General Atomics

Diagnostics Development Group

Compact Heterodyne Dispersion Interferometer (CHDI)

November 14, 2025

GA Team:

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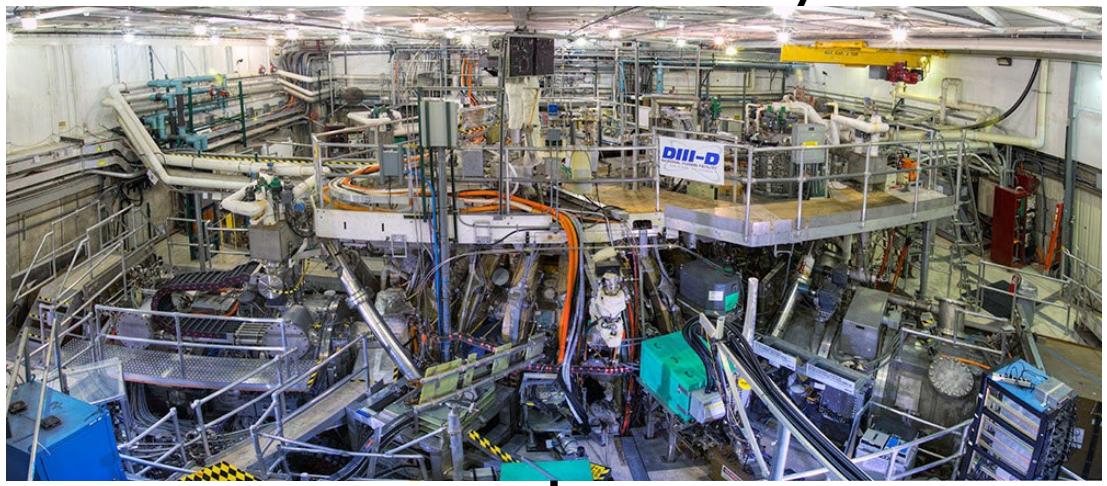
Fusion Development Overview

DIII-D Research Facility



Produces research papers

Operating Fusion Power Plant

Produces power

Fusion Development Overview

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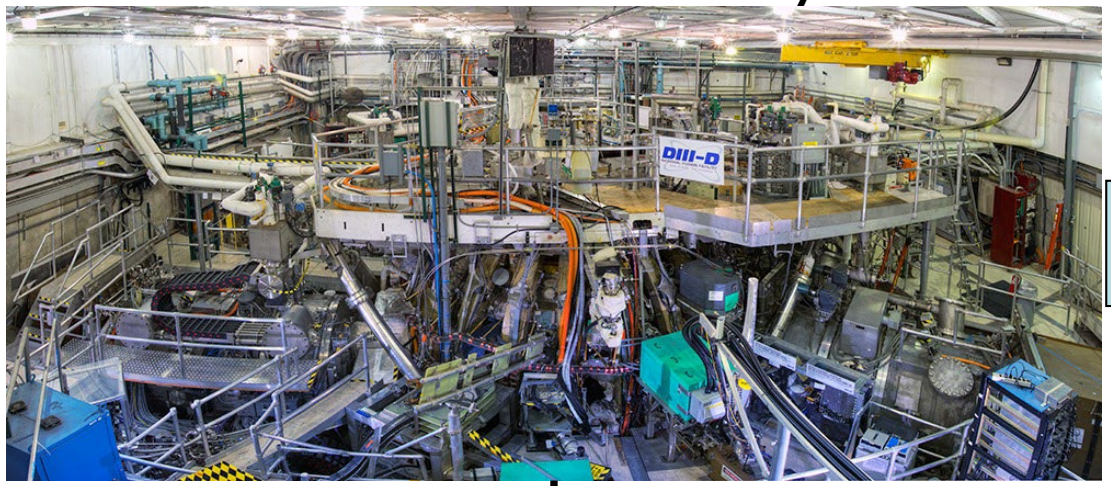

