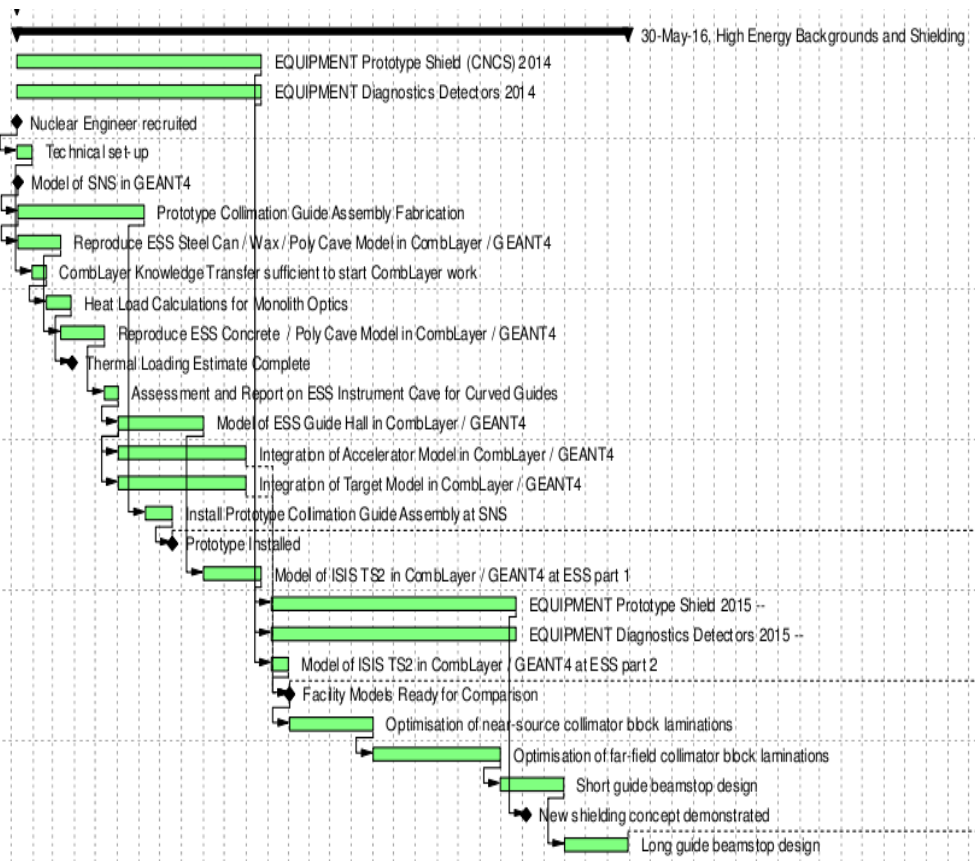




Outline

- SNS measurements
- Optimization methods
- Preliminary ESS geant4 modeling

High Energy Backgrounds and Shielding		07-Jan-14	21-Dec-14	269,709	
High Energy Backgrounds and Shielding		07-Jan-14	30-May-16	683,255	
13.6.2.5.1	A115300	EQUIPMENT Prototype Shield (CNCS) 2014	07-Jan-14*	23-Dec-14	80,000
13.6.2.5.1	A115310	EQUIPMENT Diagnostics Detectors 2014	07-Jan-14*	23-Dec-14	10,000
13.6.2.5.1	A125050	Nuclear Engineer recruited	07-Jan-14*		0
13.6.2.5.1	A125060	Technical set-up	07-Jan-14	29-Jan-14	4,800
13.6.2.5.1	A125010	Model of SNS in GEANT4	09-Jan-14*		0
13.6.2.5.1	A125020	Prototype Collimation Guide Assembly Fabrication	09-Jan-14	09-Jul-14	45,000
13.6.2.5.1	A125090	Reproduce ESS Steel Can / Wax / Poly Cave Model in CombLayer / GEANT4	09-Jan-14	11-Mar-14	9,000
13.6.2.5.1	A125070	CombLayer Knowledge Transfer sufficient to start CombLayer work	30-Jan-14	19-Feb-14	4,800
13.6.2.5.1	A125080	Heat Load Calculations for Monolith Optics	20-Feb-14	26-Mar-14	9,600
13.6.2.5.1	A125100	Reproduce ESS Concrete / Poly Cave Model in CombLayer / GEANT4	12-Mar-14	12-May-14	14,400
13.6.2.5.1	A125230	Thermal Loading Estimate Complete	27-Mar-14		0
13.6.2.5.1	A125110	Assessment and Report on ESS Instrument Cave for Curved Guides	13-May-14	02-Jun-14	2,400
13.6.2.5.1	A125120	Model of ESS Guide Hall in CombLayer / GEANT4	03-Jun-14	01-Oct-14	28,800
13.6.2.5.1	A125140	Integration of Accelerator Model in CombLayer / GEANT4	03-Jun-14	01-Dec-14	24,000
