Collaborazione con DIII-D San Diego (1995-present)

WIP 21 Febbraio 2022

Prolegomenon:
ciclo informativo WIP’s

- Risultati diagnostiche THz, Enabling Research, collaborazione Clarendon *(fatto: Febbraio 2020)*

- Collaborazione con DIII-D San Diego *(oggi)*

- Sperimentazione JET su real-time e programmi futuri

  (~Marzo 2022)

DIII-D Tokamak (from their website)

- Major radius 1.7m, Minor Radius 0.6m
- Density typically 0.3-1.5x10^{20} m-3
- Plasma current 0.4 to 2MA, Toroidal Field 0.6 to 2.17T
- Safety factor at 95% surface ~2-12
- Heating power: 25MW NBI, >6MW ECH (140GHz), 1MW helicon
- Discharge length ~ 5s

The mission of the ***DIII-D Research Program*** *is to establish the scientific basis for the optimization of the tokamak approach to fusion energy production. The DIII-D Program is a cornerstone element in the national fusion program strategy.*

The DIII-D Program is a large international program, with 106 participating institutions and a research team of over 600 users. GA operates DIII-D for the Department of Energy through the Office of Fusion Energy Sciences as a true user facility. DIII-D research has been recognized a record four times with the American Physical Society Excellence in Plasma Physics Prize.

The DIII-D program is open to research proposals from all countries with which the U.S. Department of Energy has a cooperative agreement. Worldwide, we receive some 500 research proposals per year. However, funding-constrained runtime means only about 100 proposals can get time in most years.

Collaborazione con DIII-D San Diego: come funziona?

E’ opinione diffusa che per DIII-D non vi sia un framework definito (tipo JET)
e invece c’e’ sempre stato!

Ha avuto molti nomi: Mobility, LTA, LTC, International Missions (che significa: non-EU)

Informazione scarsa o nulla, o addirittura fuorviante: se interessa serve perseveranza (e trovare contatti)

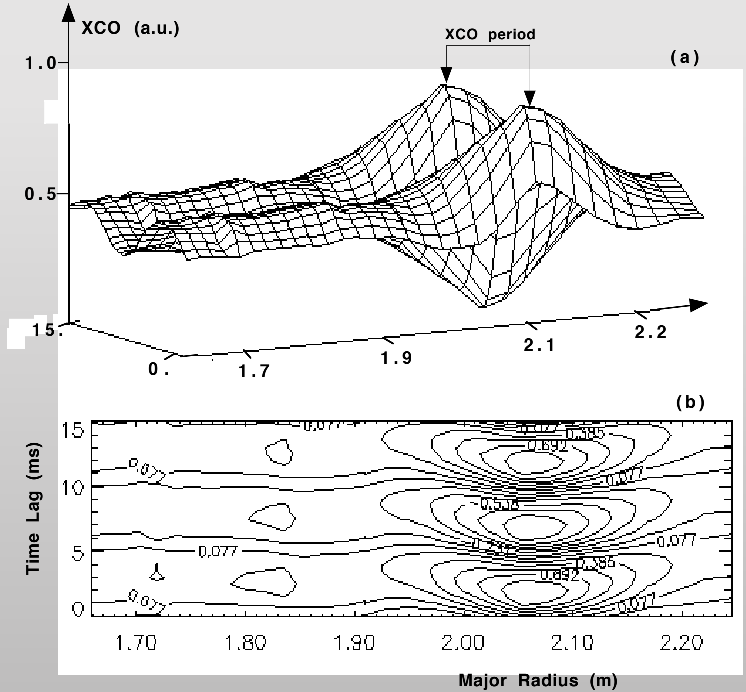
Lo schema e’ sempre esistito: con larga partecipazione italiana (ma poca o nulla da Frascati)

