Outline:

1) Motivation & Goals
2) Concept
3) Challenges
4) What's needed
5) Other programs

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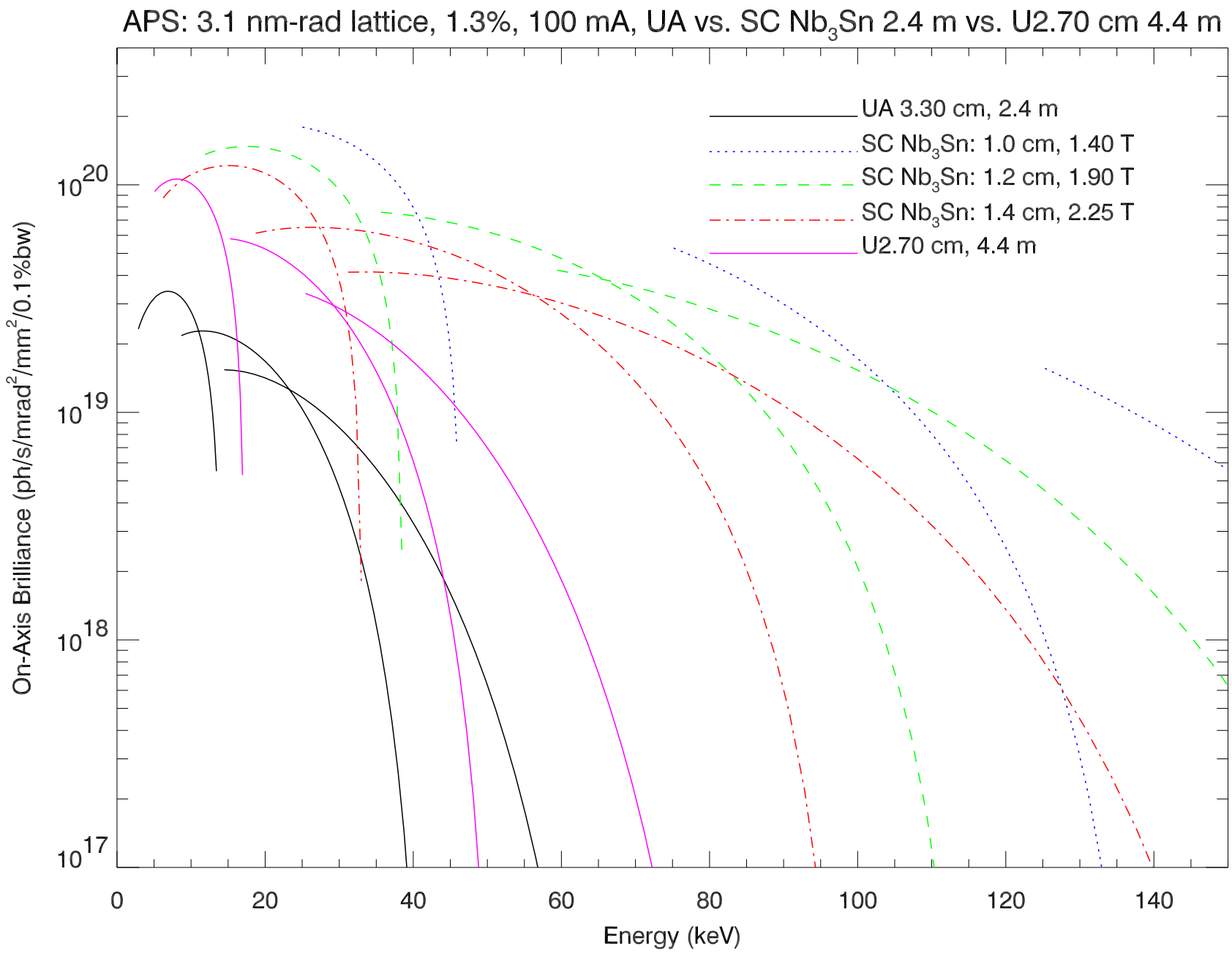
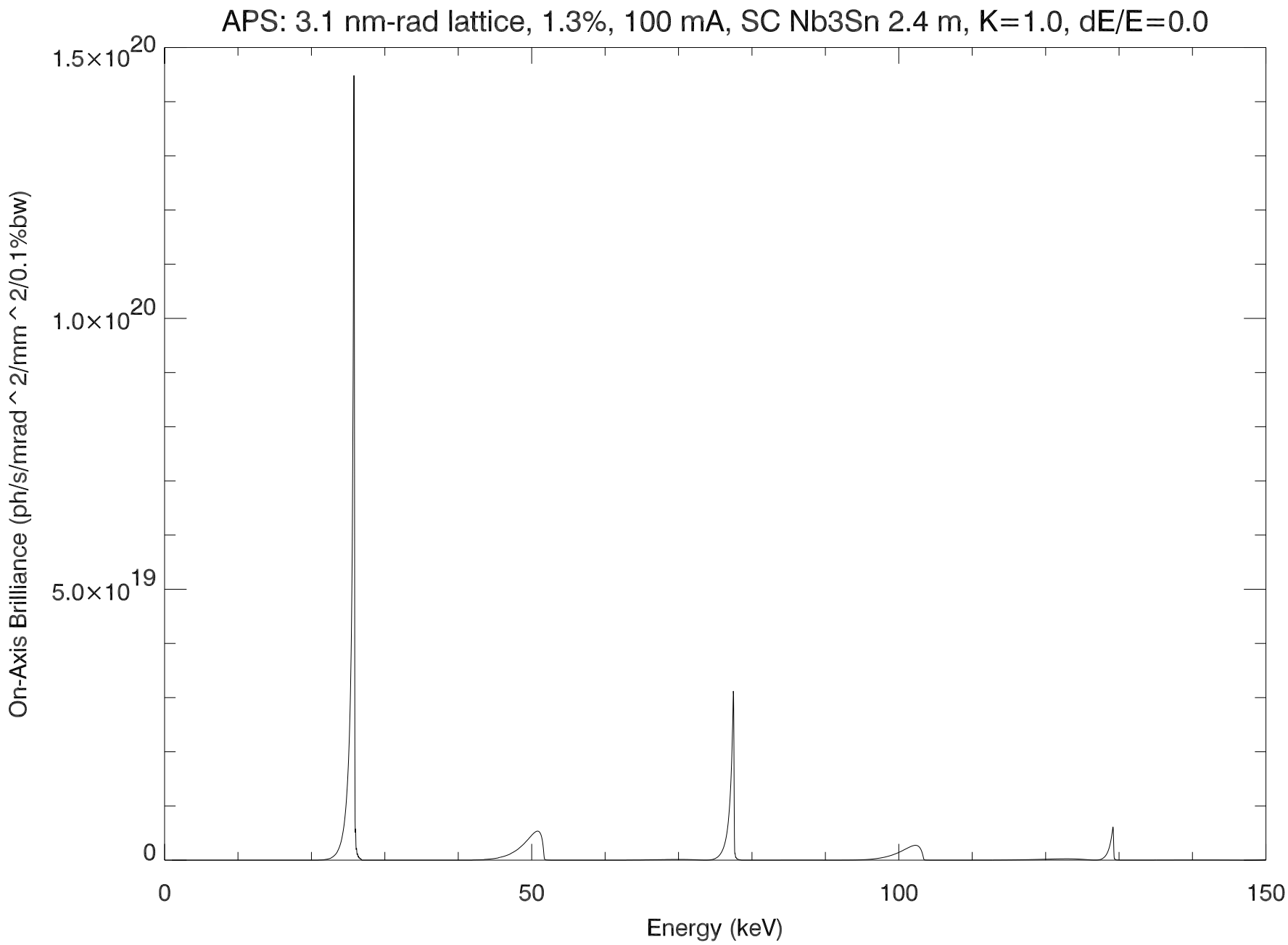
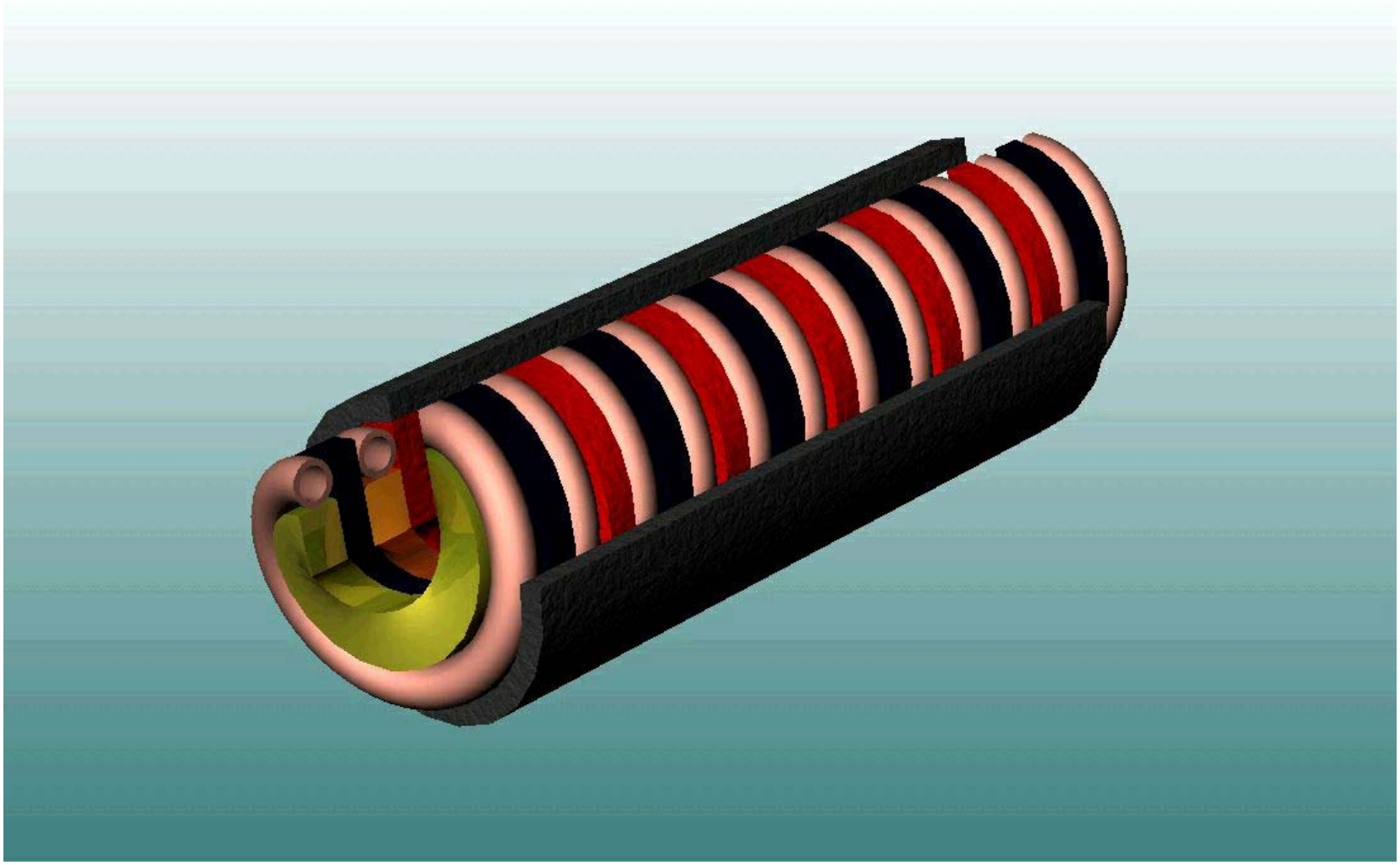
Motivation & Goals:

