WP11b – Investigate mass production techniques and capability; large scale target fabrication; high reprate injection and tracking techniques; etc. - deliverable NN 8, 9 in WP 11 (Fusion Target Delivery)

HIGH REP-RATE CRYOTARGET FACTORY:

cryotarget mass production and delivery with the rate of 0.1-to-10 Hz

(PROPOSAL OF LEBEDEV PHYSICAL INSTITUTE, Moscow, Russia)

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PROPOSAL OF LEBEDEV PHYSICAL INSTITUTE: development of a prototypical model of a high rep-rate cryotarget factory basing on the FST technologies existed at LPI

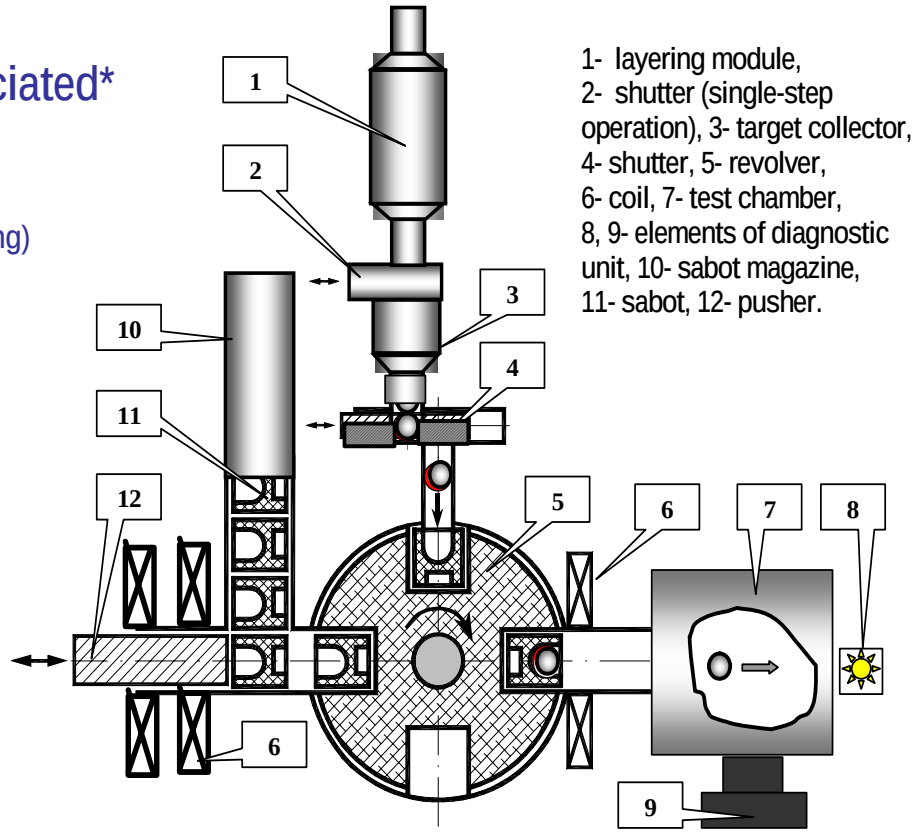
We suppose 2-stages activity

1. Development of the factory concept & feasibility study of the concept constructing
   50 kEuro, duration 1 year

2. A prototypical model of a high rep-rate cryo target factory constructing and demonstration of the rep-rate mode of its operation
   - 1.5 M$ ~ 1.03 MEuro, duration 3-to-5 years
   - support via the ISTC Project #2814 is appreciated*

*/ Current status of the ISTC Project #2814 is 3 (i.e. Approved without funding)

Preliminary concept of a high rep-rate cryotarget factory, which is based on the technologies developed and demonstrated at LPI for 1-to-1.8 mm free-standing targets



1- layering module,
2- shutter (single-step operation), 3- target collector,
4- shutter, 5- revolver,
6- coil, 7- test chamber,
8, 9- elements of diagnostic unit, 10- sabot magazine,
11- sabot, 12- pusher.

STAGE 1: DEVELOPMENT OF THE FACTORY CONCEPT AND FEASIBILITY STUDY OF THE CONCEPT CONSTRUCTING. Scope of work

- A system analysis of the main technical requirements for a high rep-rate cryotarget factory (HRCF)
- Analysis of the consistency of technical specifications for the individual sub-systems with an account for modular interface and capabilities to work as integral part of HRCF.
- Formulation of the final design concept aimed at the minimization of potential risks during the HRCF constructing and functioning
- Technical task development for HRCF constructing and manufacturing

STAGE 2: A PROTOTYPICAL MODEL OF A HIGH REP-RATE CRYO TARGET FACTORY CONSTRUCTING AND DEMONSTRATION OF THE REP-RATE MODE OF ITS OPERATION.

Scope of work, estimated cost, duration

Can be implemented in parallel

1. Creation of the layering module (LM) for reactor-scaled targets. ~380 kEuro, 3 years
2. Development of the block for target&sabot assembly (BTSA) and test chamber (TC). ~380 kEuro, 3 years
3. LM/BTSA/TC integration into a unified facility and sequential experiments. ~270 kEuro, 2 years

TECHNICAL APPROACH on the stage 2

- The special approach is the creation of a prototype of facility, which is capable of:

- to form solid layer of fuel on the inner surface of a reactor-scaled polymer shells

- to make the repeatable assembly of the unit “cryogenic target & sabot”

- to pre-accelerate the unit to speeds of about 1-3 m/s with the object of its transport to the injector.

- Within this scheme the prototype will operate with an array of free-standing shells (targets) at each stage of the production cycle that will minimize dead volume of fuel in the facility.

- The technologies dealing with free-standing targets developed in LPI for one-millimeter shells will be used as the basis for the prototype design.

IT IS EXPECTED TO ARRIVE AT THE FOLLOWING RESULTS DURING THE 2-nd stage IMPLEMENTATION

1. The results of the reactor-scaled targets fabrication and their assembly with the sabots
2. The facility prototype and the results of its testing. The prototype includes the following components:

   - FST-based layering module
   - Collector of cryogenic targets
   - Shutter
   - Set of sabots
   - Block for target & sabot assembly
   - Block for target & sabot extraction, including a coil and a guide channel
   - Automatic control system synchronizing operation of all the prototype components

3. Recommendations for the facility / injector / chamber interface for the case of the HIPER system

PROSPECTS FOR APPLICATION THE PROJECT RESULTS

- The facility created in the project can be used in IFE research with controlled energy output (for example, in HiPER program), which has become a particular field of studies aimed mainly at creating a fusion reactor for electric power generation.
- The facility forms the basis of innovative technology development for commercial application, namely - inexpensive mass/reprate production of IFE targets.
- A high-energy gain target becomes a very power source of neutrons, neutrinos, x-rays and γ-quanta allowing solving problems both of fundamental nuclear physics and of practical applications.
- The facility created in the project can be also used for the optimization of major steps of the technological phase on a repeatable target delivery at the reactor chamber. This allows one assuming the building of a target factory integrated with injector.
- Optimum-scale integration of the facility created in the project with a laser operated in the frequency range allows for the first time to create an operational model of the prototype reactor. The prototype-assisted investigations are of interest as a necessary stage under development the elements of a commercial power plant.

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