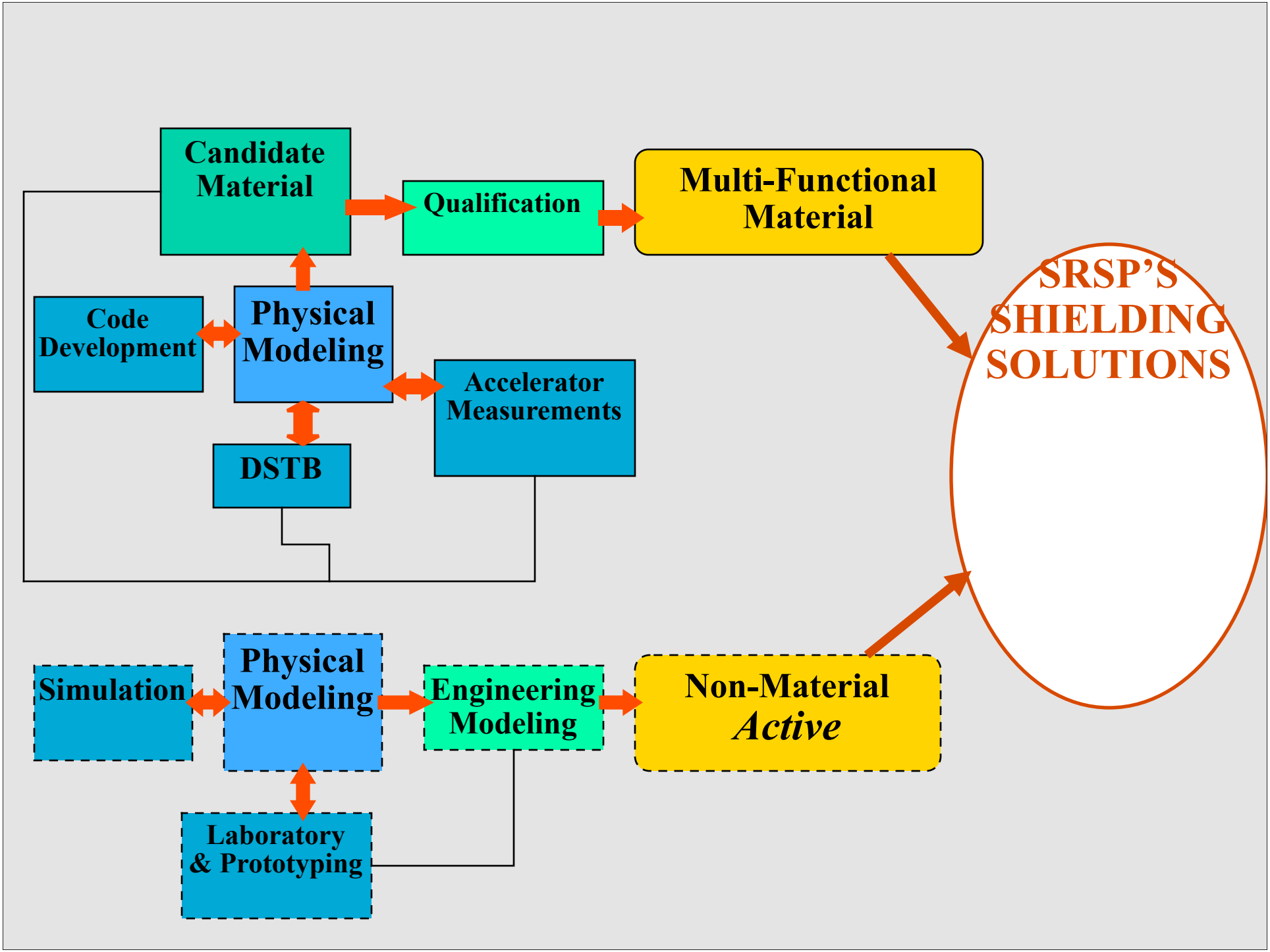
Space Radiation Shielding Program

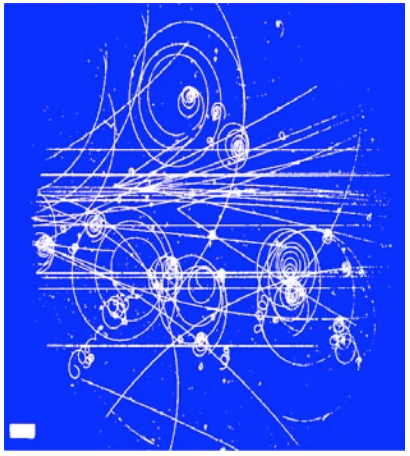
http://radiationshielding.nasa.gov

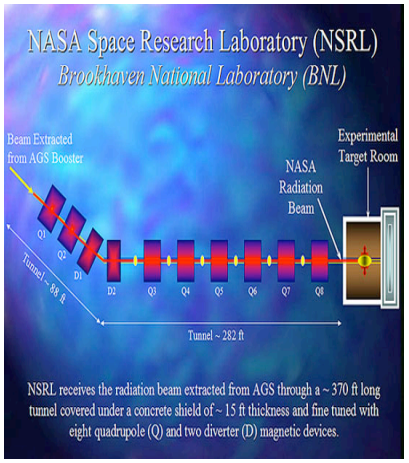

Candidate Material
Qualification
Multi-Functional Material
Code Development
Physical Modeling
Accelerator Measurements
DSTB
SRSP'S SHIELDING SOLUTIONS
Simulation
Physical Modeling
Engineering Modeling
Non-Material Active
Laboratory & Prototyping

SRSP'S Focus

Space Radiation Shielding Program

- **Radiation Transport Codes**
- **Cross Section Measurements**
- **Deep Space Test Bed (DSTB)**
- **Materials Design and Testing**





SRSP'S Personnel

- Program Manager: ***Ed Semmes*** - MSFC
- Program Scientist: ***Jim Adams*** - MSFC
- Project Scientist: ***Nasser Barghouty*** – MSFC
- Project Scientist [Material Science]: ***Frank Szofran*** - MSFC
- Research Scientist: ***Manojeet Bhattacharya*** - UAH/MSFC
- Research Scientist: ***Zi-wei Lin*** - UAH/MSFC
- Transport Consortium Lead: ***Larry Townsend*** – Univ. of Tennessee, Knoxville
- Measurements Consortium Lead: ***Jack Miller*** - LBNL
- Deep Space Test Bed Manager: ***Mark Christl*** – MSFC

SRSP'S Elements

Materials for Exploration Missions

– Development of radiation shielding materials for spacecraft, habitat, and space suits

– Testing and maturation of new materials

– Development of active (non-material) shielding solutions

Evaluation & Testing of Materials

– Simulation/radiation-transport codes: design, effectiveness, comparison

– Nuclear cross section measurements: physical models ⇒ simulation codes

– Ground-based testing of materials: NASA's SRL at BNL

Deep Space Test Bed

– Validate radiation transport codes

– Characterize shielding effectiveness of candidate materials

– Conduct biological studies

– Test new radiation monitoring instrumentation

SRSP'S Support

- **Program management**
  - **MSFC**