Cronologia

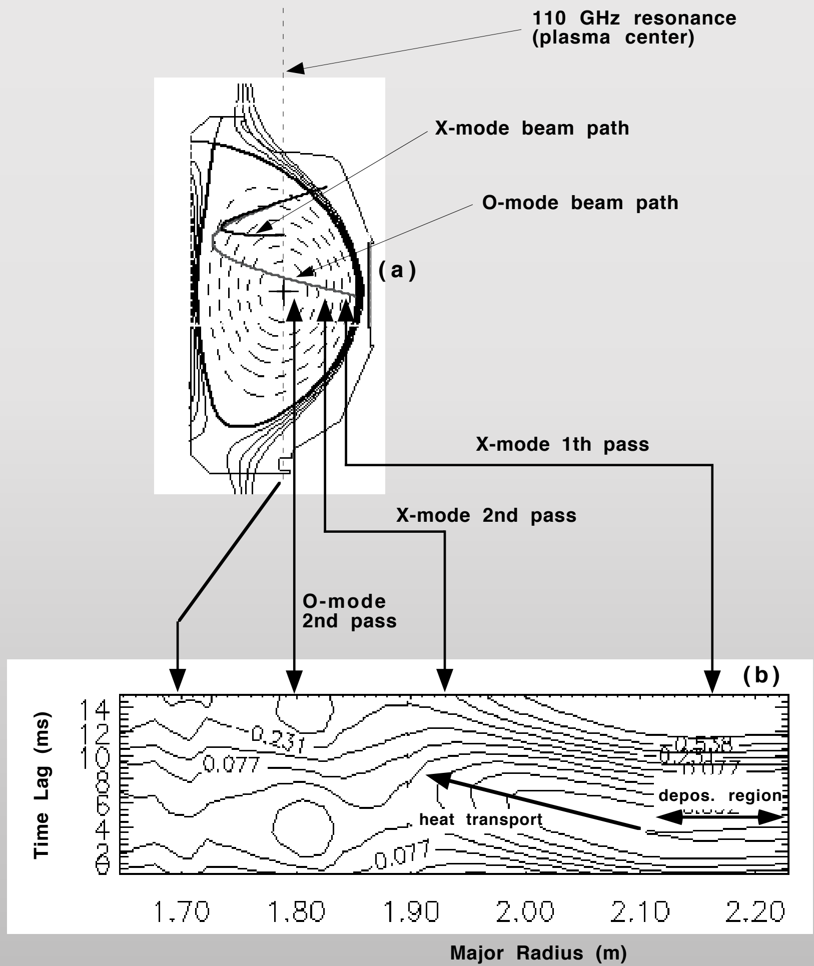
1995: first visit, work on gyrotron plan, calibration, operation, maintenance

new 4-channel launching system completed and installed.
Low power test successfully done (aligment), High power started
2 Gyrotrons, 140GHz, ~800 kW full power

1997: Heat Transport studies using ECH vs. Te crosscorrelation (XCO)
Plasma Phys. Control. Fusion **41** (1999) p. 931
Correlation analysis of 110 GHz ECH modulation experiments on the DIII-D tokamak



