MAJORANA Background Simulation Campaign

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MaGe Meeting 2010

simulation campaign status

- Reyco performed previous simulation campaign in 2005
- Preparing for new simulation campaign
  - Code new geometries
  - Write new MaGe output class
  - Run many simulations
  - Store information in new databases
  - Create code to process MaGe results into suitable input for background model framework

new geometries

- DEMONSTRATOR geometry
  - Reyco will start soon
- BEGe geometry
  - no dead layer; handled in analysis
  - first draft completed, not in SVN

new MaGe output class

- MGDO MJMCRun
  - creates ROOT file containing TTree of MGDO MGMCEvent objects
  - alternative to G4Steps
  - code to analyze MaGe results will not need to compile against MaGe
  - in development

planned simulations

Signal and Background sources

A preliminary list of sources of backgrounds and signals for the simulation campaign, compiled from Background Summary Document tables and recommendations

Source	Notes
Highest priority simulations	
0νββ	
dark matter	
U, Th, K in Cu	consider effects of cracks in shielding
U, Th, K in Pb shielding	consider effects of cracks in shielding
U, Th, K in Ge	
U, Th, K from experimental hall	
U, Th, K in electronics, cables	
surface αs on detectors (and βs)	Bela (from GERDA) says to see Eberth and Simpson (Prog. Part. and Nucl. Phys. 60(2008)283 Review)
^{40}K in electronics	
tritium in Ge	
2νββ of ^{76}Ge	
^{68}Ge	
^{60}Co in Ge	
^{60}Co in Cu	
^{207}Bi in Cu	
radon in air spaces/plate out	

and others

simulation of U, Th chains

- Split simulation of ^{238}U chain:
  - 238U->234Th
  - 234Th->234U
  - 234U->230Th
  - 230Th->226Ra
  - 226Ra->222Rn
  - 222Rn->210Pb
  - 210Pb->210Bi or 206Pb via 206Hg
  - 210Bi->210Po or 206Pb via 206Tl
  - 210Po->206Pb

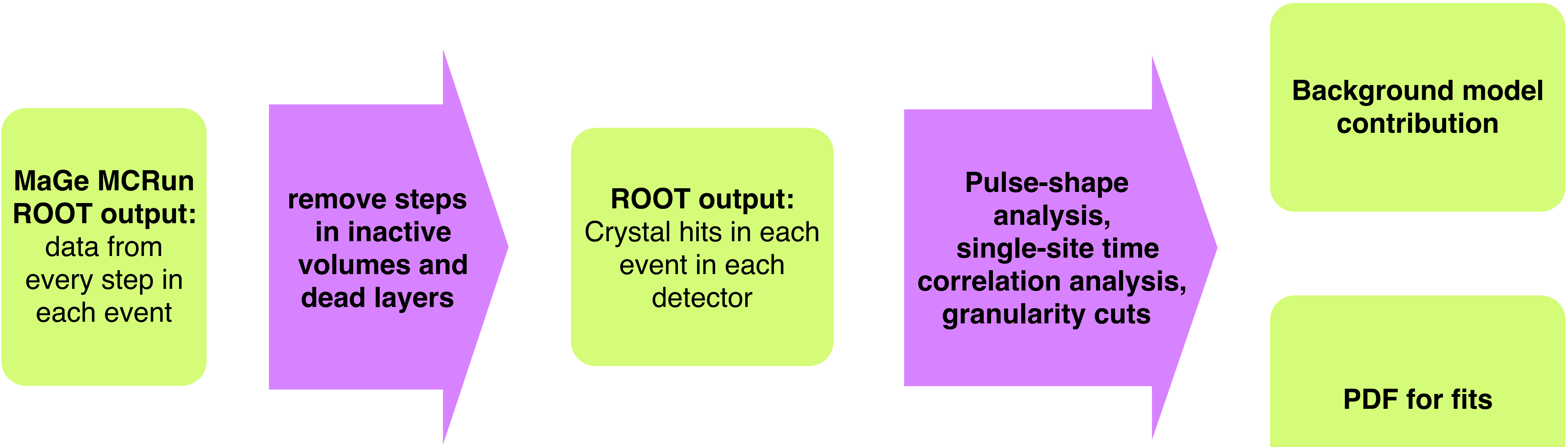
- Split simulation of ^{232}Th chain:
  - 232Th->228Ra
  - 228Ra->228Th or 224Ra via 224Fr
  - 228Th->224Ra
  - 224Ra->208Pb

simulate each step separately to allow studies of disequilibrium in decay chains

planned databases

- runs database
  - script to start a MaGe run will create a database entry
  - number of events, isotope, output file location, ...
- material purity database
- geometry information about detectors and other components

