

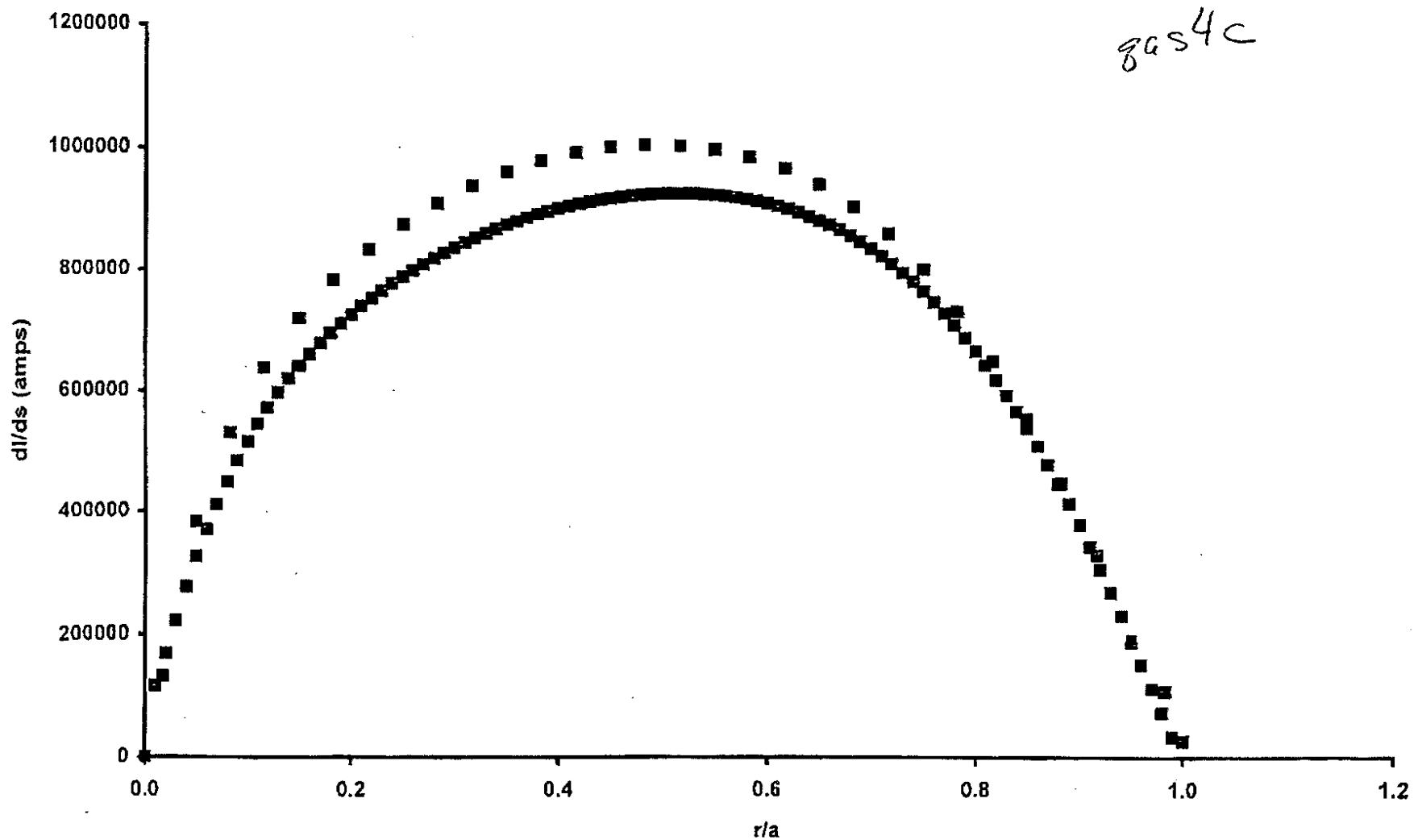
Bootstrap Current

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Roscoe White, Steve Hirshman,
Mike Zarnstorff, Don Monticello,
and Allan Reiman**

