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Possible SBN AIPs - Overview

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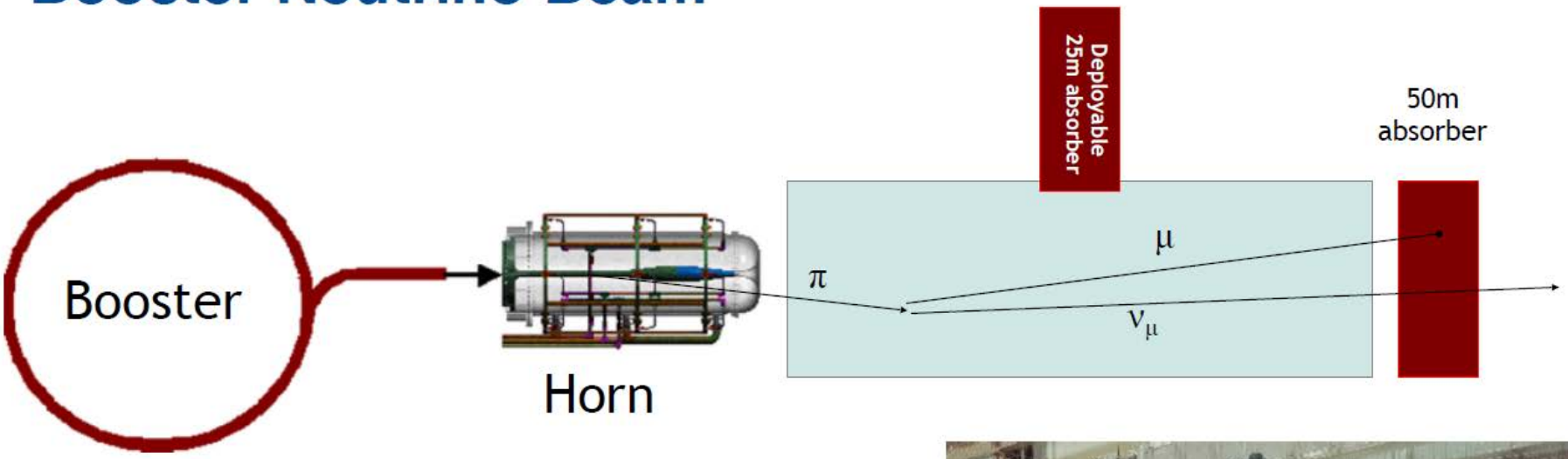
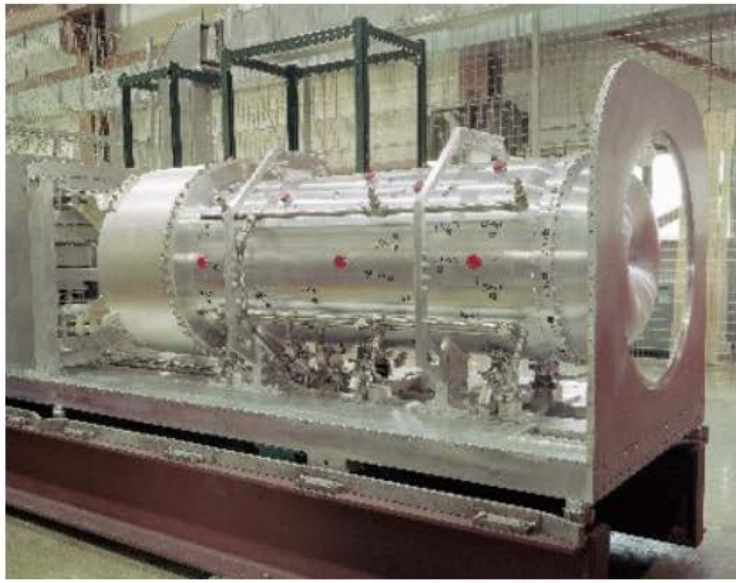
Booster Neutrino Beam

