EFDA E U R O P E A N F U S I O N D E V E L O P M E N T A G R E E M E N T

JET

Disruption Energy Loads on Plasma Facing Components in JET

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and EFDA JET Task Forces E + M

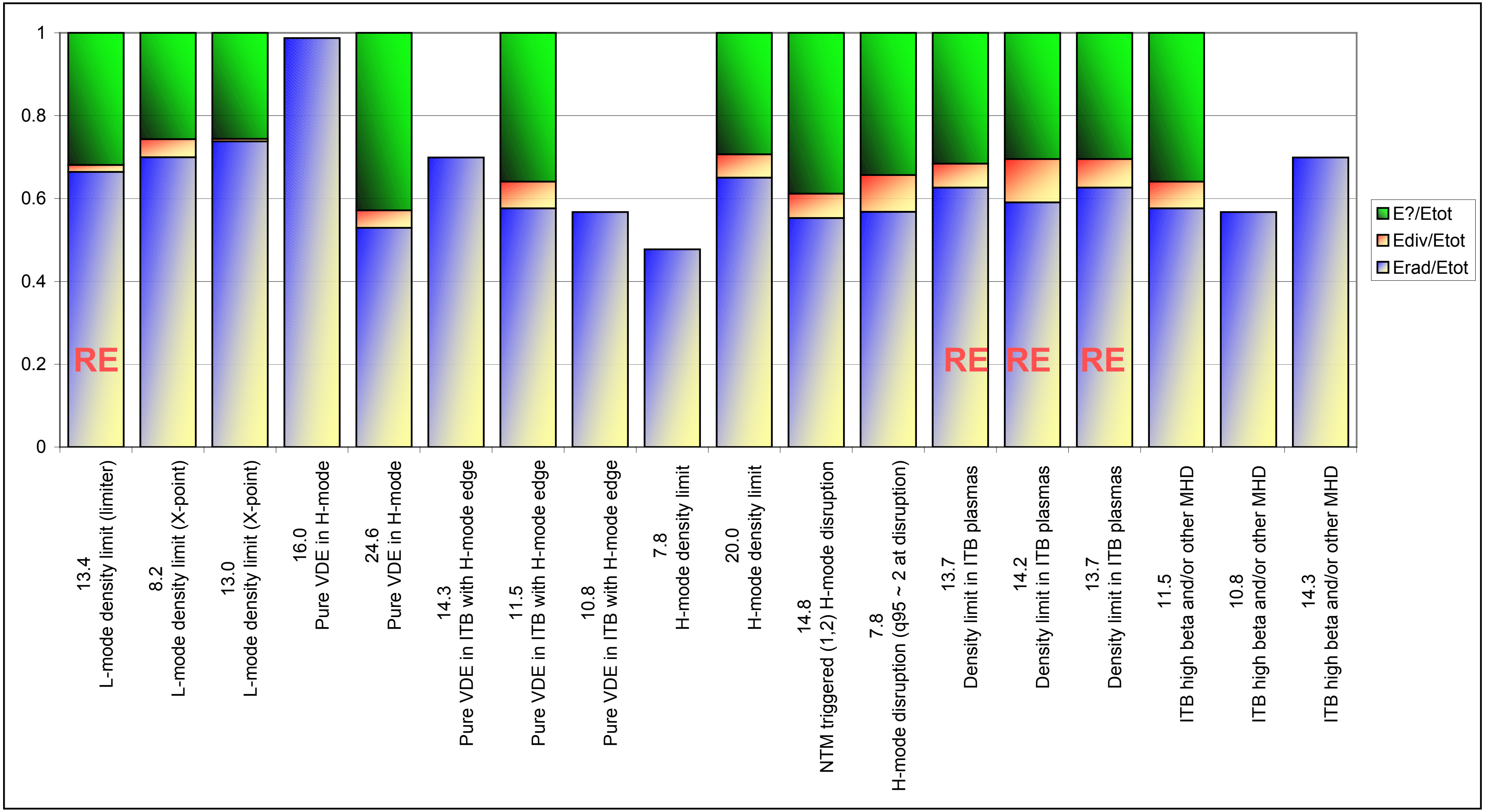
Heat Loads During Disruptions
- Energy balance
- Heat load distribution in H-mode and ITB disruptions
- Runaway electrons and toroidal asymmetries

