



LIGO
Scientific
Collaboration



Blackfoot Translation of GW190412 LIGO Virgo Science Summary
(see note at end of document)

GW190412: *maduumu**dessxgamiitsiip *anI* *matsiidumani~kugu-spiguyis sigooxga iibuutu?biiya*

tsisdabi no?guniip

ani_k matsigabisegisu *naatsigubudui*, *nixisk* [LIGO Scientific Collaboration](#) and [Virgo Collaboration](#) *nessxgatsimya* Abuduuxbiisii o?bigimskAAsts i_dubitsiiba *nAsaguuyabi* gii *nAbuutu?biya nadugaya* sigooxgiya. amu?k no?ganabi, *nitsin_gaduup* GW190412, i_tu?tsiniip nuxgayiists itu?gutsiisaduubyuyix odwitsigaduumya *udaabsduudaxiniml*: nadugayiiists [LIGO](#) itu?gutsiisaduubyuyix (miim [Hanford, Washington](#) gyanI [Livingston, LA](#)) gii mi?k [Virgo](#) itu?gutsiisaduubyuyix (*itsstiww* Casina, Italy). GW190412 *noo?gutsiisaduumyatsiya* bitsiayabodagii Advanced LIGO gii Virgo's *nuuxgl* *essxgatsimya* *oxgatsimya*, *nitsin_gadub* 03, *idumatsii* matsigabisegisu *niduxge*, 2019 gii *itsiiguya* saegisuup *natsibii_gitsigl*, 2020.

aganyup, *amustsk* nadugaya sigooxgiya *utspiguyisuwa* *niduyanisabii* mistsk *agessxgatsiip* sigooxgiyAsts. GW190412 *igu?gitsiya* ibanisdabii amustsk *utspiguyisuwaya* *matsiidumani~kugu* amuyI *iguma?gu* gii gyamu *matstsigi* iku?bugi. gyamu?k madani~kuguwAstsii *utspiguyisuwa* *aku*gitsduup* amustsk Abuduuxbiisii o?bigimskaa Iyiinapsgagii *essbumugiya* *agidAsugotsidabitsiip* gii *agidessxgwiip* myaniduiniitsi *imadanisdAtsii* *tsanitsibistsi* gii agyabi anuum spuu?ts, *manistodaku?bisuyiists* *iixsugu* sigooxgiya, gii *tsamanistsu* amu spuu?ts *Axtsiku*bi*. amustsk *noo?gitsiya* *utspiguyiists* GW190412 i_tu?tsxiniip nam Albert Einstein's bisaatsinsiimaan *ugayissxinim*; mistsk Abuduuxbiisii o?bigimskAAsts *axsabadium* o?gitsii *axsabadium*, *nidAni_gaduupya* *axdunadago?gugiya*.

tsanidessxiniip GW190412 anisdabiiw *nidabaniistabiw Abuduuxbiisii* *o?bigimskAAsts Iyiinapsgagii ?*

GW190412 *anisdabiiw* *igayisstsabiya* o?ganabii *mixiisk* *nuuxgAx* itu?gutsiisaduubyuyix. muuxsk *nuuxgAx* itu?gutsiisaduubyuyix *iku?ganAbistsiia* gii *no?ganAnimya* *niduiidanistasiiya* mu?k *uudaayiinapsguuguwa* ixugabi ibanisdabii amu?k *aku*tsxinimya* i_duutstsi spuu?ts gii *madanisdabi* *isstsabii*.

amu?k *agAdudu* *axsabadium* *awAstamatsugii* mu?k GW190412, *nidAni_gaduumya* sinaxin *Astamatsugii* *axsabadium* isawaiidagiduup (*itsiinAp* sinaxin *niduuxge*). *imadannistsii* GW190412 *ixgunadabi* i_tsatsimya "guwapssiniix" agooxtsiimaan miim Hanford gii Livingston itu?gutsiisaduubyuyix, ni *do?gwigiya* *axabaduup* *esstanistasii* *nitsidesatsiibinnaan* agooxtsiimaan mustsk Abuduuxbiisii o?bigimskaa *uudaayiinapsguuguwa* gii *idessxgatsimya* ududamabii.

