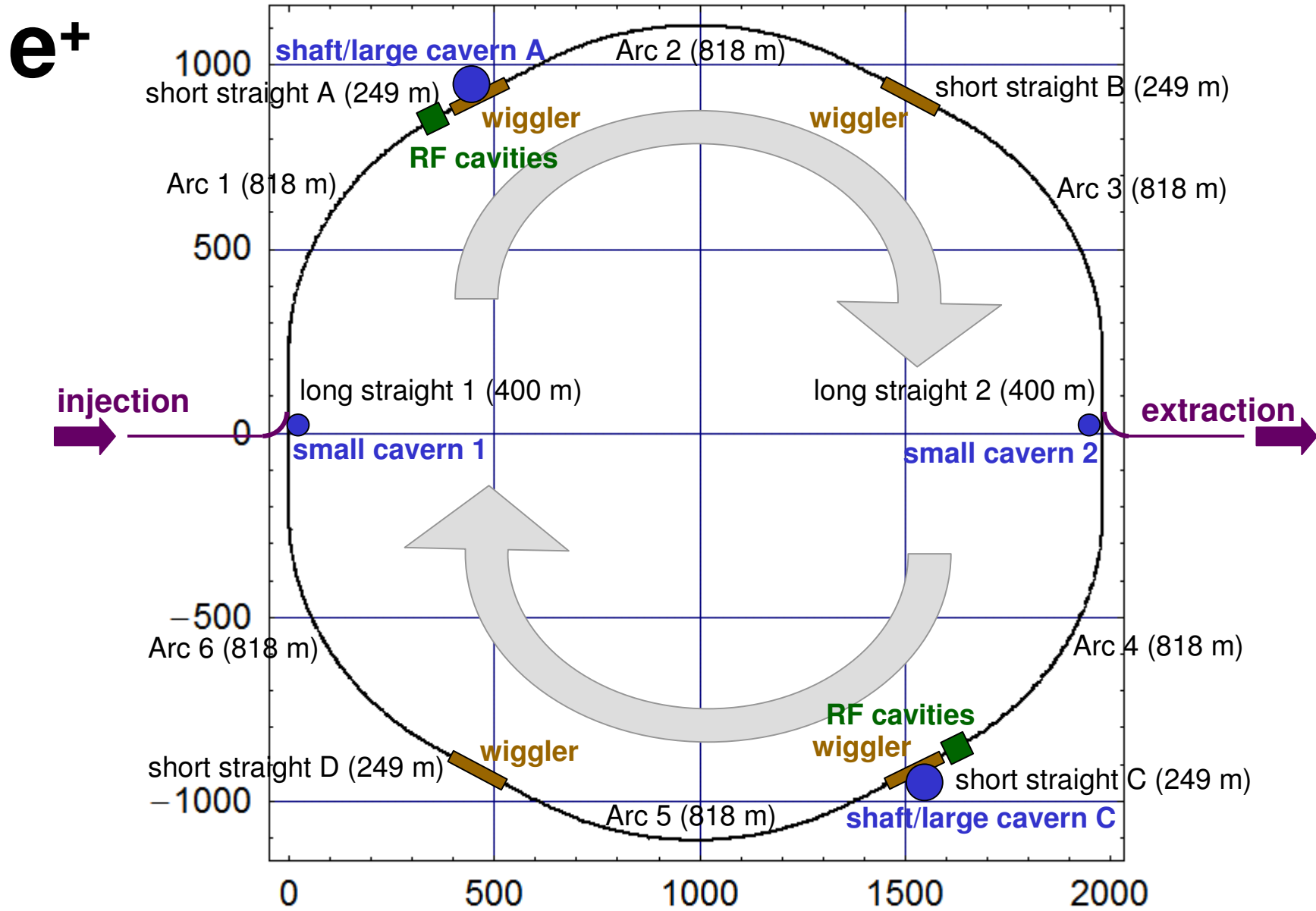


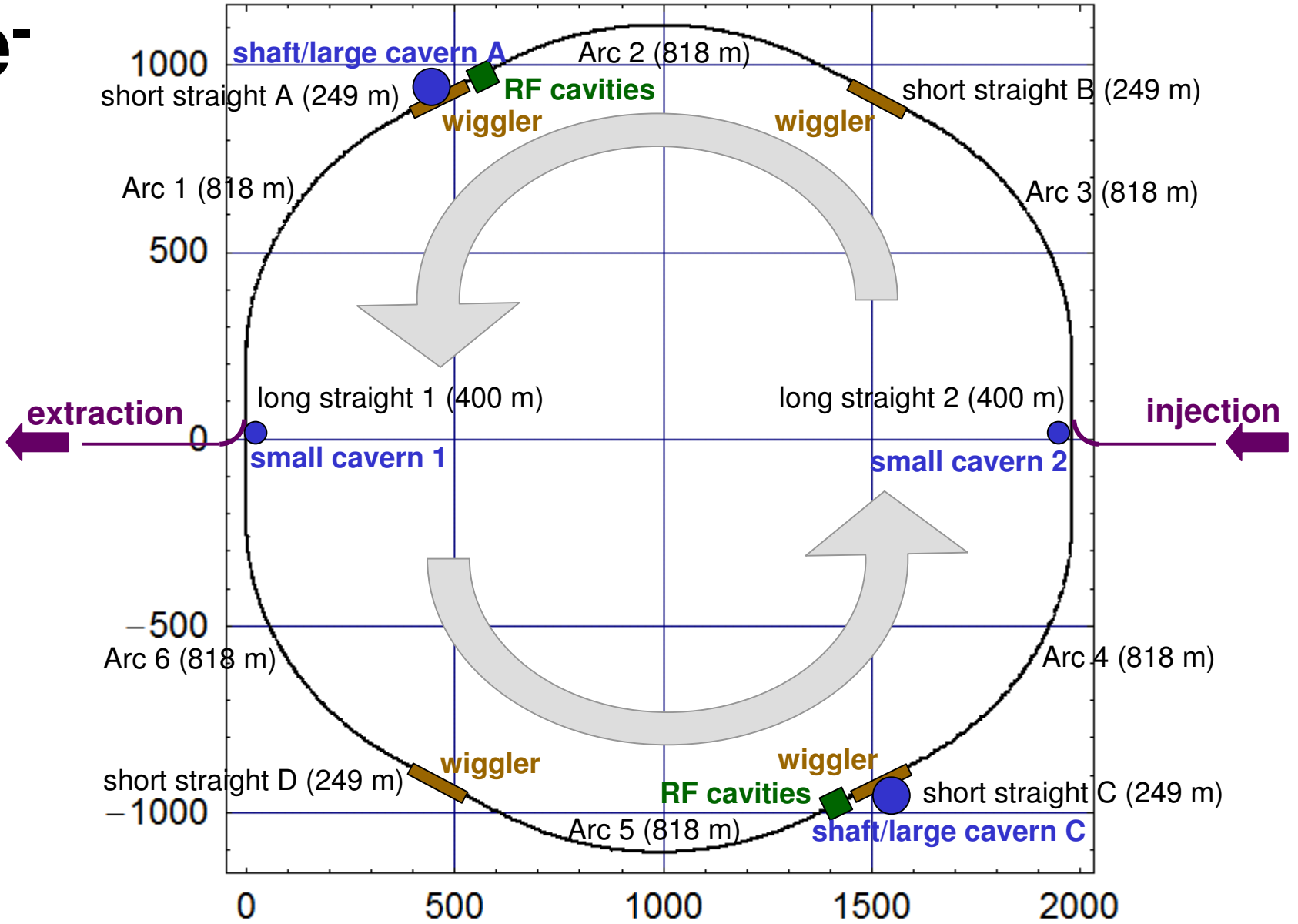
# Damping ring cryogenics summary

- Damping ring RDR cryogenics
  - The damping ring reference design for cryogenics is based on the DR layout from November, 2006
- Heat loads and cryogenic plant sizes estimated
  - Two cryogenic plants
  - Transfer lines in the tunnel to outlying wigglers
- EDR cryogenic work description



From A. Wolski, 9 Nov 2006

e<sup>-</sup>



From A. Wolski, 9 Nov 2006

# Cryoplant assumptions

- Plants at shafts A and C
- Transfer line from plant A to wigglers at B
- Transfer line from plant C to wigglers at D
- Add 40 W at 4.5 K and 200 W at 70 K per plant for other heat due to distribution system (transfer lines, distribution boxes, and end boxes)

