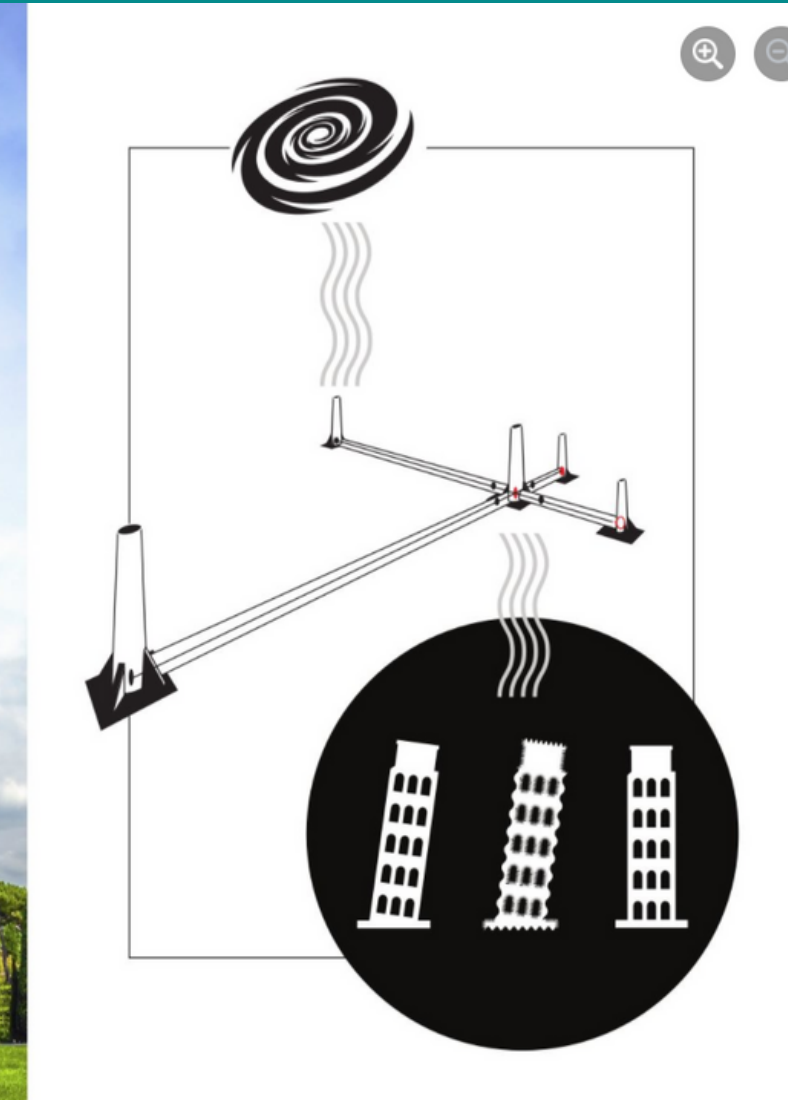
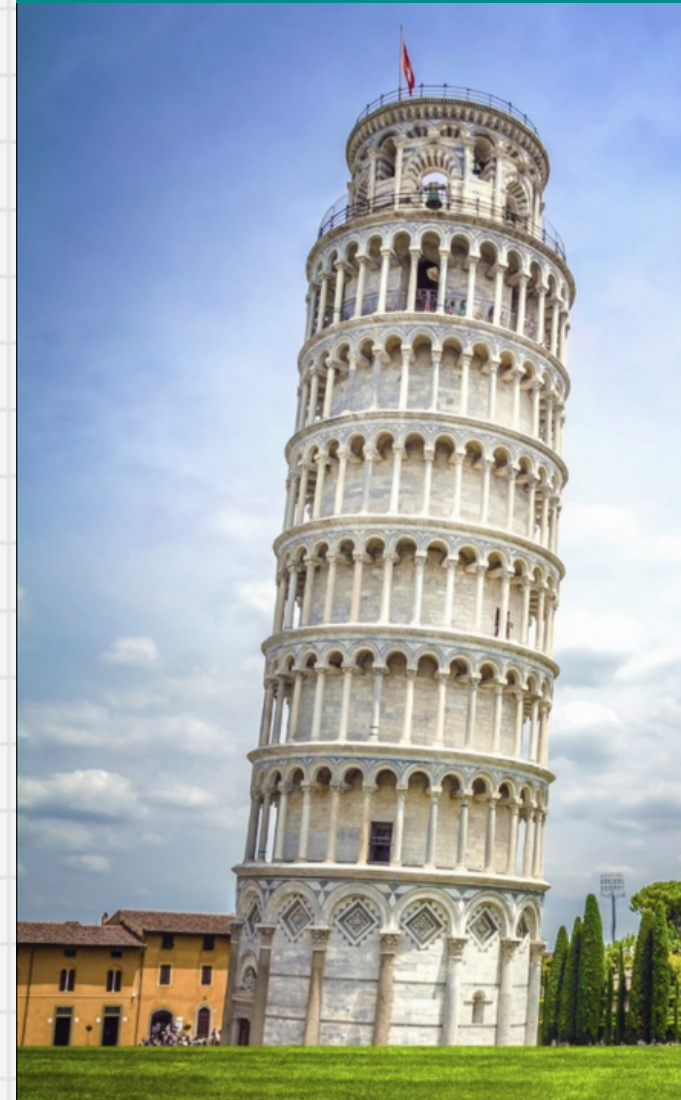