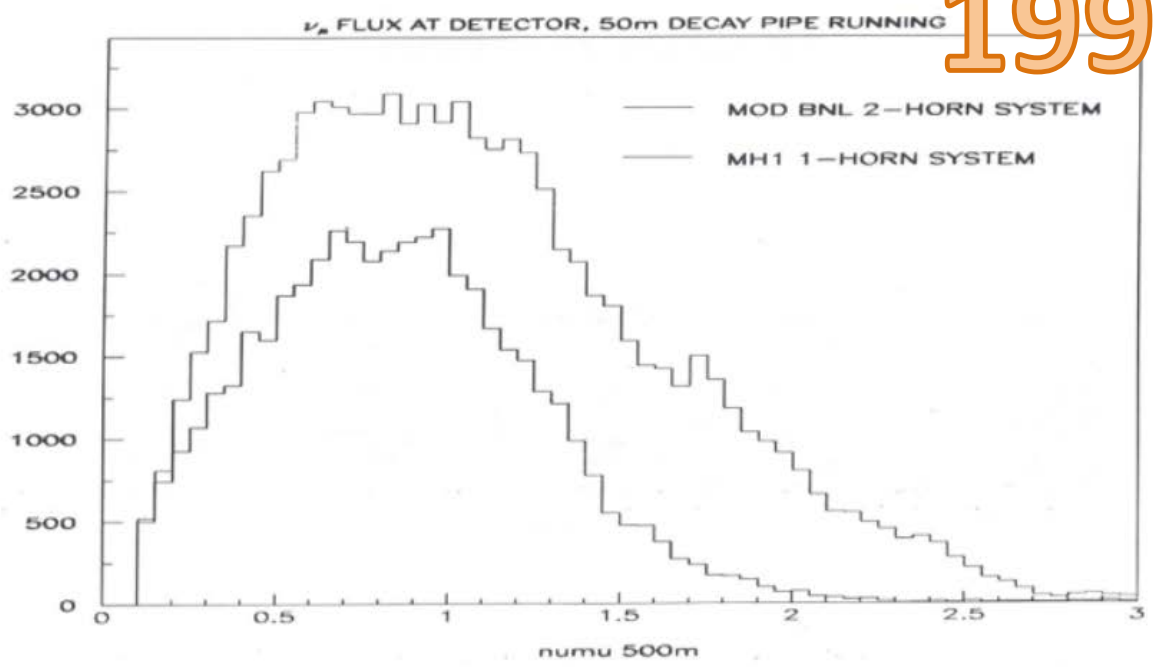


- 8GeV protons from Booster
- 4-5e12 protons per pulse
- Up to 5Hz average rate (10 pulses in a row)
- 1.7 interaction lengths Beryllium target
- Horn ±174kA (neutrino or antineutrino running)
- 50m long decay pipe



MiniBooNE design

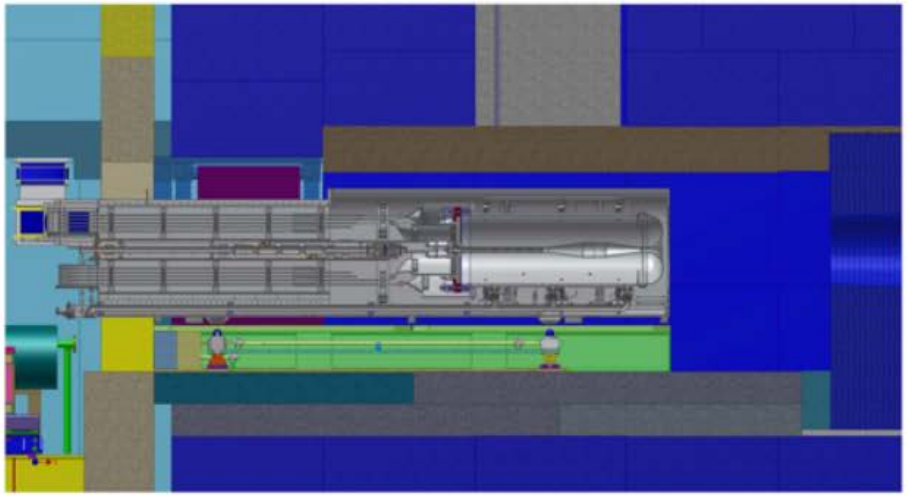
- BNB optimization for MiniBooNE started from BNB 2-horn design
- Final design with single horn
  - Significant loss of signal, however in Cherenkov detector higher energy neutrinos create π^0 background so S/B remained similar