Disruption Mitigation
- He, Ne and Ar

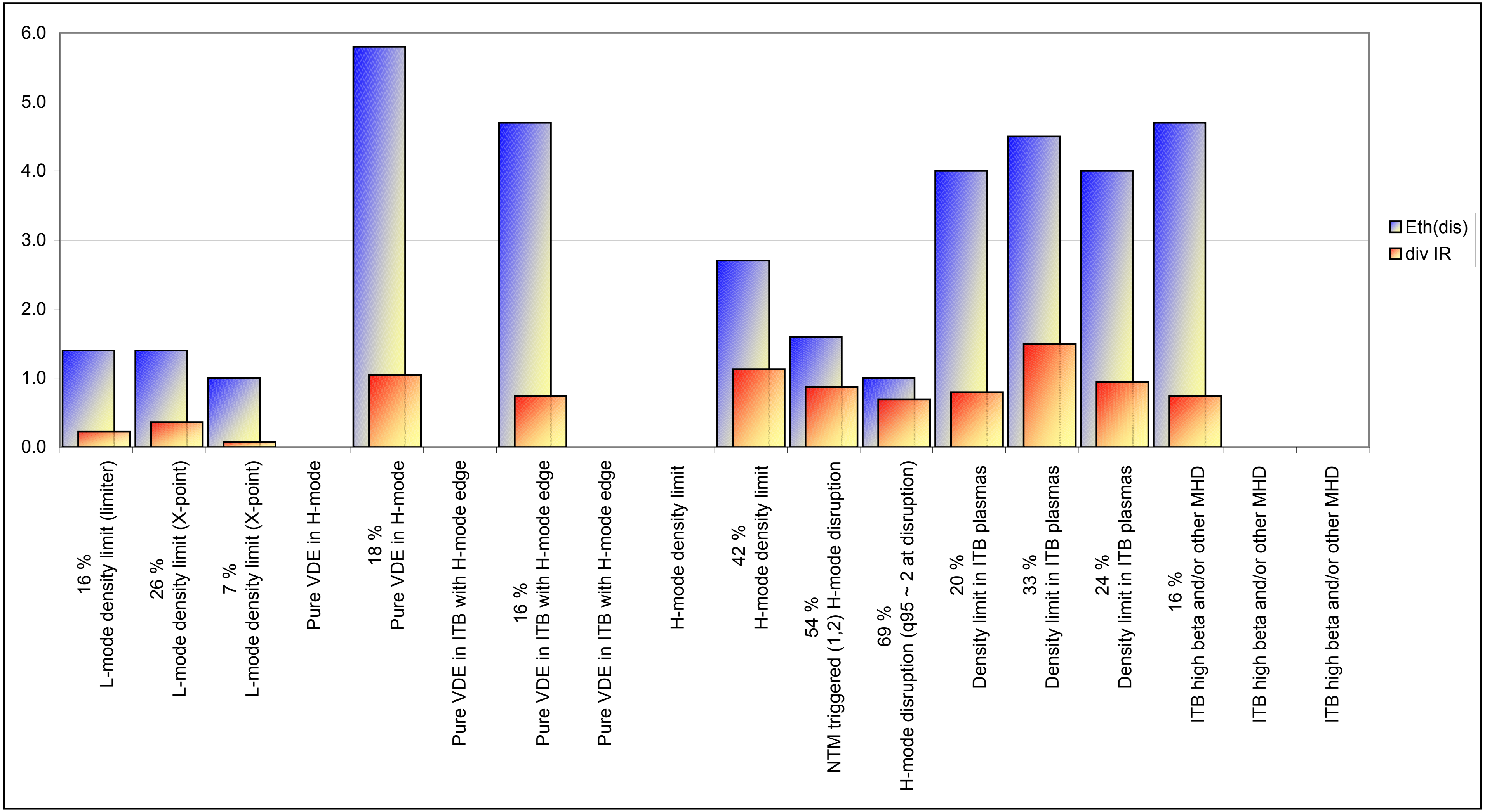
UKAEA Fusion

ITPA St. Petersburg 15th-17th July 2003

DISRUPTION HEAT LOADS: THERMAL+CURRENT QUENCH BALANCE

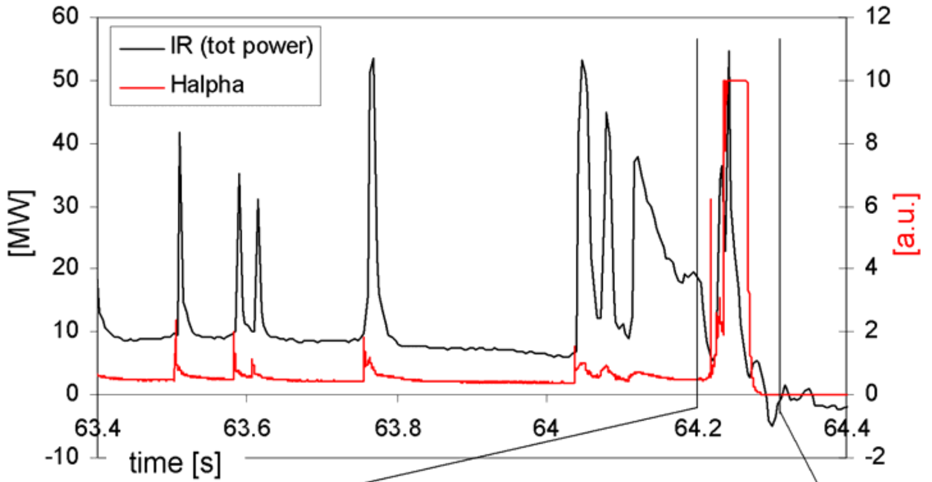


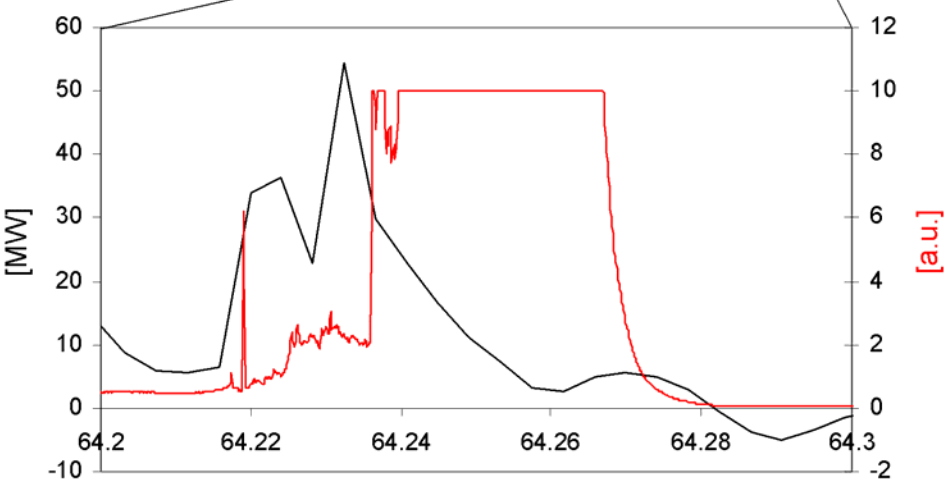
