Additional Proposals from General Atomics for 2004

Modeling support

Modeling and analysis support through post doctoral or exchange scientists to work on the MCI code under the direction of Dr. T. Evans. MCI is a kinetic code with flexible geometric boundaries and derived from fundamental scrape off layer physics. The code is ready but not easy to run, it needs manpower to run the code to produce results. This effort will be one of the key elements of the overall SOL modeling activities, supported by experimental results like DIII-D.

Budget: $50k per year to GA.

Outboard DiMES station

Task: We will design, fabricate and operate the outboard DiMES station to enhance the understanding on chamber wall PMI and impurities transport. We will build on the experience of the lower divertor DiMES and will use the same DiMES team.

Description:

The DiMES project has confirmed two key plasma material interaction uncertainties, erosion and the transport of eroded material from the first wall. Significance of this topic is further enhanced by the identification of the intermitent convection to the first wall chamber (blob). The erosion due to charge exchange neutrals and plasma interaction at the first wall is shown to be important because of the relative large surface area of the first wall and the unexpectedly high particle flux due to convective transport (blob). The transport of eroded material is important because of its potential impact to the performance of the plasma. For example, the erosion and transport of carbon and corresponding imbedded tritium are key performance limitations for the ITER design.

An outboard DiMES station, located at about the lower 45 degrees or mid-plane of the DIII-D outboard wall, can be used to evaluate first wall erosion and material transport of different chamber wall relevant materials. Its function will be similar to the lower divertor DiMES.

For example: An instrumented solid-state hydrogen sensor with a sensitivity of 10^{14} particles is proposed to measure the charge exchange neutral flux. To study material transport, a doped sample with specific isotope (e.g. ^{13}C) can be exposed at the outboard DiMES and the eroded material can be detected at the lower divertor DiMES. In addition, the scraped off layer physics at the first wall can be studied. This information is necessary for the design ITER, advanced high power density experiments and fusion power reactors. Outboard DiMES can also be used to support the development of outboard diagnostics. An in-situ material diagnostics station at the more accessible outboard location can also be envisioned at a later phase of the project.

A mechanical insertion mechanism is proposed.

A bellows design will separate the insertion mechanism from the primary vacuum. The use of a dedicated vacuum pumping system will separate the moving parts from the high vacuum of DIII-D. Similar to the lower divertor DiMES, control of the sample movement will be performed from the DIII-D control room. Allowances will be made for more than 10 electrical leads to be connected to external instruments. As with the operating lower divertor DiMES, the outboard sample changer will allow material samples to be exchanged overnight after as few as one plasma shot.

Budget: $90k per year for three years beginning 2004.

Smart Tiles

The Smart Tile concept is to group selected diagnostics into a few "mass producible" smart tile packages. The technical goal is to use the distributed smart tile data (i.e. many smart tiles distributed in the plasma chamber) to enhance the scientific knowledge base to areas of PMI, edge physics, and impurities transport, leading to information on predictive behavior of the first wall materials and plasma performance. In parallel we propose to use the smart tile platform to demonstrate feedback wall protection concepts and the study of in-situ wall conditioning techniques. At a later stage we will demonstrate radiation tolerant smart tiles that can operate at high temperature for high power steady state DT operation. This would be suitable for devices like CTF and ITER, and would improve the design for DEMO and Fusion Power Reactors. This is a very aggressive program. But considering the reality of limited budget on technology development, we are proposing two demonstrative diagnostics.

1. Microbalance to measure deposition on surfaces

This diagnostic can be demonstrated on DiMES in 2004 at a budget of $50k for two years. The second year's budget is to place more than one microbalance around DIII-D chamber. Proposed by Prof. D. Whyte of U. of Wisconsin. Budget goes to Prof. Whyte.

2. Hydrogen sensor

Proposed and being worked on by Bob Bastasz of SNL. This measurement of neutral hydrogen flux can be demonstrated on DiMES in 2004, and an advanced version can be demonstrated in 2005. Budget request is $50k for two years. Proposed by Dr. R. Bastasz of SNL. Budget goes to Dr. Bastasz.

GA coordination $20k