Promote

3 37 117

Reach

- = how many people your post has reached
- Heavily depends on shares and the algorithm
- Is directly related to new followers
- It's the most realistic estimate of the final audience of a post
- Things in the real world can make it change (eg. the pandemic)



17.589
Persone raggiunte

2064
Interazioni

This post

2693
Persone raggiunte

171
Interazioni

An average post of ours

The Algorhythm

- = how much your posts appear on the feeds of your followers
- It's the wild card of this game
- It ties together the previous three things, at least partially
- We don't know how it works, it is a secret, experts work on inferring things about it
- It's different for every social media, and it changes constantly

The image shows a screenshot of a Twitter home feed. On the left is a teal sidebar with navigation icons: a Twitter bird, a house (Home), a hashtag (Explore), a bell (Notifications), an envelope (Messages), a bookmark (Bookmarks), a list icon (Lists), a person (Profile), and a speech bubble (More). Below these is a blue 'Tweet' button. At the bottom of the sidebar is the EGO-Virgo logo and handle @ego_virgo. The main feed area is titled 'Home' and shows three tweets. The first tweet is from New Scientist (@newscientist) about the Yutu-2 lunar rover. The second is from ESA Italia (@ESA_Italia) about a live session with the ESA Director General. The third is from The New Yorker (@NewYorker) about permafrost. Each tweet includes a profile picture, name, handle, time, text, and engagement icons (reply, retweet, like, share).

Home

New Scientist @newscientist · 13m
China's Yutu-2, the first rover to explore the far side of the moon, has discovered significant differences from the moon's near side – including stickier soil and more numerous small rocks

newscientist.com
Yutu-2 lunar rover finds sticky soil on the far side of the moon | New S...
We haven't been able to take a close-up look at the far side of the moon until now, and the discoveries being made by the Yutu-2 rover ...

8 21

ESA Italia @ESA_Italia · 14m
Oggi alle 15:00 con la partecipazione del Direttore Generale @esa @AschbacherJosef e con @esaspaceflight @astro_matthias in collegamento dalla @Space_Station - #DavosAgenda - Per seguire: esa.int/About_Us/Corpo... #ESAWebTV

ESA @esa · Jan 18
Coming this week: Thursday, 20 January, 14:00 GMT/15:00 CET, ESA Director General @AschbacherJosef and astronaut @astro_matthias will join the 'Live from Space' session at #DavosAgenda 📍
twitter.com/wef/status/148...