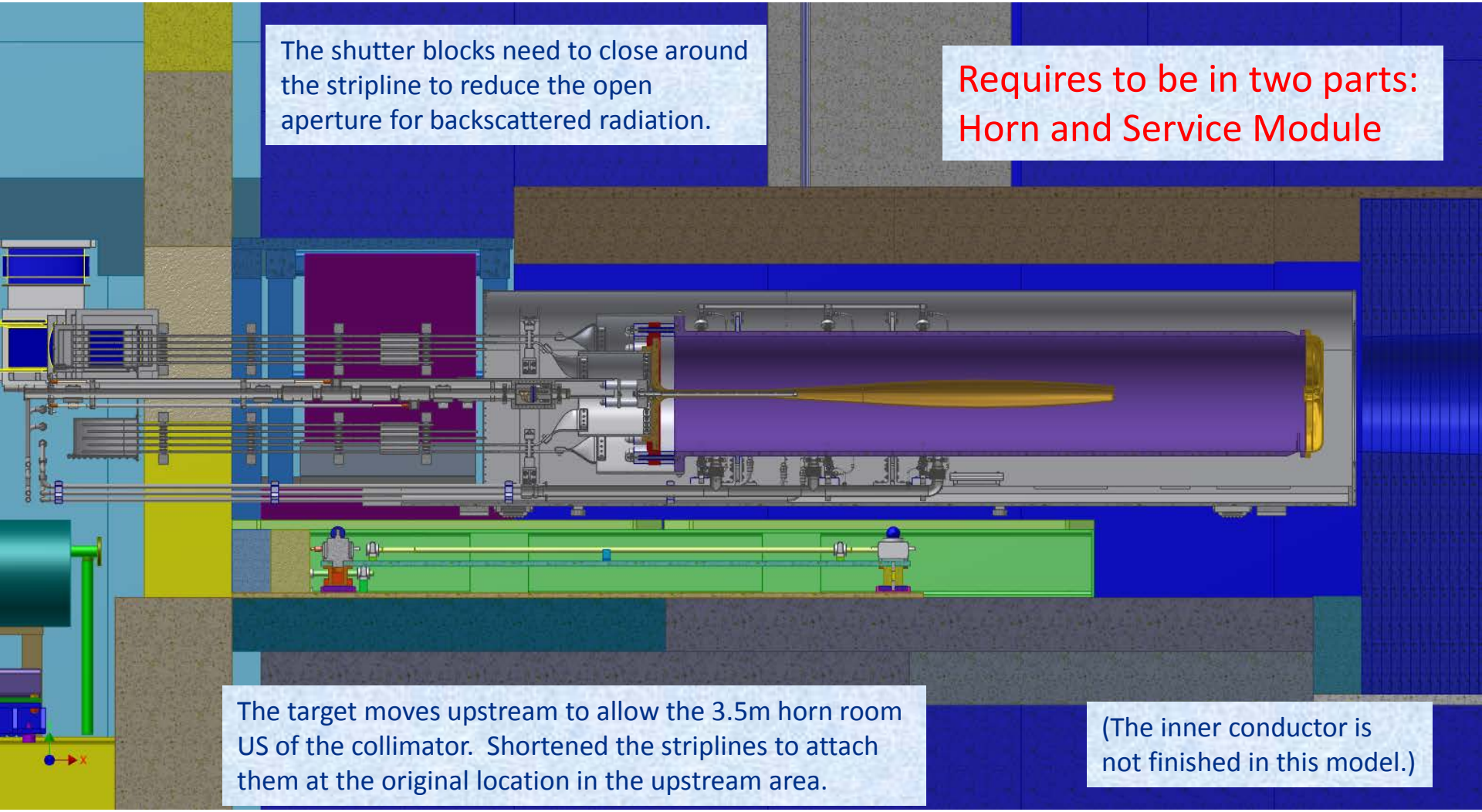
1990's

Physical constraints

- Target pile shielding
  - Rebuilding prohibitively expensive (~$15M) and would require long downtime (12-18 months)
- Hatch size matched to the coffin length
- Collimator at the entrance to decay pipe (r=30cm)
  - Matched horn outer conductor radius



