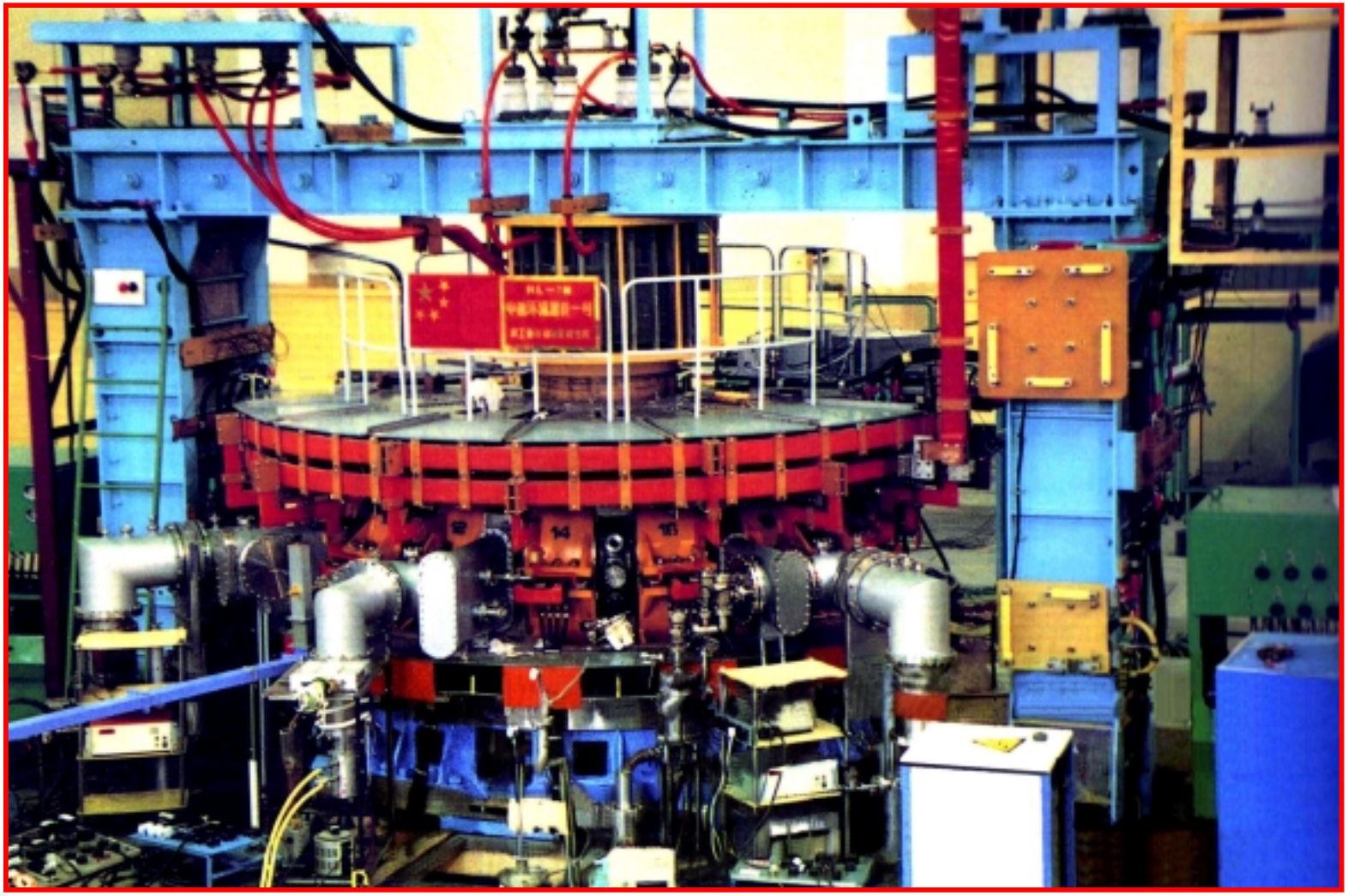
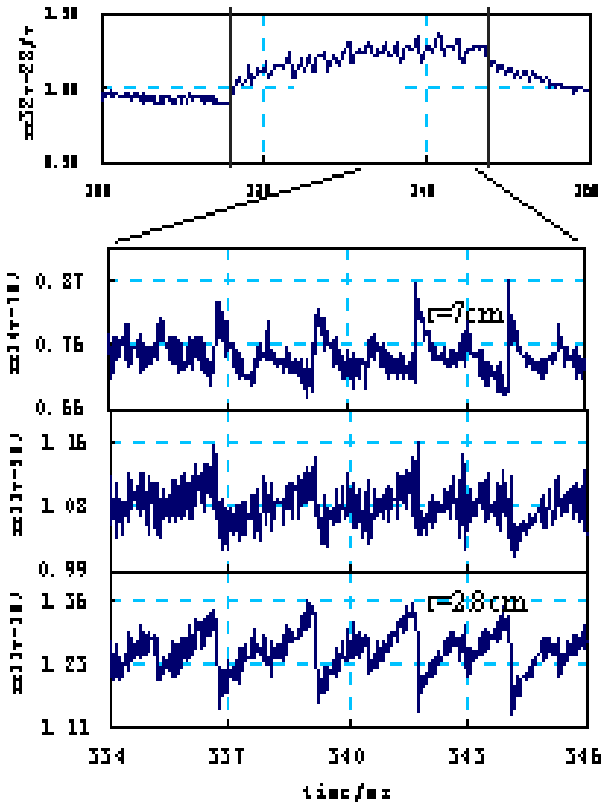
Experiment on HL-1M

- Parameters: R= 1.02 m; B_t= 3.0 T; a = 0.26 m
- Objective: High power auxiliary heating
  (NBI,ECRH,ICRH,LHCD)
  New fueling techniques
  (PI,Supersonic Molecular Beam Injection)
- Maximai parameter: I_p=320 KA , n_e=8x$10^{19}m^{-3}$ achieved;
- Off axis ECRH: Double sawtooth was observed
- Advanced fueling with PI and SMBI:
  Improve confinement and density limit