13.6.2.5.1	A125150	Integration of Target Model in CombLayer / GEANT4	03-Jun-14	01-Dec-14	27,000
13.6.2.5.1	A125030	Install Prototype Collimation Guide Assembly at SNS	10-Jul-14	18-Aug-14	3,000
13.6.2.5.1	A125040	Prototype Installed	19-Aug-14		0
13.6.2.5.1	A125130	Model of ISIS TS2 in CombLayer / GEANT4 at ESS part 1	02-Oct-14	23-Dec-14	21,600
13.6.2.5.1	A8910	EQUIPMENT Prototype Shield 2015 --	07-Jan-15*	23-Dec-15	220,000
13.6.2.5.1	A8915	EQUIPMENT Diagnostics Detectors 2015 --	07-Jan-15*	23-Dec-15	25,063
13.6.2.5.1	A125240	Model of ISIS TS2 in CombLayer / GEANT4 at ESS part 2	07-Jan-15	30-Jan-15	6,912
13.6.2.5.1	A125160	Facility Models Ready for Comparison	02-Feb-15		0
13.6.2.5.1	A125250	Optimisation of near-source collimator block laminations	2-Feb-15	01-Jun-15	38,880
13.6.2.5.1	A125260	Optimisation of far-field collimator block laminations	2-Jun-15	30-Nov-15	52,320
13.6.2.5.1	A125700	Short guide beamstop design	01-Dec-15	29-Feb-16	26,400
13.6.2.5.1	A125750	New shielding concept demonstrated	07-Jan-16		0
13.6.2.5.1	A125740	Long guide beamstop design	01-Mar-16	30-May-16	29,280





SNS measurements

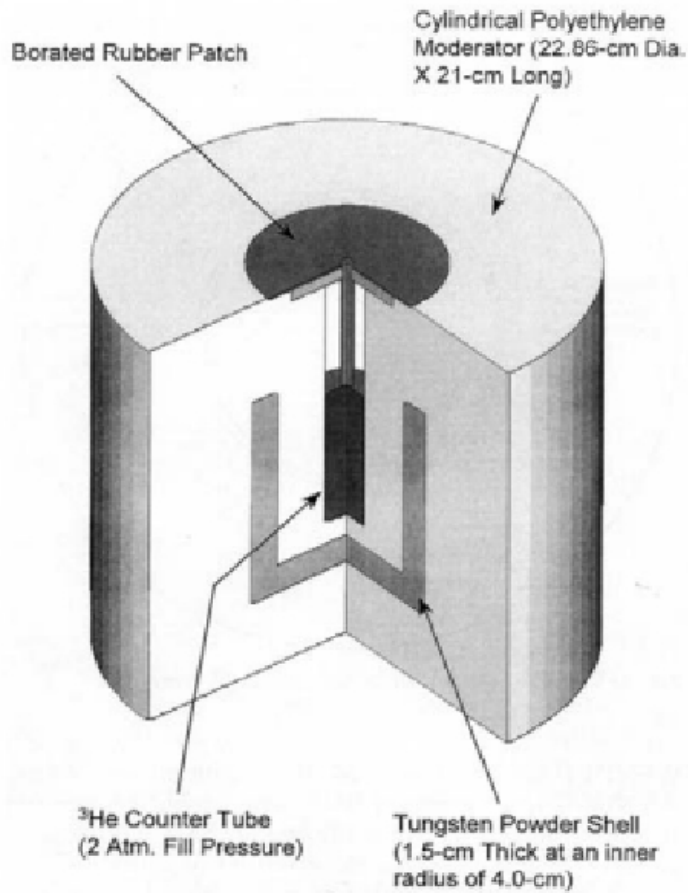
- Measure the radiation background at SNS
 - Neutron background, particularly the fast neutron component
 - Gamma-ray background
- Key areas
 - Measure around instruments, particularly CNCS and HYSPEC (prompt pulse)
 - Measure outside the experimental hall
- Collaboration with the ESS detector group, SNS, PSI, ISIS and MAXIV