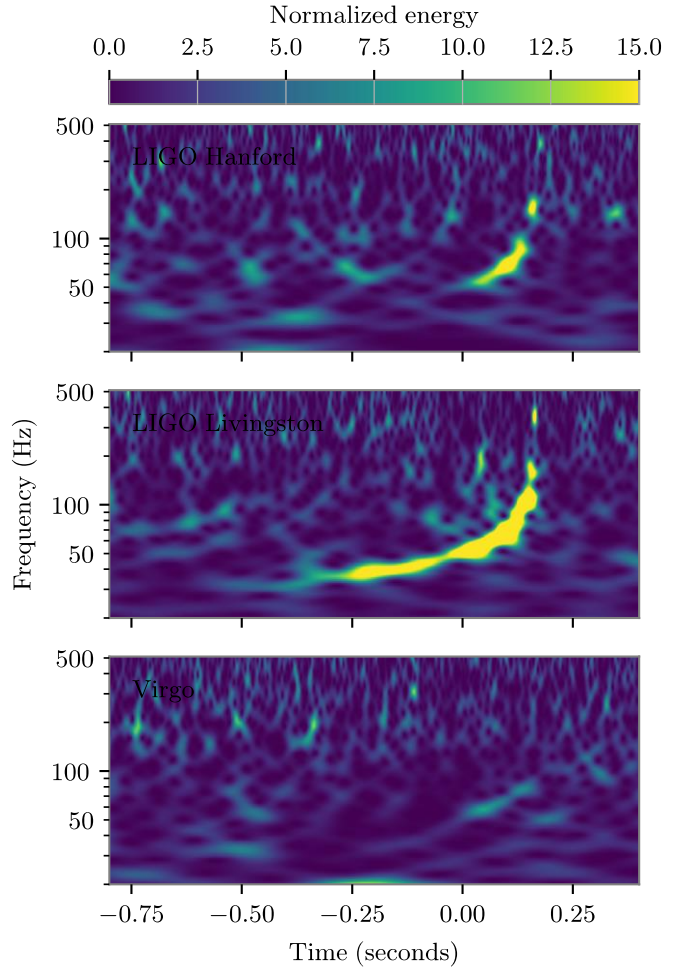


Figure 1: The spectrogram of GW190412 in the three gravitational-wave detectors. The horizontal axis represents time, and the vertical axis shows the frequency of the signal. Color represents the amount of energy in a certain frequency at a certain time. The familiar “chirp” can be seen from this signal as an increase in frequency and energy over time, resulting from the increased power of gravitational-wave emission as the two black holes orbit closer and closer (the “inspiral”) and subsequently merge.

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<http://www.ligo.org>
<http://www.virgo-gw.eu>



gyamuustsk *essdagiists* *esssagaduup* *aganistsiists* i *dodagiya*, *idA*buut?duumya agooxtsiimaan *essxgamiists*tsiists gii *ayimada* *Iy*inapsgagiists *üg*ayissxinimya, i *du*sttsii bisaatsinsiimaan. *nitsü*dessxgatsibinaan amuu *Iy*inapsgagii idudabii isstsabii miix itu?gutsiisaduubyuyix *nidani* gadubinaan *ag*itsip~atsabii *madumanabii* *Asetsigabixi* tsanidoxuu?si. *nitü***do*?gwiigin_binaan agooxtsiimaan ani_k matsigabisegisu *nanisui* gii *udA*dpsttsii matsigabisegisu *nanisui*gubudus, *nitü**gunibinaan *madumanabii* *Asetsigabixi* tsanidoxuu?si *niduxge* o?ganabi aganyuup stunatsisamuu! amu?k *madumanabi* *Asetsigabixi* tsanidoxuu?si *igaku** ododomsii *ayessatsiip* agooxtsiimaan mu?k 03 *ayessxgatsiip*. *nimats*satsibinaan *mats*sigii *idex*istsgum gii *ido*?ganop* *uutsu*?guunimanuwa *ayists*inabiists, gii *mats*itsip nogabiists agidugamuudanyup ixsgabi mu?k itu?gutsiisaduubyuyix *gyL*~ *idessxgatsimya* mu?k GW190412.

Astamatsaa mu?k GW190412

amuxk *spiguyis* nadugaya sigooxgiya mu?k GW190412 *nidü*yaanistsiia mistisk *nig*Asatsibinaan *ayoxgatsimsin* — amuu *niduxge* sigooxgiya aganyup *igu*tsistsguma?gu nah nadus, *niiü*buu nadusiix gii amuu *stigi* sigooxgiya *no*?bugi, *nanisui* nadusiix. *udayessxgatsibuwa* amux *nadugayiists* manists*spiguyis*, GW190412, amuu *stunaduma*?gu gii anai iku*bugi, *no*?gitsiya i_t**du*uttsiya miistk sigooxga *iibuutu*?biya. gibui *tsaniiduu*?gitsii sigooxga *iibuutu*?biya *nits*atsibinaan *nidü*yaanistsiisa mu?k *spiguyis*, anii GW190412 aganyup *nyuxgoma*?gu.

