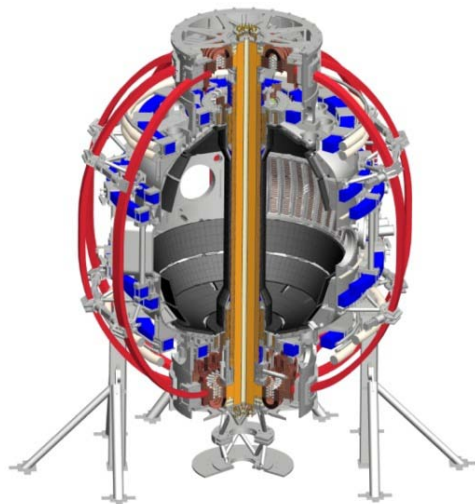


Update on the Fast-ion D-alpha (FIDA) and Solid State Neutral Particle Analyzer (SSNPA) Diagnostics

Coll of Wm & Mary
 Columbia U
 CompX
 General Atomics
 FIU
 INL
 Johns Hopkins U
 LANL
 LLNL
 Lodestar
 MIT
 Lehigh U
 Nova Photonics
 ORNL
 PPPL
 Princeton U
 Purdue U
 SNL
 Think Tank, Inc.
 UC Davis
 UC Irvine
 UCLA
 UCSD
 U Colorado
 U Illinois
 U Maryland
 U Rochester
 U Tennessee
 U Tulsa
 U Washington
 U Wisconsin
 X Science LLC

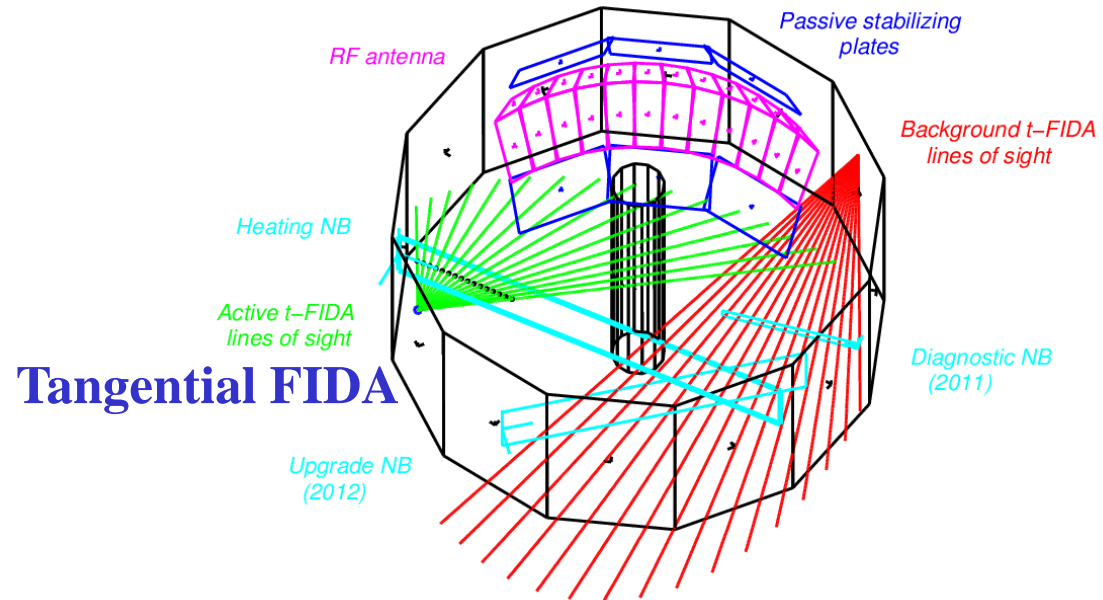
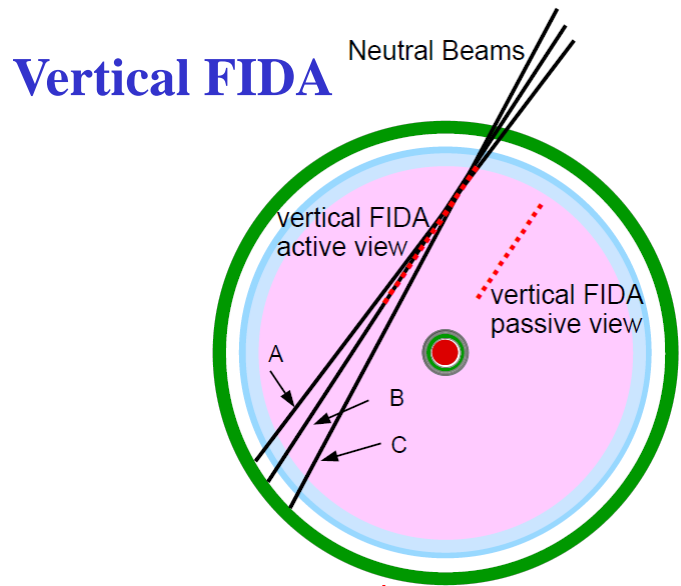
D. Liu, W.W. Heidbrink, G. Z. Hao
University of California, Irvine

