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A Nobel for Détente?

Laser and scientific internationalism in the Cold War

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The Nobel prize in physics for 1964 was one of a few controversial awards given by the Nobel Committee. The controversy surrounding that prize may be summarized in the following quote by Theodore Maiman, the man who actually made the first laser work, but was left out of the prize: "[The Nobel Committee] did not do their homework. It would have made more sense to recognize the Russian physicist Fabricant."[1] Maiman was certainly aggrieved for being left out of the prize. As historians we should not take his words for granted. To judge whether or not someone did a homework well we need to take in account several factor, the most important being to know what exactly the homework was. And that is what I am going to discuss in this paper.

The paper is organized in the following way. First, I will discuss the Nobel Prize of 1964 in physics and what is controversial about it. Then, I will talk about Nobel Prize and Politics and how taking politics in account might help us to make sense of the 1964 physics prize. Finally, I will present some preliminary results of archival research.

The Nobel Prize of 1964 was awarded to Charles Townes, Alexander Prokhorov and Nikolai Basov "for fundamental work in the field of quantum electronics that has led to the creation of oscillators and amplifiers based on the maser/laser principle". The first was a leading American

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[1]Graham, L. R. (2013). Lonely Ideas: Can Russia Compete? (ebook). Cambridge: MIT Press.

physicist based at Columbia University, and the other two were prominent Soviet physicists based at the Physical Institute of the Soviet Academy of Sciences, in Moscow. Townes got half of the prize and Prokhorov and Basov shared the other half.[2]

The maser/laser principle is easy to grasp. In its core are the two quantum mechanical effects called spontaneous and stimulated emissions. According to quantum mechanics, electrons within an atom, or molecules, may occupy only well defined energy levels. To change energy levels, they must absorb, as in Figure 1, or emit a photon. Thus this excited atom in this upper energy state may emit a photon and move to the ground sate. That is spontaneous emission. However, as Einstein showed in a paper in 1917, we may stimulate that atom in the upper state to emit radiation and move to the ground state by irradiating it with a photon of frequency equivalent to this energy difference (Figure 2).

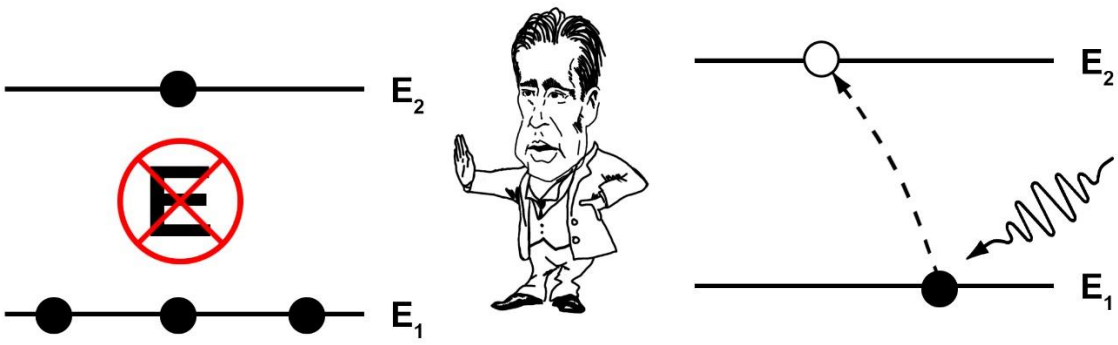

Figure 1. According to quantum mechanics, the region between two energy states (E_1, E_2) is a forbidden zone. An electron may change energy level when the atom absorbs a photon. Designed by Daria Chusovitina.

[2]The Nobel Prize in Physics 1964". Nobelprize.org. Nobel Media AB 2014. Web. 3 Apr 2016. <http://www.nobelprize.org/nobel_prizes/physics/laureates/1964/>