- **Outline**

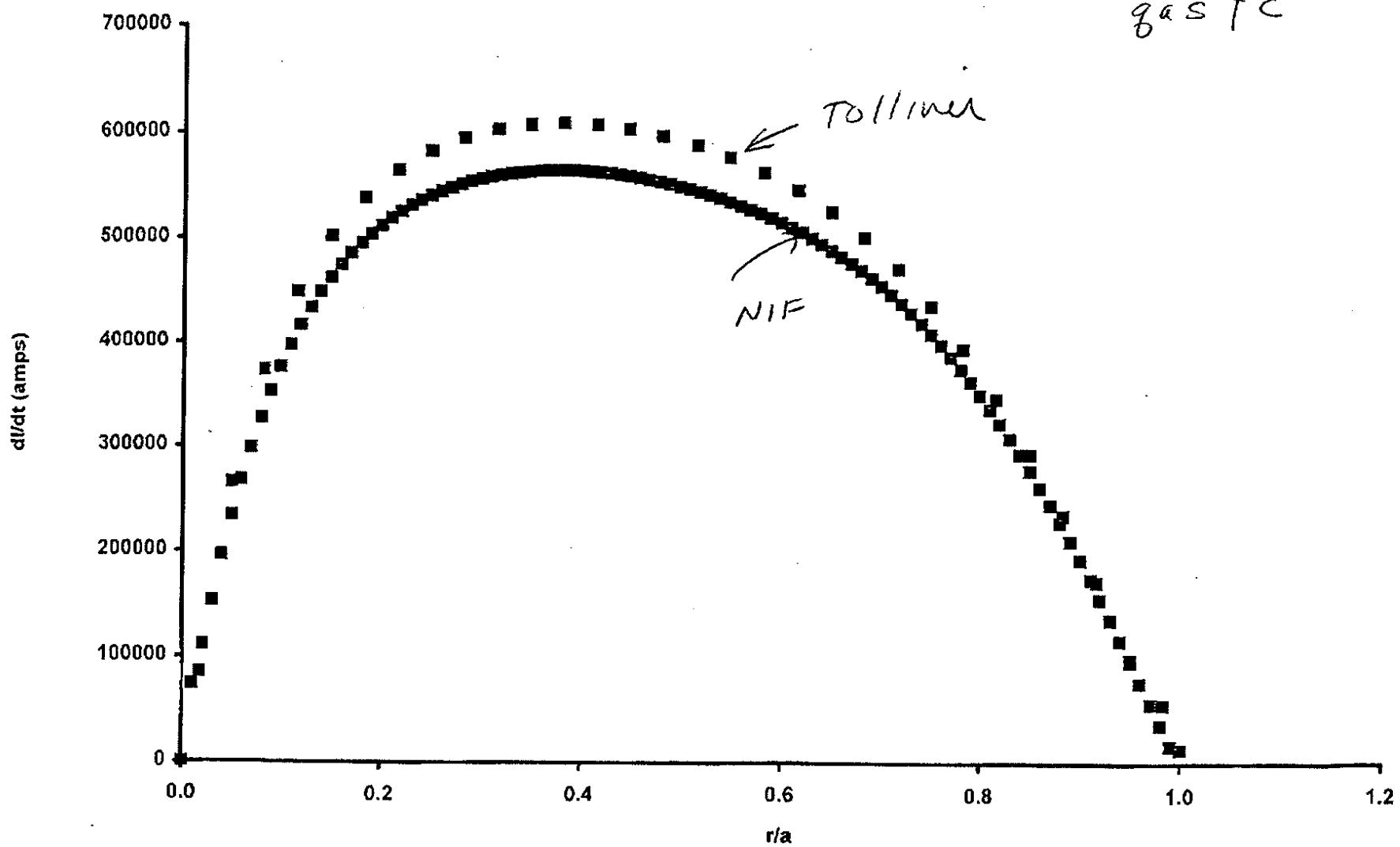
- **Update of Benchmarking of Bootstrap Codes**
 - Comparison of NIFS and Tolliver codes - analytic expressions
 - Comparison of NIFS and Monte-Carlo codes
- **C-82 results**
 - Reactor and Experimental Relevant C-82 Cases
 - * All n
 - * Only n=0
 - Reactor Relevant C-82 configuration - Various Seed current Fractions
- **Proposal For Test Cases**

