

-----A Fault Tree Analysis and future plans

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CAFe (China ADS Front-end Demo Linac) is the prototype of CiADS (China initiative Accelerator-Driven System), whose aim is to verify the feasibility of transmutation technology of accelerator-driven system. There is an introduction to the superconducting (SC) section of CAFE. And whether we put all protection logic or not, the number of failures located in SC section is larger than in any other subsystem. So a simple Fault Tree Analysis is applied to see all kinds of events that cause beam trips in SC section. Future plans about reliability studies are also listed.

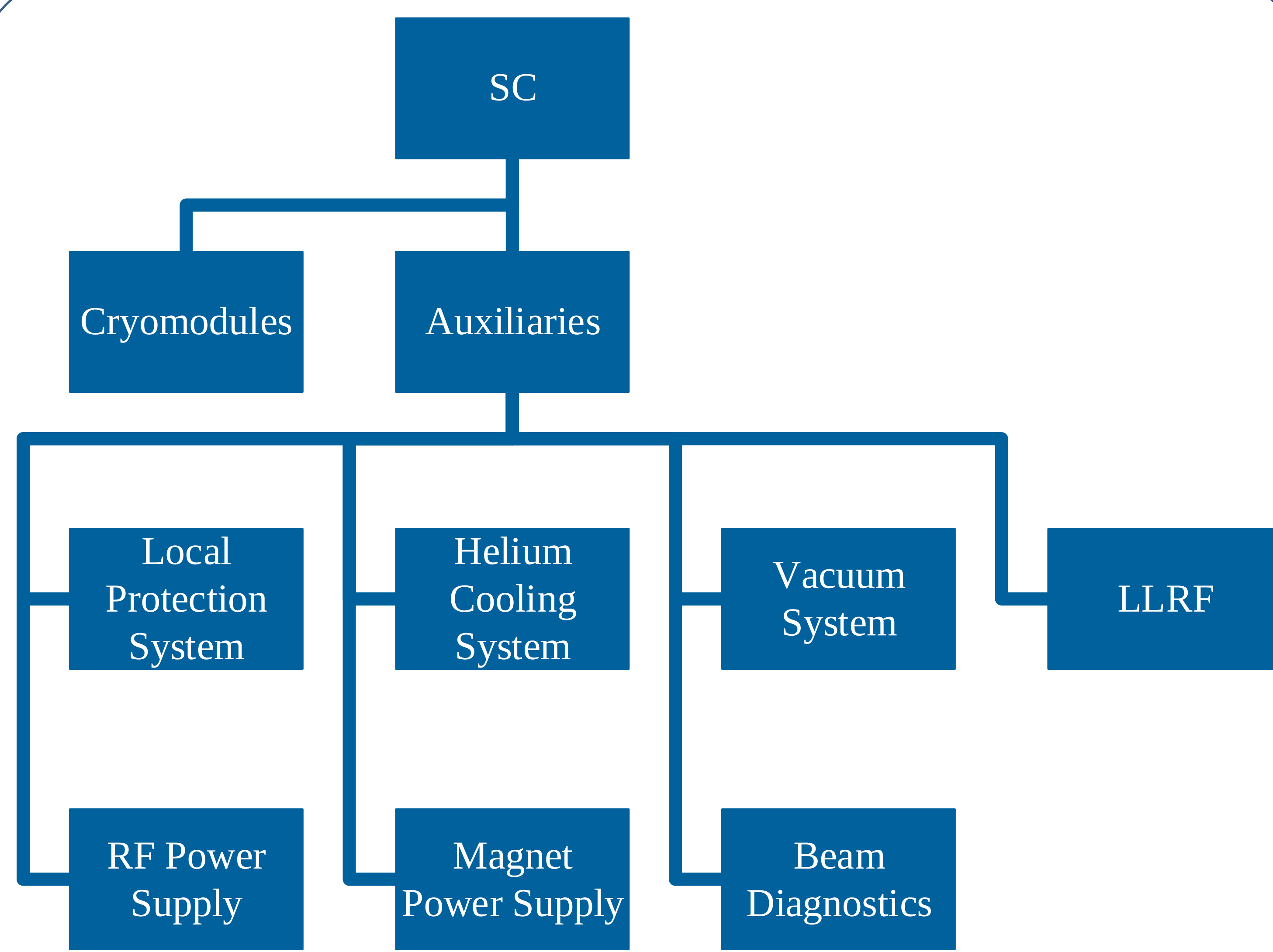
1 An introduction to SC section of CAFE

Figure 1. Subsystems in SC section

- ◆ The function of SC section is to accelerate particles (protons) from about 1.5MeV to about 25MeV.
- ◆ SC section consists of 4 cryomodules and 7 auxiliary subsystems. The first three cryomodules were fabricated and commissioned in IMP, and the fourth was in IHEP.