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Evaluation of new plant concepts

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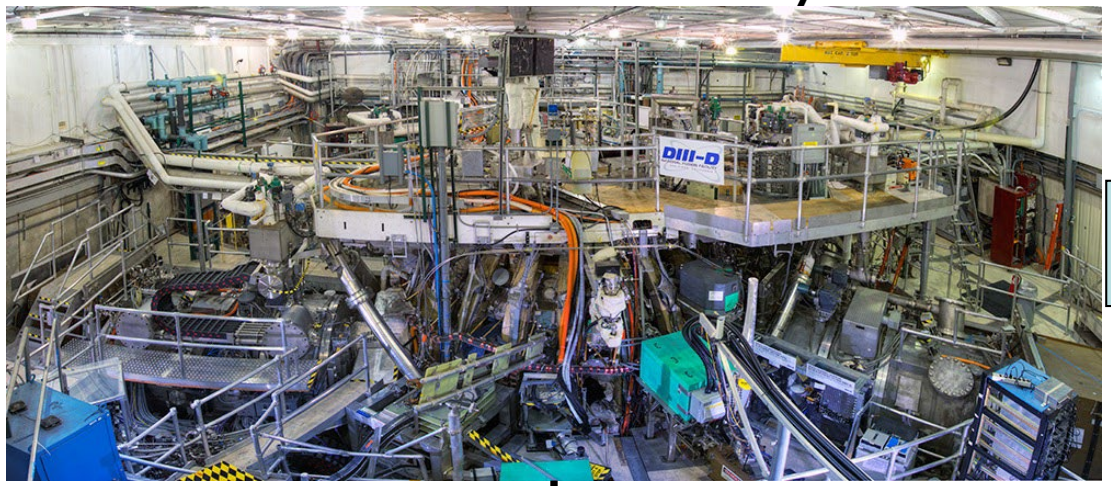

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Evaluation of new plant concepts