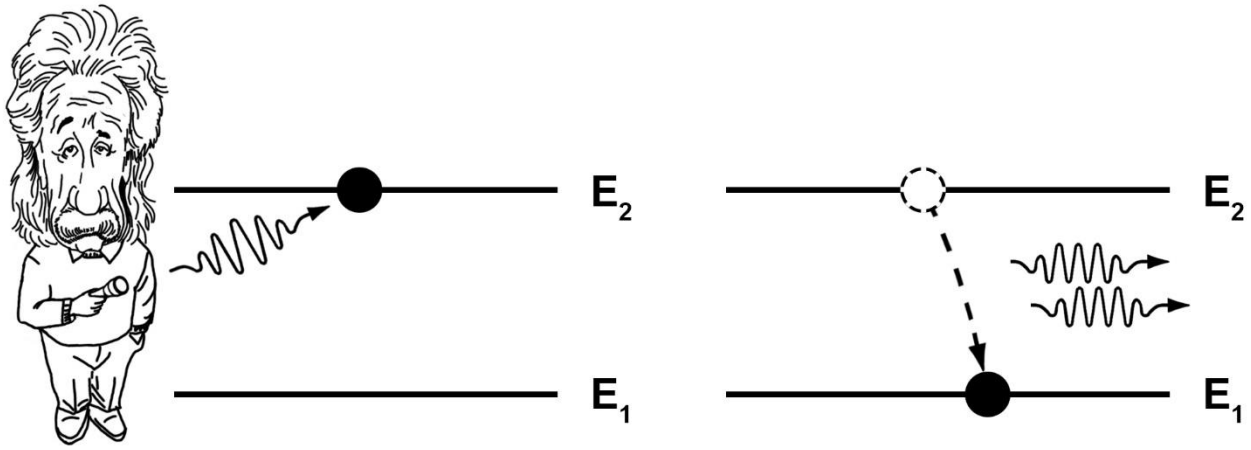

Figure 2. Stimulated emission. An electron in the excited state may be stimulated to emit by another photon with the same energy. Designed by Daria Chusovitina.

The merit of Townes, Basov, Prokhorov, and other physicists, was the realization that those effects could be exploited to devise very sensitive amplifiers and powerful generators of radiation. For that, one would need to find a laser medium in which most of the atoms, or molecules, are in the excited state and a high-quality cavity to confine the radiation. When one of these atoms emits, it stimulates others to emit, and as the radiation bounces back and forth, it grows in intensity. Nowadays, it seems easy, but back in the 1950s physicists had a hard time trying to find proper medium and a way to excite most of its molecules. Devising a high-quality resonator was also not an easy task.

In the early 1950s Townes in the US, and Basov and Prokhorov in the USSR independently came up with the idea of separating excited molecules from ground-state molecules in a molecular beam. And once the molecules are separate, they would send only excited molecules into a microwave cavity in which the radiation would be confined. That is how they came up with the maser, which is like a laser, but emits microwave radiation. Townes and his collaborators managed to build the first maser in 1954, and Basov and Prokhorov published a theoretical explanation of that

device that same year, and built their own a little later.[3]

However, the invention of the laser, as most of important inventions in the history of sciences, was not a product of two or three bright minds. It was the result of the work of several scientists and engineers. Masers attracted a lot of attention in the 1950s and many scientists dedicated their time to development and application of masers. Several men contributed somehow to that end, most of them, as we will see, were nominated to the Nobel prize for their laser work. The exceptions are Valentin Fabrikant and James Gordon, interestingly enough, two of the earliest pioneers.[4]

Fabrikant is now acknowledged as the real pioneer in the invention of the laser. That is why Maiman said it would have made more sense to award him the prize. He stated that atomic or molecular transitions could be used to amplify light as early as 1939, in his doctoral dissertation. He was also the first to observe experimentally the phenomenon using a mixture of mercury vapor and hydrogen. What he did not consider was using a resonant cavity to sustain oscillations.[5]

James Gordon was Townes PhD Student whose dissertation was precisely the maser. We will talk a little more about him in a minute, but first lets see who were the other candidates. Besides them, Joseph Weber, a physicist from University of Maryland, gave the earliest public presentation on the principles behind the maser. Townes was part of the audience and, some have claimed, was probably influenced by the presentation. Nicolaas Bloembergen, a Harvard Physicist, proposed the three-level maser, the first step towards solid state masers. Arthur Schawlow was co-author with Townes of the paper that is considered to be starting salvo of the race to make the first laser. In 1981 Bloembergen and Schawlow shared the Nobel prize "for their contribution to the development of

[3]Silva Neto, C. P. (2015). Red Descendants of Apollo: The making of Soviet laser physics. PhD Dissertation: Universidade Federal da Bahia/Universidade Estadual de Feira de Santana, Salvador, Brazil.