comparison of NIF and Tolliver (n=0)

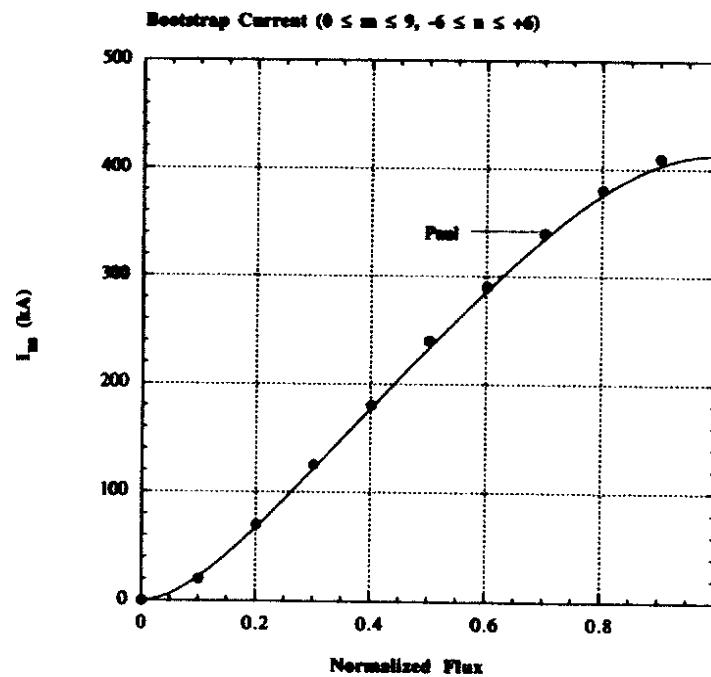
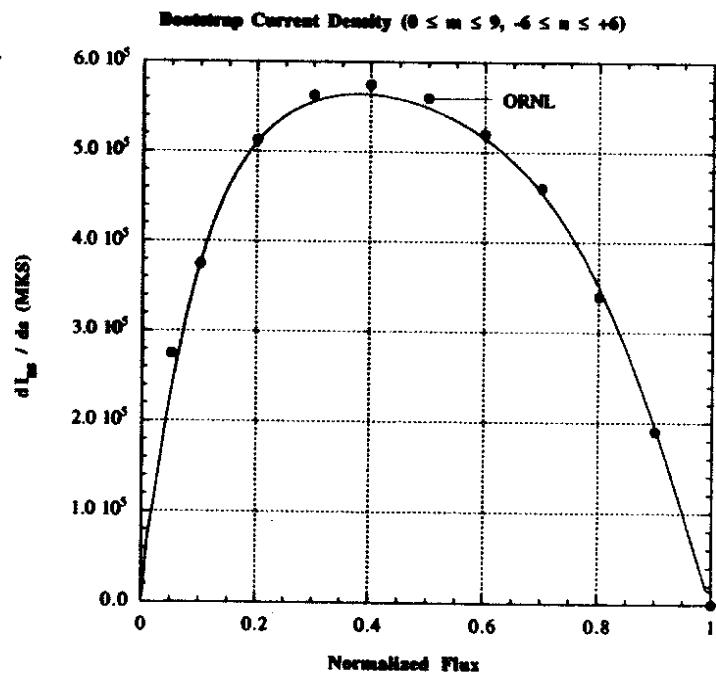
gas 4c