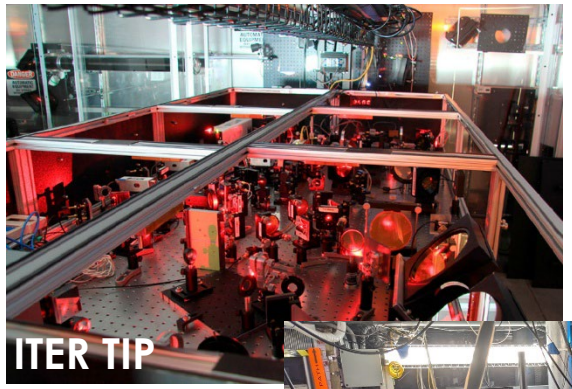
Operating Fusion Power Plant

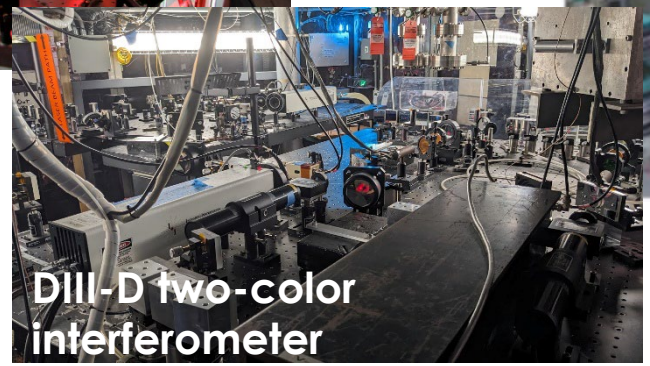
Produces power

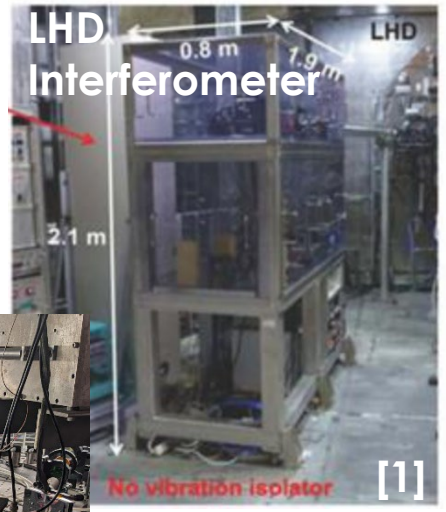
- **Transition from fusion research to fusion power needs proven plant design; trying many new plant ideas**
- **All designs require diagnostics for control, monitoring, and verification of performance**
- **Currently, diagnostic systems are all custom-built for each machine**
  - **Requires significant custom design and engineering; all increase cost and time**
  - **Inhibits rapid evaluation of fusion plant concepts**

GA Diagnostics Group Acceleration Effort

- **Electron density, ρ_e, critical for any MFE machine evaluation and typically measured with interferometers**
- **Large, complex setups (PhD level & more)**
- **GA leveraging expertise to build <u>Compact Heterodyne Dispersion Interferometer (CHDI):</u>**
  - Boxed
  - Turn-key
  - Off-the-shelf
  - Run by plant engineers and technicians
- **Goal: Enable testing of fusion plant designs by reducing development time for new interferometers**
  - Requires <u>only</u> beamline and corner cube installation
  - CHDI outputs phase shift proportional to density
  - Error checking, monitoring, and user-friendly GUI







1-T. Akiyama, et al. *Rev. Sci. Inst.* 2014

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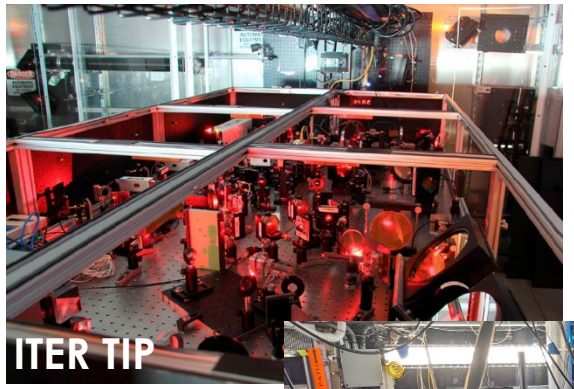
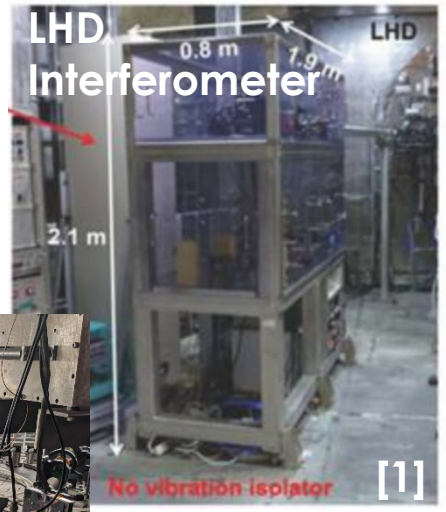
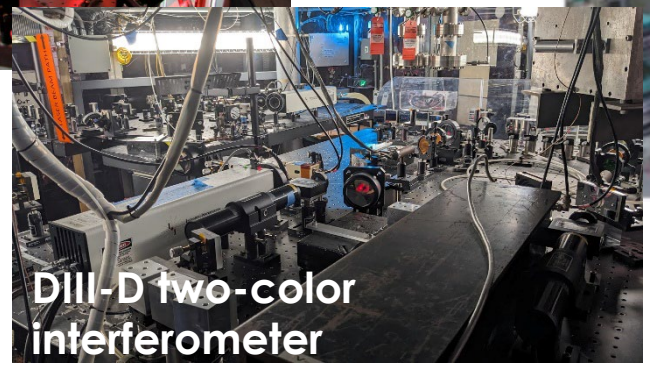
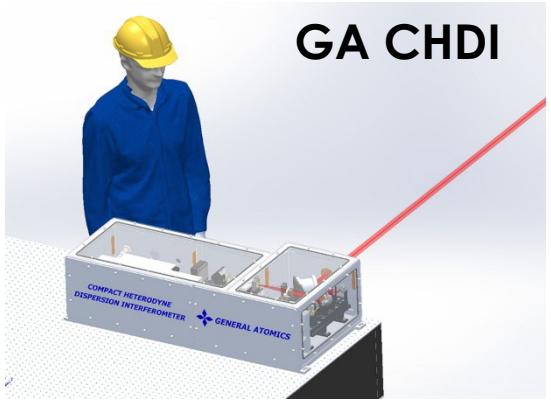