[4]Bromberg, J. L. (1991). The Laser in America, 1950-1970. Cambridge, Mass: MIT Press; Hecht, J. (2005). Beam : the race to make the laser. New York: Oxford University Press.

[5] Lukishova, Svetlana G. 2010. “Valentin A. Fabrikant: Negative Absorption, His 1951 Patent Application for Amplification of Electromagnetic Radiation (ultraviolet, Visible, Infrared and Radio Spectral Regions) and His Experiments.” *Journal of the European Optical Society: Rapid Publications* 5 (September): 10045s.

laser spectroscopy".[6] Finaly, Theodore Maiman was the man who actually built the first laser.

Each of those men gave important contribution to the invention of the maser. The list is long, longer than this, and I do not have time to talk in detail about everybody. I will just talk a little more about Gordon.

James Gordon is curious absence in the nominations. Townes himself thought James Gordon deserved the prize and gave part of the money to him. And he, Townes, later said: "I worked with him, but it was really Jim who made it work".[7]

Indeed, between the "early-morning epiphany" on a park bench in Washington D.C., in the spring of 1951, when Townes took the first notes that would lead to the maser, and the moment Gordon broke into a seminar room announcing that he had finally obtained the long-sought oscillations, in April 1954, the concept of the device evolved from a generator of 5 mm wave, to a spectrometer and amplifier of 1.25 cm wave. Along that evolution Gordon was the main driver.

Why, then, he did not get the prize? Some speculate that he was left out because he was a student. But Basov too was a student. Others speculate that he was left out because the Nobel could be given to a maximum of three people at a time. But, then, why not o leave both students out? It would be more fair. Gordon, like Basov, was the first author of the first papers on maser. Gordon, like Basov, was the one who delivered the first public lecture on maser. Why not to leave both students out and to include to include Weber in the prize?

My hypothesis is that to explain the committee's decision we need to consider two major factors:

First: At the time of the award Townes, Basov, and Prokhorov were highly regarded in

[6]"The Nobel Prize in Physics 1981". Nobelprize.org. Nobel Media AB 2014. Web. 3 Apr 2016. <http://www.nobelprize.org/nobel_prizes/physics/laureates/1981/>

[7]Martin, D. (2013). James Gordon, Who Paved Way for Lasers, Dies at 85. The New York Times, p. B10. New York. Retrieved from http://www.nytimes.com/2013/07/28/science/james-gordon-dies-at-85-work-paved-way-for-laser.html?_r=0

their communities. Their status were significantly higher then the status of all other scientists in the rank.

Second: They had developed friendly and effective cooperation across the Iron Curtain. Despite being leading figures of the scientific-military industrial complexes of their respective nations. Townes, Basov, and Prokhorov could be held as exemplars of scientists collaborating across the Iron curtain. Laser physics itself, in the words of Zhores Alferov, a pioneer of Soviet laser physics, was considered "a rare example of an open and friendly competition between Great Powers".[8]

How did I form those hypotheses? Along the last century, Nobel prizes have raised a lot of controversies. The most controversial are the prizes for literature and peace. But the prizes for sciences had their share of controversies.

If you google "Nobel Prize and politics" today you will discover that Donald Trump, the man who wants to force Mexico to build a wall on the borders with the US, was recently nominated for the next Peace prize.[9]

A lot has been written about the Nobel prizes, but I will briefly mention two books that are well documented and comprehensive. The first one in *The Nobel Prize: a history of genius, controversy, and prestige* by Burton Feldman. According to Feldman: "At the height of the Cold War, from about 1950 to 1970, the Nobel jury found itself dogged by politics as never before. The media, East and West, were eager to turn Nobel awards into simulacra of Big Power hostility or détente."[10]

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[8]"Zhores I. Alferov - Biographical". Nobelprize.org. Nobel Media AB 2014. Web. 3 Apr 2016. <http://www.nobelprize.org/nobel_prizes/physics/laureates/2000/alferov-bio.html>

[9]Sola, Katie. 2016. Why Donald Trump's Nobel Nomination Shows The Prize's Vulnerability. Forbes. Retrieved from: http://www.forbes.com/sites/katiesola/2016/02/03/trump-nobel-prize/#63b81be2100f

[10]Feldman, Burton. 2001. The Nobel Prize: A History of Genius, Controversy, and Prestige. Arcade Publishing. p. 76.