2 Historical data and the analysis

- ◆ In high-power mode we will put all protection logic to ensure the safety of the accelerator. But in low-power mode we only use protection based on interlocking to accelerate pulsed beams.
- ◆ We compare one experiment result about failures in high-power mode with the other in low-power mode and we can see that whether in high-power mode or not, SC section contributes to the most failures.
- ◆ So a simple FTA is applied to see what kind of events in SC section will cause beam trips.

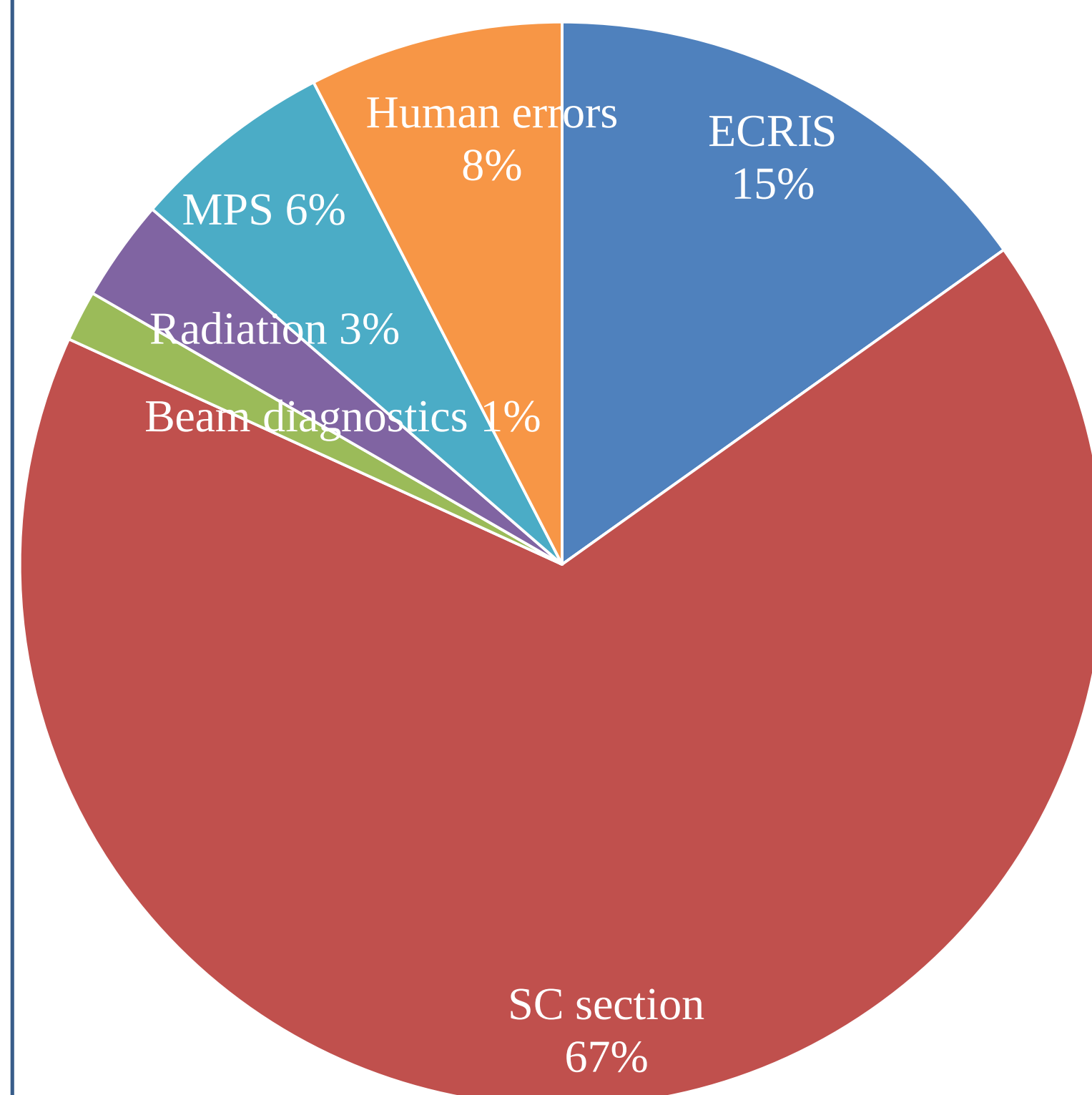