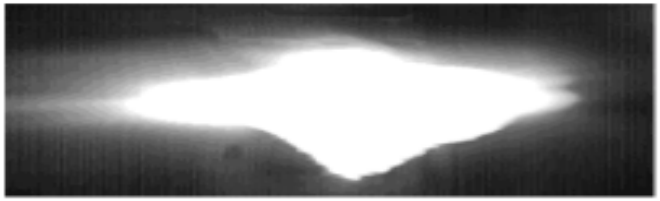
HL-1M tokamak in SWIP

Off Axis ECRH Experiments

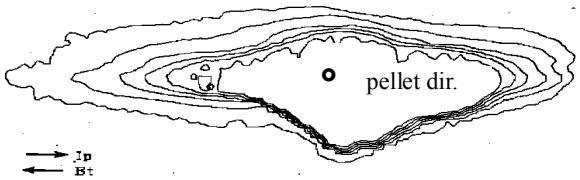


- 75GHz /300kW(o-mode)
- I_P=150-200kA, B_t=2.4-2.7T
- n_e=0.5-4.0° $10^{13}cm^{-3}$.
- T_e increased 450eV -> 700eV
- The MHD activities were modified
- The double ST means that the reversed magnetic shear is formed

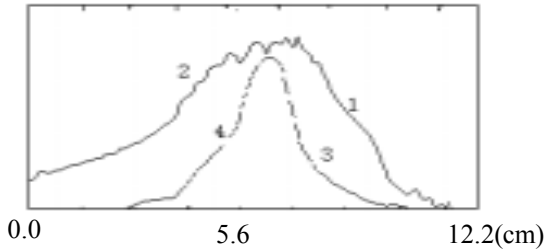
E. Wang



(a) pellet ablation cloud



(b) Contour line of the intensity of ablation cloud



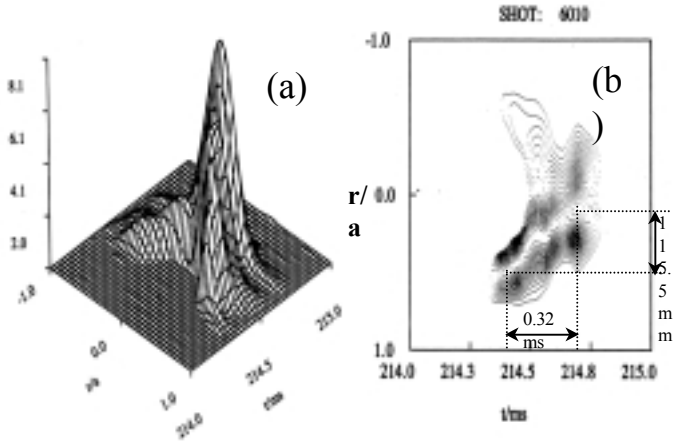
(c) Toroidal (solid line) and poloidal (dashed line) emission profile

FIG. 2 Asymmetry in the intensity of pellet cloud

PI Experiments on HL-1M

- Size: 2° ¡ 1.0, 3° ¡ 1.2, 3° ¡ 1.3mm
- up to 8 pellets injected
- improved energy and particle confinement
- enhanced density limit
- asymmetric cloud in toroidal and poloidal direction

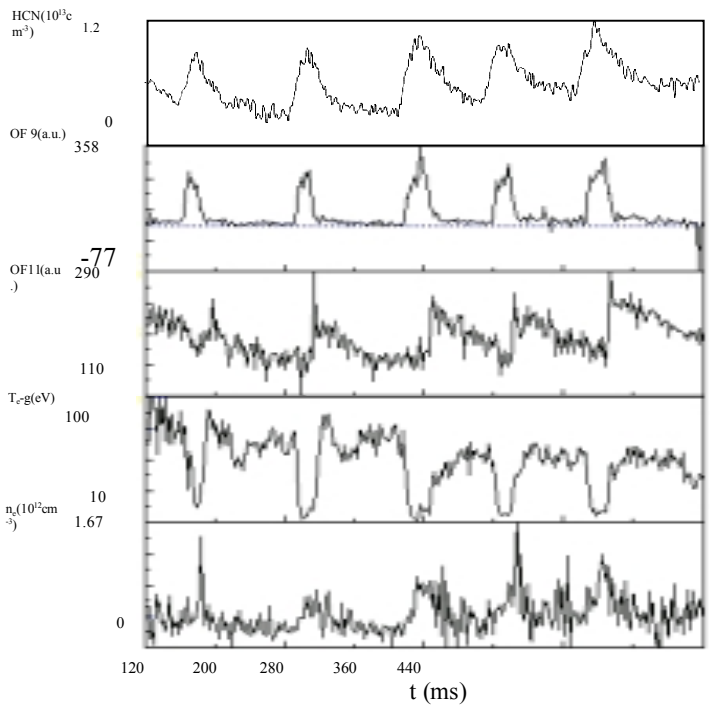
PI Experiments on HL-1M (2)



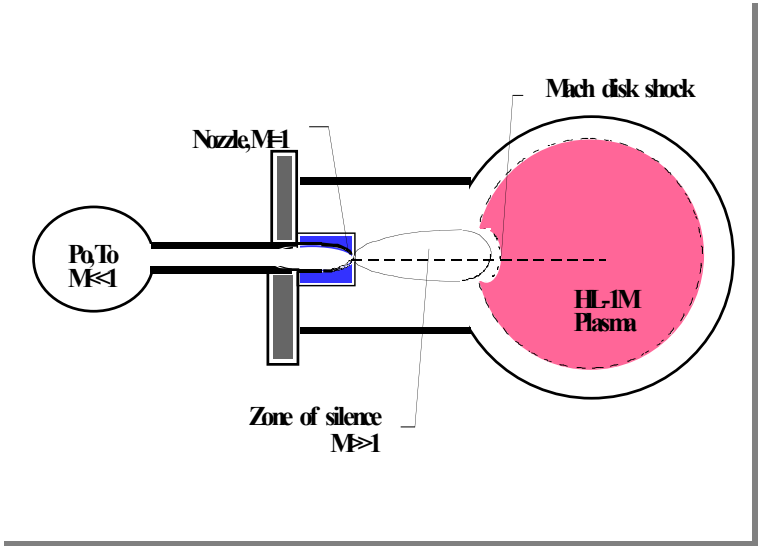
The evolution of radial profile of the H_{η} emission during pellet injection. (b) The contour for (a)

