Transcript of interview of Hans de Vreij (Radio Netherlands) with professor André Gsponer, Geneva, October 20th, 2003, on nuclear isomer weapons

(Slightly edited for reading)

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I am a physicist by training and since more than twenty years I'm dealing with nuclear weapons, about 50% of my time. I'm also teaching as a professor in a university. However, my most important activity with regard to our discussion is with an institute I created in 1982, the Independent Scientific Research Institute, that is working on nuclear weapons, non-proliferation issues, mainly from the technical point of view.

Q. If you agree, I would like to go through a number of conclusions that we have found in an American government document, drafted by the Institute for Defense Analyses. First of all, the document says, "Isomer triggering is theoretically possible".

A. Yes, I think this is a very important element, the first consideration for a scientist when one is dealing with a future possibility, whether a weapon or a new tool in medicine, whatever, is: "Is it feasible?" Isomers, either atomic or nuclear isomers, are one possibility of a new form of energy storage. And if energy can be stored, it can be delivered. If it is delivered in one moment, we get an explosion. The possibility of having a new explosive based on nuclear isomer is explored since several decades. It is not a new issue, what is new is that one has reached a point where experiments are showing that the most difficult part of the concept, the release of energy, might be feasible and not too complicated for making a practical device.

Q. The document lists nine countries where it says research into isomer triggering is currently taking place. This includes the US, Germany, Russia, Belgium, France. Does that number of countries or the identity of the countries come as a surprise to you?

A. No, it is well known that all the countries that have nuclear arsenals are looking at the possibility of new generations of nuclear weapons. And the research on nuclear isomers has been going on in most of these countries at some level of intensity. Moreover, there are some outsiders who have come into that research, in particular Germany and also Japan, because this kind of research is not within the bounds of treaties that are restricting their activity with the science of nuclear weapons.

Q. Do I gather it correctly from your words that a discussion between scientists about the theoretical feasibility of studying isomer triggering is really irrelevant at this point in time?

A. No, it is very much relevant and in fact there is a very lively discussion going on right now. And it may be a surprise to people not knowledgeable to the activity in weapon science engineering that it's quite an open discussion, contrary to the first impression. So, scientists from these countries collaborate and share their knowledge, up to certain limits of course. There is indeed a discussion which can be even acrimonious at some point and the outsider must right away make a difference, if he can, between several levels of discussion. For example, with isomers, the two main issues are that one has first to be able to produce these isomers, identify them, find them (this is done in big laboratories working completely in the open) and the more difficult task of releasing the energy. There, the discussion is much more classified, it is much more difficult to know what is going on. In particular, looking at the report of the Institute for Defense Analyses, it is striking that many researchers, many people, even within the US that are actively working on that part of the issue are not mentioned. Moreover, several possibilities, very general scientific possibilities for doing this triggering, are not even addressed in that report.

Q. This report is a public report, not classified.

A. Of course, this is possibly why this information is not there, but this is an indication that there is also an internal discussion, which only people having access to classified information know about.

Q. Being a simple journalist let me step back and take an "irresponsible helicopter view". If it is theoretically possible, people are now thinking about the implementations, while researching the issue itself. The next step has already been taken, I presume.

A. Well at present, one is in a stage that is very critical in the sense that basic

research has been done over the past 20, 30 years. Now, there are indications that isomers are much more numerous and possibly easier to produce than was expected let's say 20 years ago. Incidentally, a whole family of isomers was discovered in Russia, in the 60s or 70s (I don't remember the exact year) by Polyakov, and these isomers were completely unexpected. There are thousands of natural nuclei and many, many thousands of short-lived, artificially produced nuclei, some of which are isomers. So what happened is that special facilities have been built during the 80s, and are still being improved and built upon now, for instance Japan has very recently created a special facility for producing isomers. The Germans also have updated their facility, while there are very important facilities in France and in the US for much longer. At these facilities one is trying to search through thousands of different nuclei, looking for a little bit of gold in a lot of sand. That activity is going on in parallel with theoretical and experimental activity for triggering the isomers. Now, what Dr. Collins at the University of Texas has done with his collaborators is to find, or at least explore ONE possibility of triggering isomers. However, what this Institute of Defense Analyses report does not say is that the MOST promising avenue for triggering such isomers is not the one on which professor Collins is working on, it is just one possibility.

Q. What is the other?

A. Well, the other one is using a brand new generation of lasers, that should be properly called super-lasers, just like one has super-conductivity, super-fluidity, one has super-lasers, that is, lasers that operate in a completely different regime than normal lasers. These lasers are able to induce nuclear reactions directly. In other words, you can fission uranium with such lasers. You can induce fusion with such lasers and these lasers are, amazingly, extremely small. A table-top facility is enough for producing a few fusions or a few fissions. Which means that a small facility could be build, I mean a small device could be build to induce fission or fusion, or to trigger an isomer and do something else with it which has practical consequences.

