To Understand Iranian Centrifuges, Look to a Top

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A key element, if not the key element, in the nuclear negotiations with Iran, appears to be the number and type of centrifuges which Iran will be able to retain. Curiously, part of the discussion can be illustrated using a children's top.

High-speed centrifuges are used to enrich uranium. "Enriching" means increasing the proportion of the fissile isotope uranium-235 (U-235). In normal uranium, it forms less than 1 percent; the rest is uranium-238 (U-238). To make a bomb, you need uranium containing 90 percent U-235. The principle in enrichment is simple enough. Uranium in the form of gas is fed into a spinning centrifuge. The minute difference in weight between U-235 and U-238 enables separation to occur. But the centrifuges have to spin for weeks, or even months, for a useful quantity of U-235 to be collected.

The efficiency of a centrifuge relates to its length - how tall it stands - as well as its velocity - how fast it spins. But these two factors trade off against each other because of what are known as "critical speeds." At such a speed, the centrifuge vibrates, or resonates. If this effect is not minimized, the centrifuge will crash: the spinning rotor will break against the outer casing. The so-called Stuxnet virus, which delayed Iran's centrifuge development a few years ago, made use of this. The particular critical speed of the centrifuge depends upon its design and what it is made of: aluminum, carbon fiber, or special steel.

The concept can be demonstrated using, of all things, a child's spinning top. Critical speeds occur when the top is being accelerated and when it slows down. As the top slows, there are moments when it wobbles slightly before stabilizing again. That is a critical speed.

A challenge in the negotiations is to keep Iran from developing more efficient centrifuges, ones less affected by critical speeds. This is not child's play, even if a child's top helps explain it.

For more background on nuclear terminology, read Nuclear Iran: A Glossary (http://www.washingtoninstitute.org/policy-analysis/view/nuclear-iran-a-glossary-of-terms) , by Simon Henderson and former IAEA deputy director general Olli Heinonen. ❖

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