Optical head dimensions: ~90cm x 30cm x 25cm

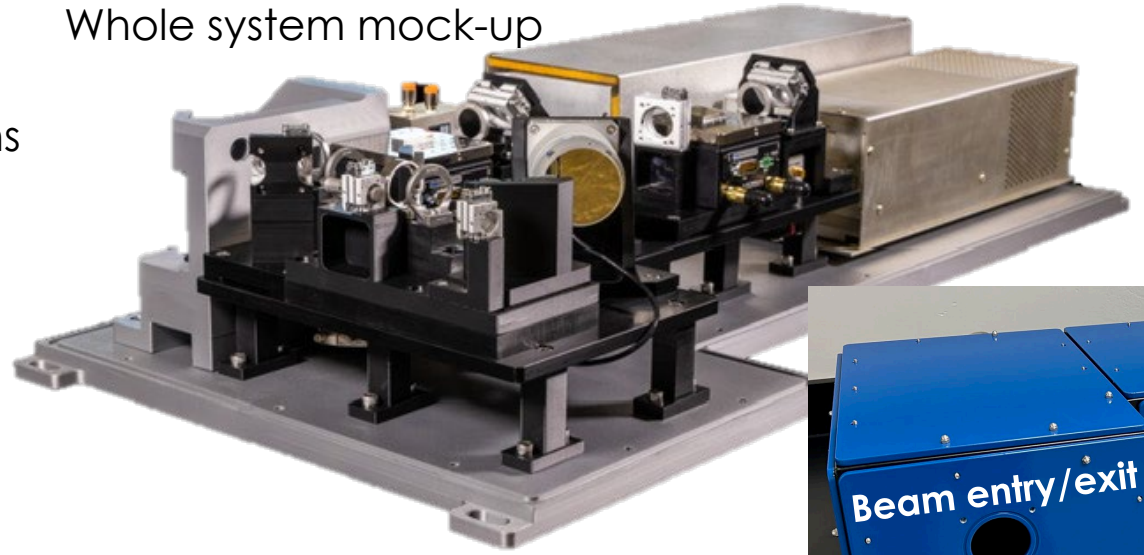


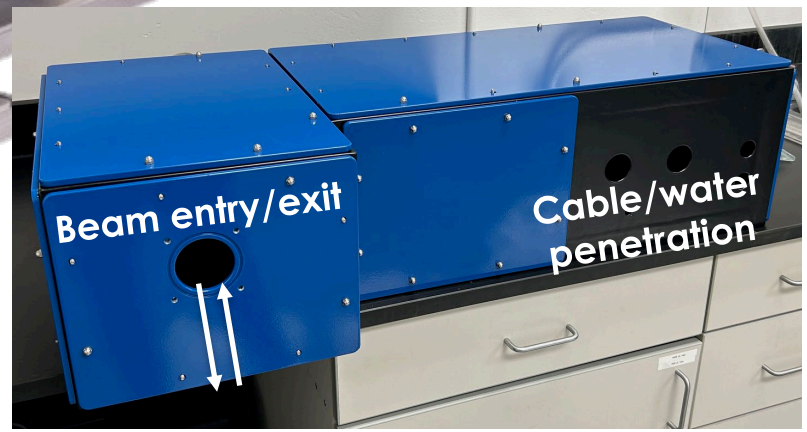
1-T. Akiyama, et al. *Rev. Sci. Inst.* 2014