XCO heat transport measurements



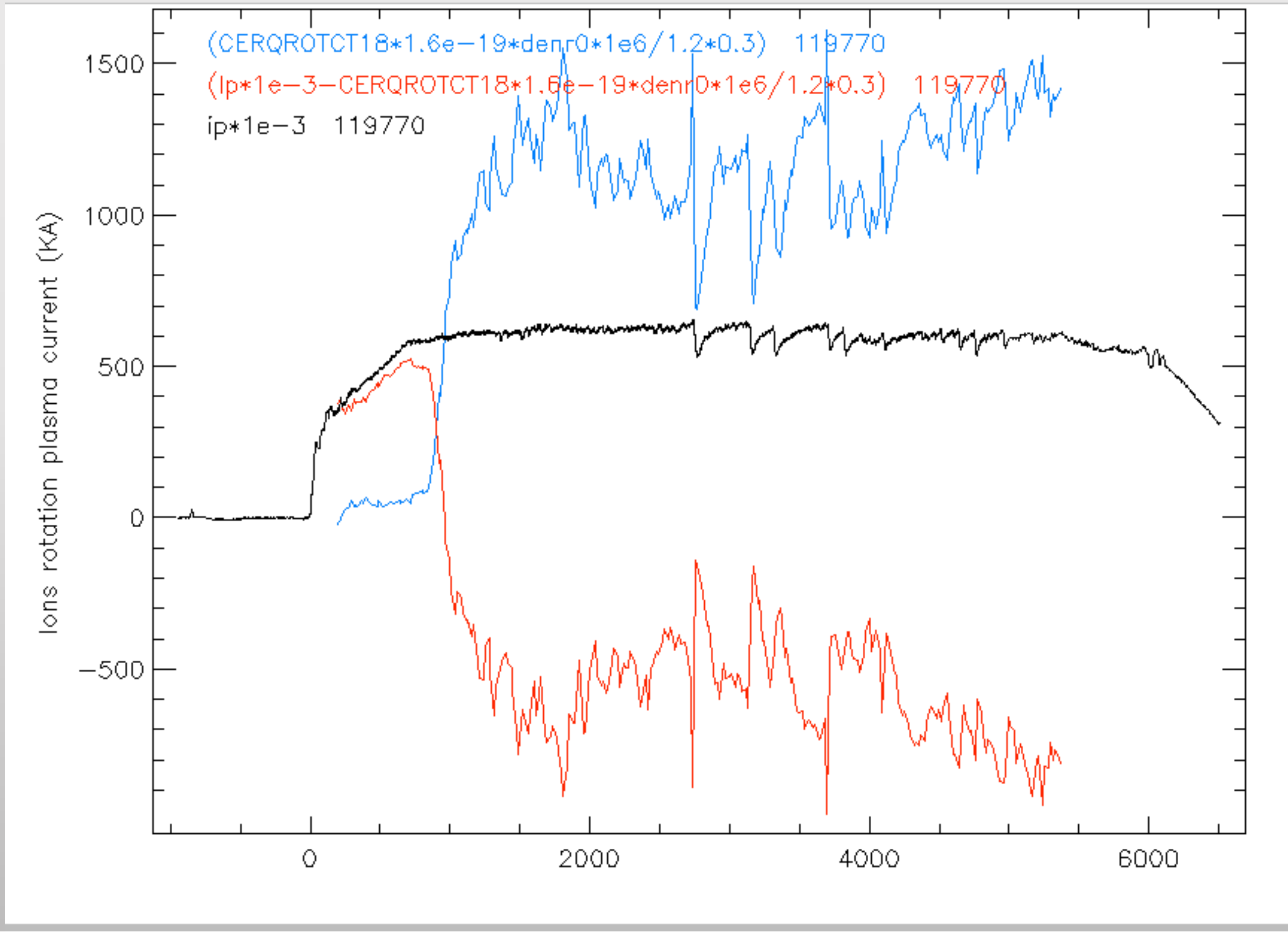
21^{th} Century……

2008-2009-2010-2012-2013
Plasma ROTATION: start and basis
ECE/ECH: Database, Experiments setup
Hollow Te, ROF. ROT: advanced, models & estimates, data evaluation
XCO renewed, other quantities (Vloop..., radio channels, gas puff), transport, ITB
Diagnostics development and proosals: FIR, microWave, Fabry Perot