Detector list

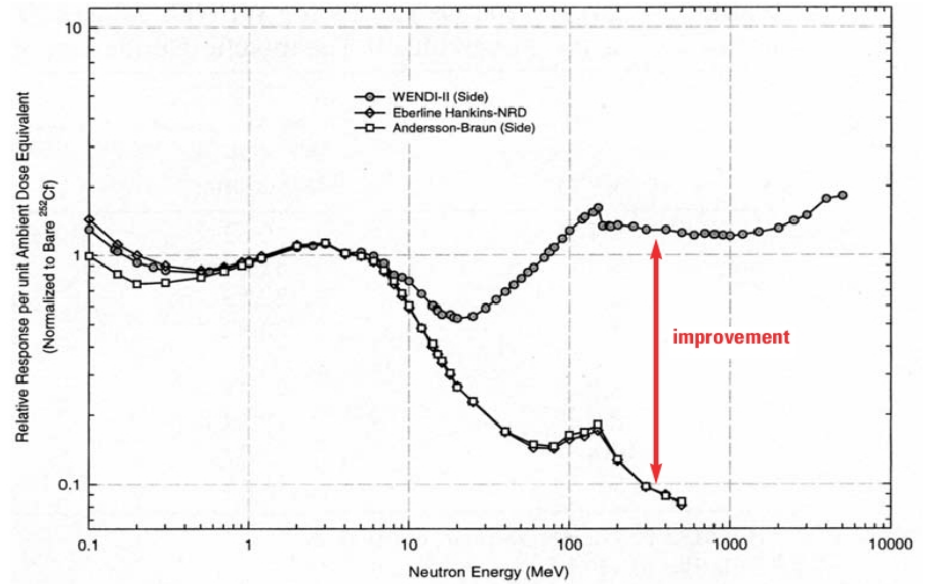
- WENDI-II – Wide energy neutron dosimeter
- REM ball – neutron dosimeter
- Bubble detectors – neutron spectrometers
- Arktis ^4He detector – fast neutrons
- LaBr3 and NaI – gamma-ray detection
- Scintillator paddles – charged particles
- Medipix2 neutron camera – thermal, fast neutrons, gammas, electrons and heavy particles