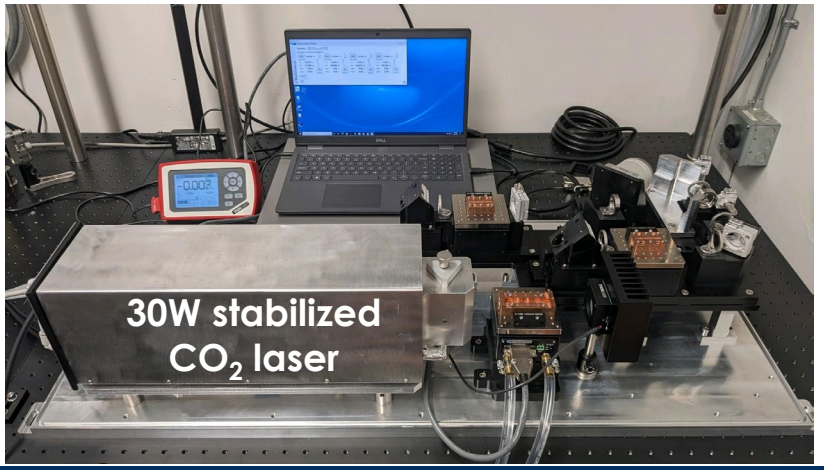
CHDI Current Status

- **Multi-year GA internal development project**
  - Patented and proprietary GA solutions
- **Prototype is nearly complete with assembly and initial testing ongoing**
  - Laser long-term stability/drift
  - Phase noise
  - Test laser replacement accuracy
- **Final software to be developed in early 2026**

Whole system mock-up

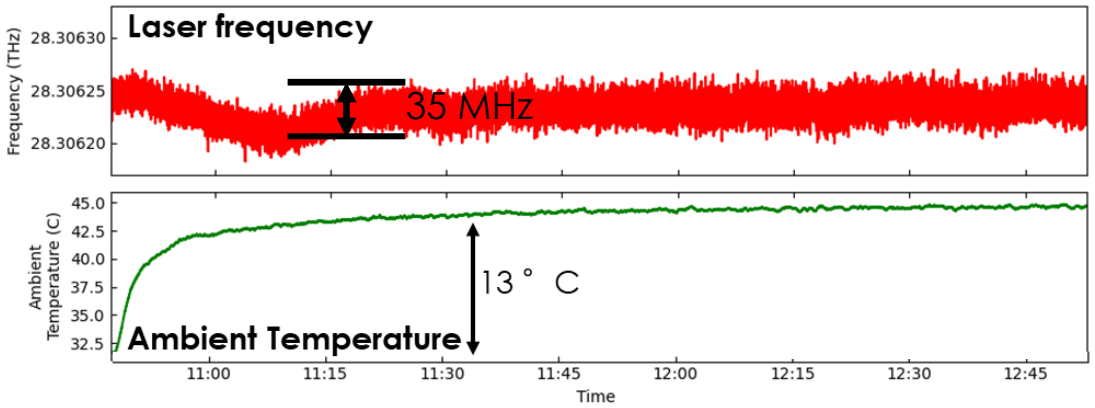






No wavelength jump during 13˚C temperature change

CHDI specs require ±60MHz laser frequency



CHDI Future

- **For-sale design expected by mid-2026**
  - Relevant performance specifications
  - Software package
  - Price
  - Lead time (expecting about 6 months)
  - Service/warranty

- **Customization is possible based on requirements**

- **If this can address your diagnostic needs, reach out**

- **Contacts:**

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