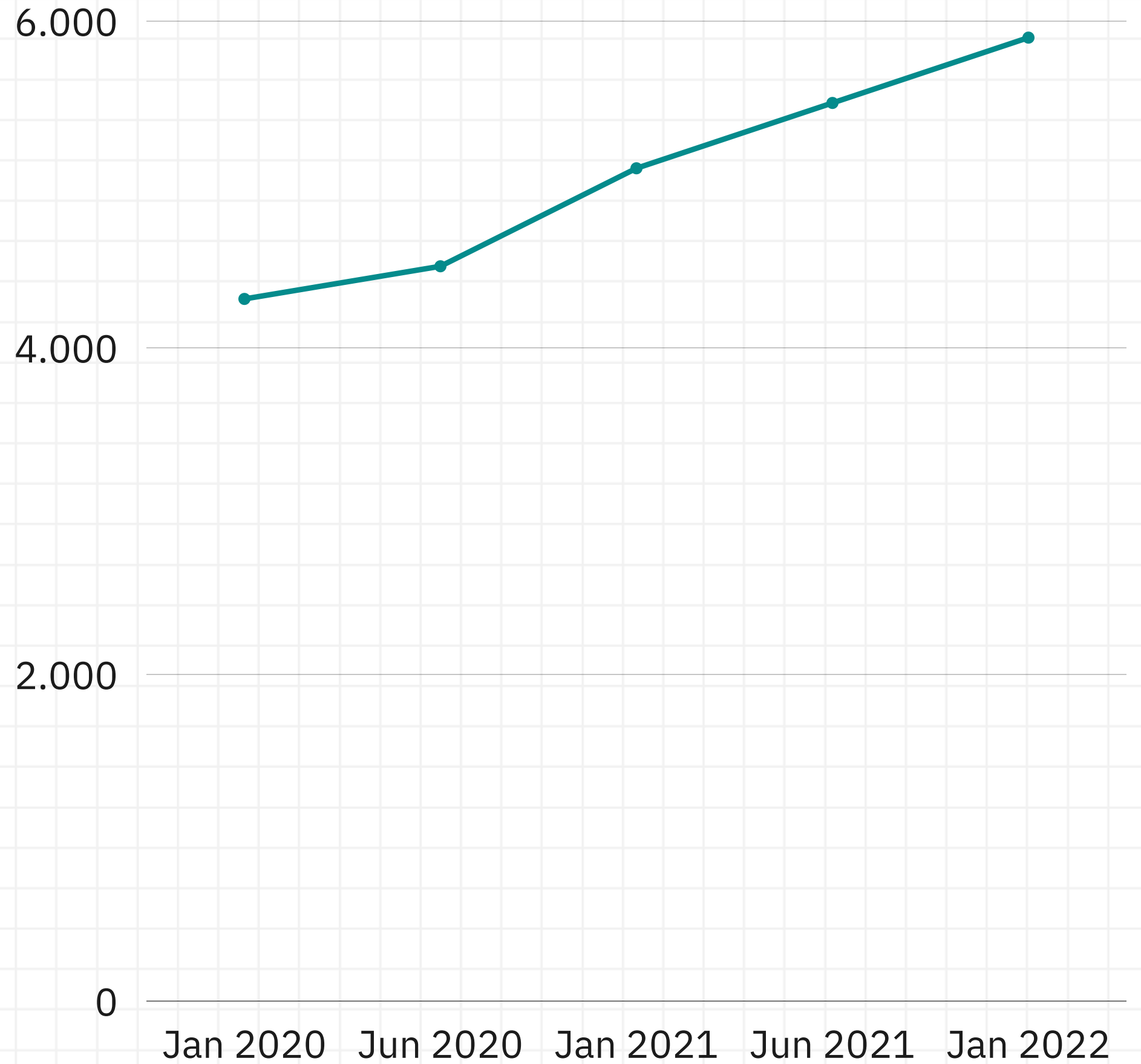
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The New Yorker @NewYorker · 15m
“There is one way to keep permafrost frozen that we know is proven and demonstrated,” one scientist said: “reducing human emissions.” Other solutions, she argues, are merely a distraction.