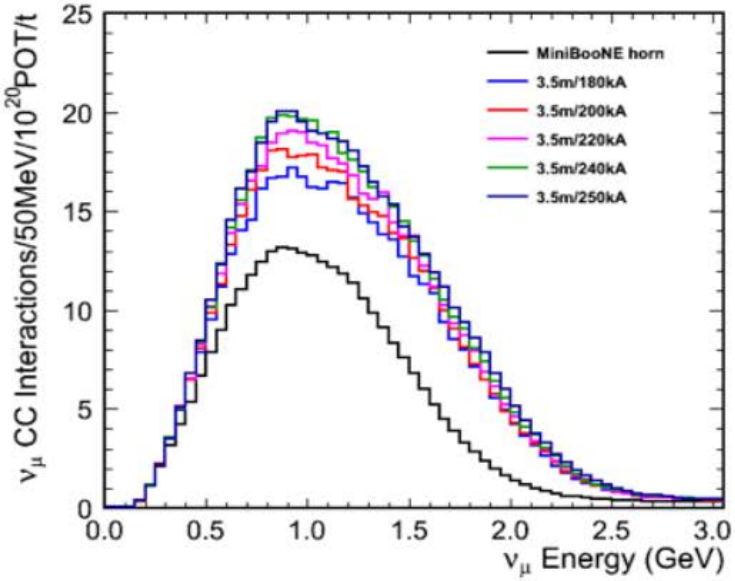
3.5m Horn to fill in the available space

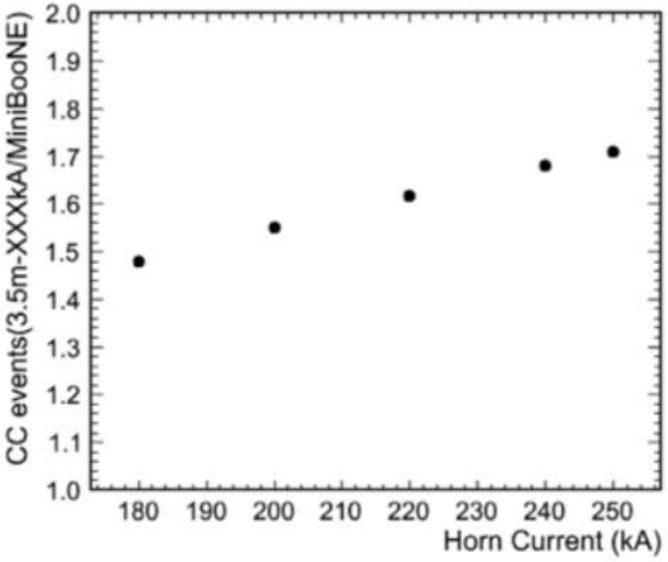


Optimization

- Vary inner conductor shape, horn length,horn current
- Optimization prefers longer horns and higher current
- Longest horn that can fit 3.5m
- Power supply capable running up to 250kA

	Overall rate/ MiniBooNE
MiniBooNE	1
3.5m/180kA	1.48
3.5m/200kA	1.55
3.5m/220kA	1.62
3.5m/240kA	1.68
3.5m/250kA	1.71





Annual proton delivery

- Assuming 71.4% uptime
  - Historical proton source/linac/booster uptime 85%
  - Two months annual shutdown (uptime 84%)

	Average rate	Spills/year (M)	POT (10^20)	Spills/year (w/ uptime) (M)	POT (w/ uptime) (10^20)
3.76Hz	3.8	119	5.3	85	3.8
3.76Hz+(5Hz slow spill)	3.9	122	5.5	87	3.9
3.76Hz+5Hz(slow spill) +5Hz(NuMI/muon down 10%)	4.0	126	5.7	90	4.0
3.76Hz+10Hz(slow spill)	4.3	137	6.1	98	4.4
3.76Hz+10Hz(slow spill) +10Hz(NuMI/muon down 10%)	4.9	154	7.0	110	5.0

There will be a power supply upgrade for operation at 210kA up to 10 Hz

Short Baseline Neutrino Group Proposing two AIPs

- Replace Horn
  - Make as long as possible ~3.5m
  - Make capable of pulsing at 10 Hz
  - Keep existing target
  - In addition requires
    - Service module able to do horizontal (dis)connections
    - New water skid
    - Other Infrastructure?
- Upgrade Power Supply
  - Run reliably at 210 kA
  - Make capable of pulsing at 10 Hz