Figure 2. A high-power experiment result about failure distribution

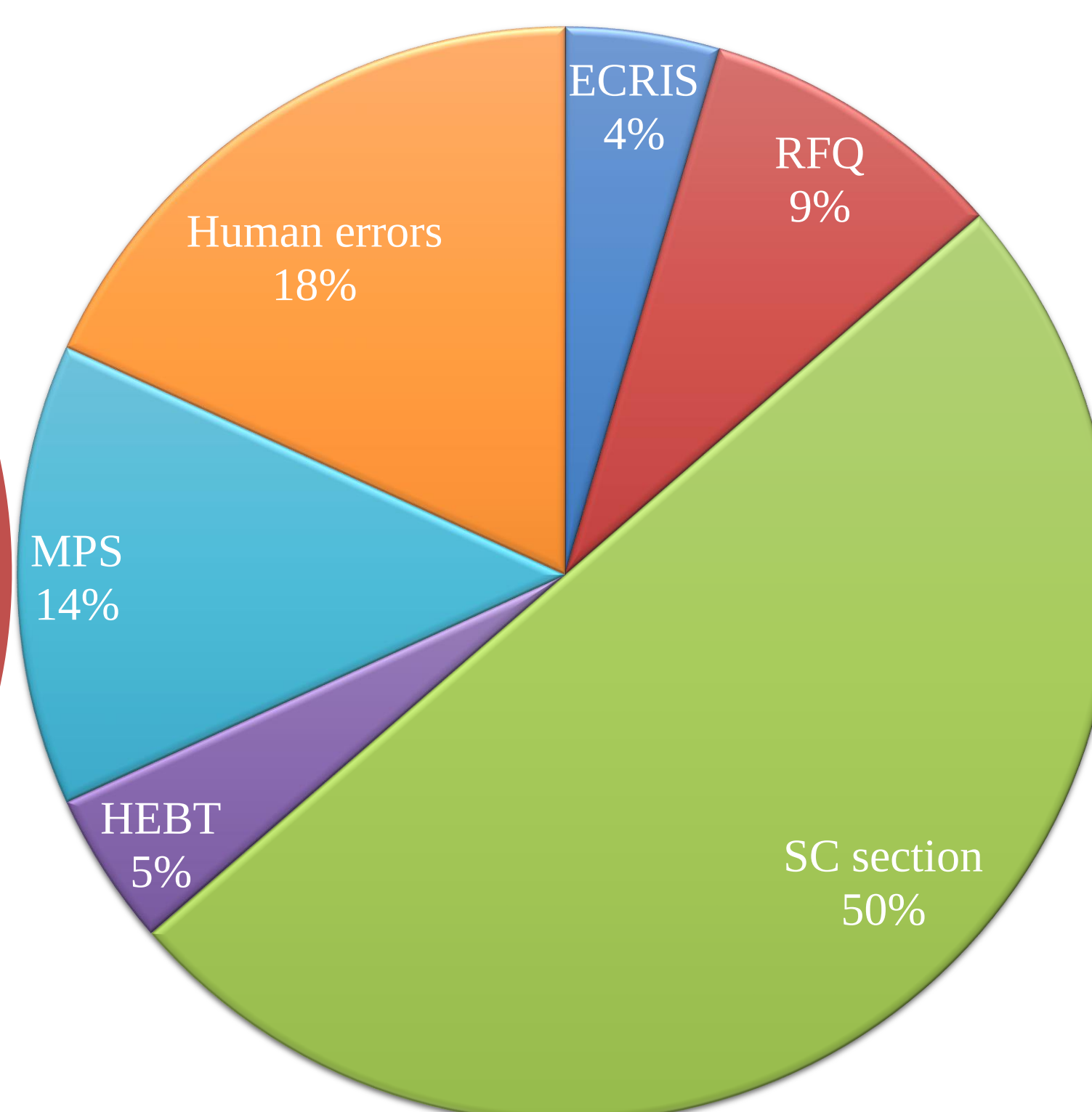


Figure 3. A low-power experiment result about failure distribution

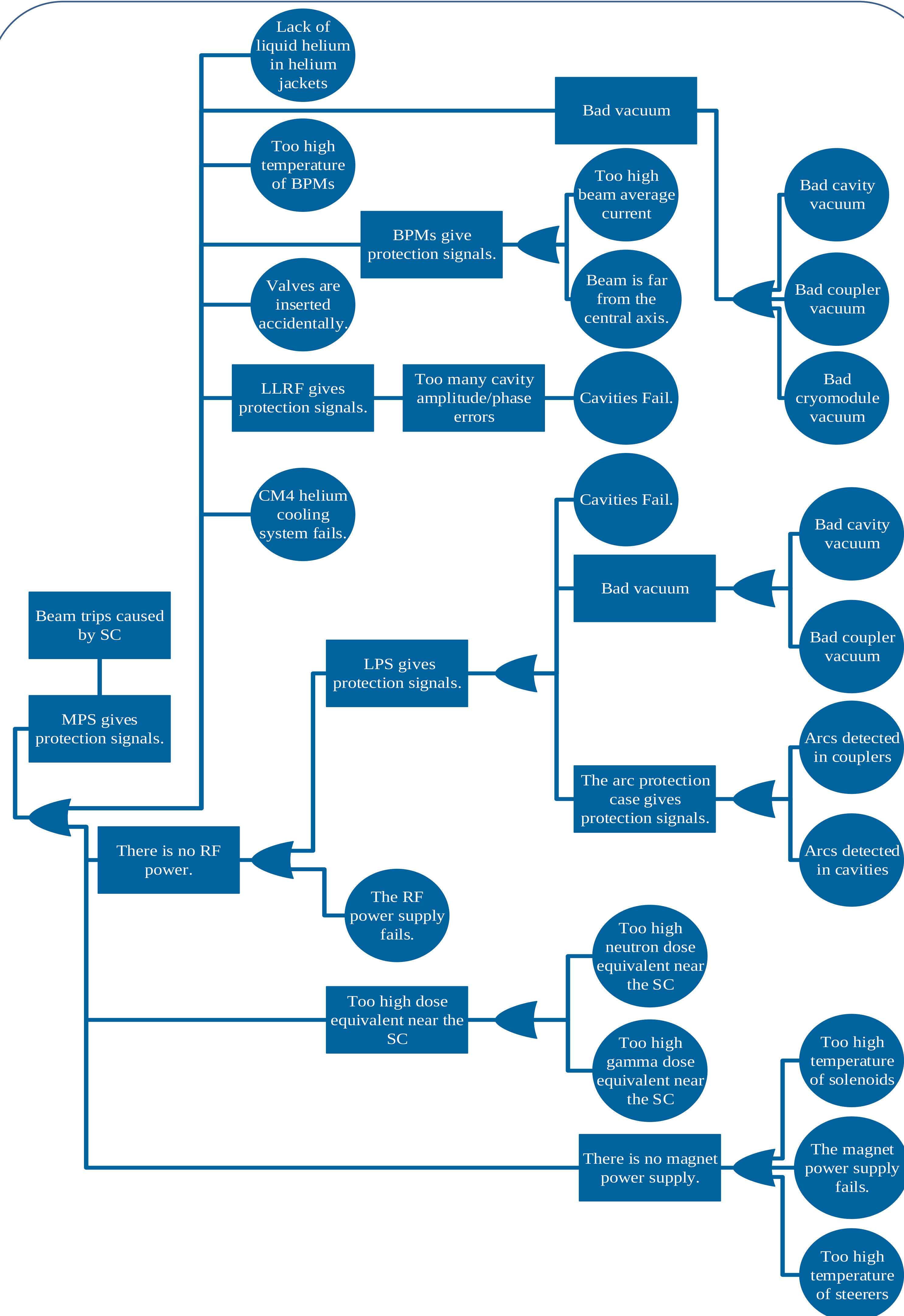
3 A FTA about beam trips caused by SC section

Figure 4. A FTA about beam trips caused by SC section

- ◆ According to previous commission experience, a qualitative FTA is shown above. It is mainly based on MPS protection logic. Next we will make this FTA more specific and add quantification into it.

4 Future Plans

Based on CAFE:

- ◆ We will discuss about task assignments with head of all subsystems.
- ◆ A digital event recorder for easily searching and doing statistics is needed. Meanwhile reliability and maintainability data about components will be collected.
- ◆ A Plant Breakdown Structure(PBS) about the whole accelerator is needed. And on this basis, a FMEA on all components will be implemented.
- ◆ A model about reliability, maintainability and availability will be made and a probabilistic analysis using the data collected will be carried out to learn about our facility in a quantitative way and to help designing and constructing CiADS in a reliable way.