- There are APS users interested in higher energy x-rays on their existing beamlines, typically in the 35 – 45 KeV & 40 – 90 KeV ranges.
- There is an expectation that applied physics programs would develop if this energy range were available on the APS.
- There's considerable outside interest developing for other synchrotron radiation facilities.
- The goal would be to achieve as nearly as possible an undulator that would have a 12 mm period, a 1.9 T peak on-axis field, and 5 mm gap.


APS: 3.1 nm-rad lattice, 1.3%, 100 mA, UA vs. SC Nb3Sn 2.4 m vs. U2.70 cm 4.4 m
UA 3.30 cm, 2.4 m
SC Nb3Sn: 1.0 cm, 1.40 T
SC Nb3Sn: 1.2 cm, 1.90 T
SC Nb3Sn: 1.4 cm, 2.25 T
U2.70 cm, 4.4 m
On-Axis Brilliance (ph/s/mrad2/mm2/0.1%bw)
10^20
10^19
10^18
10^17
0
20
40
60
80
100
120
140
Energy (keV)


APS: 3.1 nm-rad lattice, 1.3%, 100 mA, SC Nb3Sn 2.4 m, K=1.0, dE/E=0.0
On-Axis Brilliance (ph/s/mrad ^ 2/mm ^ 2/0.1%bw)
1.5×10^20
1.0×10^20
5.0×10^19
0
0
50
100
150
Energy (keV)