Near Term Work

- Hand-off of design to TSD
  - Review of preliminary design
- Form Project
  - Identify leaders for sub areas
  - Create AIP documentation
- Resource Loaded Schedule
  - Better estimate of M&S required
  - Better estimate of Labor required
- FY17
  - Final design
  - Prototyping
    - Be-Al Weld
    - Remote connections (Stripline, Water, Air)

Horn & Horn Box
Fixturing
Target & Support
Service Module & Remote Connections
Platform
Water Skid
Storage Casks
Power Supply
Integration & Installation

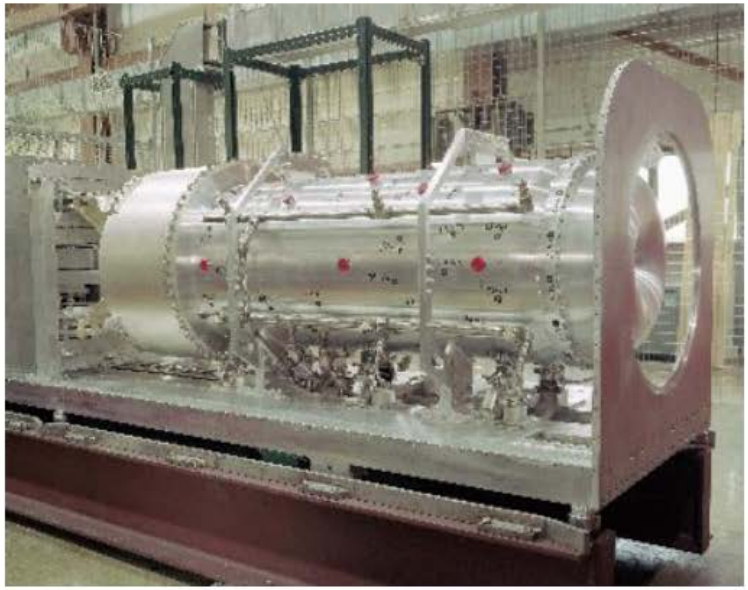
Possible SBN AIPs Summary

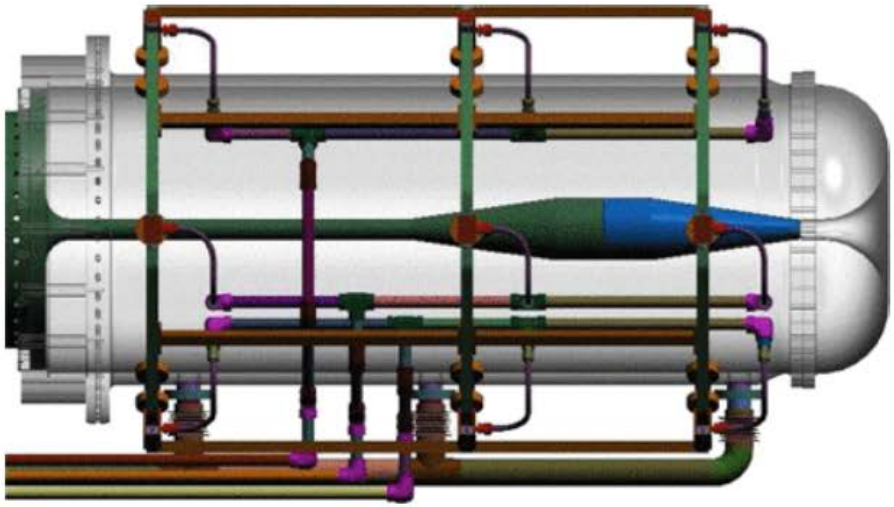
- A 3 year AIP for making a new longer BNB style horn may be starting this fall
  - Short time for a new horn
- Preliminary design work has been going on and will be taken over by TSD shortly
- People will be asked to contribute to the Resource Loaded Schedule

BNB horns

- Both horns suffered water system failure
  - 1st horn developed leak and short to ground due to stagnant water (late 2004)
  - 2nd horn had plugged cooling lines
- 3rd horn installed in spring 2015
  - Tested in June 2015
  - Started MicroBooNE run in October 2015
- 4th horn under construction
- Horns designed to last >200M pulses