DISRUPTION HEAT LOADS: THERMAL & DIVERTOR ENERGY



EFDA EUROPEAN FUSION DEVELOPMENT AGREEMENT JET

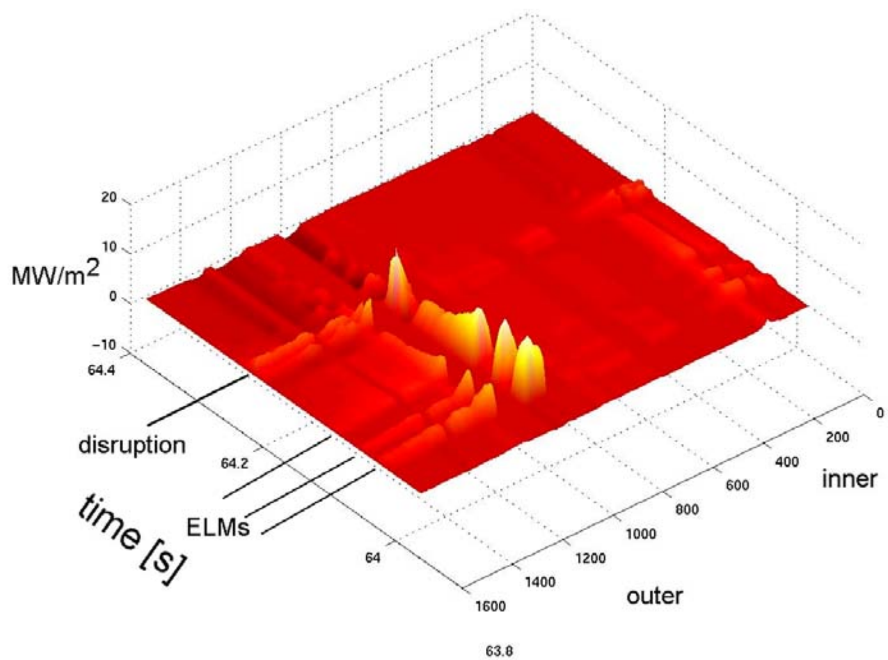
H-MODE DENSITY LIMIT (JET-58009)





Thermal energy ~3 MJ
Divertor energy ~1 MJ
33% of E_{th} to divertor

Magnetic energy ~17 MJ
Radiated energy ~13 MJ
6 MJ not accounted (30%)