- Ablation and penetration are investigated by fast CCD
- q-profile was estimated with the inclination angle of ablation cloud with respect to the torus

Supersonic molecular beam injection (SMBI) on HL-1M



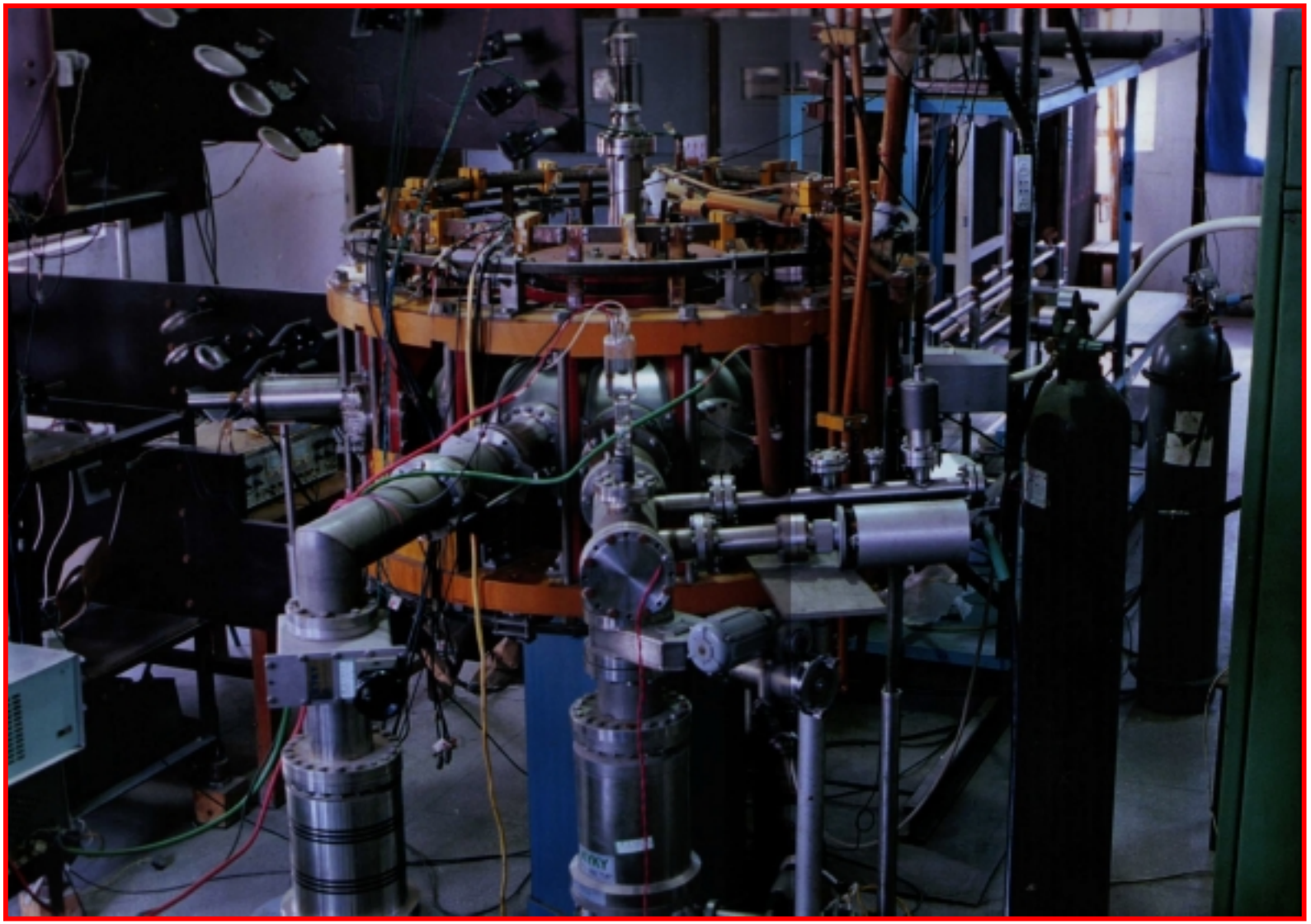
Edge Plasma Parameters during SMBI at r = 23 cm



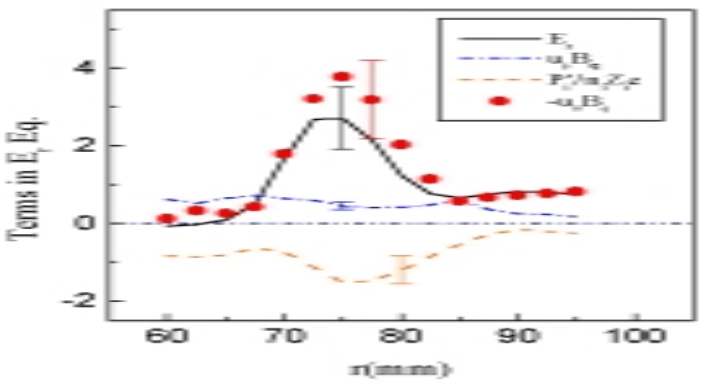
- High fueling efficient and deep penetration.
- The hydrogen cluster-like may be produced in the SMB, which is beneficial to deep injection.