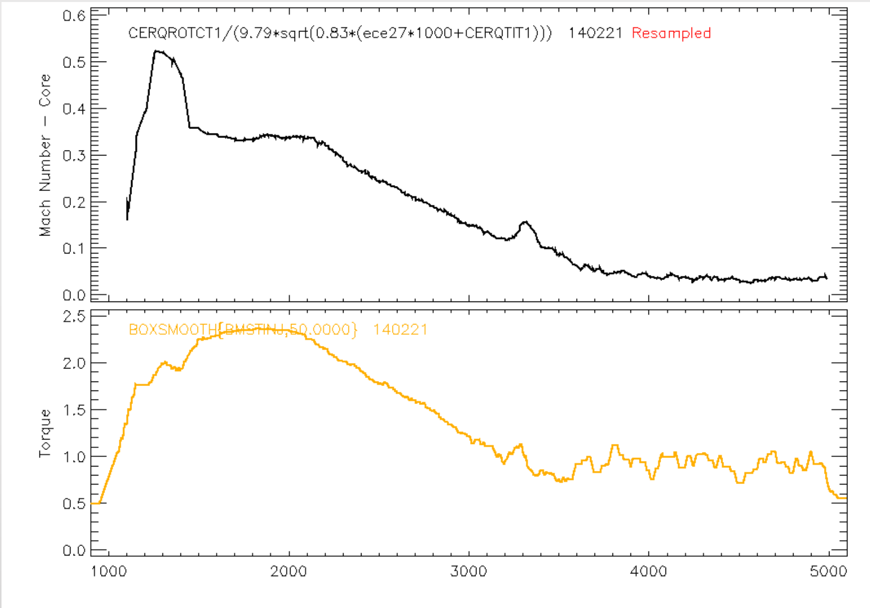
July 2018: *DIAG-3*, *Resolving the discrepancy between ECE and TS at high Te. Completed data access DIII-D, get_hece and get_ece, practiced and tested reviewplus, gaprofiles and other programs. Scan hight Te new database DIII-D and comparison FTU & JET. General survey and devise analysis method. References previous papers Tece/TS.*

July 2019 - Study of ITER-relevant tokamak scenarios. Heating of advanced tokamak discharges with O-mode ECH. 3rd harmonic ECE measurements, Real Time developments. Mode suppression mechanisms and actuators. Tokamak disruptions, control mechanisms, including SPI, for runaway and disruption effects. Cross comparative database between JET and DIII-D.

Plasma rotation and Current



Plasmas with high rotational Mach number (from ROF)



In DIII-D database there are examples where a situation with M~0.5 or more is reached for a limited time in the discharge center. The idea is to obtain a few shots with very high Mach number ($M = V_{\perp} / Cs > 2$) maintained for an experimentally consistent interval of time, to study clear supersonic conditions.

