Ray-Tracing Code *LHDGauss* for Electron Cyclotron Heating and Microwave Reflectometry

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1. Purpose / Application

The purpose of the ray-tracing code *LHDGauss* for electron cyclotron heating (ECH) is to calculate a power deposition profile along with multi-ray trajectories and ordinary(O)/extraordinary(X)-mode contents [1, 2]. This code is applied to ECH experiments in the Large Helical Device (LHD) so that ECH injection settings can be adjusted for achieving a desired power deposition during experiments. This code is also used to calculate ray trajectories for microwave reflectometry (MWRM).

2. Developer / Improver

This code was originally developed by S. Kubo [1] and is being improved mainly by T. I. Tsujimura [2].

3. General Description

The outline of the calculation procedure of *LHDGauss* is described in Fig. 1. The more detailed description is available in Ref. [2].

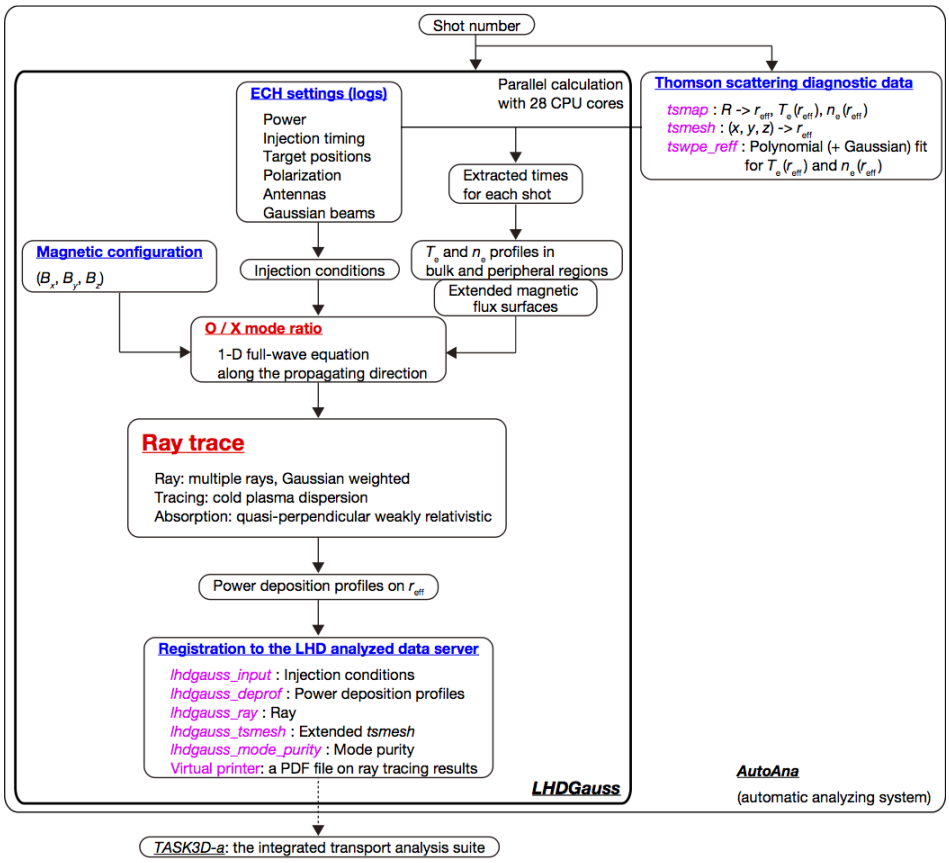

Fig. 1. Calculation procedure of the ray-tracing code LHDGauss for ECH experiments in LHD [2].

4. Requirement in Use

One of the developers, T. I. Tsujimura, or the developer of the *AutoAna* system, M. Emoto, can only execute this code at the moment. The calculated results are registered to the LHD Kaiseki (analyzed) data server as Kaiseki data. Users can ask the code developer (T.I.T.) to execute this code for specific shots unless the Kaiseki data file is registered or the code version is latest. The version is 3.3 as of August 31st, 2016. The version is written in the [Comments] space of a Kaiseki data file.

5. Type in Use

The names and the short comments for the registered Kaiseki data in the Kaiseki server are listed below. Users can download the data from the server.

There are five kinds of registered data for ECH:
- LHDGAUSS_DEPROF : ECH power deposition profiles
- LHDGAUSS_INPUT : ECH injection settings
- LHDGAUSS_MODE_PURITY : ECH O/X-mode purity
- LHDGAUSS_RAY : ECH O/X-mode ray trajectories
- LHDGAUSS_TSMESH_RAY : TSMESH expanded outside of the last closed flux surface for *LHDGauss*

There are four kinds of registered data for MWRM:
- LHDGAUSS_RAY_MWRM1 : Ray trajectories for mwrm_ray_set1
- LHDGAUSS_RAY_MWRM2 : Ray trajectories for mwrm_ray_set2
- LHDGAUSS_RAY_MWRM3 : Ray trajectories for mwrm_ray_set3
- LHDGAUSS_RAY_MWRM4 : Ray trajectories for mwrm_ray_set4

Shot summaries of *LHDGauss* for ECH and MWRM are also available from the *Virtual Printer* service:
- diag=LHDGAUSS : Virtual printer of *LHDGauss* for ECH
- diag=LHDGAUSS_MWRM : Virtual printer of *LHDGauss* for MWRM

References

[1] S. Kubo *et al.*, "ECH Power Deposition Study in the Collisionless Plasma of LHD", AIP Conf. Proc. **669** (2003) 187.
[2] T. Ii Tsujimura *et al.*, "Development and application of a ray-tracing code integrating with 3D equilibrium mapping in LHD ECH experiments", Nucl. Fusion **55** (2015) 123019.