Our numbers

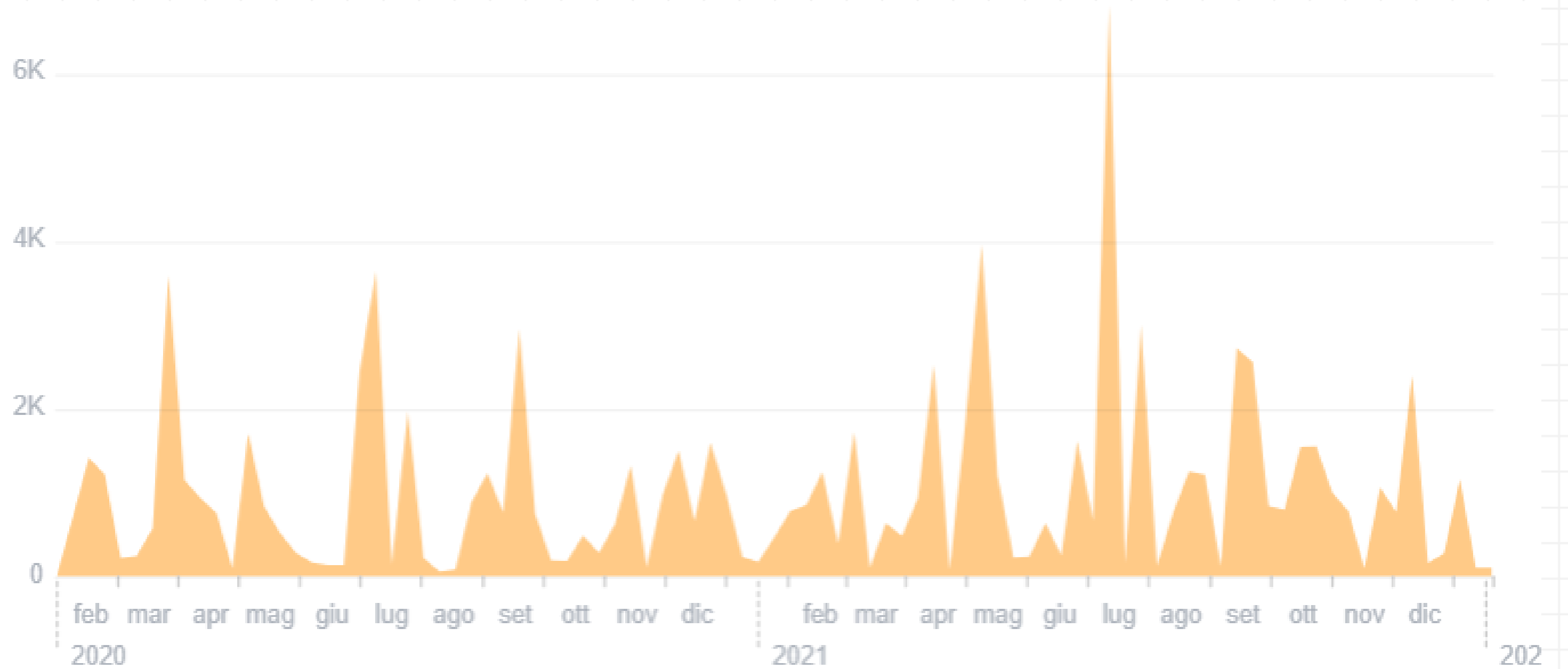
Facebook

Followers



Facebook

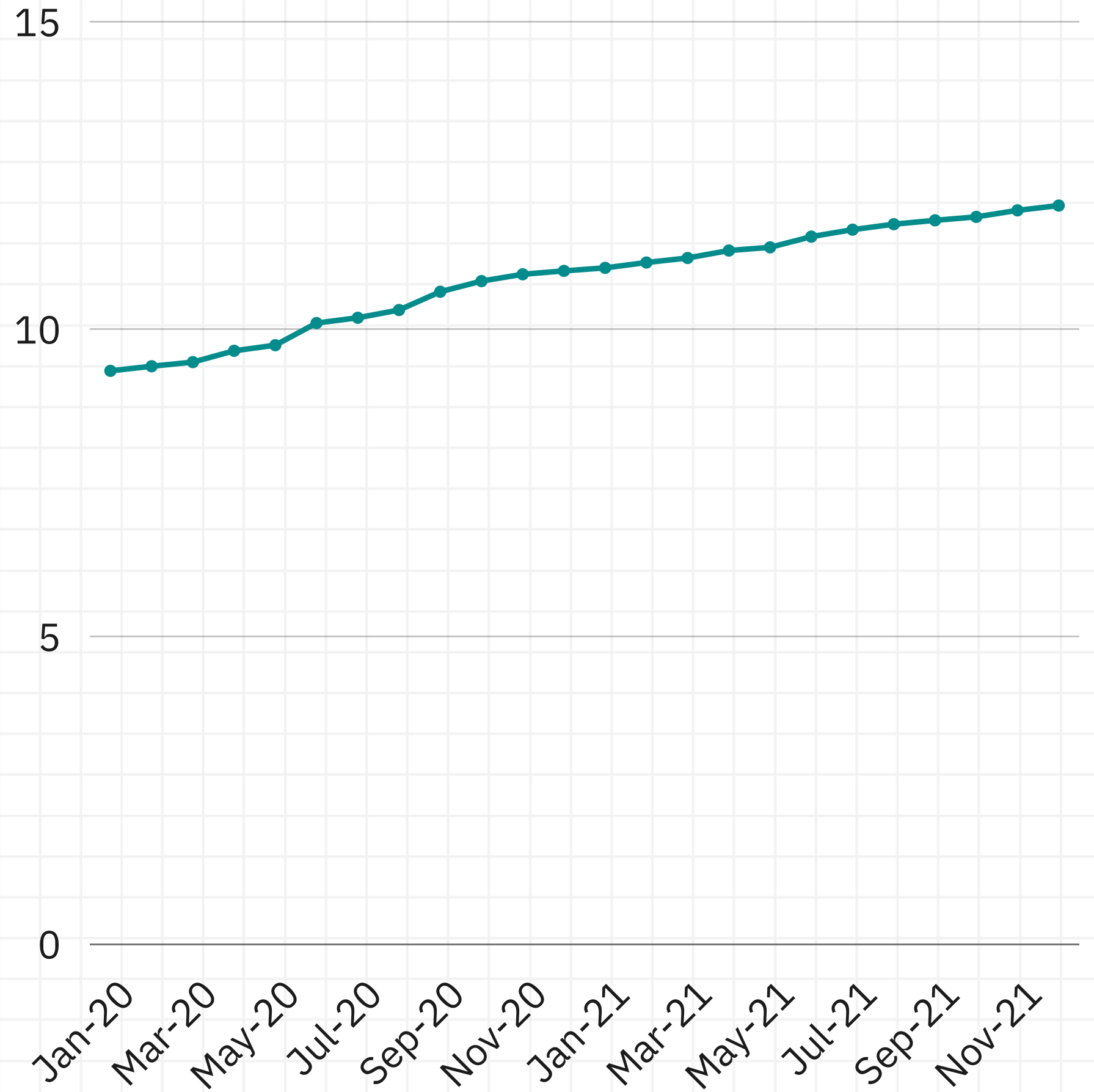
Reach



how many people have been reached by at least one post each day

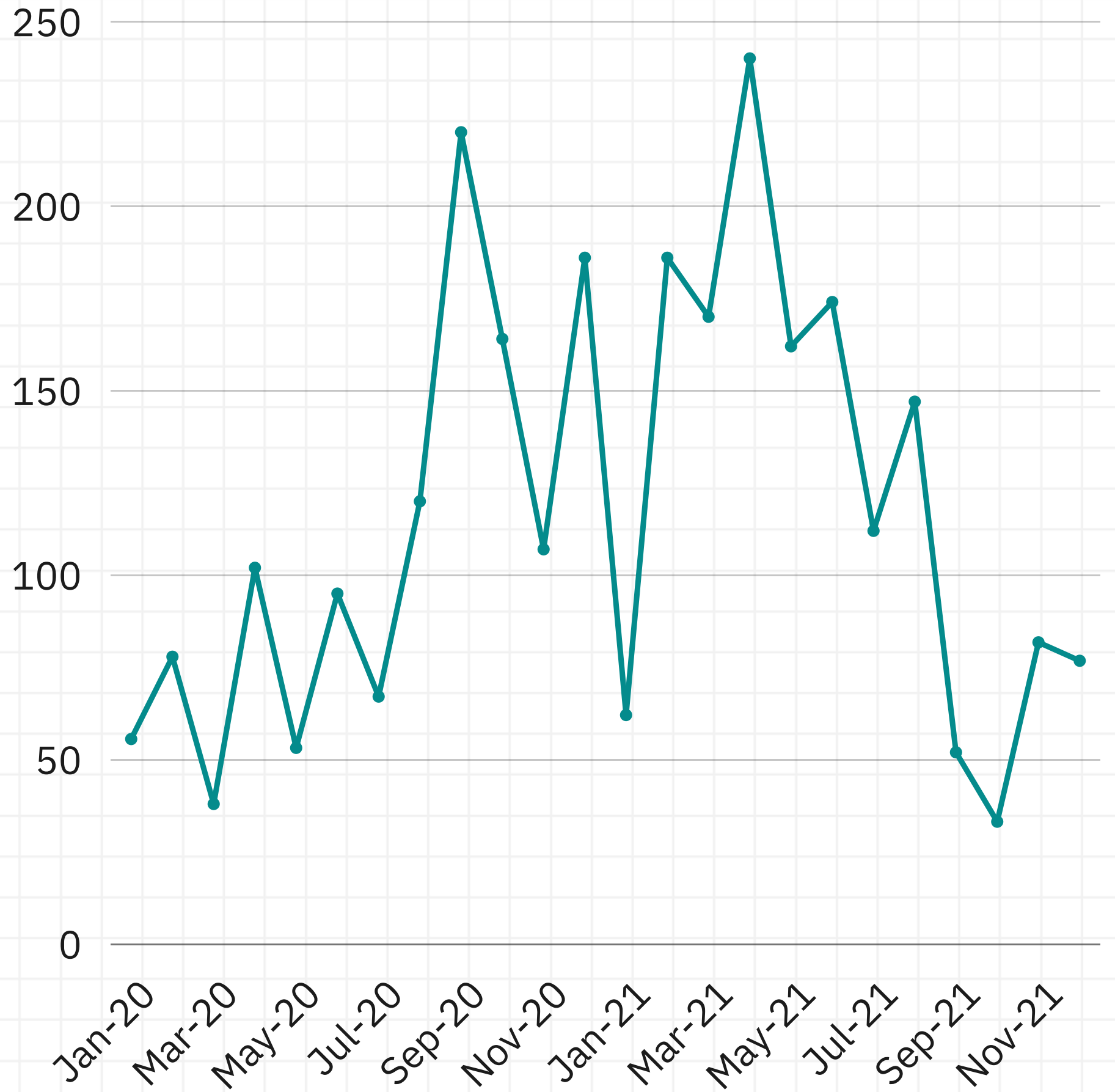
Twitter

Followers (K)



Twitter

Impressions (K)



Current status and strategies (some examples)

Targets

- different content for different targets
- but at the same time no target has to feel alienated by posts: our posts strive to a balance meeting the needs and the engagement of different targets
- to expand we need to first determine "where" (in terms of targets) we want to expand and then
- figure out how



EGO-Virgo @ego_virgo · Sep 17

Last week we fully controlled the Virgo interferometer in all its parts, in a stable and reliable way for over an hour, with an input power of about 40 W. This is called "locking the interferometer" and it's the first time it has been done with such laser power since the upgrades