Q. I read in one of your papers that your theory is that the research we have discussed so far is not research into the possible use of isomer triggering, producing gamma-rays, as a new gamma-ray weapon, but that it is a step towards another kind of weapon, a kind of semi, quasi nuclear weapon not covered by the treaties.

A. Yes, it is a very general principle that in every device, one has a process in which there are stages. For example, to start your car, which is quite a powerful engine, you start by turning the key, in other words, you can say that starting the engine is multiplying the energy of your hand (that is turning the key) to turn on the engine. This is the same in nuclear weapons. You have a primary system, rather low energy, which is then triggering a higher yield explosive, which is called the

secondary. And in present-day nuclear weapons the primary is an atomic bomb, the secondary is a fusion bomb. It turns out that isomers are one possible candidate for getting rid of the fission primary in order to create a new type, a new generation — it would be the 4th generation of nuclear weapons — in which you would have no fission part anymore, but some trigger and then fusion reactions providing the largest part of the militarily useful yield. This is why I consider that developing the technology for using very expensive materials like isomers — but the same reasoning would apply to antimatter — very expensive and rare materials, will NOT be used as explosives as such but as primaries where you need to miniaturize something else, like a hydrogen bomb getting its yield down from megatons to a few tons and still have something that would be extremely more powerful than existing chemical explosives.

Q. You are saying this will be the 4th generation of nuclear weapons. Could you take our audience through those four steps please?

A. The first generation are just atomic bombs, Hiroshima-type, and the second generation are bombs in which you have a second stage, thermonuclear stage. These are the present-day thermonuclear weapons, so-called hydrogen bombs and so on. The third generation are things like the neutron bombs. Their specificity is that they have never been deployed. In fact, there is no real military need for them because they are still nuclear weapons. The fourth generation, in which the atomic trigger is being dispensed of, offers entirely new possibilities to the military and are highly destabilizing since their yield can be made lower than the few kilotons which are normally the minimum for either atomic or thermonuclear weapons.

Q. Could the entire discussion about isomer triggering and especially gamma-ray weapons be a smokescreen for this?

A. Yes, you can use the word "smokescreen". But at the same time, you have to see that just talking about such things can have a positive impact. It turns out that the recent debate has been triggered by an investigative journalist who suddenly discovered that something was going on. But he might just as well have found out that there is big research going on metallic hydrogen or on antimatter. Or to take another example, of which the Russians are specialists: magnetic compression, which means that instead of compressing something passive with explosives, you compress a magnet. Then, at the same time as you compress the magnet you compress the magnetic field, which is just electromagnetic energy, in other words exactly the same thing as the X-rays coming from an atomic bomb which are squeezing down the fusion fuel of the hydrogen bomb. In other words, by compressing a magnet with chemical explosives you can actually produce the same result — obtain the same result as with an atomic bomb, except that you have no fission.

Q. So, if I understand you correctly, we shouldn't pay too much attention to articles focusing exclusively on gamma-ray weapons, new gamma-ray weapons, "isomer triggering is it true or not". What you are saying is: isomer triggering is feasible, but is part of something bigger.

A. What can be observed by people following the field, we are only one independent institute doing that, is that there is a vast amount of activity. In the language of technological assessment, one would talk about "a bundle of technologies". This bundle of technologies is converging towards a number of very precisely defined applications, which are new types of nuclear weapons. Now, talking about one technology of this bundle is already alerting the public opinion and the strategic thinkers that something is going on. In that sense it is good that we talk about gamma-ray weapons. But it is already clear now that there are very cheap explosive materials like deuterium, tritium, or lithium-deuterid, which are used in the secondary part of present-day thermonuclear weapons, and that these materials would be used as the main explosive, provided one has new types of triggers. In that sense, one would never make an isomer bomb, gamma-ray bomb, or a antimatter bomb for that matter, because these materials are likely to be very expensive. However, it is good that the discussion has started.

Q. So, returning to the car key, light and cheap. Is that how we should see the isomer discussion, a cheap possible trigger of much larger weapons?

A. In a way, yes. What one has to be careful about is that, as much with isomers as with most of the technologies that I referred to in this bundle of possible technologies for triggering 4th generation nuclear weapons, one is at a research and development stage. At present, I don't think one has identified the right isomer for that application. Hafnium is most likely NOT the one to come out. Similarly, one has NOT identified the correct triggering mechanism. However, one has to remember a remark that goes to Hans Bethe, who directed the theoretical part of the atomic bomb program at Los Alamos during the war, that for some reason, nature has given us not only uranium or plutonium, but also lithium. And lithium is a very benign material but it can be turned into a thermonuclear fuel. And it is possible that a rather benign artificially made, most likely, but maybe even naturally occurring isomer could become a fuel that used in small or large quantities could be used for that purpose. So, it is much too early to claim that Hafnium will be a possible weapon of the 4th generation as such. But at the same time it would be extremely irresponsible to talk about these things as "Science Fiction" since there is NO fundamental scientific or even engineering arguments for saying that these things are definitively not possible.