anii *matsü*dumani-kugu *spiguyis* GW190412 *nitsid*abskuginaan nu?gitsii miistk Abuduuxbiisii o?bigimskaa abatseegiiduyii *nidum**dotsidabitsibinaan *nidA*natsi spuu?ts. *nitsxgatsiip*binaan aganisduup iixgunadabiists amuu *niduxge* sigooxga oda~ku*bii gyamuu matsiik sigooxga iduuttsiw nu?gadoda~ku*bi gii *idodaguuya*. anistsii *matsi*dumani~ku*gustsü *spiguyis*iists mu?k GW190412 *nidA*ximsta?binaan anl uma?gu *igigixidabii*. iixgunadabiists oda~ku*bii gii *spiguyis* oxtsimaniists i_d*Ats*ganyup mu?k GW190412 (*itsin*Ap sinaxin *naduge*). *nimadessatsibinaan* amu?k *itsü*_daan Axtsiku*bi, *matsxin*binaan anistabii. gii umatsi*dumani*~ku*gustsü madebuumskadagyup mi_k tsaanitsibyyu gii adapudiiimop amuu *itsü*_daan, *agitsuku** issxgwiip *nadugaya* *niduin*tsi. GW190412 itu?gabii *stunait*sibi_bi anum xa?gui!

ayu?tsiip *essduni* gii i *bugAni* gi

bisadabii mu?k GW190412 ododomsii *ibanis*dabii *awAstamatsugi* mustsk Abuduuxbiisii o?bigimskAAsts. *idumadaabi* nam Einstein *udabudaxin* gii Asamu *itsugabistutsimya* miixsk Newman, Penrose, Thorne gii *igag*Adabiya, Abuduuxbiisii iesstuumskuutsp i_d*ots*tsii inaku*tsiya gii *igess*suguya nadugisstsii *Astamatsugi* no?k abatseegiiduyiia o?bigimskAAsts. i_d*ots*idabitsiip *igamesxinuwa* miixk Asatu**dugi*, gii ota?gwiigyup n*l* Asatstsüimigya agitu*d*As*apsgabada n*l* ixtu**dugi*, *axistsiwada* *essbini_giya*. gyamustsk *axdunadago*?gugiya *igayigu a*?gitsotsipyia amusts *Iy*inapsgagi miistk sigooxga agitu**niduyanisdabi* spiguyis. madani-kugu*Aw*astsii *spiguyiists* mu?k GW190412 iku*d*Asugu*?tsimop miistk *Iy*inapsgagi Abuduuxbiisii o?bigimskaa abatseegiiduyii. agooxtsimaaniists *awAstamats*daya *essbi_bugAni* gi anii *Iy*inapsgagi. *issu*?tsiigi aganistsii amustsk *essbi_bugAni* gi *dagess*bumuginaan ma?gidotsistabitsiip axibuttsiia sigooxgiya. istu?tsixiists *nidanisdutsibinaan* na?gitsxiniip igamu* *mats*igyabiwa bisaatsinsiimaan. *matu*?gunima?binaan mu?k bisaatsinsiimaan, imanii nam Einstein.

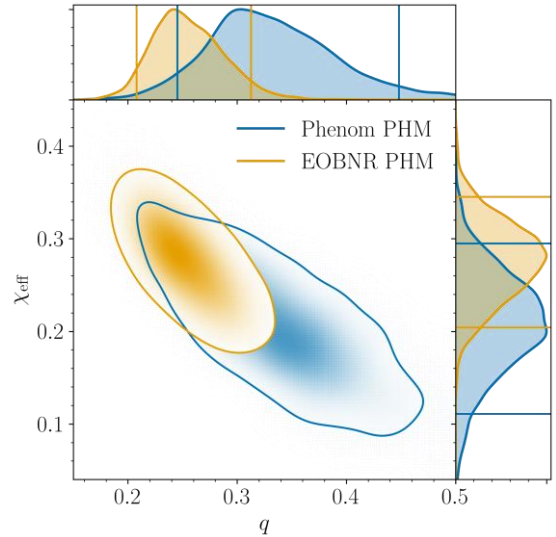


Figure 2: The inferred mass ratio (q) and effective spin (χ_{eff}) of GW190412. The orange and blue contours show the distributions on the parameters recovered using two different waveform models, which make slightly different approximations for modeling the true general-relativistic signal.

GLOSSARY

Black Hole: An object so compact that not even light can escape its gravitational pull.

Compact Binary: A system made of two compact stellar remnants, e.g. neutron stars or black holes.

Effective Spin: The best-measured parameter encoding spin information in a gravitational-wave signal. Formally, it is a mass-weighted projection of the individual black hole spins in the direction of the orbit of the two black holes.

General Relativity: The theory of gravity proposed by Albert Einstein in 1915. In this theory, space is like malleable fabric that bends in the presence of matter and energy, and objects follow trajectories through this curved space.

Higher Multipoles: Emission from gravitational waves can be described as an expansion of “spherical harmonics”. Higher multipoles are terms in this expansion beyond the dominant, quadrupolar term.

Inclination: The tilt of the orbiting black holes with respect to Earth.