comparison of NIF and tolliver codes

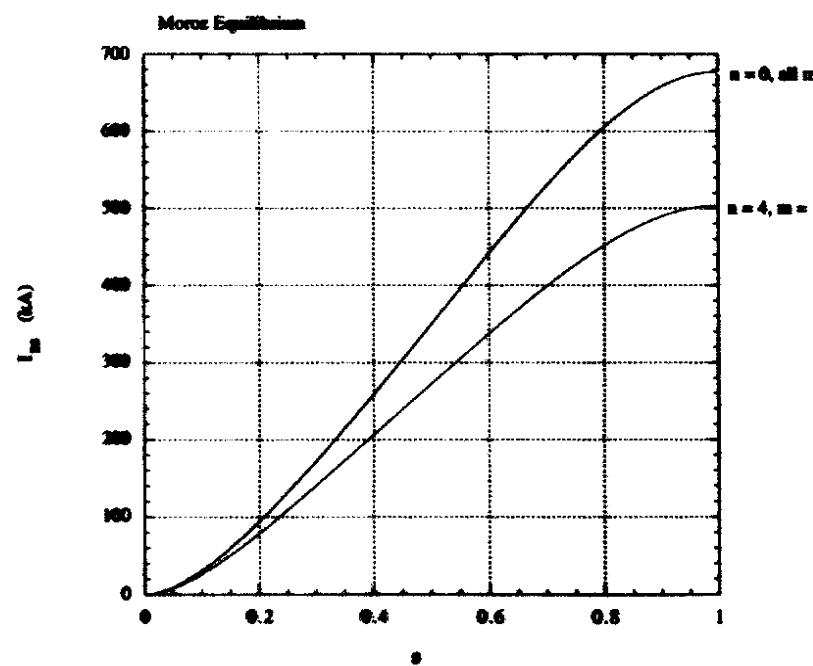
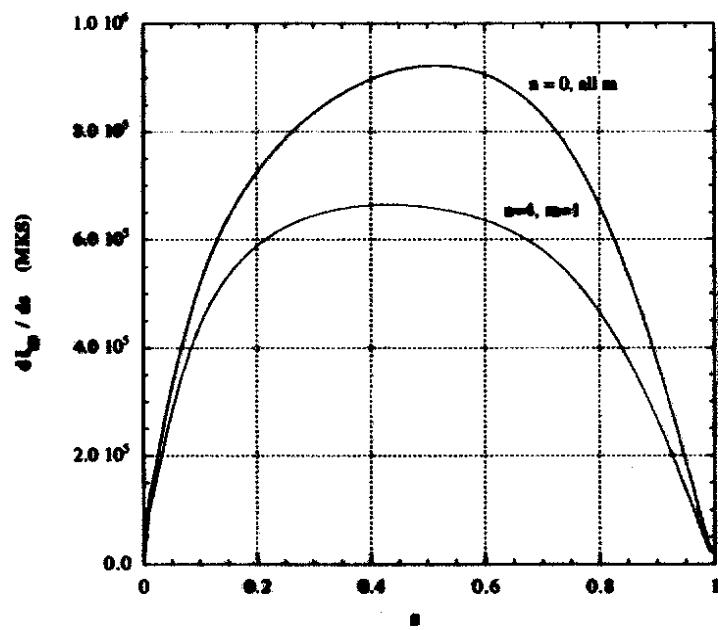
gas 4c