Jan. 6, 2015



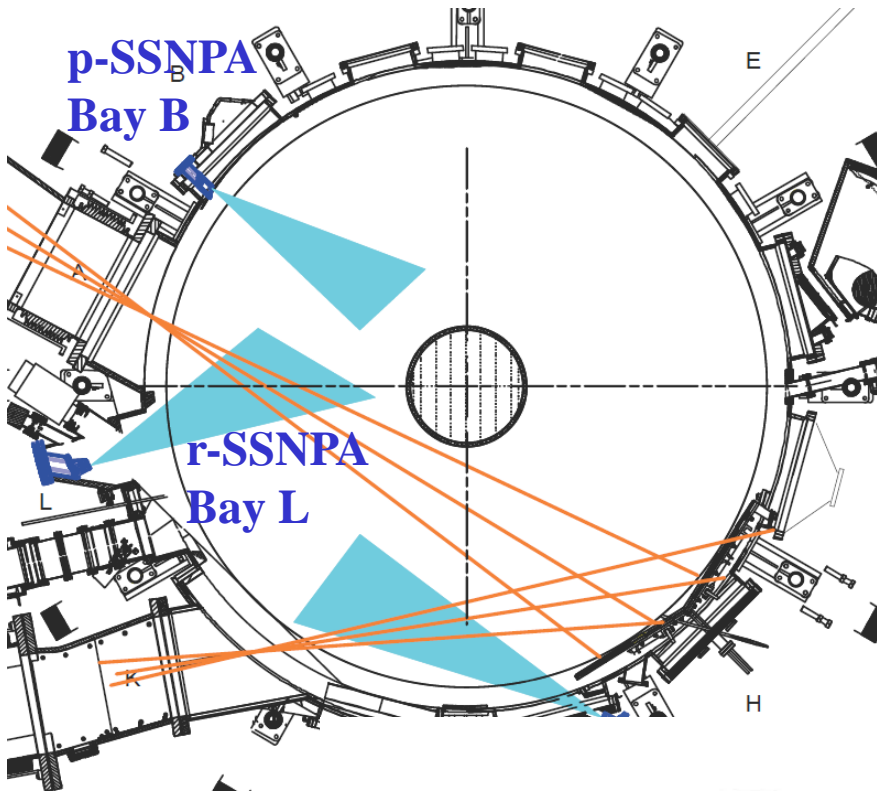
Culham Sci Ctr
 York U
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 Hiroshima U
 Hyogo U
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 Kyushu Tokai U
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 Chonbuk Natl U
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 POSTECH
 Seoul Natl U
 ASIPP
 CIEMAT
 FOM Inst DIFFER
 ENEA, Frascati
 CEA, Cadarache
 IPP, Jülich
 IPP, Garching
 ASCR, Czech Rep