Disruption similar to ELMs

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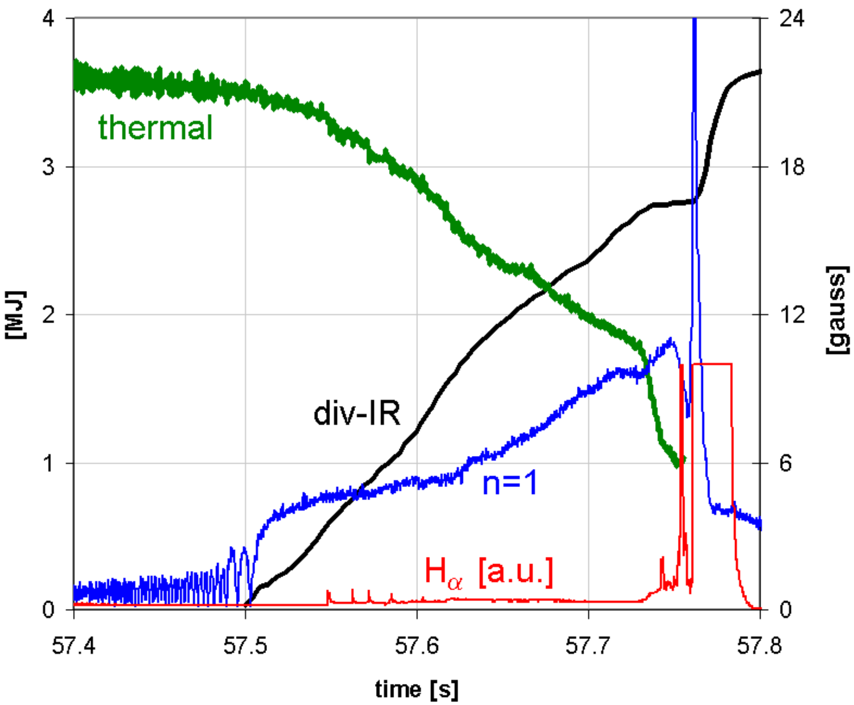
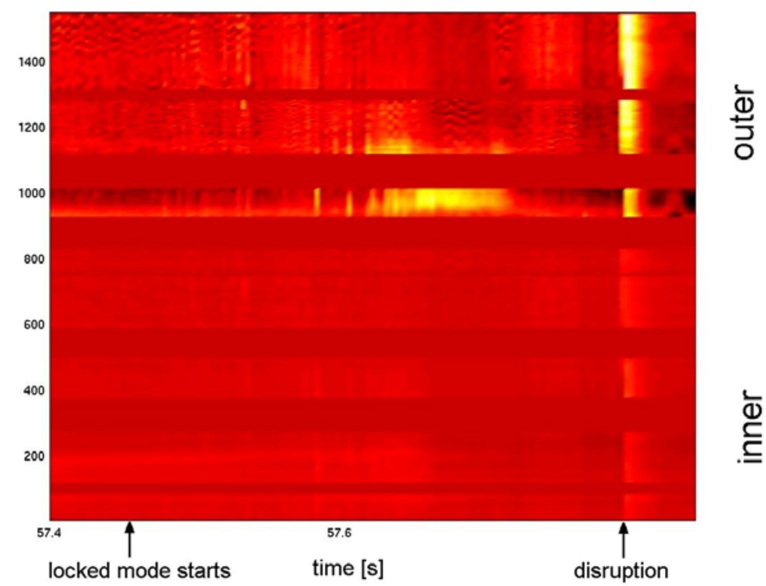
NTM-TRIGGERED (JET-59027)



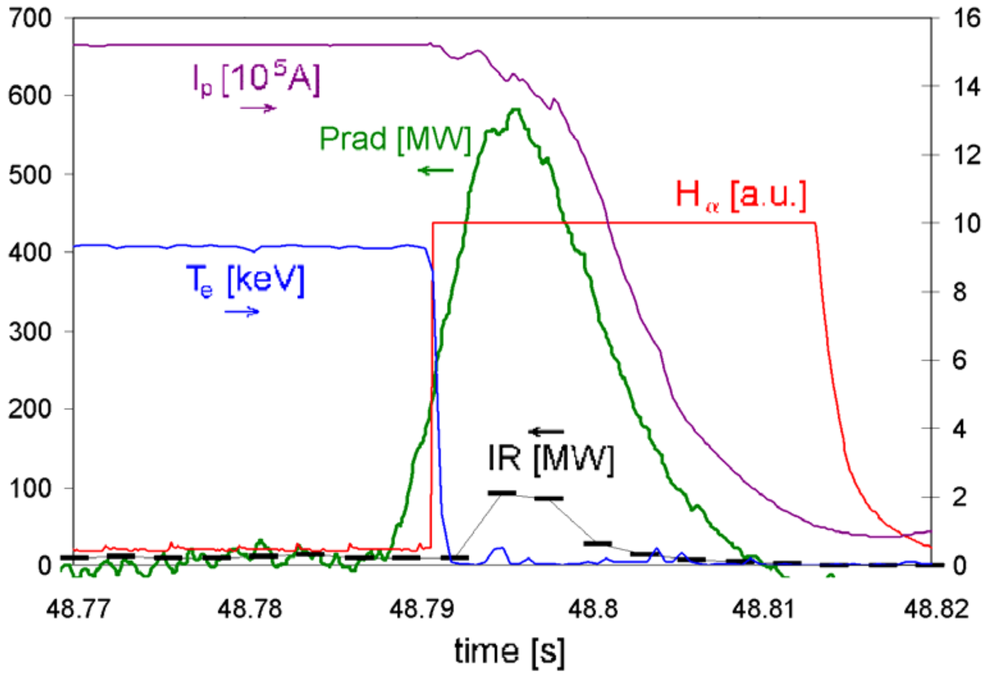
Thermal energy ~ 1.8 MJ
Divertor energy ~ 0.8 MJ
45% of E_{th} to divertor