One might think that the controversies are restricted to the prizes of literature and peace, because the choices are more subjective, but in the book *The Politics of Excellence,* Robert Friedman makes the strong case that the Nobel Prize has little to do with scientific eminence and much to do with political power and manipulation. According to him: "´[his] book breaks the illusion of the Nobel Prize as being an impartial, objective crowning of the best in physics and chemistry… it explores the history of why and how various people used the Nobel Prize to further their own scientific, cultural, and personal agendas."[11]

How that relates to our story? 1963 was the apex of the Cuban Missile Crisis, one of the tensest moments of the Cold War. If one were to use the physics Nobel Prize to help cooling down the tensions, there could hardly be a better choice of laureates. Because the prize bought to the spotlight a friendly cooperation between scientists on different sides of the Iron Curtain.

In June 2002, few months after the death of Alexander Prokhorov, Charles Townes expressed his "admiration for Aleksander [sic.] Prokhorov as a great scientist and enjoyable personality", describing their exchange in the following terms:

> "I first met Sasha in 1955 at a scientific meeting in England, and immediately enjoyed his company and talking with him about science. I had already read some of his publication on microwave spectroscopy, but was fascinated to learn at that time of his work towards a maser... I also enjoyed an early visit to Russia on his invitation, visiting his dacha and collecting mushrooms..."[12]

Sasha is the informal, shortened form of Alexander. In Russia, among adults, used only to address family members or close friends.

Shortly after his first visit to Moscow, Townes paid back the courtesy during Prokhorov's first visit to the USA, at his invitation. In 1992 Prokhorov's wife wrote that "the relationship [with

[11]Friedman, R. M. (2001). The Politics of Excellence: Behind the Nobel Prize in Science. New York: Henry Holt & Company.

[12]Letter read at the International Conference on Quantum Electronics held in Moscow in 2002. Reprinted in Shcherbakov, I. A., Mikhailova, G. N., & Prokhorov, A. K. (Eds.). (2006). Alexander Mikhailovich Prokhorov. Vospominaniia, Stati, Interviu, Dokumenty. Moskva: Fizmatlit. pp. 480-481.

Townes and his wife] up to now is very good. Townes visited our home and our dacha. In turn, during my husband's trip to America Charles invited Alexander Mikhailovich to his farm on the outskirts of New York."[13]

That first trip of Alexander Prokhorov to the United States happened in 1959, when he traveled with Basov and two other former graduate students to the USA to take part in a conference organized by Charles Townes called *Quantum Electronics – Resonance Phenomena*. The conference took place at Shawanga Lodge, a resort about 100 km away from New York City, from September 14 to 16. That conference, for many reasons, is considered a milestone in the history of the laser. It was the first conference in Quantum Electronics. The organizers invited every one who was anyone in maser research. There were about 185 scientists from 9 countries. Besides US and USSR, they came from Britain, France, Germany, Holland, Israel, Japan, and Switzerland.

The travel report[14] written by the Soviet Delegation is a fantastic historical source. I wrote an entire chapter of my dissertation based on it. The report describes, for example, their struggle with the Department of State to extend their visas to be able to visit some laboratories after the conference. The request was denied. In any case, they would not be able to visit many laboratories. American physicists consulted the DoD whether they could invite the Soviet delegation to visit their institutions and laboratories and the answer was negative. In the end only Charles Townes took the Soviets to visit his lab at Columbia University. Townes had visited the Soviet Union the previous year and even visited Prokhorov's dacha. Besides he was the host. In that position it would be unpolished to deny the Soviets a visit that visit.

The report also tells much about the willingness of the participants to share information.

[13]Prokhorova, G. A. (2006). Luch Nadezhdy. In I. A. Shchgerbakov, G. N. Mikhailova, & K. A. Prokhorov (Eds.), Alexander M. Prokhorov: vospominaniia, stati, interviu, dokumenty (pp. 25–100). Moskva: Fizmatlit. p. 96.

[14]Prokhorov, A. M., Basov, N. G., & Barchukov. (1959). Otchet o komandirovke v SSHA na 1iu Mezhdunarodnuiu konferentsiiu po kvantovoi radiofizike. Archives of the Russian Academy of Sciences (know by its Russian acronym ARAN) 471-5-34. pp. 1--23.