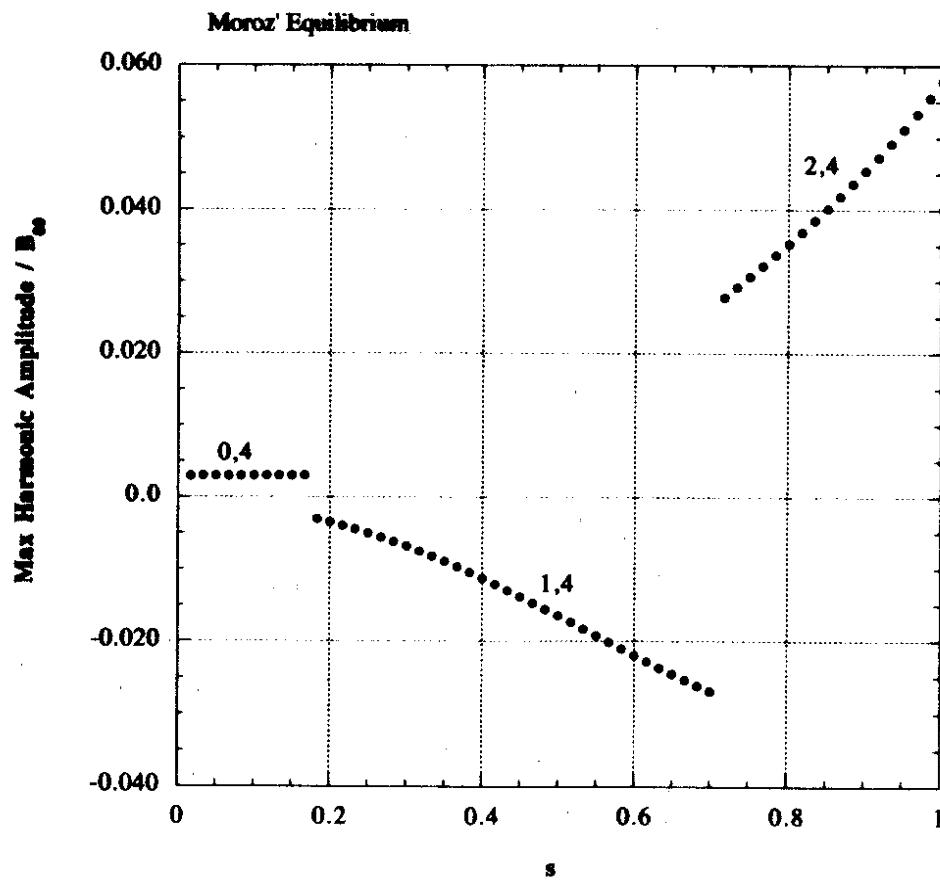
Comparison with Paul Moroz



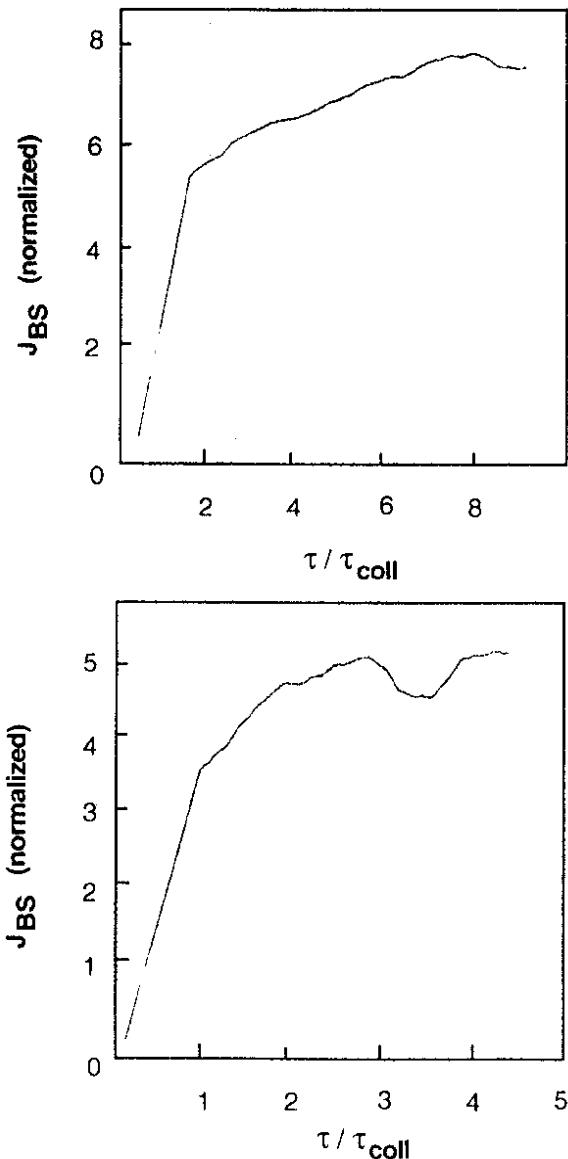
Bootstrap Current : Effect of $n \neq 0$ Harmonics