Advanced Photon Source
Short Wavelength Undulator

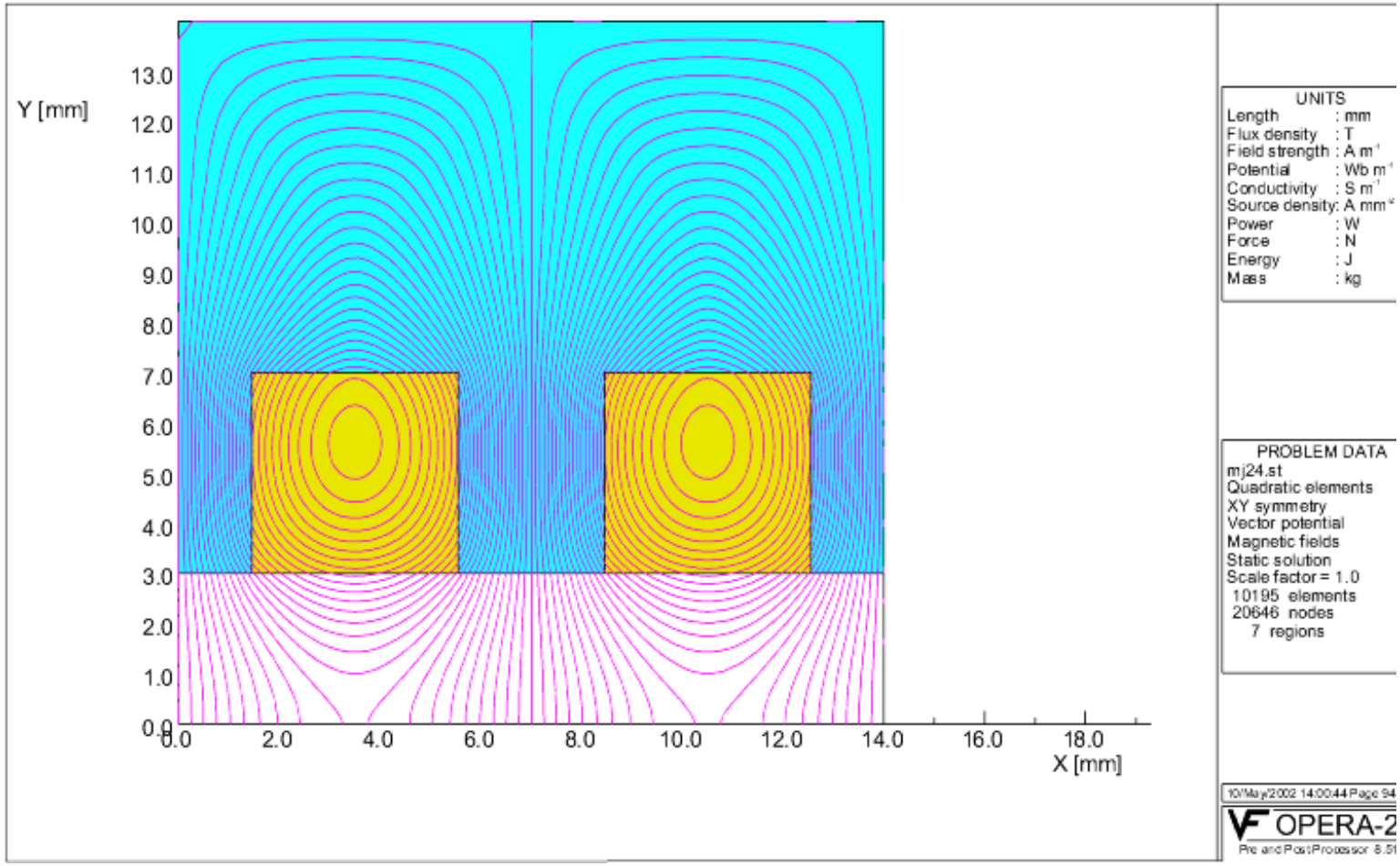


Concept:

- Bifilar wound, oblong helical structure
- NbTi @ 1.8 to 2.1 K, Cu/NbTi = 1.92
- Cold bore, in-vacuum design
- High Jc (2000-2500 amperes/mm**2 required to get larger k-value [Jc(1.8K, 4T) ~ 2810 amperes/mm**2]
- Heavily saturated iron yoke [mu @ pole tip ~ 2]

Challenges:

- High Jc
- High current/single turn or multiple turn
- Insulation/persistent currents
- Winding technique/transposition
- Field uniformity
- Field correction/end transition
- Heat loss/radiation
- Magnetic measurement technique
- Power supply/quench protection


Y [mm]
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
X [mm]
UNITS
Length : mm
Flux density : T
Field strength : A m⁻¹
Potential : Wb m⁻¹
Conductivity : S m⁻¹
Source density: A mm⁻²
Power : W
Force : N
Energy : J
Mass : kg
PROBLEM DATA
mj24.st
Quadratic elements
XY symmetry
Vector potential
Magnetic fields
Static solution
Scale factor = 1.0
10195 elements
20646 nodes
7 regions
10/May/2002 14:00:44 Page 94
OPERA-2
Pre and PostProcessor 8.51

Other Labs

- Several designs have been proposed with longer period lengths (2 – 2.4 cm), Budker Institute, LBL, Karlsruhe
- ANKA project in Karlsruhe has the most advanced effort.
    - Use a design with two vertically displaced helices
    - Have tested short sections, including installation in the MAMI ring at Mainz

Status

- Have spent several months reviewing concepts and visiting US Labs [FSU, LBL, UW-Madison]
- At a point where we need to focus on a straw woman/man design and develop an R&D plan
- Definitely need to develop one or more collaborations since we no longer have the expertise or infrastructure in superconductivity that is needed

Equipment needed for an R&D program

- Vertical cryostat
- Liquid helium supply with 1.8 K capability
- Background field coil
- High current power supply
- Magnetic measurement equipment