Present status and near future plan of the Fusion Research in ASIPP

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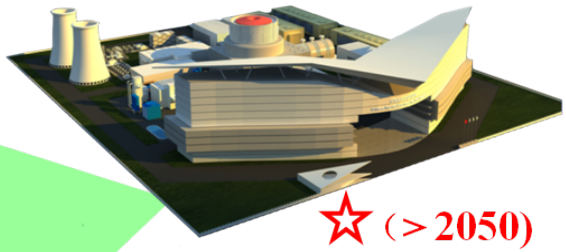
Roadmap of Fusion Energy Research in China (draft)

Consensus from Chinese fusion community!
10th anniversary ITER China celebration
Beijing Fusion Declaration

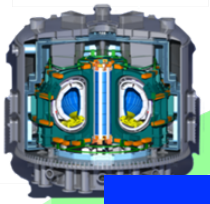
Y. Wan, et al. Nucl. Fusion 2017

PFPP

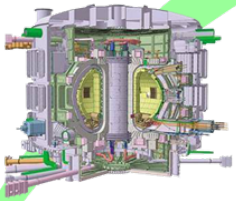


☆ (>2050)
1GWe, Power Plant Validation

CFETR



ITER



★ (~2025)

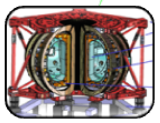
Phase II: Q=5, 3000s, 350MW, steady-state burning plasma

Phase I: Q=10, 400s, 500MW, Hybrid burning plasma

Steady-state with duty cycle >0.3~0.5
Tritium self-sufficiency with TBR>1.0

EAST

EAST Advance PFC, steady-state advanced operation



HL-2M Advanced divertor, high power H&CD, diagnostics

J-TEXT Disruption mitigation, basic plasma

2015 2020 2025 2030 2035 2040 2045 2050 2055 2060

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The 13th five year's plan is strongly orientated

to make CFETR ready for proposing

Mainly support:

- **Integrated design (physics and engineering)**
- **Key physics research (high β, SS, PWI, EP…)**
- **Key R&D for engineering design (SC conductor, magnet)**
- **…tics)**
- **…**
- **…**

In 2017, six projects approved:

- **CFETR integrated engineering design;**
- **High β_p and f_{BS} Steady-state operation,**
- **Gyrotron, NNBI,**
- **Blanket and Tritium**

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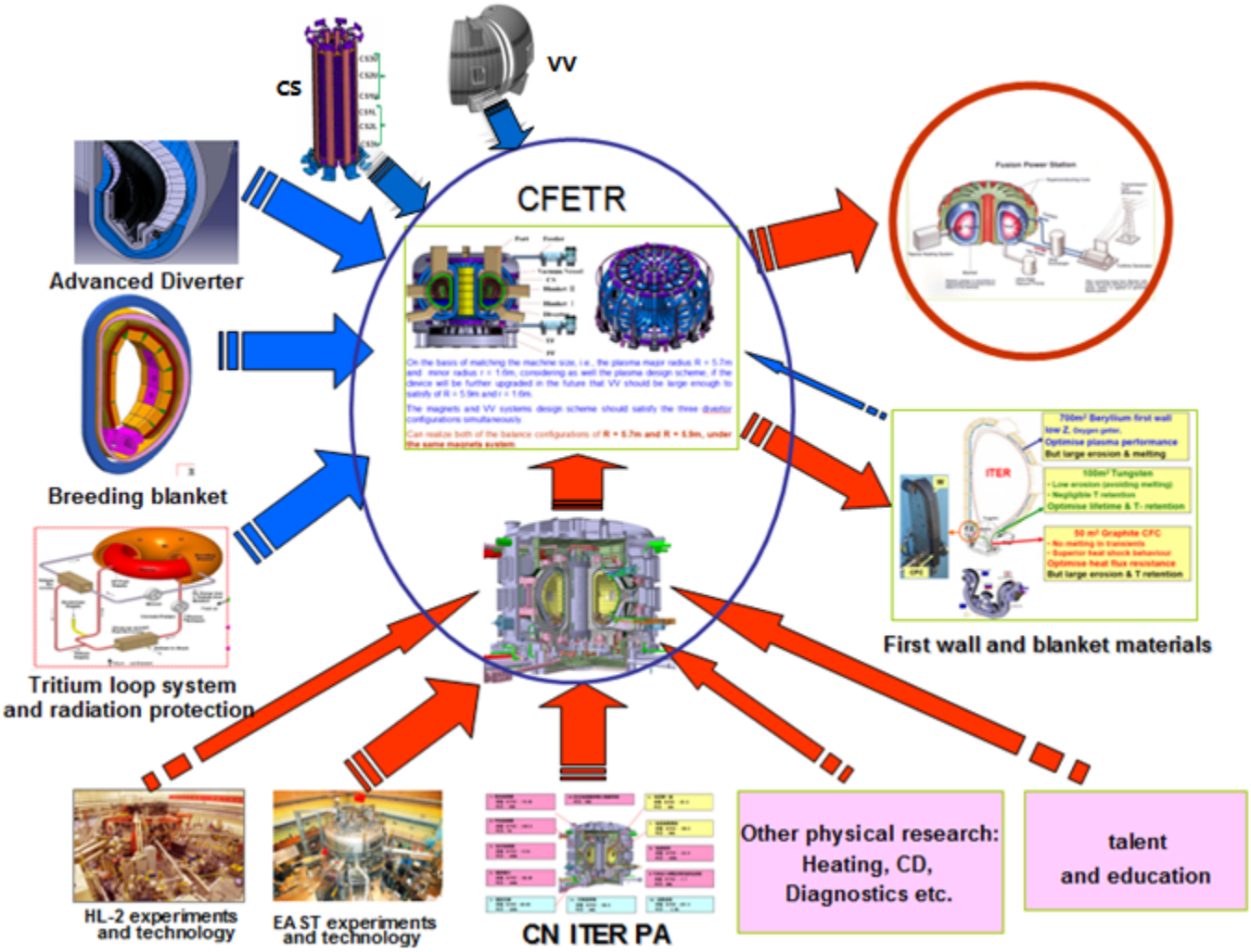
Strategy for 13th five year research program