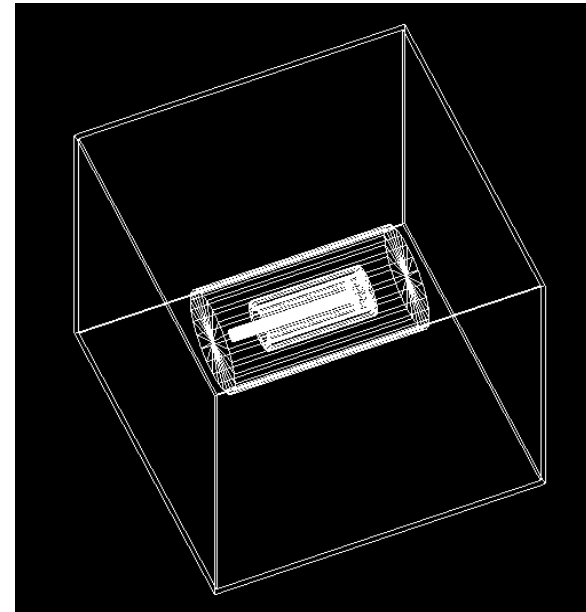
WENDI-II



Reference: *Osher et al, Health Physics, 79(2): 170ff, 2000*



Reference: *Osher et al, Health Physics, 79(2): 170ff, 2000*



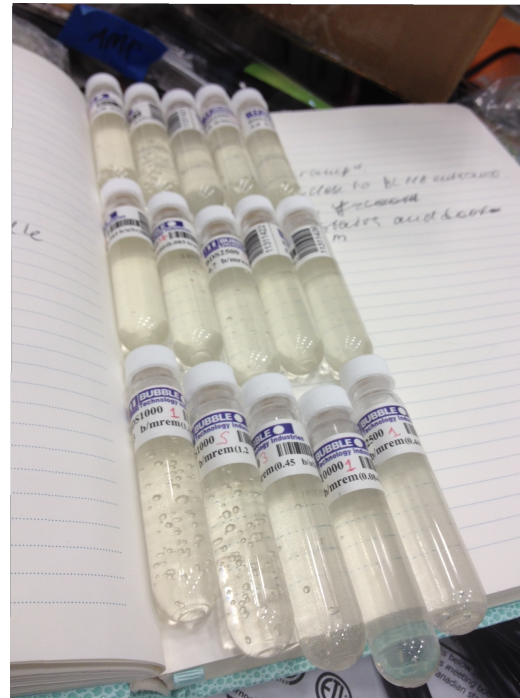
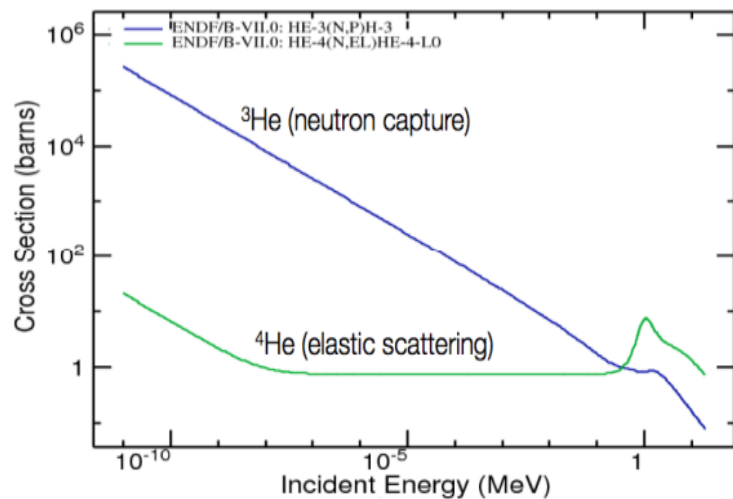
Geant4 model of WENDI-II

Other detectors

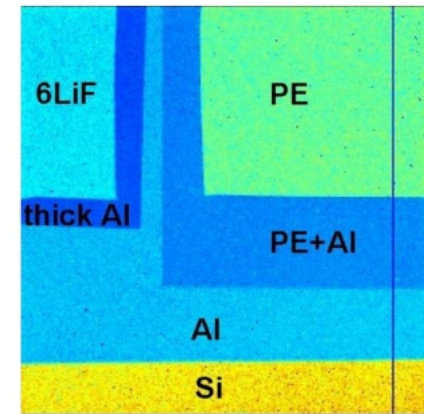
Bubble detectors

Medipix2 neutron camera

Arktis ^4He detector



A Ball et al 2011 JINST 6 P08005 doi:10.1088/1748-0221/6/08/P08005



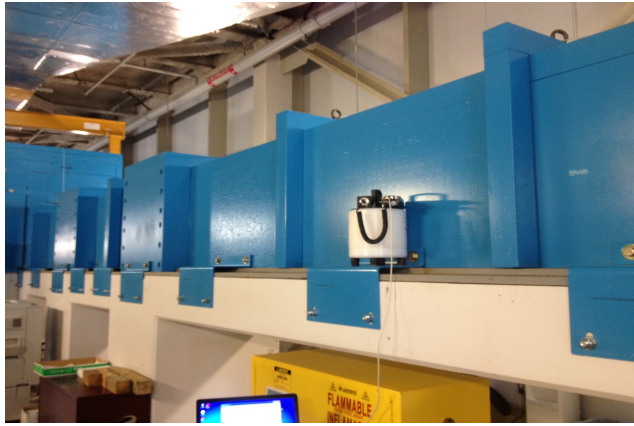
- Active area $\sim 2 \text{ cm}^2$
- 256 x 256 pixels
- Particles identified by tracks

R Chandra et al 2012 JINST 7 C03035 doi:10.1088/1748-0221/7/03/C03035

- Sensitive to six neutron energy ranges 0.01-20 MeV
- Unfold to get the neutron spectrum