Maximum Harmonic Amplitude

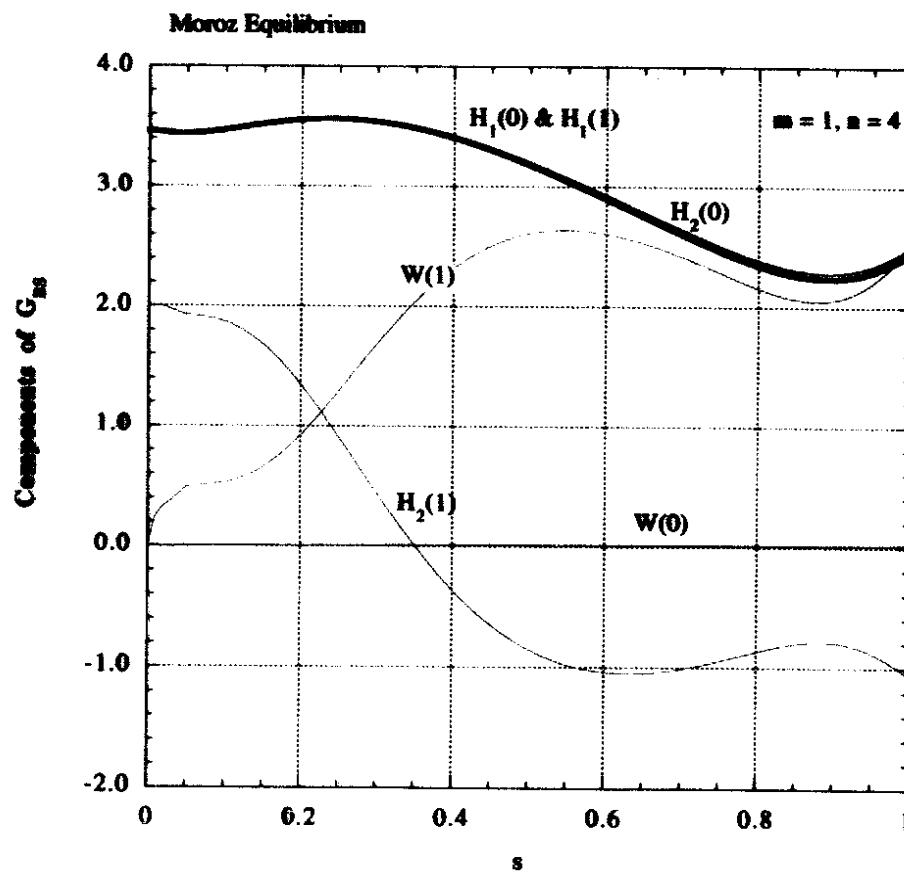


δf Bootstrap Current Simulation



- Monte Carlo simulation using B_{mn} supplied from NIFS code
- Asymptotic result is final value of bootstrap current at selected surface
- First graph shows result retaining only $n=0$ components of B_{mn} . Second includes $n=1$, $m=4$. This results in $\sim 30\%$ reduction in bootstrap current.
- Consistent with NIFS (and Tolliver) code result