To build a centralized team for integrated design



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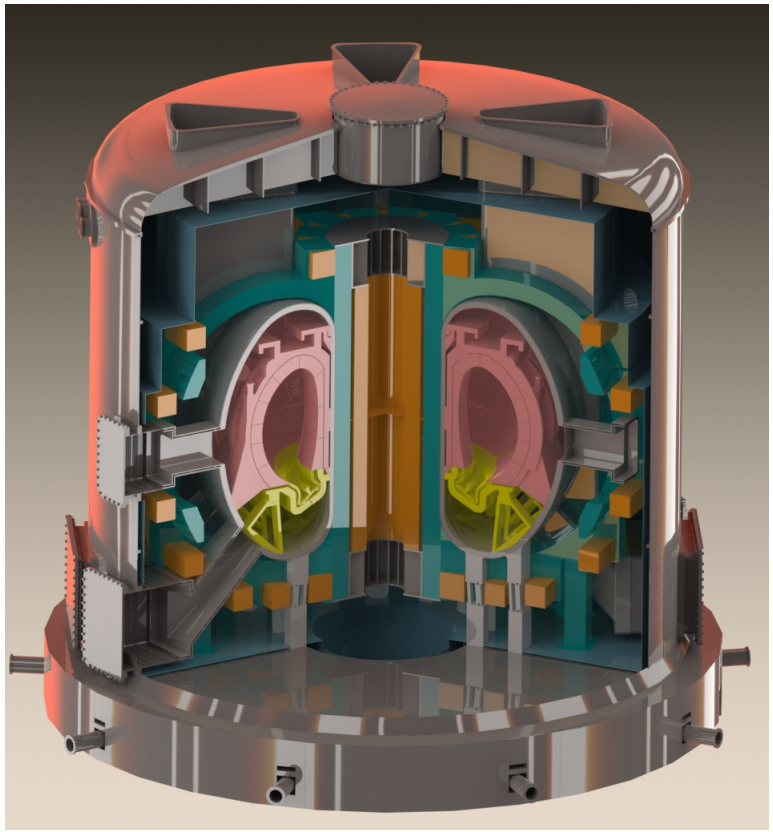
Continuing iteration of CFETR conceptual design

New version



Based on more Advanced Magnet design

TF (Nb_3Sn, 7.0-7.5 T);
PF (Nb_3Sn , Nb_3Al),
CS （Bi 2212 ClCC, 480VS)

- **Larger size:**

  R= 6.6-7m(5.7), a=2-2.2m(1.6)
- **Higher B_T: 5.0-7.0 T (5)**
- **Advanced CS magnet:≥ 480 VS**