Horn	Pulses	POT
1	97M	3.7E+20
2	375M	1.6E+21





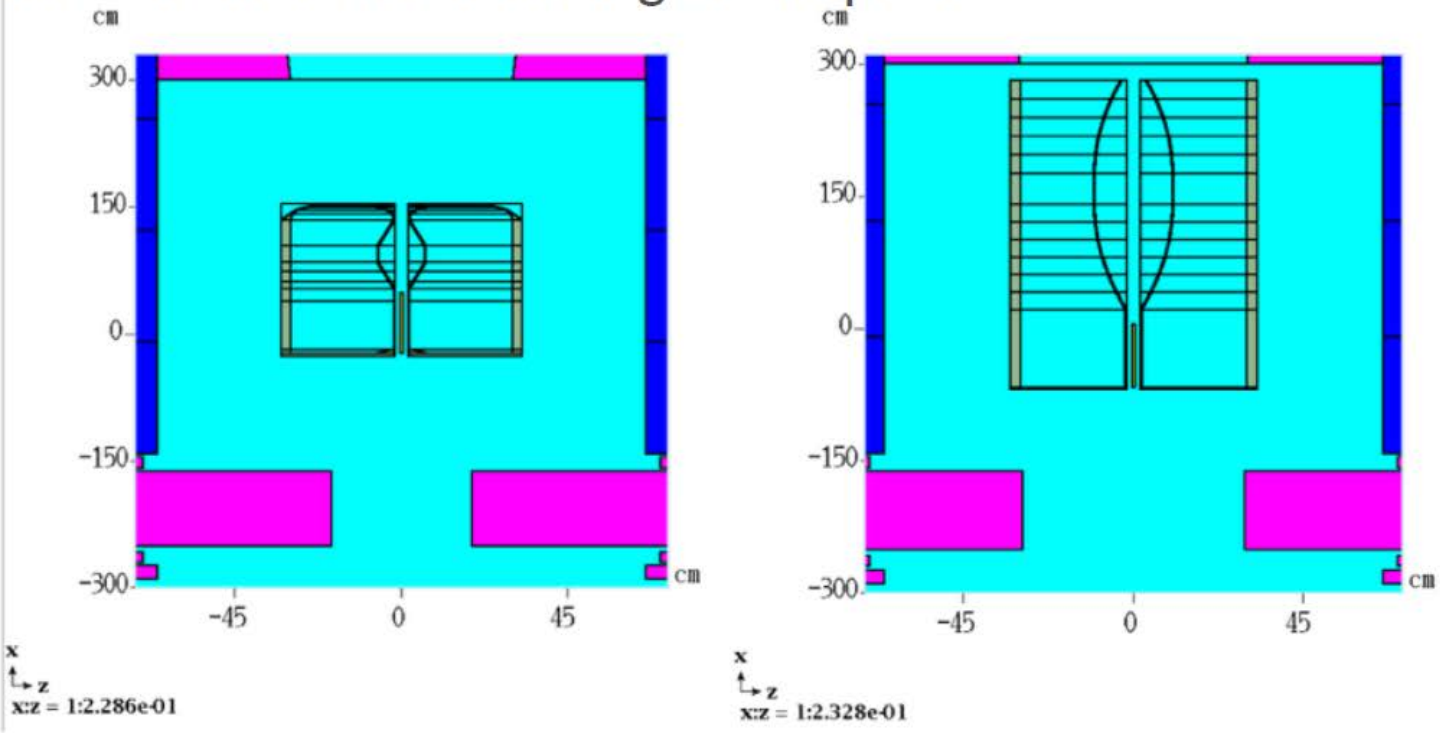
Upgrade paths

1. Increase focusing efficiency of target/horn system
   - optimized horn length, inner conductor, and current
   - take into account physical constraints of present target hall, stripline limitations, and power supply capability
2. Increase rate at which horn system is capable running
   - Booster will operate at 15Hz
   - Maximize use of available cycles (beyond those sent to NuMI and muon program)
   - Requires improvement in horn power supply, mechanical integrity of horn (both depend on horn current)

- Account for coupling between paths, i.e. higher focusing efficiency with higher current, but mechanical integrity and power supply push maximal rate down
- Optimize cost/benefit with potentially affordable solutions

Radiological limits

- 3.5m long horn requires target to be pulled 50cm upstream
- Service module and cooling pipes might require additional opening of shield doors
- These could have radiological impact



Radiological limits (preliminary)

- Similar dose on surface with MiniBooNE and optimized horn running