Measurements

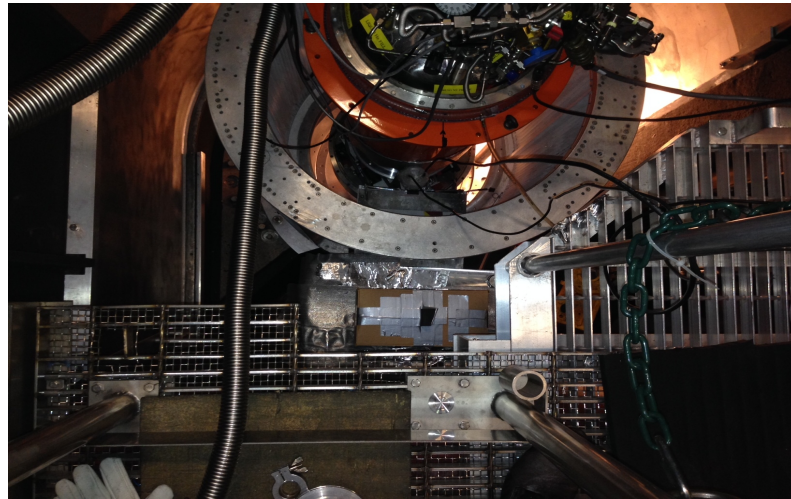


Along basis-curved beamline



Outside: ring2target

Between BL13 & BL14

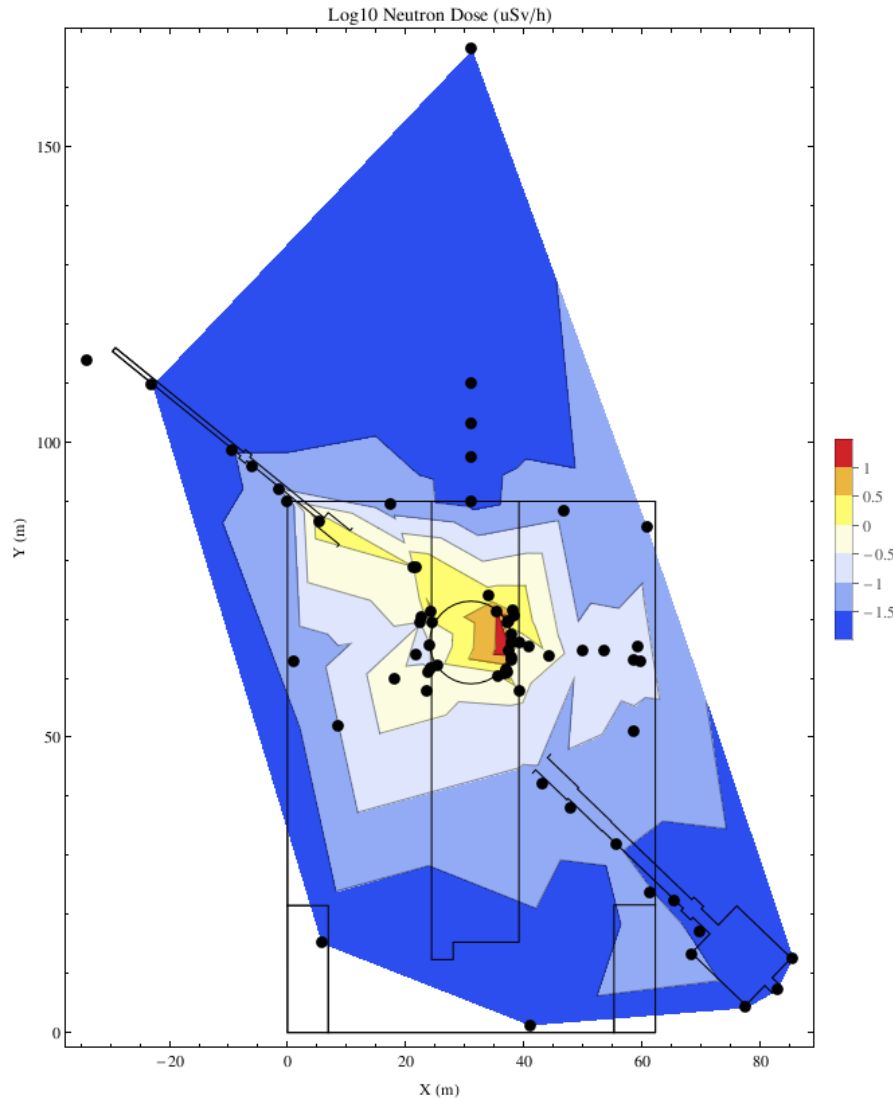


Inside CNCS



On top of BL14

Neutron dose map



- Geant4 model of SNS to compare with measurements, preliminary PSI and ESS models are underway
- Compare measurements from the different detectors
- Correlate measurements with shutter/beam status