Magnetic energy ~ 13 MJ
Radiated energy ~ 8 MJ
Neutral beams during NTM ~ 1 MJ
6 MJ not accounted (33%)



EUROPEAN FUSION DEVELOPMENT AGREEMENT

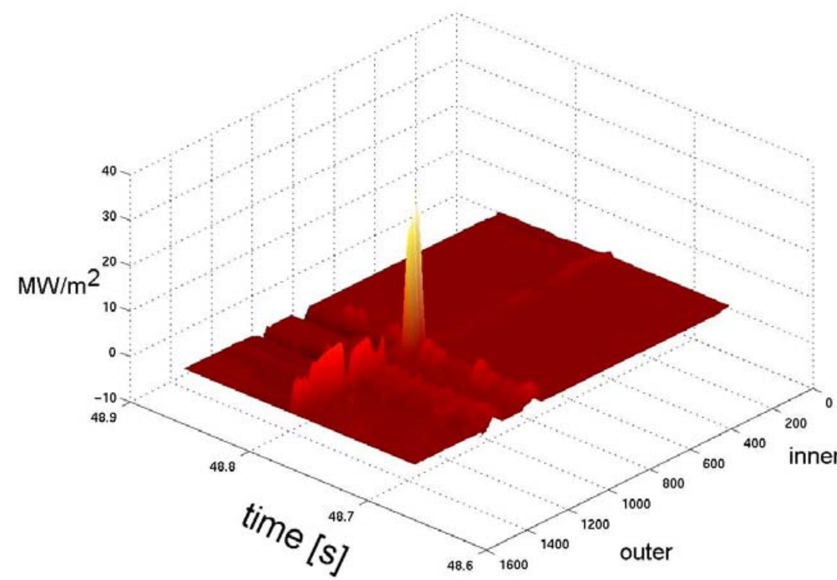
HIGH β ITB (JET-58456)



Thermal energy ~4.7 MJ
Divertor energy ~0.7 MJ
14% of E_{th} to divertor

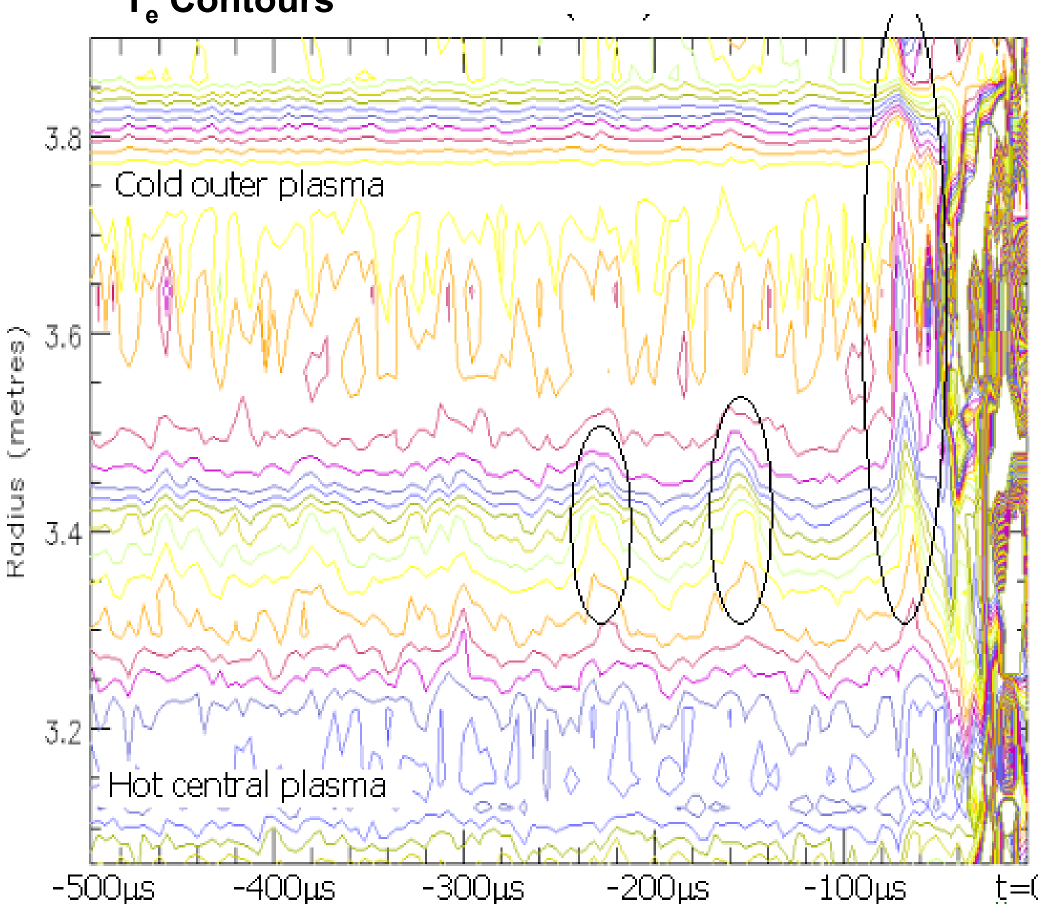
Magnetic energy ~6.7 MJ
Radiated energy ~6.7 MJ
4 MJ unaccounted (35%)

