NCSX
Physics Strategy Overview

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Physics Plan

Past phase: Configuration development
Tool development

- Milestone: Improved Plasma Configuration ~ June 1

Current phase: Coil design
  – Without generating islands
  – Flexibility
Physics assessment
  – Flux surface robustness, Flexibility, Startup
  – Transport adequacy, sizing
Configuration decisions

- Milestone: Improved Experiment Configuration ~ Sept. 1

Config Description	c82	PG2	II75_286 high iota	II378_218 high iota	A3k2.45b5.0 high kappa	A4k2.45b5.00 high kappa	LI65_136 med iota	LI383_328 med iota	A3k2.45b5.5 high kappa	A4k2.45b4.75 high kappa	II379_328 higher beta	II283_16 2 periods
A	3.4	4.3	4.8	4.3	3	4	4.7	4.4	3	4	4.3	3.3
β max	4.0%	3.5%	4.0%	4.3%	5.0%	5.0%	4.0%	4.1%	5.5%	4.8%	4.8%	3.7%
limiting instability	kink	ballooning	Mercier	ballooning	kink	kink	Mercier	ballooning	kink	kink	kink/ball	ballooning
Ip	200	180	120	150	277	244	120	150	298	232	200	200
Iboot	200		115	135	277	244	125	134	298	232	150	
Ip/Iboot	1.00		1.04	1.11	1.00	1.00	0.96	1.12	1.00	1.00	1.33	
iota(0) full beta	0.26	0.14	0.46	0.45	0.24	0.31	0.39	0.4	0.27	0.3	0.44	0.26
iota(a) full beta	0.47	0.495	0.75	0.74	0.48	0.48	0.67	0.66	0.48	0.48	0.78	0.47
iota(0) vacuum	0.05	0.16	0.51	0.50			0.41	0.45			0.52	0.30
iota(a) vacuum	0.29	0.29	0.61	0.59			0.52	0.49			0.59	0.30
R (for fixed volume)	1.46	1.70	1.82	1.70	1.34	1.64	1.81	1.70	1.34	1.64	1.70	1.46
<horiz. half-width>	0.425	0.390	0.380	0.390	0.450	0.400	0.380	0.390	0.450	0.400	0.390	0.440
min. horiz. half-width	0.250	0.215	0.140	0.144	0.250	0.215	0.160	0.160	0.240	0.214	0.140	0.177
Surface Quality												
β=0 (S2) total island flux		r/a~1 15%	r/a~1 20% islands	20%	~0	~7%	12%	20%	~3%	~7%	21%	20%
full β (S3) (no bootstrap)	r/a ~0.75	r/a~0.7	20%	25%	r/a~0.7	r/a~0.6	16%	16%	r/a~0.7	r/a~0.6	21%	20%
Thermal Transport												
GTC ions (D, 1.26 T)	18 ms	13.5	26 ms	29	18	24	27	28	18	24	29	22
GTC elec												
QA χ^2 10^{-4} (s=0.5)	1.9	10.8	1.4	1.3	8.8	1.4	1.7	1.7	9.0	1.4	1.4	2.3
iota(ρ=2/3)	0.32	0.31	0.59	0.59	0.31	0.38	0.51	0.54	0.33	0.37	0.62	0.37
H min for beta-lim, 5MW, <a>=30cm, 4x rector collis.	2.05	2.12	1.91	1.89	1.94	2.19	1.99	1.92	2.34	2.35	1.99	1.79
Fast Ions												
NBI loss (H->H, 2 T)	22.5%	32.2%	17.5%	20.7%	27.8%	25.5%	16.6%	19.0%	27.1%	19.2%	23.1%	19.2%
Alphas												
Coils												
Current Sheet on 18 cm Surface, B=2T, saddle coils												
Max Field Error, %	2.97	0.45	2.26	3.3	5.77	8.52	1.82	1.19	7.21	5.58	3.64	6.87
Mean Field Error, %	0.21	0.05	0.12	0.14	0.03	0.32	0.09	0.13	0.26	0.26	0.17	0.15
Complexity	3.11	2.02	2.00	2.12	3.06	3.02	1.98	2.05	3.04	2.84	2.19	1.75
Max Current Density, A/m/Curpol	1.190	0.880	0.885	1.120	1.550	1.000	0.740	0.760	1.360	0.820	1.190	0.708
Max current Density, MA/m	3.3	3.0	3.2	3.9	3.9	3.1	2.6	2.6	3.4	2.5	4.1	2.8
Coils from Uniform Contours, B=2T, saddle coils												
Num Contours	12	10	12	12	12	12	12	10	12	12	12	12
Max Field Error, %	4.00	4.35	4.71	5.88	7.16	7.84	4.68	5.41	6.88	6.02	6.33	6.61
Mean Field Error, %	0.92	0.99	0.98	1.07	1.42	1.05	0.87	1.08	1.30	1.11	1.13	1.69
Max Current Density, KA/cm2 for 2T@R(0,0)	35.8	27.2	26.0	40.5	54.1	42.0	18.0	17.8	34.9	25.5	51.7	19.3

External Milestones

- PAC meeting - Aug. 1
  - PAC issues
  - FESAC issue
  - Will have some FESAC attendance

IAEA & APS Meetings, October

- PVR - December
  - Including FESAC issue
- CDR - March

Physics Preparation for PAC (Dominant issues)

- Flux surface quality/robustness
  - Remove islands from II283, LI383
  - S1, S2, S3 fixed boundary, alternate profiles
  - Progress on ability to design coils preserving surfaces
- Flexibility

  Work on c82, initial look at new configurations
  - Profile variations
  - Startup scenarios
  - Physics program flexibility (e.g. vary beta limits)
- Complete configuration assessment, choose
  - F-B reconstructability of physics objectives, new configs
  - Transport study of beta accessibility, new configs.
  - Finish fast ion studies (e.g. can counter-inj be used?)