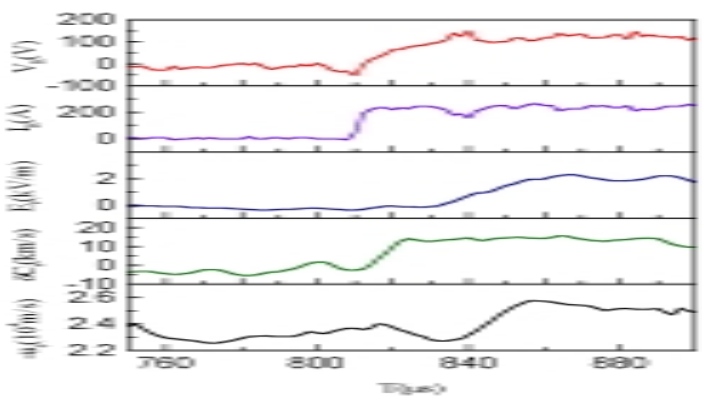
L.H. Yao

KT-5C tokamak in USTC



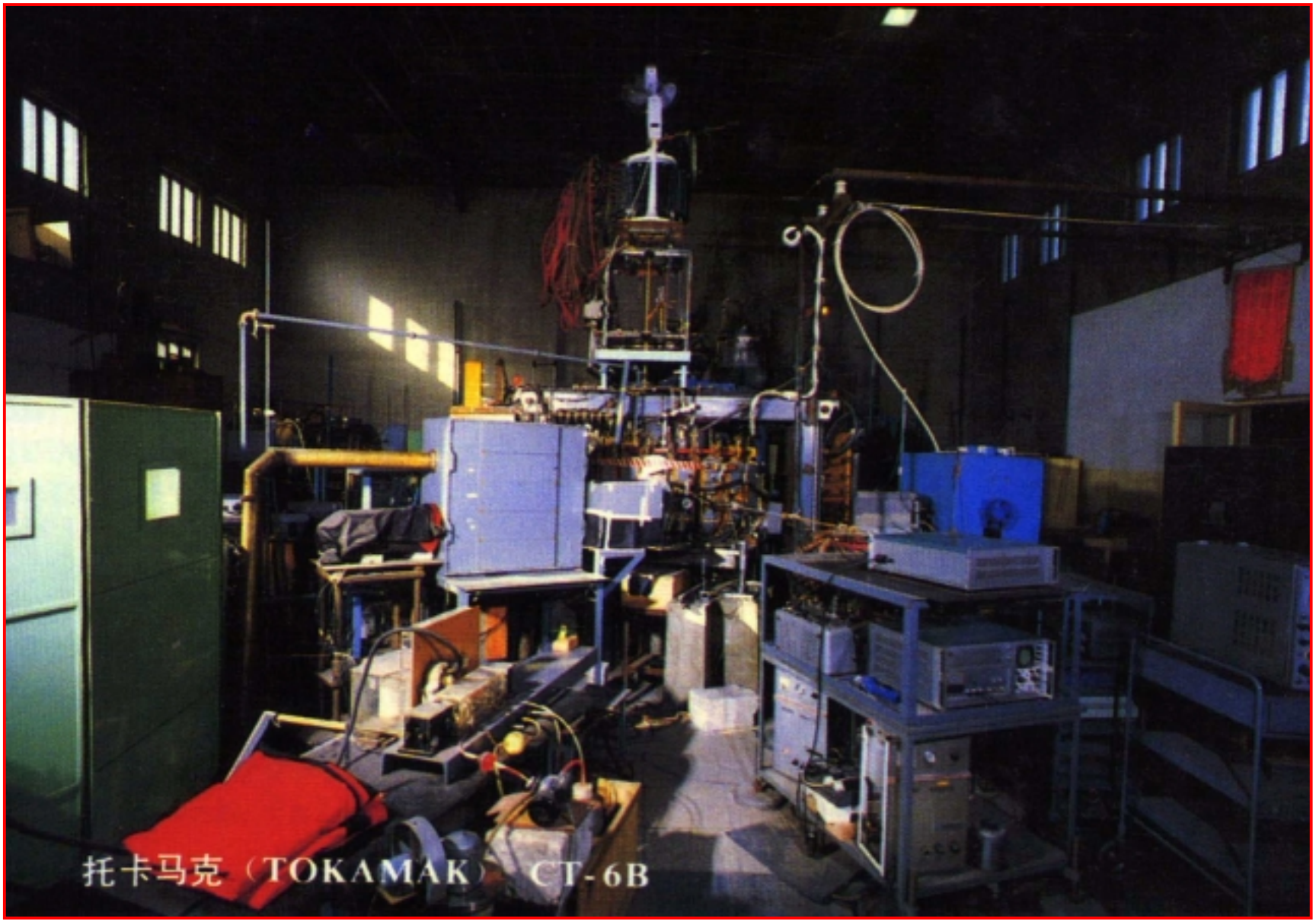
E_r by biasing on KT-5C



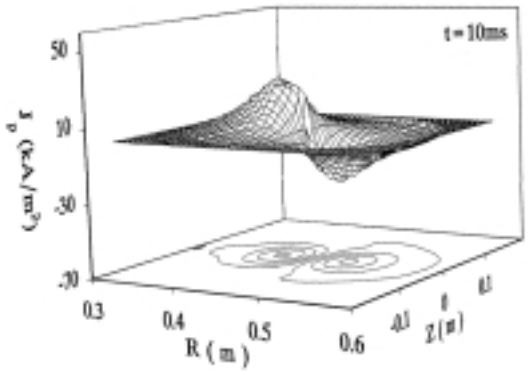


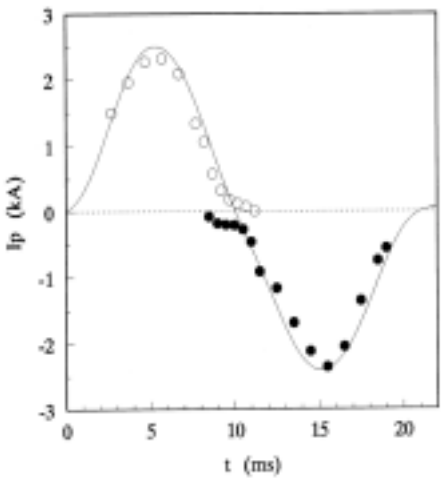
- The turbulence suppressed with the change of E_r induced by the biasing
- The poloidal flow contributes to the main part of the E_r,
- The change of the poloidal flow has a lead of about 20μs to the formation of E_r, suggesting that a radial current drives a poloidal flow, in turn drives the radial electric field.