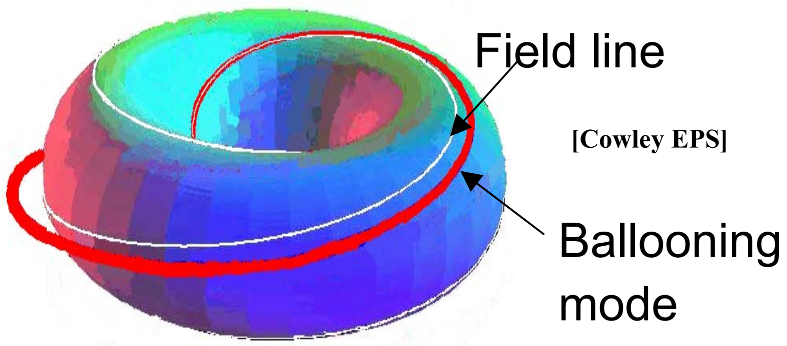
- **Radiation follows thermal quench**
- **Divertor energy fraction small**
- **Wall loading is implied**



HIGH β ITB Disruption Mode Structure Implies Localised Wall Loading

T_e Contours



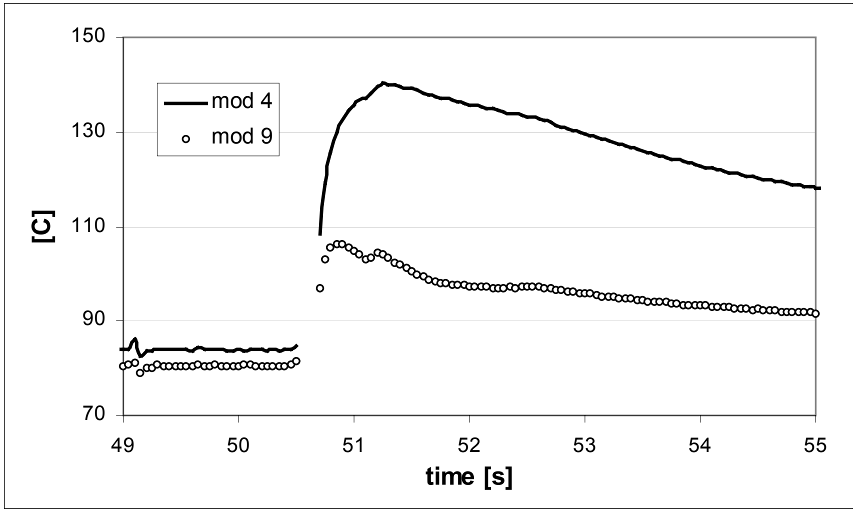


[Cowley EPS]

What is the peaking factor?

Wide angle IR is required

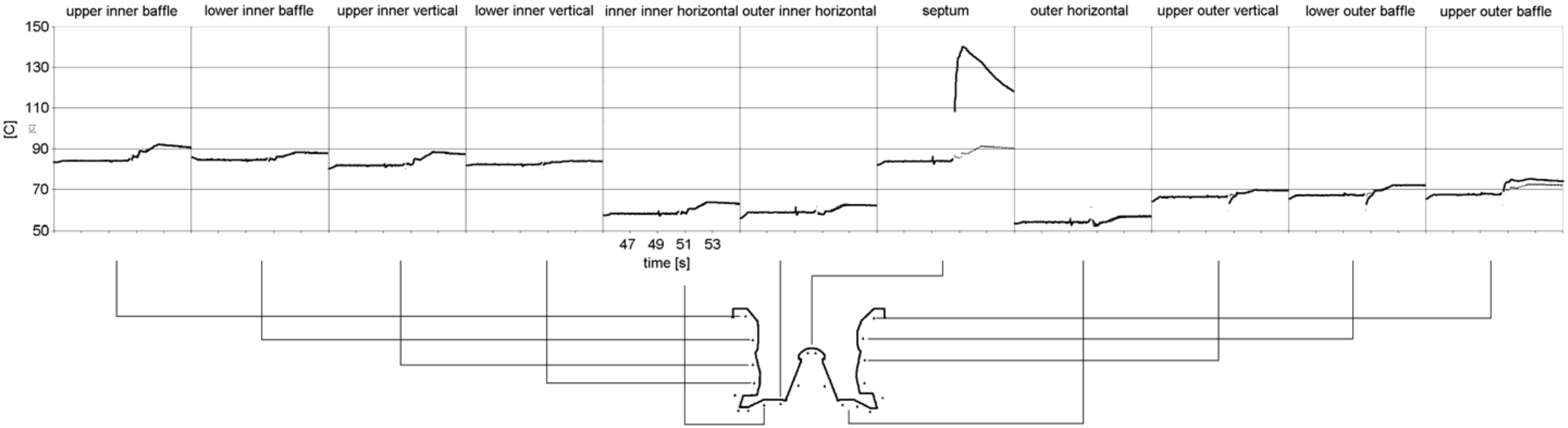
Runaway Electrons (JET-54327&53790)