- **Ground-based and balloon-based testing**
  - **NSRL, DSTB**
- **Dedicated computer cluster**
  - **MSFC**
- **Systems engineering**
  - **LaRC**
- **Dedicated materials laboratories**
  - **LaRC and MSFC**

SRSP'S Active Solutions

From the 2000 Workshop at MSFC

Electrostatic fields [?]

- Keep the protected area neutral using a capacitor-like potential and field
  Requirements: ~GV and ~10's MV/m + large structures

  Not practical!

- Protected area as charged conductor

  Unrealstic due to discharging!

SRSP'S Active Solutions

From the 2000 Workshop at MSFC

Magnetostatic fields [?]

-Confined, e.g., toroidal:

Requirements: Strong field ~10 T

power and mass prohibitive, But…

-Unconfined, not too large a field but over large distances:

high T_C superconducting coil; inflatable field; far, upstream deflecting sail

still mass prohibitive, But…

SRSP'S Active Solutions

From the 2000 Workshop at MSFC

Plasmas as shields [?]

-Early concepts combine E & B fields shielding capabilities with an 'electron cloud' ***cumbersome and impractical!***

-Artificial magnetospheres: plasma-inflated B field of about kilogauss, better power, mass and size economy, simulations suggested reasonable scalability, also looked plausible for propulsion

Feasibility and shielding effectiveness studies were recommended to NASA

SRSP'S Active Solutions

From the 2003 Non-Advocate Review:

"The concept of shielding with an inflated field must be carefully re-examined using proper trajectory simulations".

"There are significant, strong, general physical arguments, based on fundamental physics, that cast considerable doubt on the possibility of producing the required magnetic field configurations".

"If the fundamental issues can be successfully addressed… further progress requires significant investment…"

"Achieving these objectives might require involving a significantly larger part of the community…a workshop…"