# Heat load assumptions

- Damping ring cryogenic loads come from 650 Mhz RF cavities operating at 4.5 K and wiggler magnets operating at 4.5 K. Heat load estimates are taken from the following sources:
  - 650 MHz RF cavity at 4.5 K
    - e-mails from Mark Palmer and Andy Wolski, 15 Dec 06
  - 650 MHz RF cavity at 40-80 K
    - heat load is my guess
  - Wiggler magnet
    - heat loads from Mark Palmer, personal communication from and S. Guiducci DR System Area Status Videoconference 4/4/06
  - Current leads assume 118 amps, independently powered wigglers, conventional (copper) leads assumed here, but may be HTS for a reduction in cooling requirements.

# Heat loads

	e- RF module (one cavity per module)	e+ RF module	e- wiggler (2.5 m)	e+ wiggler (2.5 m)
Static 4.5 K heat per module or magnet (W)	30.0	30.0	5.0	5.0
Dynamic 4.5 K heat per module or magnet (W)	40.0	40.0	0.0	0.0
4.5 K liquid per pair wiggler current leads (g/s)			0.01	0.01
Number of modules or magnets per string A	10	8	20	20
Number of modules or magnets per string B			20	20
Number of modules or magnets per string C	8	10	20	20
Number of modules or magnets per string D			20	20
Number of strings per ring	2	2	4	4
Number of modules or magnets per ring	18.0	18.0	80.0	80.0
Number of strings per cryoplant	1	1	2	2
Total 4.5 K static heat per cryoplant A-B (W)	300.0	240.0	200.0	200.0
Total 4.5 K dynamic heat per cryoplant A-B (W)	400.0	320.0	0.0	0.0
Total 4.5 K liquid per cryoplant A-B (g/s)			0.4	0.4
Total 4.5 K static heat per cryoplant C-D (W)	240.0	300.0	200.0	200.0
Total 4.5 K dynamic heat per cryoplant C-D (W)	320.0	400.0	0.0	0.0
Total 4.5 K liquid per cryoplant C-D (g/s)			0.4	0.4
Static 70 K heat per module or magnet (W)	50.0	50.0	50.0	50.0
Dynamic 70 K heat per module or magnet (W)	10.0	10.0	0.0	0.0
Total 70 K static heat per cryoplant A-B (W)	500.0	400.0	2000.0	2000.0
Total 70 K dynamic heat per cryoplant A-B (W)	100.0	80.0	0.0	0.0
Total 70 K static heat per cryoplant C-D (W)	400.0	500.0	2000.0	2000.0
Total 70 K dynamic heat per cryoplant C-D (W)	80.0	100.0	0.0	0.0

Notes: 2 cryoplants total for damping rings

# Cryogenic plant summary

For each cryogenic plant (of two total)		
Total predicted 4.5 K heat	(W)	1660
Total predicted 4.5 K liquid production (for current leads)	(grams/sec)	0.80
Total predicted 70 K heat	(W)	5080
Uncertainty and overcapacity (total combined) margin		1.54
Installed power	(MW)	1.13
Cryogenic plant capacity (converted to 4.5 K equiv)	(kW)	3.45

# EDR DR work package

- Damping ring cryogenic system needs some very fundamental design work
  - Conceptual layout and flow schematic
  - Cryogenic distribution plans
  - Concepts for cool-down and warm-up
  - Re-evaluation of system heat loads
- Like for main linacs, cryogenic distribution design is a major part of the cryogenic system effort.
- This work will be done in close collaboration with the damping ring area leaders.



# EDR -- information needed

- Heat loads
  - Static
  - Dynamic
  - Uncertainty
- Conceptual designs of cryostats, cooled devices
  - Integration with cryogenic supply
- Locations in the tunnel
- Tunnel layout, potential interferences

# Deliverables

- Conceptual mechanical layout of cryogenic system
  - May include conceptual designs of cryogenic distribution and end boxes if resources suffice
- Cryogenic system flow schematics (P&ID)
  - Includes draft cryogenic instrumentation list
  - Concepts for cool-down and warm-up
- Updated spreadsheet of heat loads, flow rates, plant sizes
  - Provides input for pipe sizes, etc.
- Updated cryogenic plant size estimate
  - With error bars
- Updated cryogenic system cost