T rise in divertor module 4 (60°) more than double than in module 9 (135°)

A similar RE event gave no temperature increase on module 4

REs give asymmetric divertor load

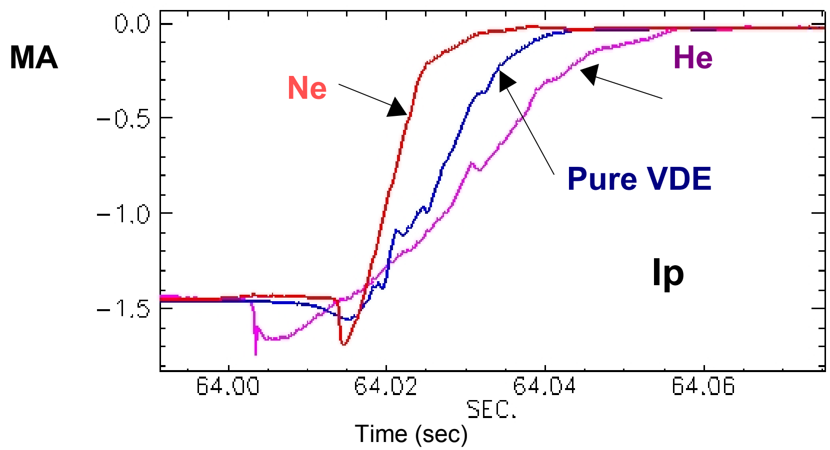


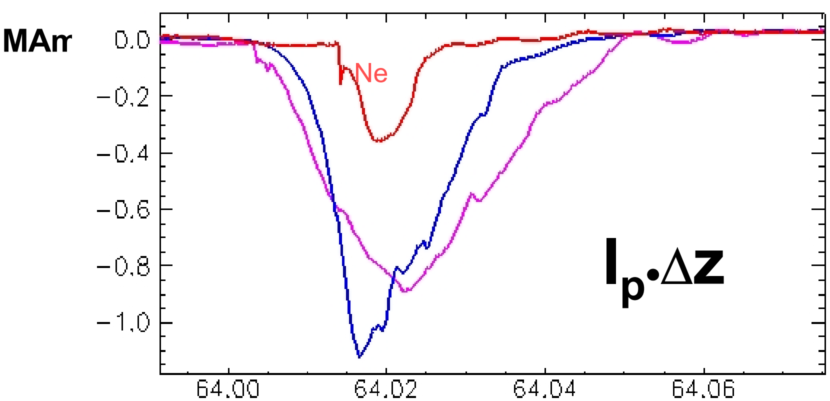
Disruption Mitigation

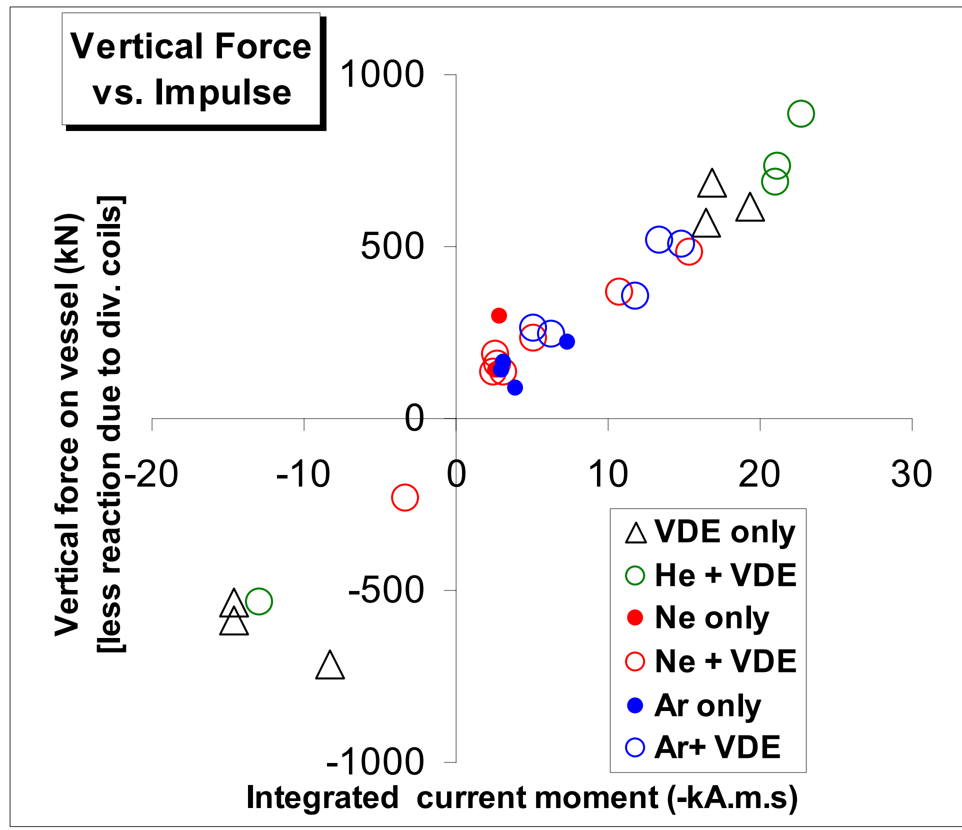
Objectives :