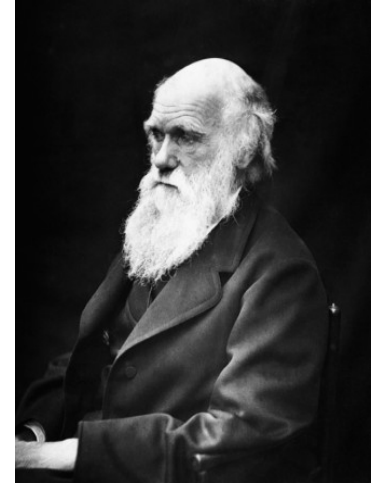
Optimization methods



Particle Swarm Optimization (PSO)
Eberhart and Kennedy (1995)



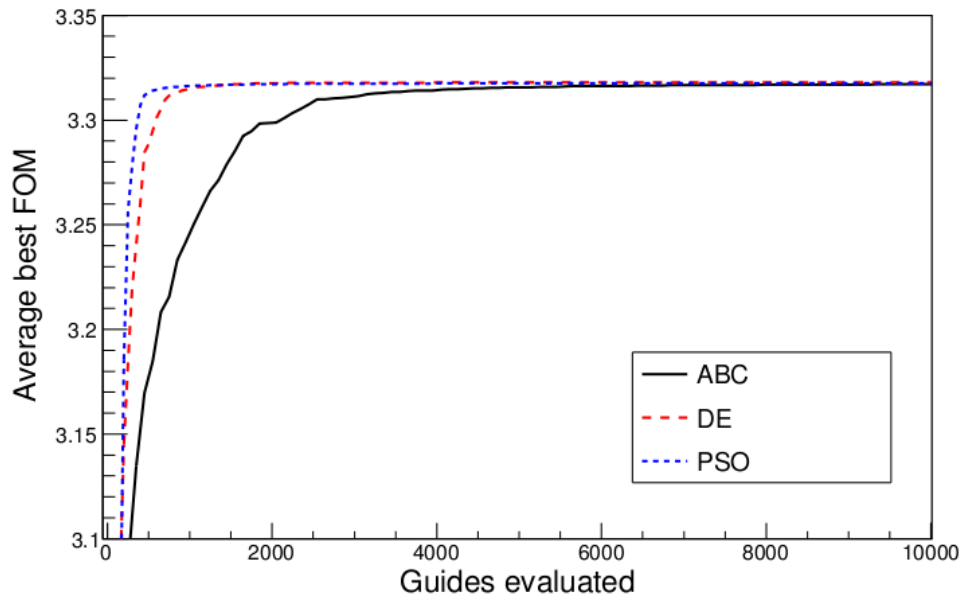
Artificial Bee Colony (ABC)
Karaboga (2005)



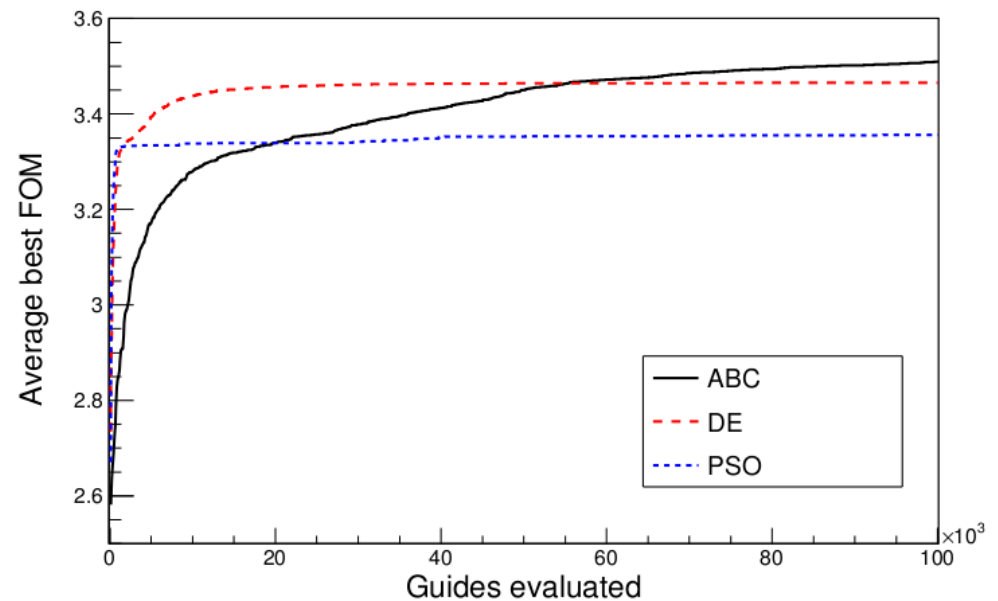
Differential Evolution (DE)
Storn and Price (1995)