- ✓ **More confident plasma targets**
- ✓ **Easier for duty cycle 0.3~0.5**
- ✓ **More flexible for blanket/divertor**
- ✓ **Potential DEMO issues**
- ✓ …

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EAST continues to conduct SS high performance operation in ITER-like condition and deliver relevant physics basis for ITER and CFETR

EAST resources are strongly focused on

- **Capability enhancement**
  - ***In support of steady-state long-pulse scenarios***
- **High performance steady-state plasma operation with ITER-like Tungsten Divertor**
  - ***Long-pulse steady-state (SS) H-mode with RF dominated H&CD***
  - ***High β_p Scenario development***
  - ***High β_N Scenario development***
- **Key Physics Issues towards Steady-State Operation Regimes**
  - ***LHCD at high density and current density profile control***
  - ***ELM control with Multiple technologies***
  - ***Exploration of small / No ELM regime***
  - ***Particle/power exhaust control***
  - ***Impurity control***

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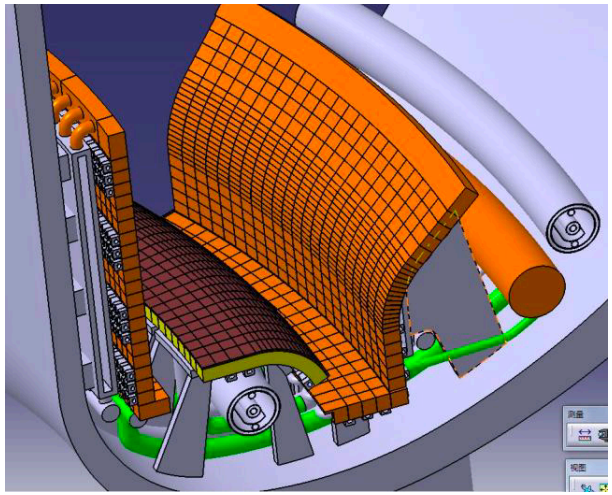
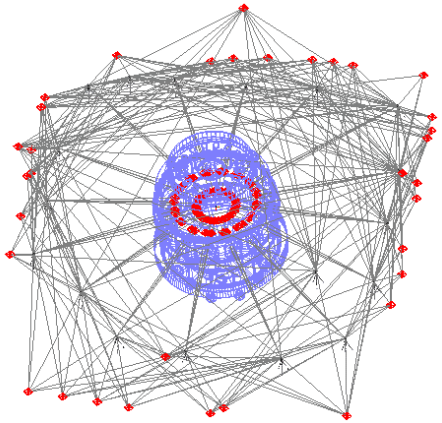
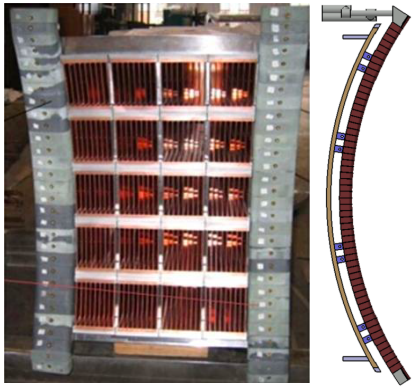
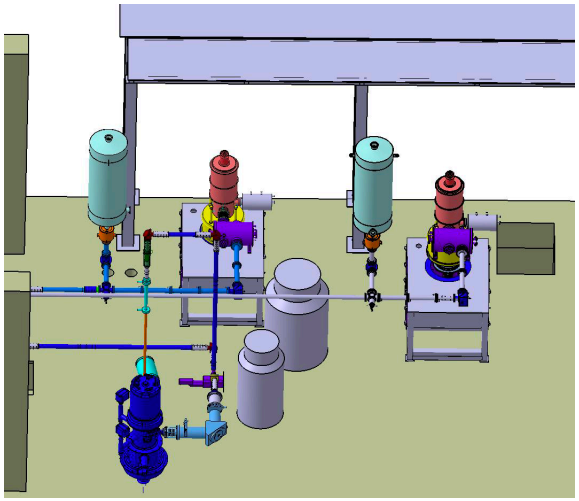
Enhancement of experimental capabilities

- In next few years:
- Lower divertor (10MW/m^2)
- Guard limiters of RF launchers
- ECH power (4 Gyrotrons)
- New ICRF antenna
- NBI→ long pulse
- Diagnostics (Div/SOL & PFC)
- Plasma control