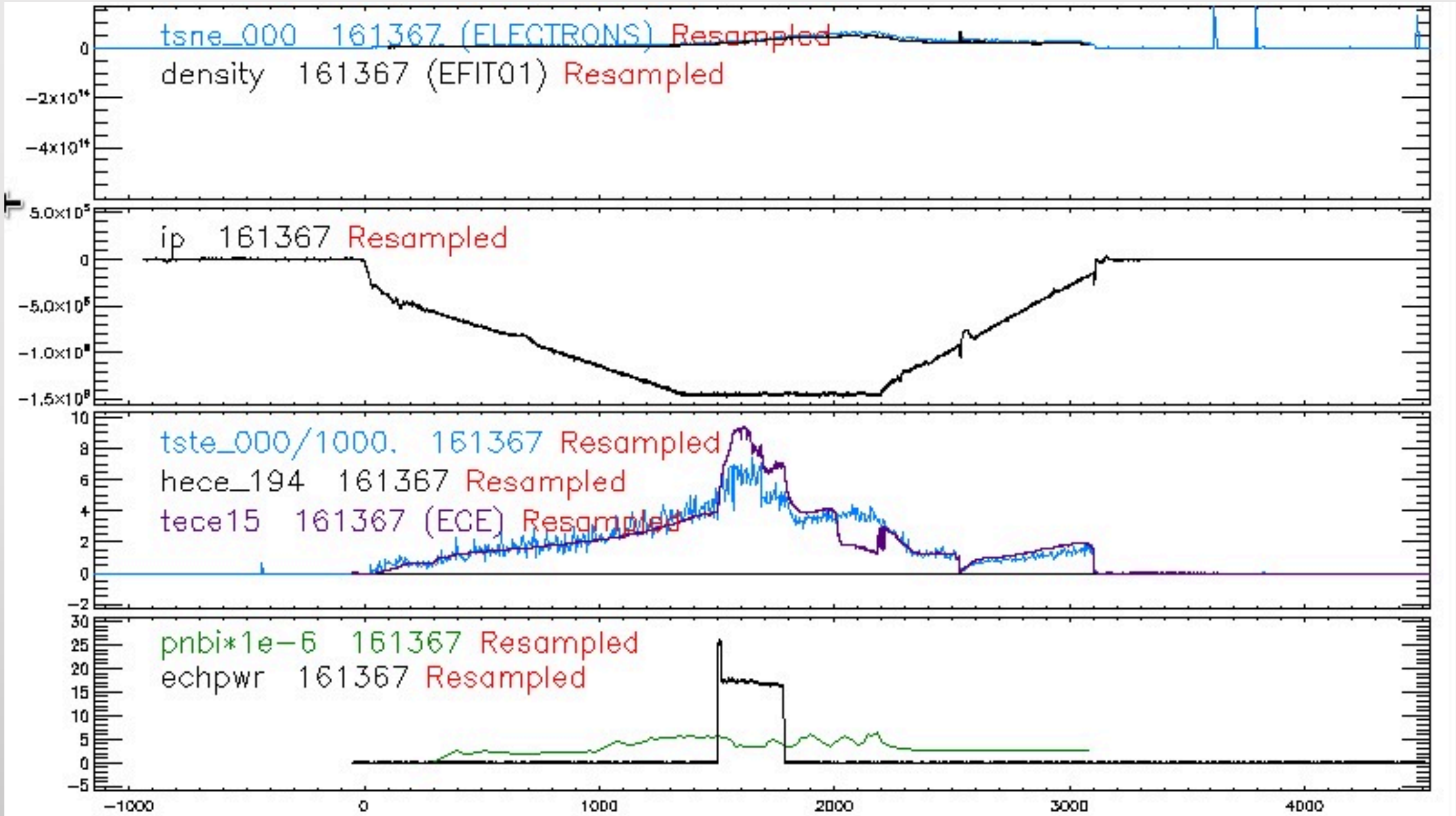
This can give information about equilibrium in presence of non-linear shock effects, capable to locally increase some plasma parameters. The shock waves could be intrinsic, i.e. self generated in the supersonic fluid, or induced by an external cause (pellet).

Description: Study of plasmas with high rotational Mach number in the discharge core.