- Metaheuristics
 - Tendency to avoid local optima
 - Thoroughly sample the parameter space
 - No partial derivatives
 - Low sensitivity to random noise

Optimization methods (focusing guide geometry)



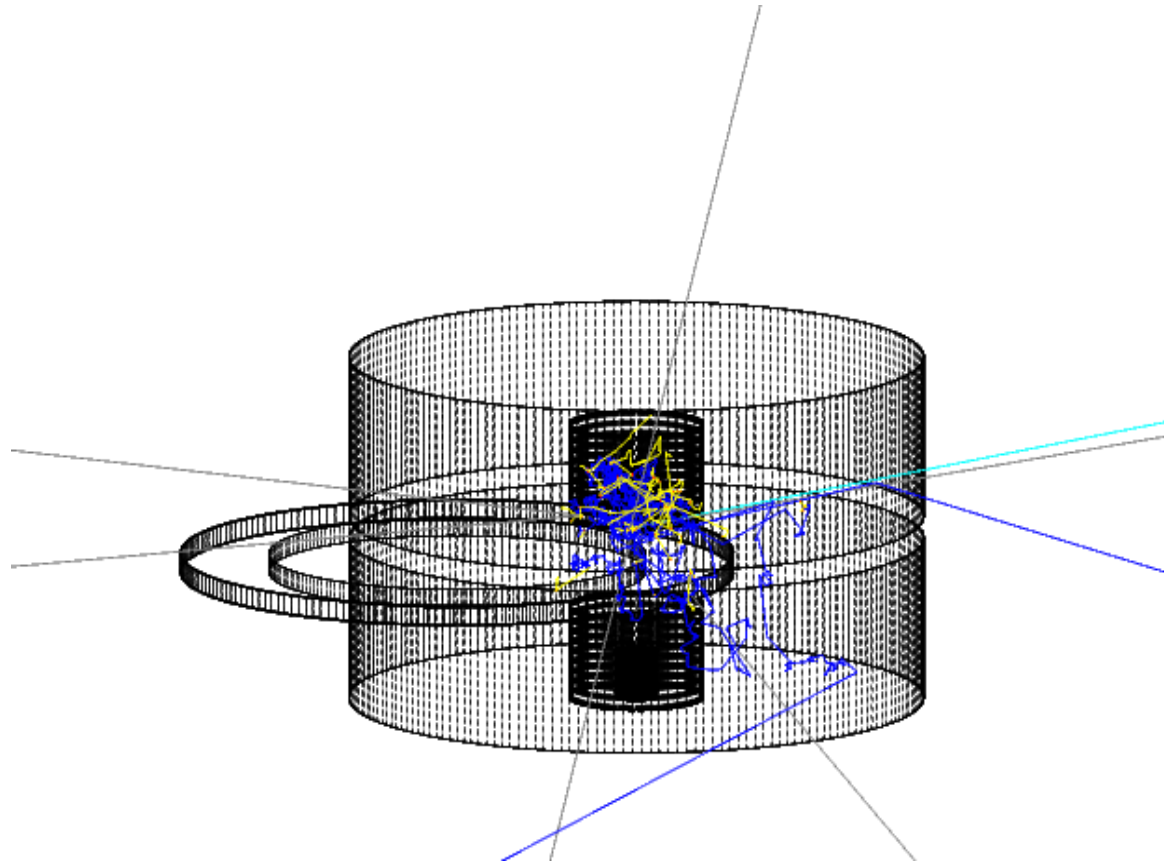
3 parameters



20 parameters

- Future work: apply to shielding design (combination of different shielding materials).
- Additionally, PSO has been coupled with VITESS for the study of elliptic focusing guide geometries (Damian)

Geant4 modeling



- ESS target model implementation in geant4
- Increasing complexity
- Add beamports, evaluate backgrounds
- In contact with the target division