Matched Filtering: A technique to detect signals buried within noisy data. Templates of gravitational waveforms calculated from general relativity are scanned across the data, and ring off when matching patterns are found in the data.

Precession: Due to conservation of angular momentum, when black holes are spinning in a direction different than the orbit of the binary, the plane of the orbit will rotate (“precess”) around the direction of the total angular momentum.

Quadrupole: The strongest of the multipoles for gravitational-wave emission from a compact binary. Thinking of these waves as the “sounds of spacetime”, the quadrupole emission is the fundamental tone. The name refers to the emission pattern in different directions; for comparison, a simple radio antenna sends out a dipole as its strongest emission.

Spectrogram: A time-frequency-energy representation of time-series data. The strength of individual frequencies are shown as colors.

Waveform: A theoretical gravitational-wave signal produced using approximations of Einstein’s general relativity.

abAstutsiip amui matsiidumani~kugu *spiguyis* nadugisstsii sigooxgiya

*nido?*gwisxiniibinaan *ayox*gaduminaan amustsk istu?tsixiistsmiim Advanced LIGO gii Virgo udaabsduudaxin *nino?*guniibinaan maniists gii idamidagii u?ku*tsisadI amuu myanistsii bugiists nadugisstsii. *maduum*stsix nadugisstsii sigooxgiya *itsii*_daan anii *stunaduma?*gu gii anai iku*bugi, GW190412 *nidA*stamatsuginaan ododomsii agooxtsiimaan *nidumu**dotsidabidaxinaan nadugisstsii sigooxgiya manistA gasbya. amu?k *nitsinn*apsinaan madani~kuguwAstii *spiguyi*ists *igagawuya*, gii dagatsiniipinaan mats*tsigi* issu?tsiigi.

gyamusts Adabsuxinimya *gagadusiix* manibugAsts idabesspsabiix abAstutsimya manistsnim itu?bugabistutsii amustsk nadugisstsii sigooxgiya *agomadabanstsi* miim spuu?ts, gii *manists spiguyis* gii mats*tsigi*. *nixi* manistsnim itu?bugabistutsii Astamats*ugi* nadugisstsii *niduyanisdabii igagagawuya* nixi mats*tsigi* awaniya *igagagawuya* amustsk *itsii*_daan *anisduub* GW190412, aganyup matsiidumani~k*gu. amustsk *itsii*_daan *igayissxinimya* awaniya *igaku*inaku*ts*tsiia. *esxgatsimya udayesxgatsibuwa* mu?k GW190412 *madu?*kgiku*gabi, *aganimya* gibui o?ganabiists. *gyamusts nidAnibinaan* Abuduuxbiisii-o?bigimskaa spuu?ts gii agomidabagawu miistsk doxdubinaaniists iku*bugiists nadugisstsii *iibuutu?*biia, *nidanistsii*ximsta?binaan na?gatsinisinaan *igagagawuya itsii*_daan *nidagitsiidabsuxxinibinaan* amuu *gagadusiix* Abugaasiix, iku*bugiists nadugisstsii idAstuwassii, gii *utsidomAydakibuwl esssatsimya tsiimai_duutstsi* naduusi gii *gagaduusi*.



Blackfoot Translation By: Sharon Yellowfly (Siksika Nation)

This Blackfoot translation of a LIGO-Virgo Science Summary was made by Sharon Yellowfly (daughter of Percy Yellowfly & Cecile Yellowfly [Sleigh] & mother of LSC member, Corey Gray). Sharon grew up in the Little Washington community of the [Siksika Nation](#) in Alberta, Canada. Blackfoot was her first language. She began working on making a Blackfoot Dictionary in the 1970s when she noticed the pool of fluent Blackfoot speakers declining and not many language resources available. Her dictionary & the Blackfoot Pronunciation Guide below come from her language work several decades ago. She made this dictionary for her children.

In recent decades there has been a revitalization with Indigenous language work, and there is now Blackfoot language curriculum available and used within and outside of the Blackfoot communities. You will notice variations in this current curriculum and Sharon’s dictionary. Sharon made her dictionary utilizing her B.A. in Anthropology & background in linguistics. Sharon is very happy to see the resurgence in Blackfoot language, and is very proud of all the teachers teaching our language to Blackfoot youth.

Blackfoot Pronunciation Key For Vowels, & Other Symbols:

<u>BLACKFOOT</u>	<u>ENGLISH</u>
a	<i>father</i>
i	<i>eat</i>
u	<i>book</i>
e	<i>let</i>
o	<i>go</i>

x - <i>six</i>	? - glottal stop
A - <i>acorn</i>	_ - as in ‘ <i>he</i> ’ but held a little longer
I - <i>ice</i>	* - <i>who</i>
	~ - (not quite a full glottal stop) as in ‘ <i>cotton</i> ’
	[bold letters] - inflection