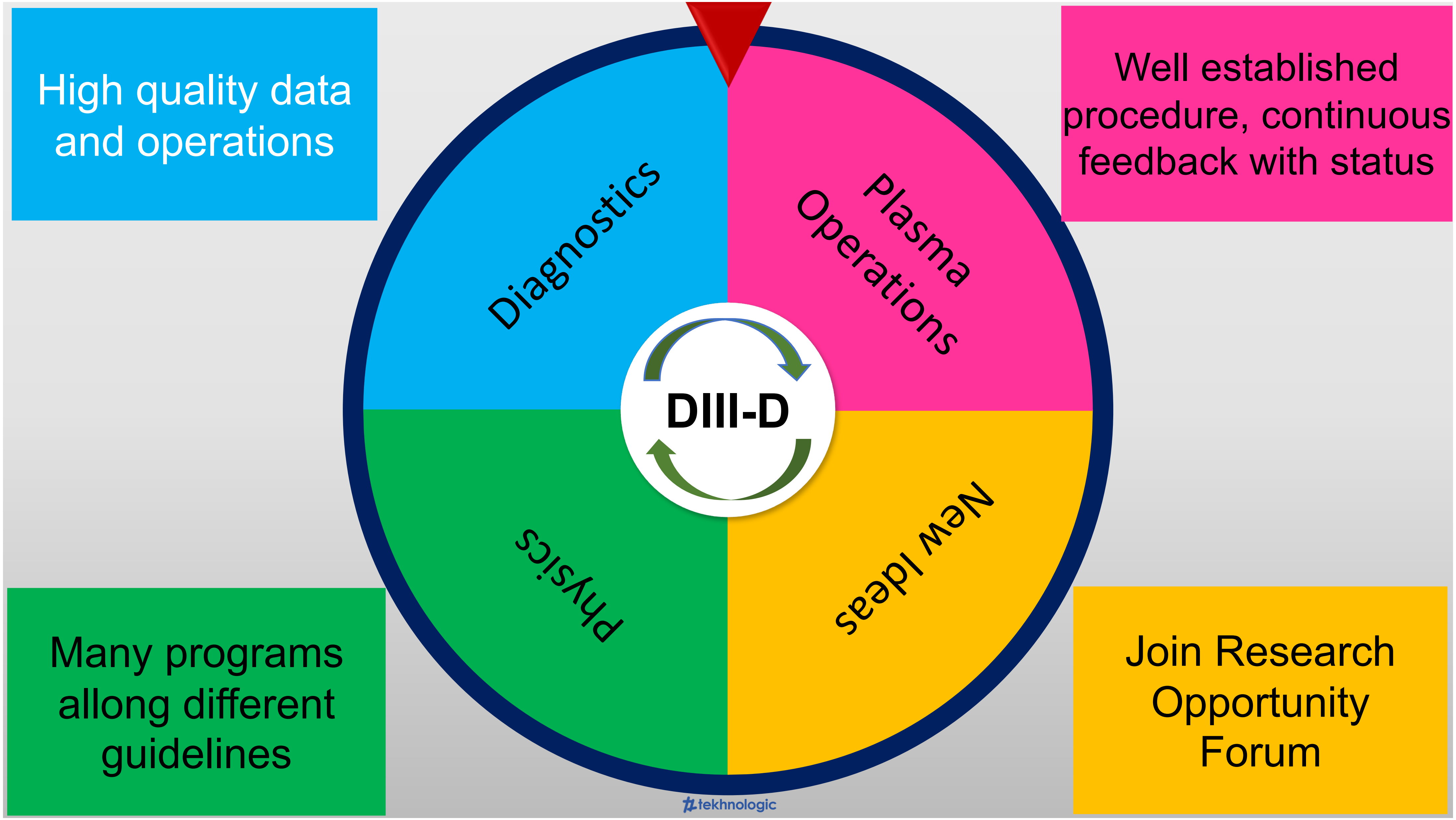
Experimental Approach: Increase torque to increase Vrot, starting from shots 140221/2 and similar. This will also increase Ti hence Cs, so plasma regime will have to be carefully adjusted to obtain M>1

The shots will not have to be dedicated, since the only requirement is high core Mach number, other programs with similar plasma conditions can use them.

Tece/TS comparison (make a long story short)



TS and ECE measurements anomalies are usually studied through statistical comparison over large sets of shot data. This is a good method only if there are well defined experimental conditions. The layout of the comparison must be verified with single shot analysis, by designing discharges with different ECE and TS relevant physical regimes.


High quality data and operations
Well established procedure, continuous feedback with status
Diagnostics
Plasma Operations
DIII-D
Physics
New Ideas
Many programs allong different guidelines
Join Research Opportunity Forum
tekhnologic

E’ una grande opportunita’ per restare agganciati a sviluppi avanzati in ambito Fusione, nel mentre che altri progetti vengono sviluppati

Possibilita’ di sviluppo di competenze importanti sul campo per i piu’ giovani

Le risorse esistono a livello Eurofusion: se non le usiamo noi, lo fara’ qualcun altro