When a Soviet Nuclear physicist was preparing to visit the international conference on clean uses of Atomic Energy that happened in Geneva in 1956 a Soviet deputy minister gave him a clear mission: "Your mission will be to give a Kopeck's worth of science and get a dollar in return".[15]

In the Quantum Electronics Conference, the Soviet delegation apparently had the same mission. The problem was that most of the participants, if not all, were there with that intention. According to the Soviets, all talks were limited to discussing physical principles. In the final sprint of the race to make the first laser, not even one concrete design was presented. Private talks during coffee breaks were the most important moments. They wrote that Most of the valuable information in the report they got from those talks. Including numbers. But, even in private, the Americans run away from question about applications of masers.

Another interesting thing in the report is the comparison between laser research and development in the USSR and USA. They claimed that many ideas appeared earlier in the USSR, but were developed at a lower pace in the USSR, due to the lack of resources and research staff, thus they ended up being scooped. Also that the Soviet research matched the American in quality, but not in quantity. Many lines of research were nonexistent in the USSR. When they returned home they made a deliberate effort to expand the field, raising funds and attracting young people. It was an impressive effort of discipline building that I discuss in a paper I am about to finish. In that paper, based on the report and other sources, I argue that Basov and Prokhorov in the Cold War played simultaneously the roles of warriors, spies, and pacifiers.[16]

[15]Richmond, Y. (2003). Cultural Exchange and the Cold War: Raising the Iron Curtain. University Park: Pennsylvania State University Press. p. 66.
[16]Silva Neto, C. P. da. (2016). Exploiting the Iron Curtain: Lasers, Scientific Internationalism and Discipline Building in Early Cold War. (forthcoming), 1–46.

Figure 3. The inventors of the maser. From left to right: James Gordon, Nikolai Basov, Herbert Zeiger, Alexander Prokhorov and Charles Townes.

Figure 4. Prokhorov, Townes and Basov at the Lebedev Institute of Physics, Mowcow, 1965.

Now, I have a question to the audience. Let's take a hermeneutic look at these pictures. What is the pattern?

First, they are posing pretending they are not posing. As though the photographer had caught them in a spontaneous and lively conversation. Second, their distribution in the pictures. The Soviets and Americans never form separate groups. Other pictures reproduce the same pattern. As I see them, those pictures were cast to pass the following message: Look, their country is on the verge of a nuclear war, but these scientists can collaborate and enjoy the company of each other.

It was this perception that the exchanges between Townes, Prokhorov, and Basov were tempered by diplomacy, added to the growing awareness of the politics involved in decisions of the Swedish Academy that led me to follow up my dissertation work on the making of Soviet Laser physics inquiring on possible political connotations of that Nobel prize. It helped, also, that the records of that prize were made available a little more than a year ago, 50 years after the prize was awarded. I still did not have access to the Nobel archives, but the nomination archive in the web page Nobel.org offers data on nominations up to 1965. And the nominations are a good starting point.

Before we move to the nominations lets discuss how the Swedish Academy chooses the physics laureates. The process consists of four stages. In the first stage, in September, a committee sends invitations to eligible persons to indicate physicists to the prize of the next year. Eligible persons are the members of the Swedish Academy, the members of the committee themselves, prior Nobel winners, professor of Nordic universities existing in 1900, and scientists from universities and research institutes specially chosen by the Academy to nominate for that prize.

In the second stage, which lasts from February to September, the committee assess the candidates and presents a report with recommendations for the prize. In the third stage, not later than the end of October, the physics section of the Academy submits its comments and observations. In the final stage, mid November, the full academy meets to make the final decision.

The interplay among the participants in each of these stages makes the history of the prize very interesting and more then a history of prize winners. Awarding the prizes entailed how those involved with nominating, evaluating, and choosing understands their roles. And, as the books on history of Nobel Prizes shows, those roles have evolved over time in response to changes in science and society.[17]

[17]The process is explained in Friedman, R. M. (2001). The Politics of Excellence. Chap. 1.

What do the available data on the 1964 Nobel Prize reveals about the choice of laureates?[18] First, what you see in this graphic (Figure 5) is that the decision of the committee was faithful to the nominations. Because Townes, Prokhorov, and Basov were indeed the physicists who received most nominations. This graphic presents the nomination to laser physicists from 1958 to 1964. The blue bar corresponds to nominations for Charles Townes, the orange for Prokhorov, and the yellow for Basov.