Bootstrap Current : Elements of Geometric Factor



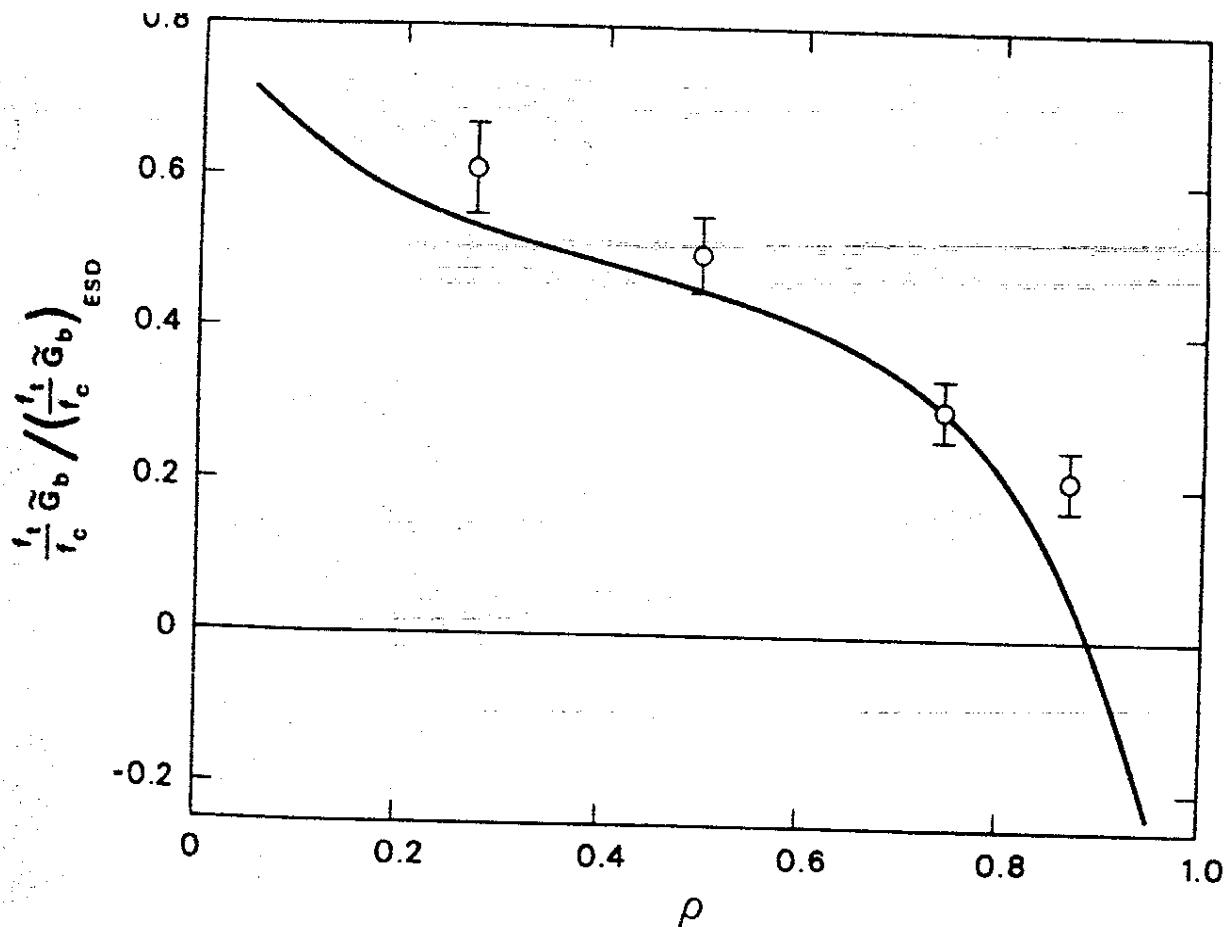


FIG. 2. Profile of the ratio of the stellarator bootstrap current (j_b)_s to the ESD bootstrap current (j_b)_{ESD} for the model magnetic field spectrum for the profiles of ϵ_r , ϵ_h , and q given in Fig. 3. The normalized radial coordinate is ρ . For $\rho \gtrsim 0.89$, $q \lesssim 1$, the results have questionable relevance. See that —: Eq. (14) and O: DKES. The error bars show the uncertainty in the DKES results.