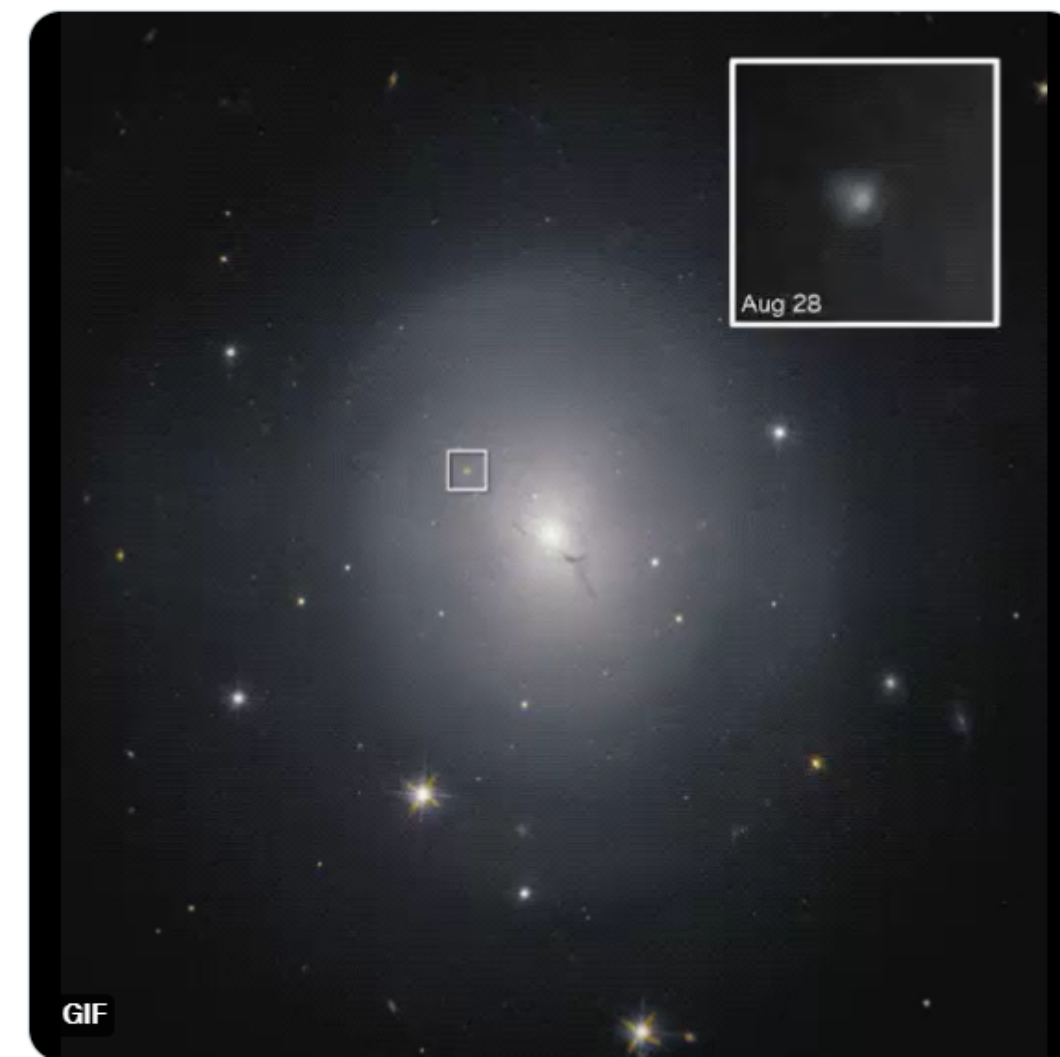
LIGO and 5 others

1 13 53



EGO-Virgo @ego_virgo · Aug 17

Exactly 4 years ago @LIGO and Virgo detected a signal that would become one of the most influential discoveries in recent astronomy, GW170817, a binary neutron star coalescence. Since the paper was published it's been cited over 3600 times, an average of 2.5 times a day!



GIF

Individuals, community, collaboration

- EGO-Virgo social media profiles are fundamentally different from individual scientist's profiles
- social media has a preference for individuals (because of parasocial relationships)
- a balance needs to be found
- **more connections and synergies between researchers' individual profiles and Virgo's one**

EGO - Virgo EGO & the Virgo Collaboration
25 settembre 2020 · 🌐

A gravitational wave detector is a very complex experiment made up of technological challenges and unique components that have to reach an optimal balance, but above all it is made up of many different research groups and people working together for the best result. Matteo Tacca tells us how Virgo manages to do it all! #VirgoInterviews

National Institute for Subatomic Physics - Nikhef
INFN - Istituto Nazionale di Fisica Nucleare
CNRS News



EGO - Virgo EGO-Virgo @ego_virgo · Nov 15, 2021
Today the @LIGO, Virgo, and @KAGRA_PR scientific collaborations have announced that, despite local and global adversities, they plan to start the O4 Observing Run in mid-December, 2022.

