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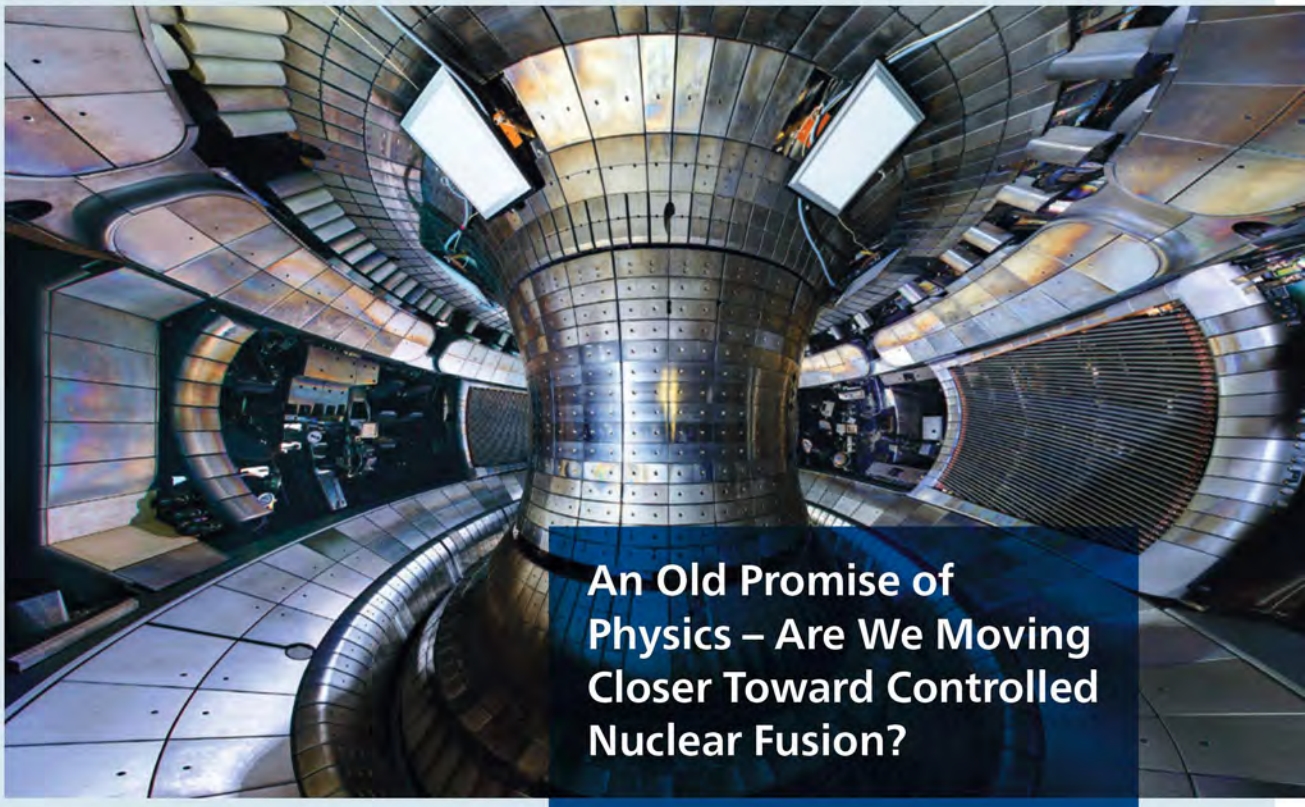

An Old Promise of Physics – Are We Moving Closer Toward Controlled Nuclear Fusion?

Highlights of the World Nuclear Performance Report 2020

The EMPIrE Irradiation Test: Lower-Enriched Fuel for High-Performance Research Reactors

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Contents

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G = German
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Feature

Major Trends in Energy Policy and Nuclear Power

BioKernSprit

Jochen K. Michels

Planned entry for KERNTECHNIK 2020

Introduction As commendable as all the efforts maybe to supply our society and industry with environmental energy, they will not nearly suffice. This is most easily seen in the quantities of imported primary energy, i.e. gas and oil, and increasingly electricity too. There is an occasional flattening or a dent, but the increase is obvious. Considering the needs for more comfort, communication, mobility, it quickly becomes clear that an increase rather than a decrease is to be expected – despite all efforts to save.

This proposal addresses an important sector: mobility. And here we focus on road-based individual traffic rather than rail-based mass transport or airborne services.