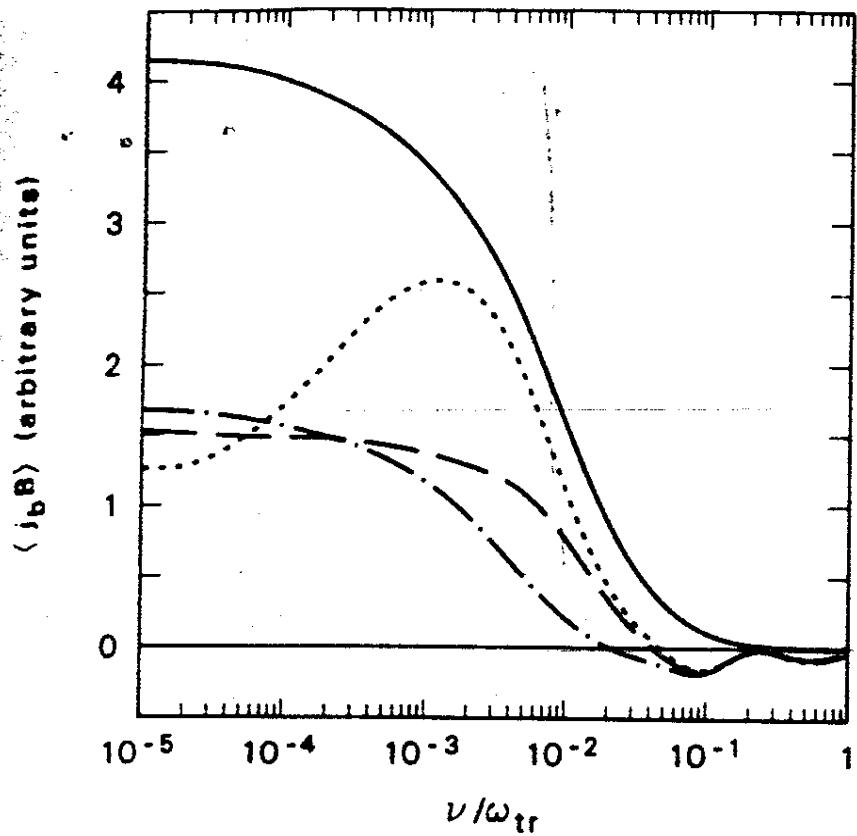


FIG. 1. Here, $\langle j_b B \rangle$ versus collision frequency for several values of $e\Phi/T$, where \bar{a} , the electric field scale length, is 0.3 m, representative of the Advanced Toroidal Facility (ATF). Model magnetic field spectrum with $\epsilon_i = 0.11$, $\epsilon_h = 0.14$, and $q = 1.5$. For the ESD, $\epsilon_i = 0.11$ and $q = 1.5$. Here, ω_{tr} is the transit frequency and $T_e = T_i = 1$ keV. See that $- \cdot -$: $e\Phi/T = 4.2$; $--$: $e\Phi/T = 1.3$; $- \cdots -$: $e\Phi/T = 0.42$; $-$: ESD.

given in Eq. (14) are valid. Between the saturated state and the plateau regime there is a transition regime in which $(j_b)_s$ is sensitive to the value of the radial electric field. In the transition regime, the bootstrap current is likely to be dominated by the contribution from the boundary layer solution discussed in Ref. 9 instead of the solution discussed here. The range of the transition regime is roughly between $\nu / \omega_{tr} = 10^{-4}$ and 10^{-1} .

ϵ_i, ϵ_h

FIG
mod

resu
ang
mag
acc
sior