CT-6B tokamak in IPP/CAS



Experiment in CT-6B Tokamak





AC Operation

- The poloidal magnetic field in the plasma measured by internal magnetic probes
- The plasma current profile and flux surface reconstructed.
- When the first positive current pulse drops, a negative current component appears on the weak field side.
- When the total plasma current passes through zero, two current components flowing in opposite direction coexist.
- The existence of flux surface and rotation transform provide the particle confinement during the current reversal

New projects which is under construction

New project: SUNIT

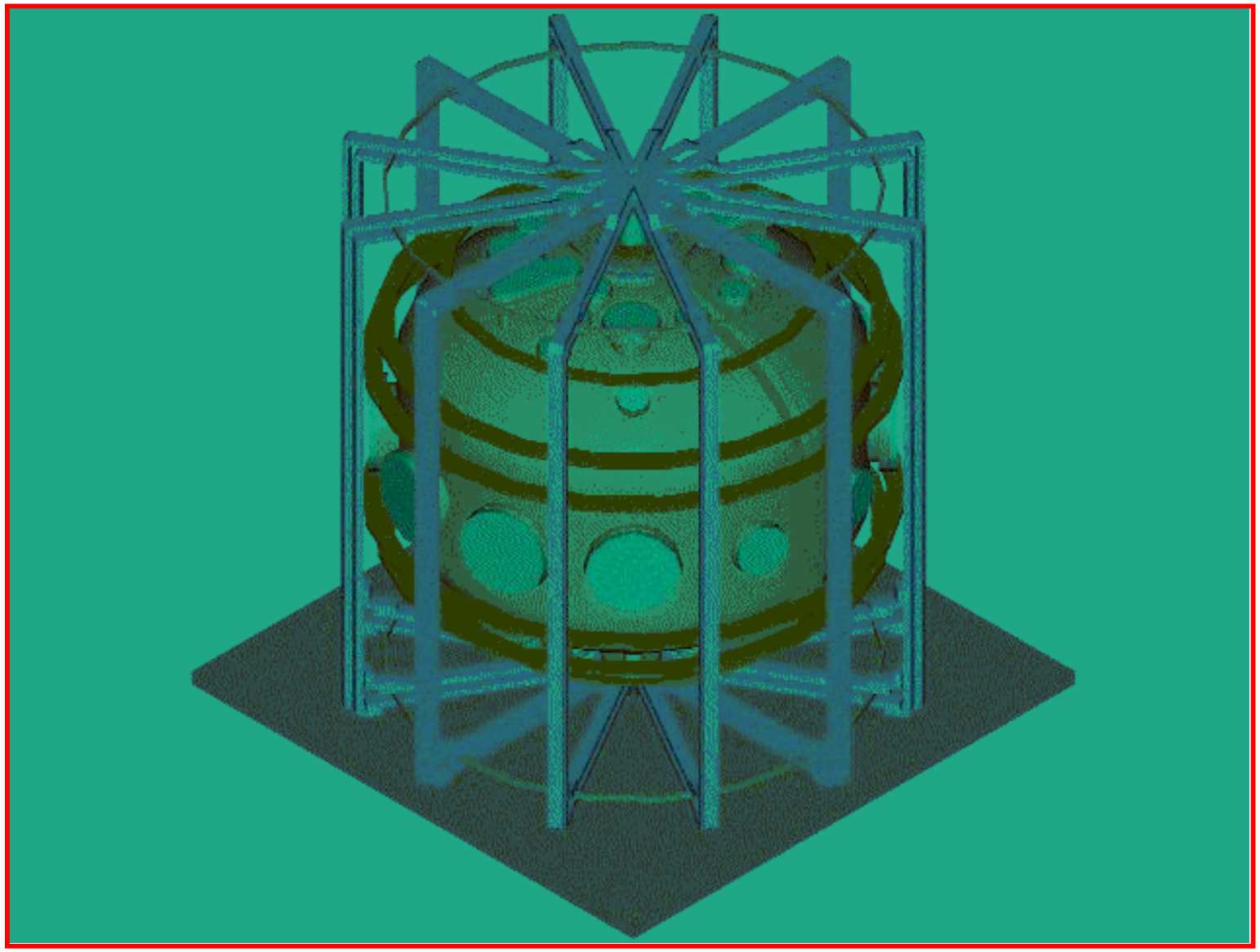
- It is first spherical tokamak in China sponsored by National Nature Science Fund
- The parameter:

  R=0.3 m; a=0.23 m

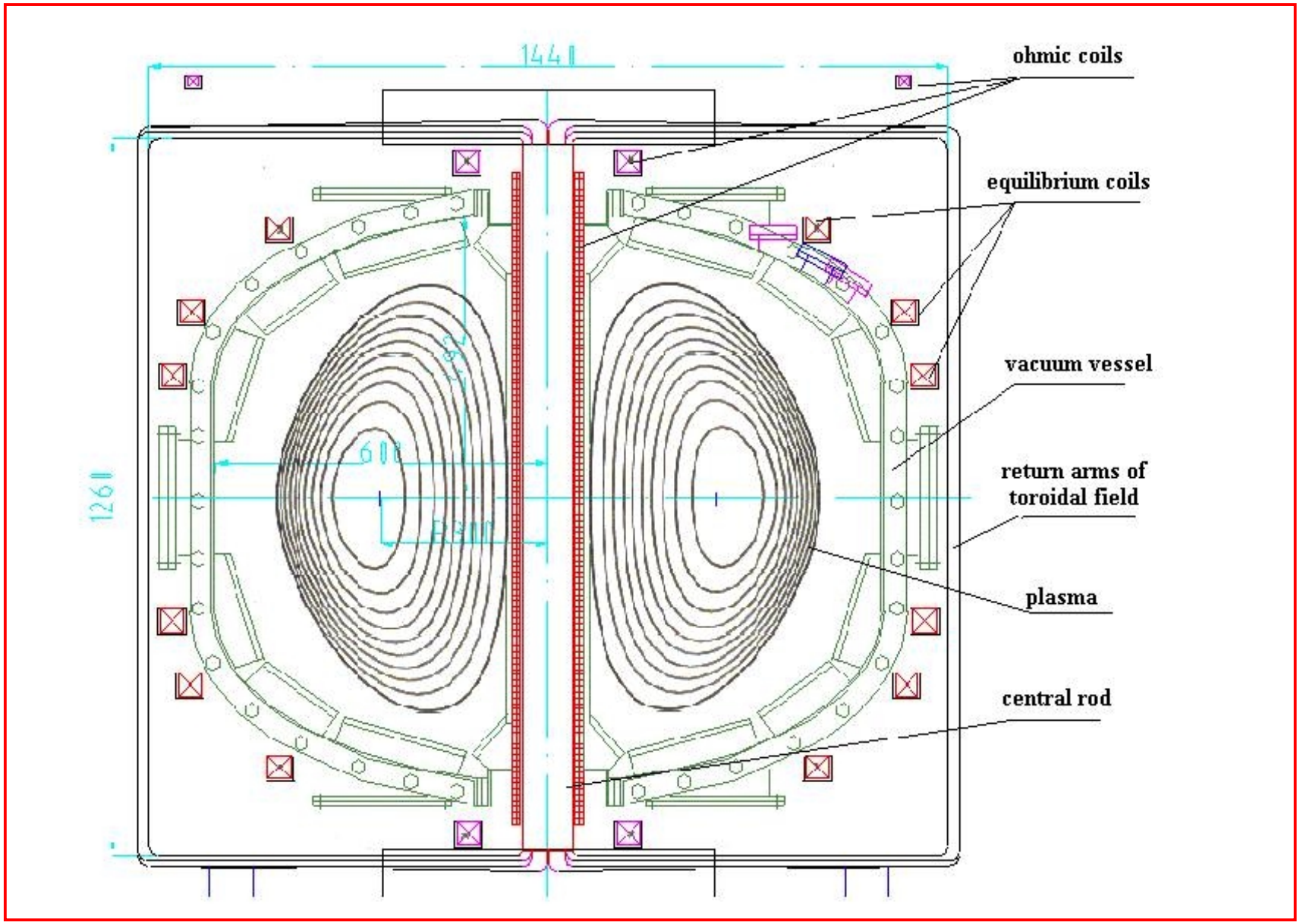
  A> 1.3 ; K ~ 1.6;

  B_{T0}= 0.15 T; I_p =0.05 MA
- Status and schedule:

  Started at 1999 and will be completed at first half of 2002

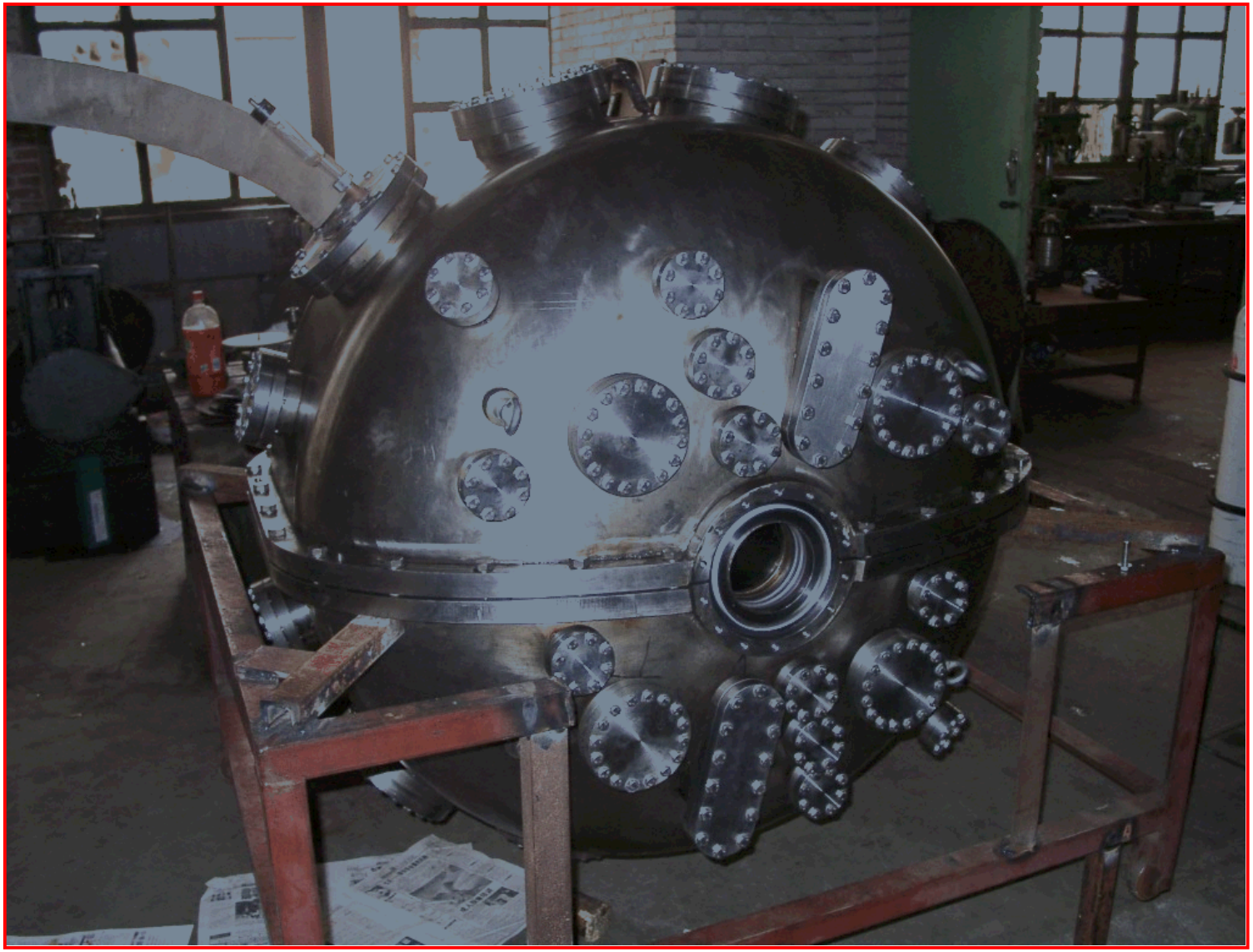


Main components of SUNIST



Magnetic surface of SUNIST

The vacuum vessel is under leak check



New project: HL-2A

- **Main mission:** obtaining experiences on divertor plasma and elongated plasma control.It is first divertor tokamak in China and based on original ASDEX main components.
- **Parameters:**

  B_t= 2.8 T, R=1.64 m, a=0.4 m, K(b/a)=1~1.3, I_p=0.48MA

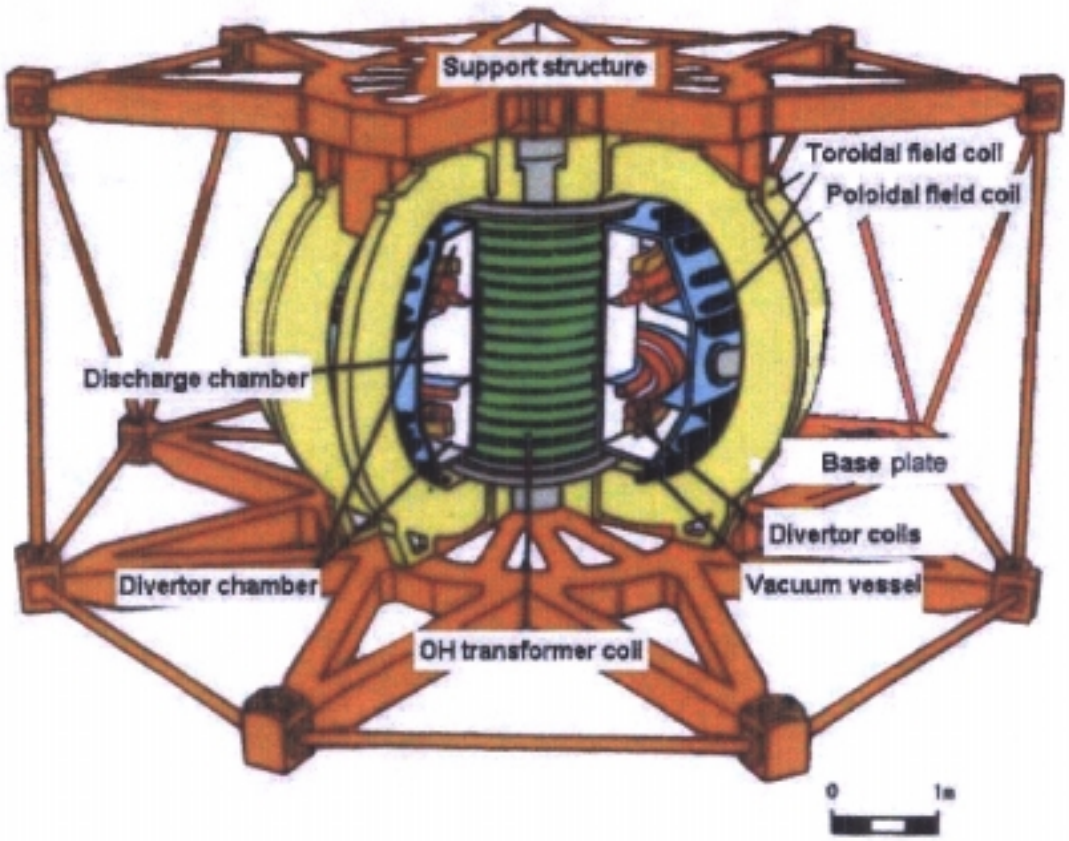
  P_{LHCD}=3 MW, P_{ICRH}=3 MW, P_{ECRH}=1 MW, P_{NBI}=3 MW
- **Status and schedule:**

  Construction is on schedule and will be completed at 2002
- **HL-2A will be upgraded to HL-2M some times late**