Precise alignment of PFC

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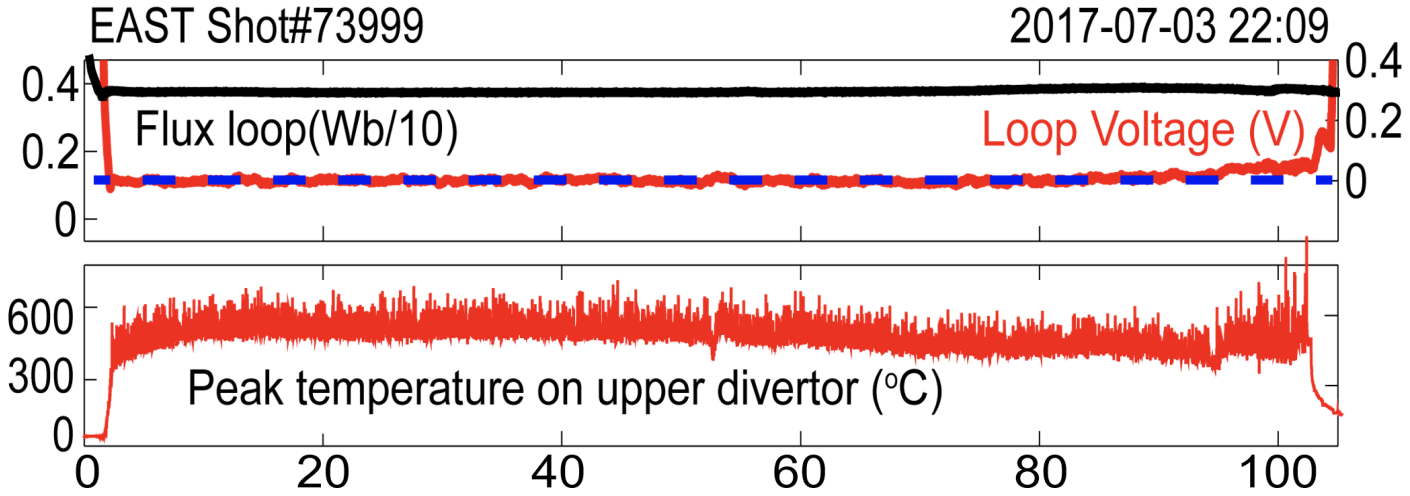
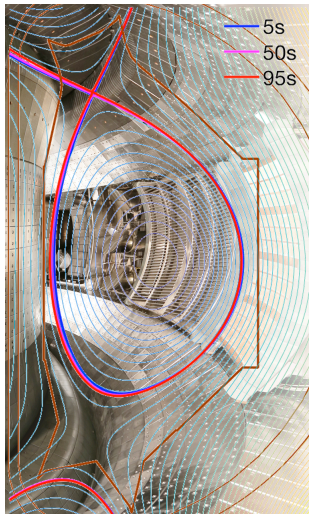
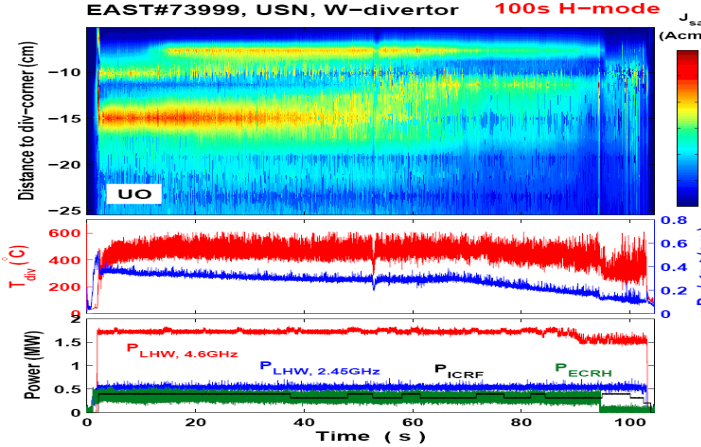
Integration of key physics and technical issues for long pulse H-mode operation





- Optimization of outer-gap to avoid Hot spot on the 4.6Ghz LHCD antenna
- Optimization of divertor configuration to maximize particle exhausting
- 3D effect of LHW on heat distribution on divertor plates
- On-axis ECH to avoid impurity accumulation
- Lithium coating and aerosol lithium injection
  - minimizing recycling and impurity generation
  - easy access small ELMy regime