(Photo Courtesy: Iztok Bončina)



INFN and 4 others

Promote

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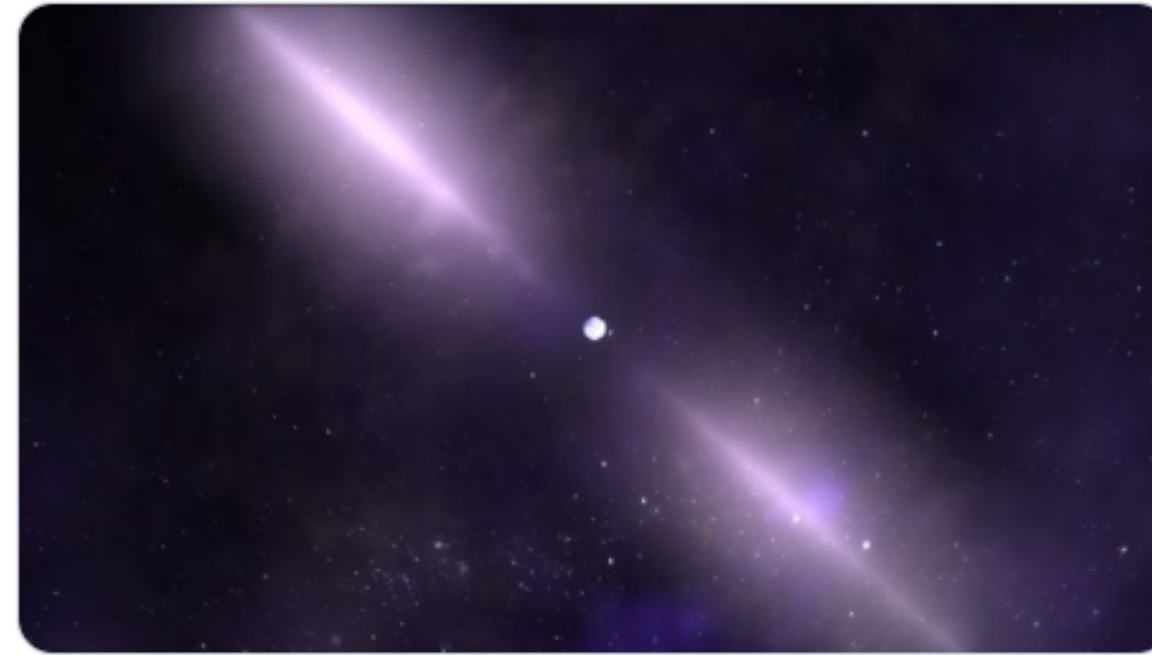
Discoveries vs. Work in Progress

- Our social media aims to highlight both new papers/discoveries and the day by day functioning of the detector
- While the first one is easier/what people expect, the second one presents more of a challenge
- Our audience has responded very positively even to the second category of posts



EGO-Virgo @ego_virgo · Dec 22, 2021

In a paper published today on [@arxiv](#) we search for gravitational waves coming from pulsars, single spinning neutron stars, accounting for the possibility that the pulsars or the GWs might be “misbehaving” (glitches, discontinuities in rotation, GW at unexpected frequencies etc)



LIGO and 5 others

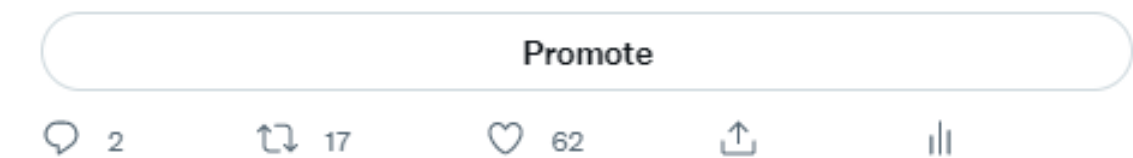


EGO-Virgo @ego_virgo · Jun 25, 2021

At the impressive sensitivity levels of an interferometric detector such as Advanced Virgo, the quantum nature of light sets the ultimate limit. During the O3 run, ‘squeezed’ light was injected into Advanced Virgo and tuned to reduce quantum noise at high frequencies.