Vertical and Tangential FIDA are nearly Ready for Operation

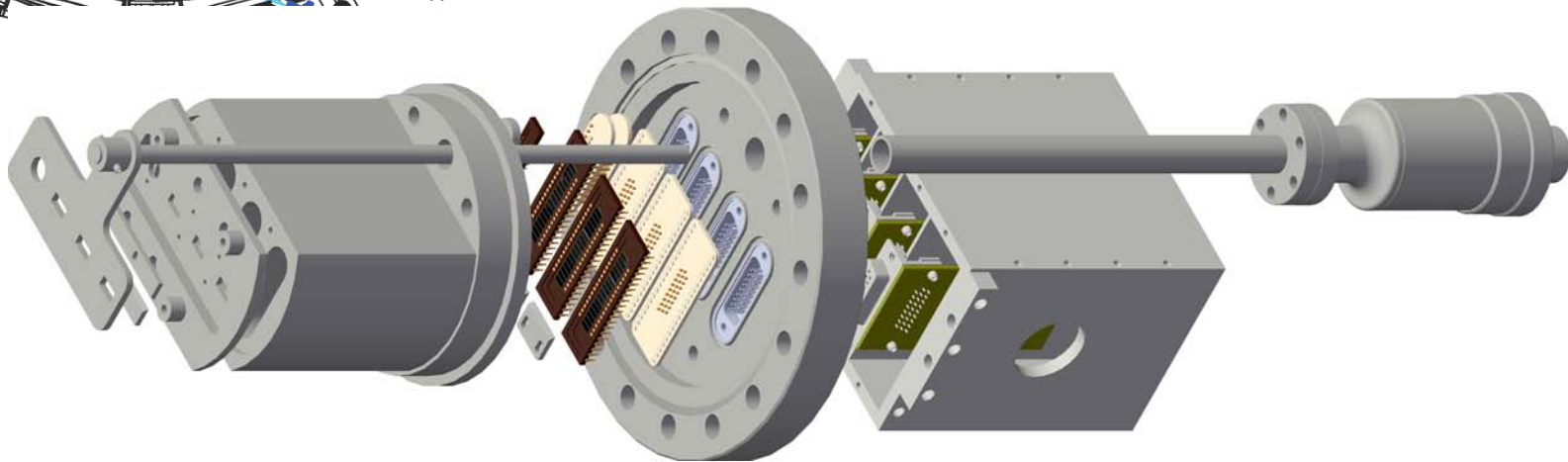


- Each FIDA system consists of
 - **spectrometer-FIDA**, full D_α spectrum, 16 ch, $R=0.85-1.55\text{m}$, 100Hz, $\sim 5\text{cm}$, $\sim 10\text{keV}$
→ measure fast ion (F. I.) profile
 - **band-pass filter-FIDA**, 3 ch at $R=1.0, 1.2, 1.4\text{m}$, 50kHz, energy integrated signal
→ measure F. I. transport associated with instabilities
- Re-installation and calibration were completed in 2014 summer, currently working on data acquisition system and data analysis software.

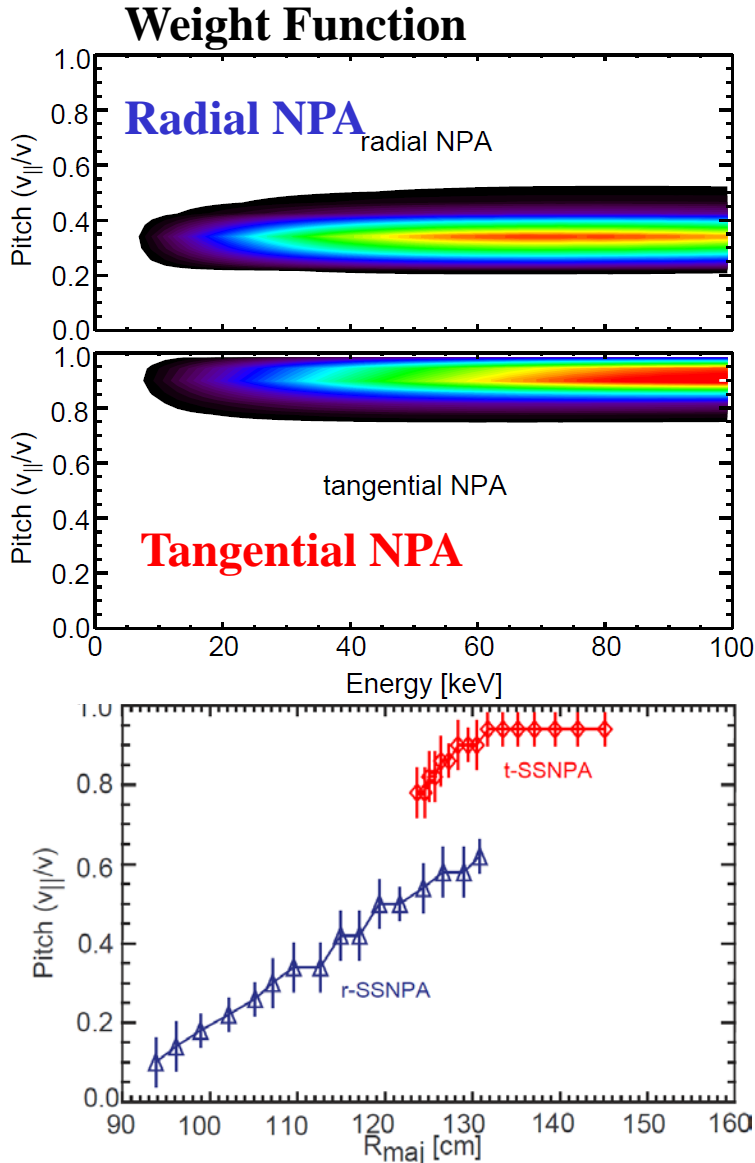
Upgraded SSNPA System Aims at Measuring Fast-Ion Distribution with Fast Time Resolution and Coarse Energy Information



