# §46. Development of Position Measurement Module for Flying IFE Target

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To realize the laser-fusion reactor system, the injected fuel target is shot by the driver lasers precisely in the fusion reactor. The initial deviation of the direction and the speed of the target cause the deviation from the expected trajectory of the target. It needs the real-time calculation of the trajectory of the flying target and real-time control of the final mirrors to shot the target by lasers. The real-time measurement of the position and the time of the flying target are indispensable to real-time calculation of the target trajectory. We have developed the position measurement method using Arago spot.[1] The measurement accuracy of lower than 0.2 μm was achieved for the stationary target.

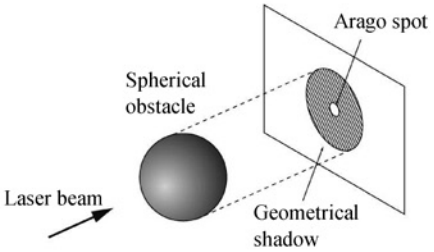


Fig. 1. Arago spot.

Conceptual design of the position measurement module, which uses Arago spot and pulse laser, has been developed as shown in Fig. 2.

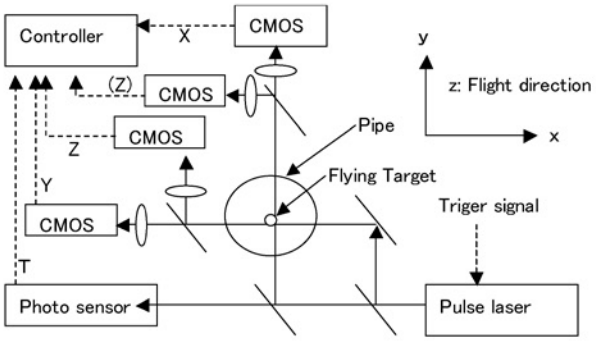


Fig. 2. Schematic view of position measurement module.

The laser pulse is divided by the half-mirror. The flying target is irradiated by the orthogonal laser pulse. The Arago spot image is divided by the half-mirror. To decrease the amount of data of the Arago spot image, the image is optically compressed into a one-dimensional image by a cylindrical lens, effectively decreasing of data (~kB) for rapid data processing. [2] Four line CMOS sensors record the intensity distribution of the compressed Arago spot image and transfer the recorded data to the controller. Photo sensor records the arrival time of the laser pulse. The position data and the time data of the flying target, ($X_i$, $Y_i$, $Z_i$, $T_i$) at each modules, will then used to predict the time and the place that the target will reach the reactor center.

In the first step of the experimental development of the position measurement module, real-time one-dimensional CMOS sensor system was developed as shown in Fig. 3.

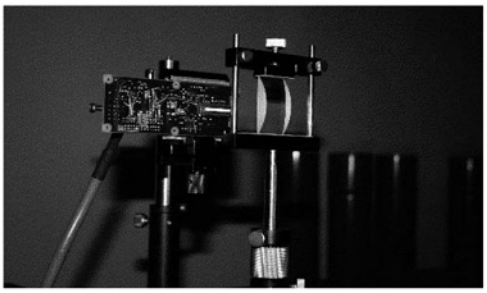

Fig. 3. One dimensional CMOS sensor system with cylindrical lens.

Data transfer time of the compressed Arago spot image on 1024 pixels is less than 1 ms. The measurement accuracy of lower than 0.2 μm was achieved for the stationary target. We are planning to integrate the photo sensor system with one-dimensional CMOS system in the next year.

1) Saruta, K. and Tsuji, R.: Jpn. J. Appl. Phys., **47** (2008) 6000.
2) Sakauchi, H. and Tsuji, R.: Plasma and Fusion Research **4** (2009) S1012.