Splitting of upper outer divertor footprint

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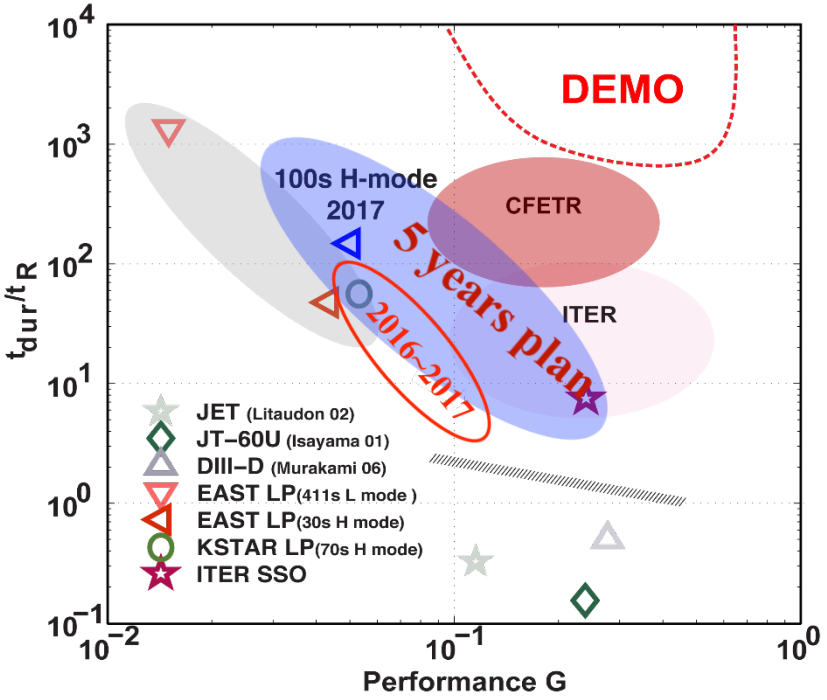
Near future plan →Extend the operation to demonstrate ITER and CFETR steady-state scenarios

1. Higher performance (β_P, β_N)
2. Long pulse demonstration with H_{98} ＞1, f_{BS} ~50%
3. High energy injection >1GJ (@10MW for 100s)

Note： Full metal PFC; low torque
EAST has large A=4.2



Biggest challenge is to integrate various technical and physical elements into one

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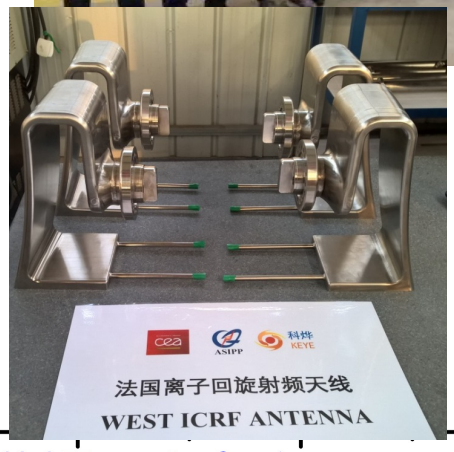
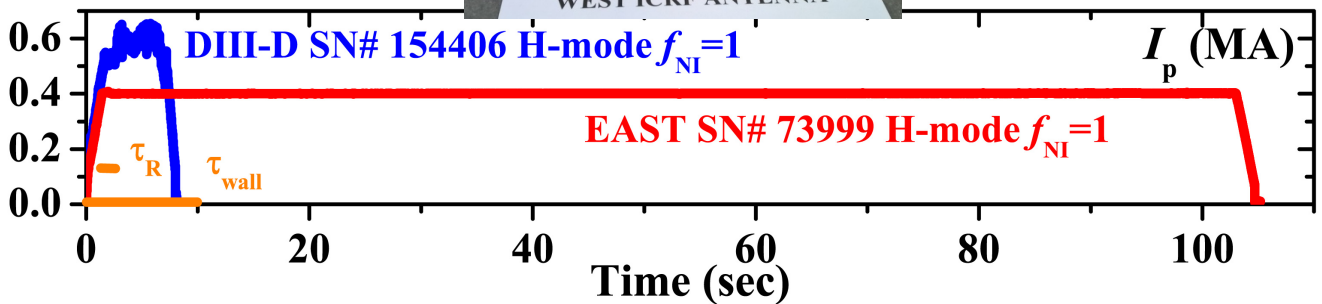
To resolve common scientific, technical and engineering challenges through close international collaboration





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More open for cooperation