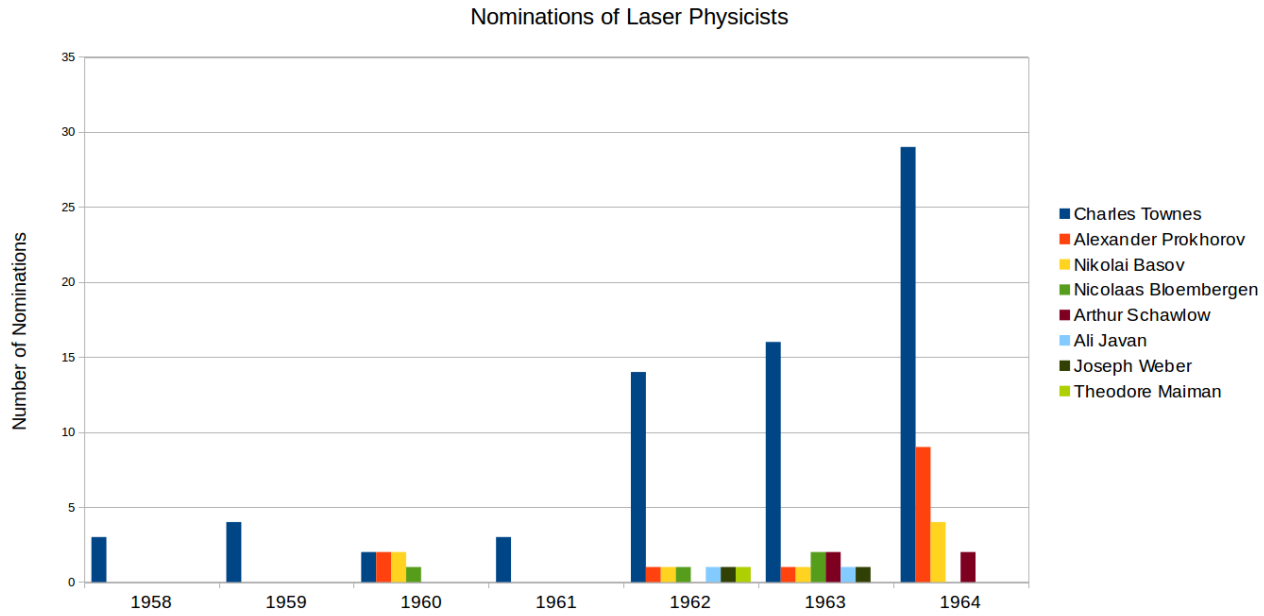

Figure 5. Nominations of Laser physicists from 1958 to 1964.

Townes received 3 nominations in 1958, for the maser, and 4 in 1959. In 1960 Townes, Prokhorov and Basov received 2 nomination each. That year Bloembergen received 1 nomination. In 62 many laser physicists were nominated. Here we have Townes with 14, and Prokhorov, Basov, Bloembergen, Javan, Weber, and Maiman with one nomination each.

In 1963 Townes received 16 nominations, Bloembergen and Shawlow received 2

[18]"Nomination Database". Nobelprize.org. Nobel Media AB 2014. Web. 3 Apr 2016. <http://www.nobelprize.org/nomination/archive/list.php>

nomination each, and Prokhorov, Basov, Javan, and Weber received 1 nomination each.

Finally in get to 1964, the year of the prize. Townes received 29 nominations, Prokhorov 9, Basov 4, and Schawlow 2. Besides the three winners, only Arthur Schawlow was entitled to receive the prize in 1964 because the Nobel committee may award the prize to physicists who received at least one nomination.

If you look at the total of nominations received by each of those physicists the prize does not look controversial either (Figure 6). Altogether Townes received 71 nominations, Prokhorov 13, and Basov 8. Bloembergen and Schawlow each received 4, and Maiman received 1.