BioKernSprit[1] refers to the project (or proposal) to combine known and proven processes in such a way that they can bridge the coming 30 to 80 years. That is, as long as the scarce and criticized fossil fuel supply will not be fully replaced by other fuels. These processes are associated with the names of Heisenberg, Fischer, Tropsch, Bergius, Pier, Schulten, Kugeler and many others. They are still familiar to many Germans from school and university. All of them have earned merits and fame between 1900 and 2000, but their pertinent developments are not used in Germany currently. Only in China there have been approaches for 15 years to implement at least a part of it into practice. Just recently also the US resume research and implementation projects for this particular flavor of nuclear energy, called "high temperature reactor with pebble fuel".

Basics

The basic idea is to combine these well proven developments, methods and inventions into one productive and economical process to make mobility ecological and affordable for a long future. It should solve some of the most urgent needs not only in Germany and Europe but also in other countries, even those with limited resources in developing and threshold regions.

The hydrogenation processes of Fischer and Tropsch (FT) as well as Bergius and Pier (BP) synthesized fuel from coal and wood. Also other carbon compounds were tested and proven as input, e.g. wastewood. In Germany 4 billion liter of car fuel were produced in one year (1944) by some 14 factories. This was already 10 percent of today's consumption of car fuel. The only outstanding detriment was, that almost half of the input feedstock was burned (oxidized) to produce the necessary high temperature for the process. Today this is unthinkable because of the large CO_2 load. The reason is well known with all chemists: if you do not have the optimal catalyst, the hydrogenation can only be reached by massive high temperature heat.

For example: the sun does the same. It converts carbon dioxide from the atmosphere into burnable plants (wood, eatables etc.) by low temperature below 50 degrees Celsius. Chlorophyll is the ideal catalyst and for plants this is acceptable. There is time enough for a slow hydrogenation process and the resulting greens have a rather low energy content per kilogram.

Today's challenge – and answer

For car fuel we want – and need – faster results and a much higher density of energy. So we require much higher temperature and/or a much more efficient catalyst. This catalyst has not been detected yet. Until better results develop we need for hydrogenation a rather high temperature – about 900 centigrade[2].

We propose to combine the proven – and continuously improvable – synthesis of FT/BP hydrogenation with HTR-heat into an overall economical production line. This complies with business and market constraints, as well as with environmental, social and compliance regulations. Even the German Atomgesetz (nuclear law) does not explicitly forbid this application of nuclear energy. Just electricity is forbidden.

First – the necessary feedstock

Input material must be found and provided in our current natural environment. It seems that about 5 to 10 percent of the national fuel consumption can be gained from today's bio-waste. Mostly wood, also plastics, blast furnace gas and other feedstocks serve as a source. Lignite and hard coal can be used to increase the initial quantities. Even the "Coal-Exit" can be softened by using coal for hydrogenation. Other sources may be developed as time progresses and experience grows. There is no promise to cover 100 % of our fuel needs in the foreseeable future. We want to make a considerable contribution with minimal economic impact.

With the help of the forest owners' associations, the above calculation was made. It shows that about 5 percent is already achievable today from wood waste. This can be expanded by using fallow land and special plants without food competition.

The Viessmann company has been showing what is possible for years. There, 1 hectare of rolling forest supplies around 5,000 litres of heating oil or diesel per year.

Second – Sizeable quantities of hydrogen

Since our proposed method does not burn feedstock it needs additional H for input. Currently H is mostly produced by the Linde process from fossil gas and other input. Obviously for ecological reasons and import dependency this cannot be the solution. But with the proposed high temperature heat and nuclear electricity, hydrogen can also be produced by cracking of normal water – a sustainable method, researched and developed in Jülich decades ago. This electrolysis currently is rather expensive because of the electricity needed. But when heat and electricity are provided by a high temperature reactor (HTR) we can overcome this obstacle.

Third – High temperature heat

This necessary heat must be provided without burning fresh or fossil carbonates (wood, plants, and coal). These input materials are too valuable to just burn them. They should be converted completely into highly precious fuel for mobility.

So the necessary heat must come from another source. High temperature gas cooled reactors (HTGCR) offer themselves as an almost ideal

1) BioKernSprit is an acronym for: Synthesized Car fuel from Bio-Waste and Coal by Hydrogenation using high temperature nuclear heat.

2) Some people claim to do it with lower temperature and optimized catalysts – not proven yet in industrial dimensions.