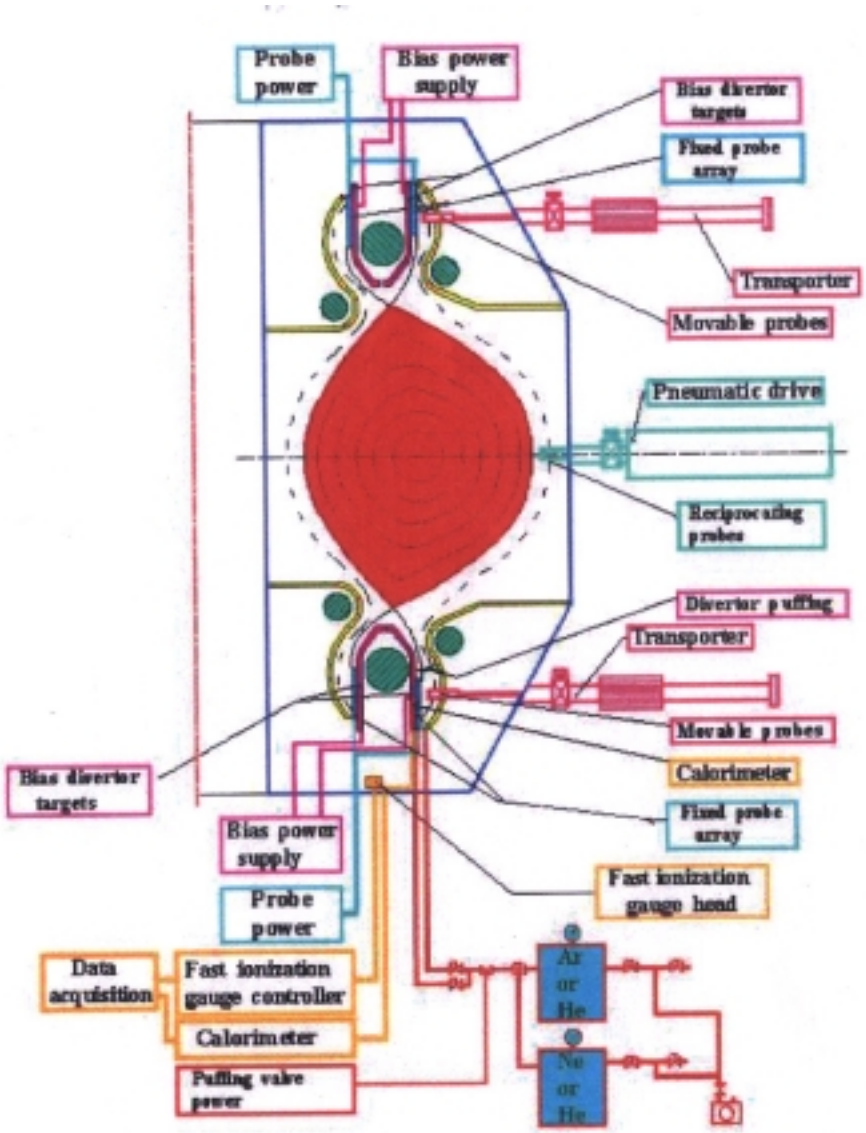
Introduction to HL-2A Project

HL-2A is the *first* divertor Tokamak in China with some main components from ASDEX.

HL-2A has well optimized operational flexibility and good accessibility for the diagnostic systems to facilitate various plasma experiments.



Divertor configuration of HL-2A



The setup of divertor study

HL-2A is under assembly

Provided by J.C. Yan

The building of HL-2A will be completed soon

Provided by J.C. Yan

From HL-2A to HL-2M

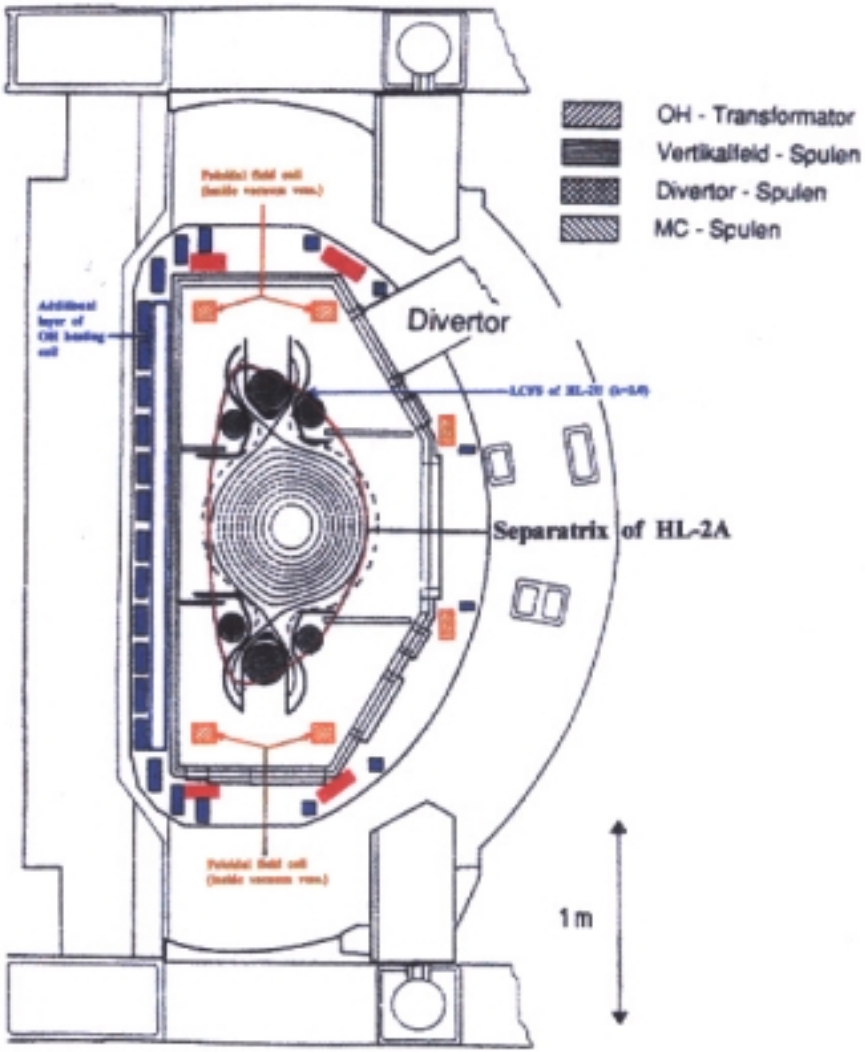


Fig.4.2 Schematic cross-section of HL-2M, also shown are the PF coil modifications