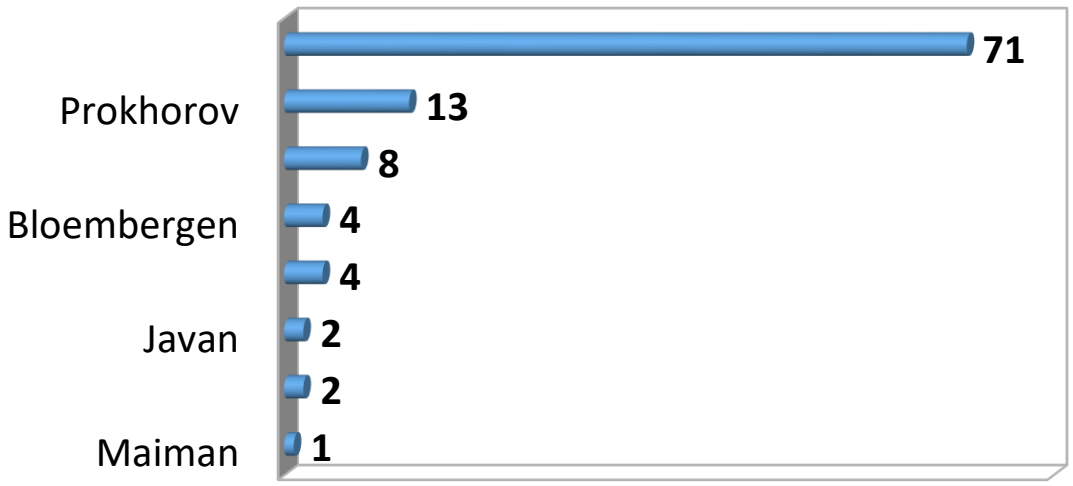

Figure 6. Total of nomination to laser physicists in 1964.

I played with the data trying to get interesting information out of it and one finding was regarding the countries of nominators (Figure 7). All nominations to Charles Townes alone came from NATO countries, most of them from West Germany, United States, and United Kingdom. Nominations to Charles Townes and Alexander Prokhorov, suggesting to share the prize between them, came from Finland (1) and from the USSR (4). And nominations suggesting to share the prize

between Townes, Prokhorov and Basov, came from the Soviet Union (3) and Italy (1).

This nomination from Italy was by Gleb Wathagin, a physicist who was born in the Russian Empire and was sympathetic to the Soviet Union. All Soviet physicists nominated Charles Townes. What seems to reflect the official narrative of the invention of the maser in the Soviet Union, which emphasized the simultaneous invention in the USSR and USA.

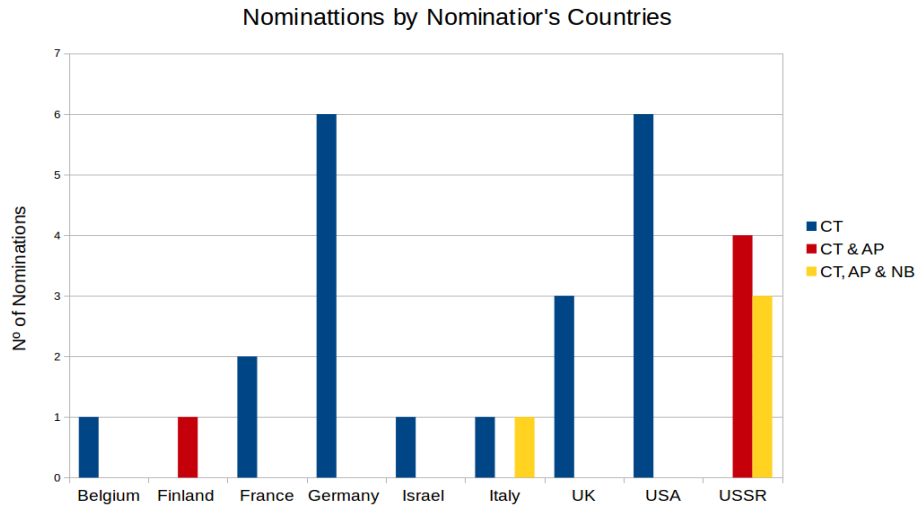

Figure 7. Nominations to Charles Townes alone, Charles e Townes and Prokhorov, an Charles Townes, Prokhorov and Basov, by country.

Did diplomacy play a role in the prize? We still need more sources to give a satisfactory answer, but from the data presented here we can make some preliminary conclusions. First, the decision of the committee respected the order nominations and therefore was not controversial in this regard. Apparently, if we want to find an attempt to use the prize as diplomatic tool, we have to look either to the choice of nominators or to the nominators themselves. In this regards, we saw that Physicists from NATO countries were less willing to share the prize across the Iron Curtain than their Soviet peers. On the other hand, Soviet physicists all chose to share the prize between the Soviet Union and the United States. And the final decision was aligned with the nominations by Soviet scientists.

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