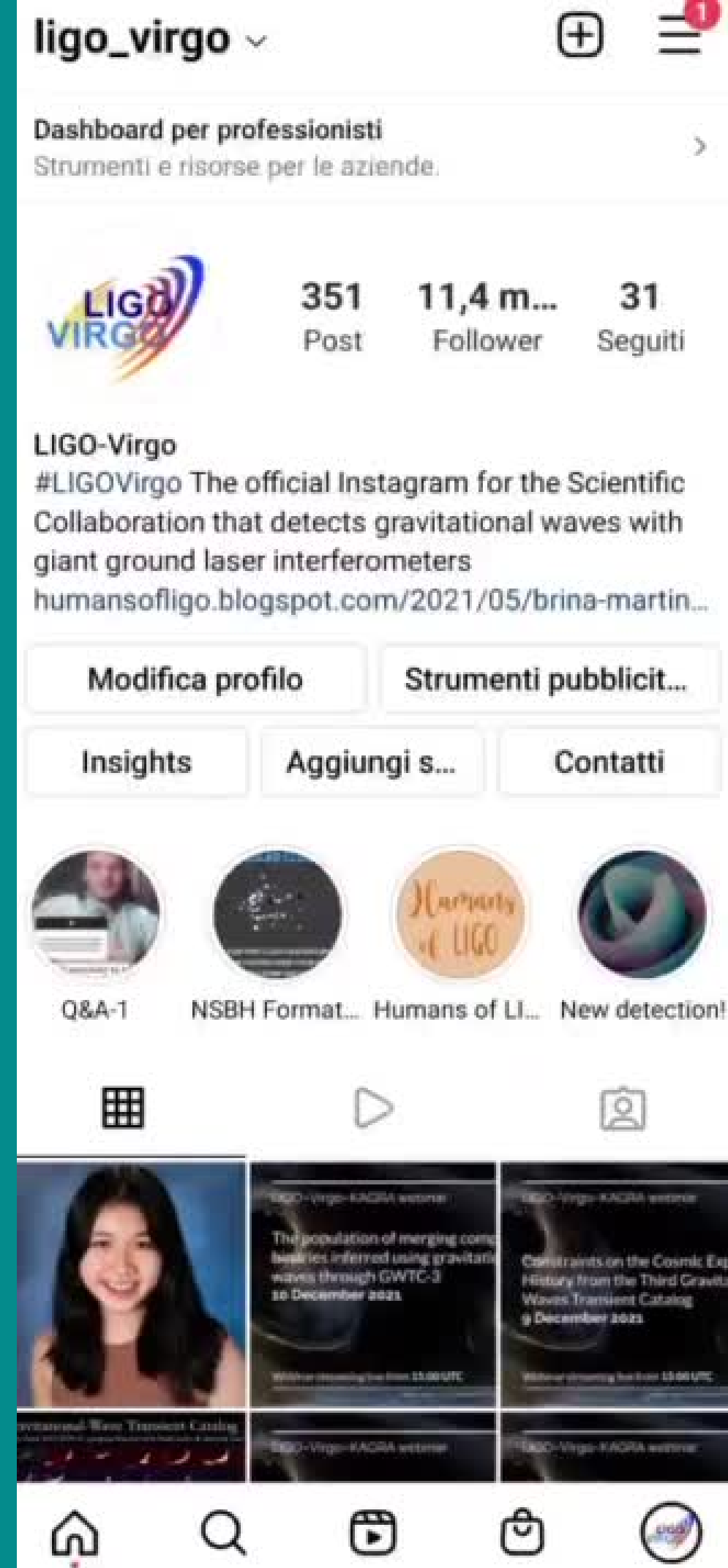


IN2P3 Les 2 infinis and LIGO India



More curated content

- Producing social media content takes time, and more curated/original content takes more time and resources
- One example: Instagram stories Q&A



Some concrete ideas

Areas of improvement

New audiences

New themes

Wider reach



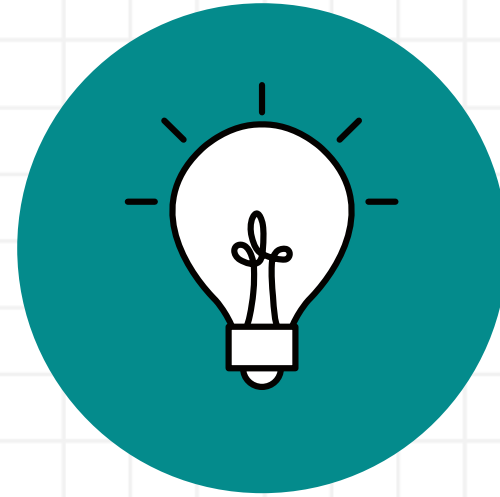
Facebook & Twitter



Engage more with the astronomers and astro-enthusiasts community

- Monitor daily what goes on in the community (~1h a day)
- Think of if and how Virgo can engage with the topic (active and timely collaboration of Virgo scientists needed)
- Prepare texts for retweets/original posts

Facebook & Instagram



Make more curated original content (eg. Instagram Stories Q&A)

- Brainstorm ideas, targets, objectives

- Discuss resources to make the content: a dedicated effort (FTE and budget) is needed.

Other social media? Tik Tok?



We could expand to other social media, most interesting candidate: Tik Tok

- Tik Tok is not, as many think, a social media for silly dances and pre-teens (even though it started that way)
- There is a big community of scientists and communicators doing outreach

- But not many institutions/collaborations, none in our field (as far as we know)
- Very challenging but interesting opportunity: original ideas could be more effective than in other contexts

3R - Reactive, Recognizable and Rigorous

- The social media requirement to expand our audience is to interact timely with the flow of social news, providing original and unique content. We also want (and have to) be scientifically rigorous.
- **This takes time and needs the involvement of researchers, able to suggest or revise content in 'real time' (partly done now in the wg2 group)**
- **Can we imagine a collective effort, with the rotating involvement of Virgo people?**
- More curated/original content takes more time and resources these resources are also needed for events, visits and other outreach activities (FTE and budget issue)
- A careful consideration of where we want to spend our resources is necessary



**Thank you for
your attention!**



Contacts

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