- Reduce electromechanical loads on vessel and in-vessel components
- Reduce energy density deposited on divertor
- Avoid runaway electrons generation

Disruption force mitigated in JET by Ne / Ar puffs but not thermal quench - current system too slow

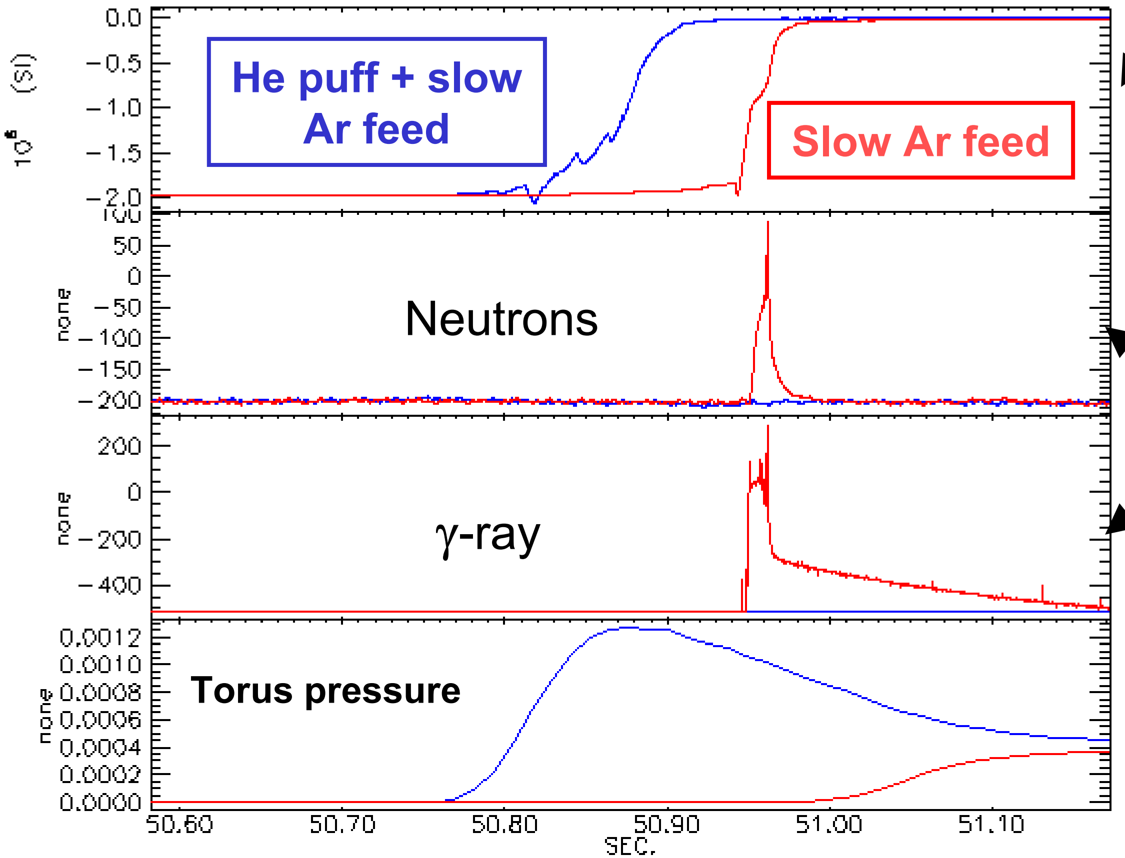






Runaway electron suppression by helium puffing only useful if REEs are the only problem - not forces

2 MA 3 T limiter plasmas 54047, 54048



Plasma current

He puffed plasma disrupts earlier than reference

Current quench is longer

REs not seen with He puff

Conclusions

ITER implications of JET disruption heat loads

- Divertor loads much less than currently assumed
- Large and possibly localised heat loads on the main wall are implied

➔ **Are high wall loads specific to JET?**
Or should ITER assumptions change?

Disruption mitigation at JET

- Slow JET system substantially reduces forces with Ar and Ne
- Too slow to affect thermal quench
- He only useful for RE supression (insufficient for ITER)
- Faster/bigger system for JET still at conceptual stage