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**Coherent electron Cooling Proof of Principle Experiment**

Equipment of Cooling Proof of Principle could be used for following experiments:

1. Demonstrate FEL-based energy (longitudinal) CeC – the main project,

Duration: 2 Years (minimum), additional budget requirements (in additional to presently committed and received funds) – $1.2M, 1 week of APEX time, 2 weeks of dedicated RHIC beam-time, X men years

1. Studies of linac-ring beam-beam effects – some limited experiments can be done in parallel with #1. Can be done as part of APEX – estimated beam time – 60 hrs, Y men years
2. Studies of components of ACeC - micro-bunching gain demonstration, in parallel with main CeC. Coherently supported by LDRD, APEX – estimated beam time – 40 hrs
3. Demonstrate space-charge compensation - ~$1M (applied for LDRD), 1 year following completion of #1
4. Demonstrating of classical bunched electron cooling at 40 GeV – can follow immediately #1, <1 men\*year,
5. Demonstrate 3D cooling – significant modifications of IP2, cost (guestimate) ~ $10M, duration – 2 years after the end of the first test, men-power

The main goal of the CeC experiment is to demonstrate FEL-based coherent electron cooling of the ion beam energy spread. All other experiments are contingent to the achieving this goal and can be postponed if necessary to later RHIC runs.

Currently the CeC PoP project is supported by DoE NP project (01435 fund code) and ARDD funds.

The 01435 fund code will cover the remaining payment for Helical wiggler (FEL) system and BPM electronics. After that 01435 fund code will be exhausted.

The ARDD funds will pay the remaining cost for the 704 MHz SRF cavity manufacturing at Niowave (remaining cost is about $310K).

There are expenses which require additional funds – they are listed in

**Bottoms-up cost estimate for the completion of the CeC PoP system at IP2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | |  |  | | | |  | |  | |  |  | | |  | |
|  |  |  | | burdened | | burdened | | Contingency | | | | Burdened | | | |
|  | hours | Material $ | | Labor | | Material | | % | | $ | | Cost | | | |
|  |  |  | |  | |  | |  | |  | |  | | | |
| Beam Dump | 0 | 0 | | 0 | | 0 | | 0% | | 0 | | $ - | | | |
| Cryogenics | 292 | $ 19,186 | | 44953 | | 29738 | | 0% | | 0 | | $ 74,691 | | | |
| Diagnostics | 0 | $ 242,337 | | 0 | | 308348 | | 22% | | 68890 | | $ 308,348 | | | |
| Mechanical | 220 | $ 22,000 | | 33869 | | 34100 | | 0% | | 0 | | $ 67,969 | | | |
| Controls | 0 | $ 47,237 | | 0 | | 73217 | | 0% | | 0 | | $ 73,217 | | | |
| Vacuum | 0 | $ 39,300 | | 0 | | 66015 | | 0% | | 0 | | $ 66,015 | | | |
| 704 Cavity Install |  |  | |  | | 58930 | | 0% | | 0 | | $ 58,930 | | | |
| Power Supply & Civil | 0 | $ 8,170 | | 0 | | 61431 | | 0% | | 0 | | $ 61,431 | | | |
|  |  | |  | | | | Total with Average 20% Contingency | | | | | | | | $ 852,721 | | |

In addition, we assume R&D type contingency of 40%, which would bring our requirements for additional funding to about **$1.2M**.

Proposed schedule (including an option of switching to DC gun if SRF gun fails) is attached as a separate file.

Personnel requirements:

Scientific personnel: for FY 16 and FY 17

1. I.Pinayev (100%)

2. B. Xiao (30%)

3. S. Belomestnykh (15%)

4. V. Litvinenko (25%)

5. G. Wang (50%)

6. Y. Jing (50%)

7. Y. Hao (30%)

8. D. Kayran (30%)

9. B. Sheehy (40%)

10. Z.Zang (50%)

11. E.Wang (50%)

12. Michiko Minty (10%)

13. Z. Zao – 50%

Engineering personnel:

1. Joseph Tuozzolo – 25%
2. Cliff Brutus – 50%
3. Charles Folz – 50%
4. David Gassner – 25%
5. James Jamilkowski – 20%
6. Robert Lambiase – 10%
7. George Mahler – 10%
8. Michael Mapes – 20%
9. Toby Miller – 25%
10. Geetha, Narayan – 20%
11. Paul Orfin - ?
12. John Skaritka – 25%
13. Loraile Smith - ?
14. Kevin Smith – 20%
15. Louis Snydstrup - ?
16. Victor Soria - ?
17. Alexander Zaltsman – 10%
18. Zyenep Altinbas – 10%
19. Antony Arno - ?
20. Dan Weis – 15%
21. Wuzheng Meng – 10%

Technical personnel:

1. R.Kellemann – 75%
2. T. Seda – 75%
3. xxxx

We need support from SMD with finishing magnetic measurements of all EM for CeC PoP and with assembly, tuning and measuring FEL helical wigglers. Total support of about 3 men-months.