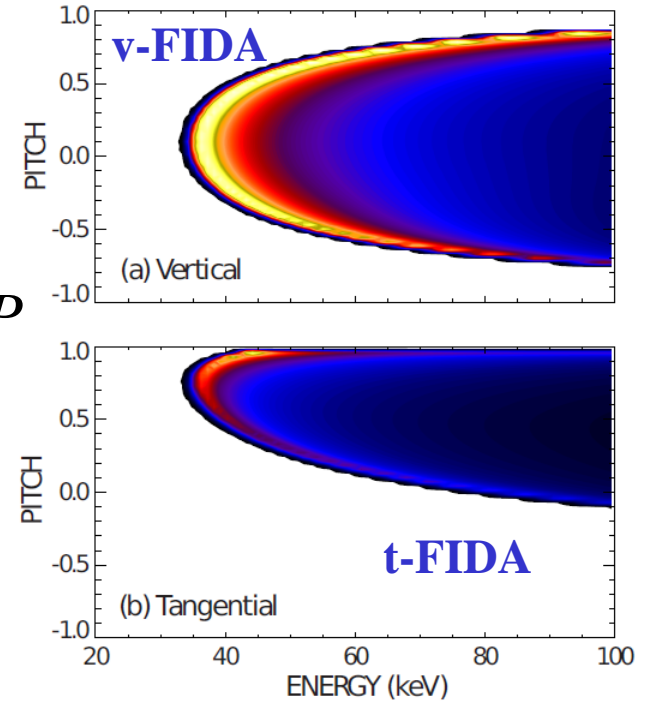
- 3 subsystems with Si photodiode arrays
 - (i) **r-SSNPA**: **trapped F.I.** in the core
 - (ii) **t-SSNPA**: **passing F.I.** in the mid-radius
 - separate the response of passing & trapped F.I.
 - (iii) **p-SSNPA**: **passive signal** near the edge
- **r-SSNPA & t-SSNPA: 16 ch, ~5cm, 120 kHz bandwidth, [>25 , >45 , >65] keV**
 - F.I. profile, transport associated with instabilities



SSNPA and FIDA Diagnostics Complement Each Other, and Other Fast Ion Distribution/Loss Measurements



$$S = \iint WF_f dEdP$$



FIDA and SSNPA System will Provide Valuable Measurements for EP Physics Studies on NSTX-U

FIDA

- **v-FIDA, t-FIDA in spectrometer scheme (16 ch, ~5cm, ~10keV, 100Hz)**
 - F. I. spatial profile
 - separate the response of passing & trapped F. I.
- **v-FIDA, t-FIDA in band-pass filter scheme, (3 ch, ~50kHz)**
 - F. I. transport associated with instabilities

SSNPA

- **Three 15-channel subsystems (~5 cm, 120 kHz bandwidth, [>25 , >45 , >65]keV)**
 - F.I. spatial profile in the core & mid-radius
 - F. I. transport associated with instabilities
- **Tangential SSNPA and radial SSNPA**
 - separate the response of passing & trapped F. I.

Will contribute to

- (i) validation of off-axis neutral beam injection
- (ii) assessment of the effects of NBI parameters on fast ion distribution function, NB driven current profile (FY15 milestone R15-2)
- (iii) study of fast ion driven instabilities and associated transport (*AE, critical gradient model, effects of 3D coils, ...)
- (iv) study of interactions between fast ions and HHFW