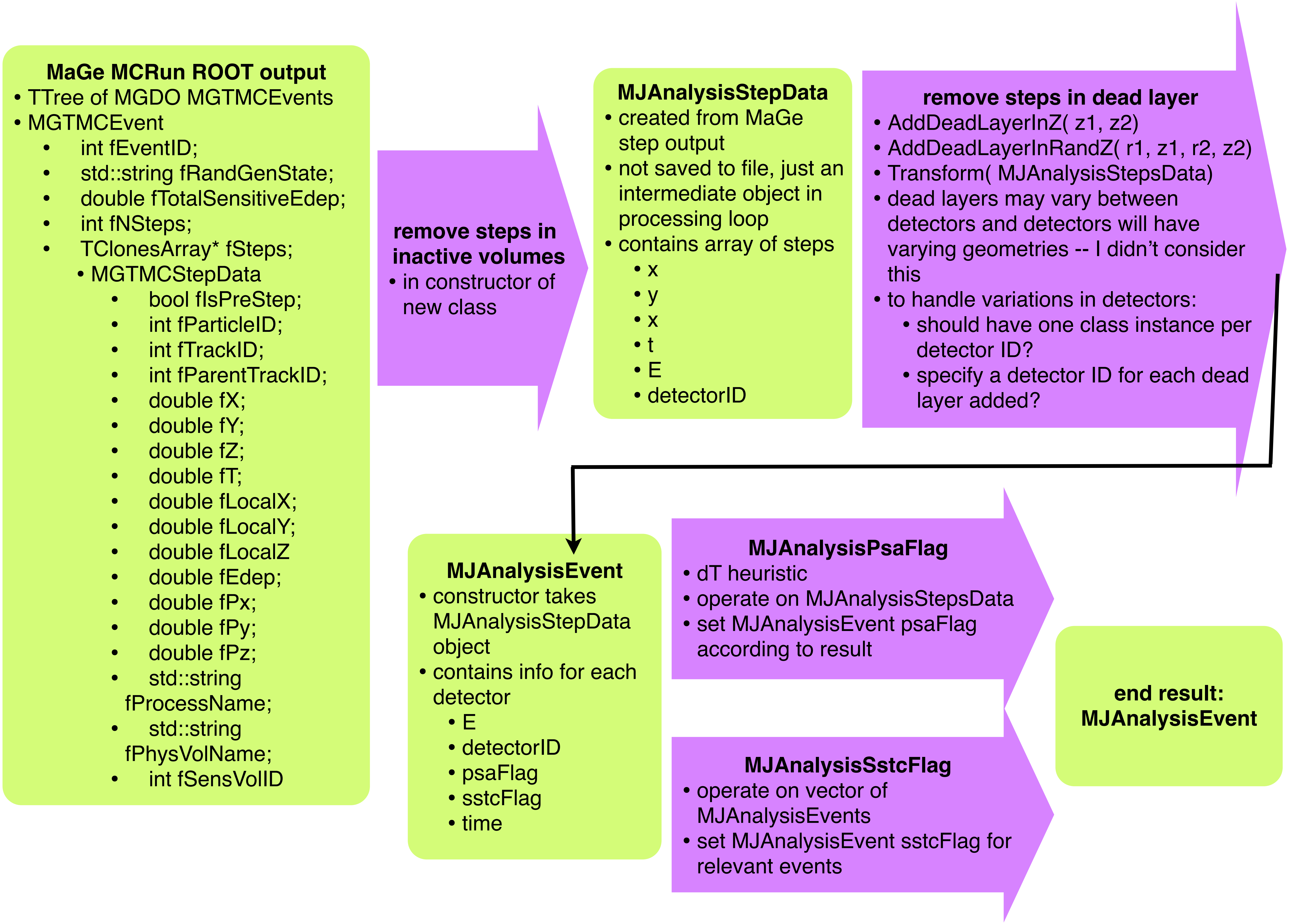
analysis chain



future work

- code DEMONSTRATOR geometry
- finalize MCRun output class
- simulate backgrounds from list
- create databases: runs (started), material purity, components
- complete and verify post-processing code

supplemental slides


MaGe MCRun ROOT output
• TTree of MGDO MGTMCEvents
• MGTMCEvent
• int fEventID;
• std::string fRandGenState;
• double fTotalSensitiveEdep;
• int fNSteps;
• TClonesArray* fSteps;
• MGTMCStepData
• bool fIsPreStep;
• int fParticleID;
• int fTrackID;
• int fParentTrackID;
• double fX;
• double fY;
• double fZ;
• double fT;
• double fLocalX;
• double fLocalY;
• double fLocalZ
• double fEdep;
• double fPx;
• double fPy;
• double fPz;
• std::string fProcessName;
• std::string fPhysVolName;
• int fSensVolID
remove steps in inactive volumes
• in constructor of new class
MJAnalysisStepData
• created from MaGe step output
• not saved to file, just an intermediate object in processing loop
• contains array of steps
• x
• y
• x
• t
• E
• detectorID
remove steps in dead layer
• AddDeadLayerInZ(z1, z2)
• AddDeadLayerInRandZ(r1, z1, r2, z2)
• Transform(MJAnalysisStepsData)
• dead layers may vary between detectors and detectors will have varying geometries -- I didn't consider this
• to handle variations in detectors:
• should have one class instance per detector ID?
• specify a detector ID for each dead layer added?
MJAnalysisEvent
• constructor takes MJAnalysisStepData object
• contains info for each detector
• E
• detectorID
• psaFlag
• sstcFlag
• time
MJAnalysisPsaFlag
• dT heuristic
• operate on MJAnalysisStepsData
• set MJAnalysisEvent psaFlag according to result
MJAnalysisSstcFlag
• operate on vector of MJAnalysisEvents
• set MJAnalysisEvent sstcFlag for relevant events
end result: MJAnalysisEvent