

## BUDGET JUSTIFICATION

### Coulomb Labs PI: Peter H Rehm, JD

#### A. Salaries and Wages

- a. **Principle Investigator:** Peter H Rehm will put full-time effort into this project, without the benefit of a salary from an academic position. Because of this, exception is sought for the practice of limiting PI salaries to a couple months. The requested salary of [REDACTED] will make this possible. Coulomb Labs is a DBA of Variety Puzzles Inc, which for decades has sold optional software and services to teachers as its main line of business. Covid-19 has severely affected sales and they have not recovered. It is still profitable because of low overhead but not profitable enough to continue to sustain even the part-time research of Coulomb Labs. This is a good time for a change of career. Mr. Rehm will hire and supervise the work of the other personnel. He has hired and worked with a dozen or so student assistants during 6 years as an undergraduate and then graduate research assistant and later during the current company's most profitable years.
  - b. **Other personnel:** A total of [REDACTED] is requested to fund one part-time graduate student at about [REDACTED] per hour and two part-time undergraduate students at about [REDACTED] per hour. Those majoring in physics and engineering will be sought, with special emphasis on [REDACTED]. They will not be required to work a fixed schedule. The nature of the project is that there will rarely be set hours in which things need to be done. The exceptions are some meetings and experiments, and contacting suppliers that have daytime hours. This gives flexibility to work around the student's schedule, which in combination of the opportunity to work in their fields is expected to be a significant draw for talent from two nearby universities (Utah Valley University and Brigham Young University). The type and amount of work will vary from month to month. Finding suppliers and customizing parts will be the emphasis early on. Finding a source of optically transparent material with an extremely high refractive index and an optical path length of 100 – 300 mm has been exceptionally challenging. Then assembling interferometers, providing for data acquisition, writing custom software, running tests and interpreting results. This will be cyclic with several variations of interferometers to find the best variation. Depending on the skill sets the other personnel have or don't have, it may be necessary to split some of these positions among more students.
  - c. **Fringe benefits:** A payroll service will be used. 20% is requested to cover legally required taxes and some common fringe benefits.
- B. **Travel:** [REDACTED] is requested for travel, mostly for airfare and some train fare. For this project, most travel will actually be a direct cost of testing the interferometers and taking measurements. It is listed here to avoid accounting hiccups. The anticipated travel is for the unusual requirement of testing the interferometers in motion, at high speed. The flights will likely be for same-day round trips to nearby cities such as Denver Colorado, with no expectation of leaving the airport (and having to go through security again) before the return flight and no need for ordinary expenses such as hotel or per diem expenses. Measurements can be taken in both directions, to and from the other city. To get the most out of each test run, the destination airport and flight will be chosen by price, type of airplane, cruising speed, weather, and schedule. There is tremendous variation in price arising from when a flight is booked and for what day it is booked, so the project's flexibility will be used to obtain reasonably economical flights. If they are ready, more than one interferometer can be tested in a single flight. Some interferometers will be small enough to bring on as carry-on luggage. Others will need the booking of a separate seat. Actual ordinary air travel to reach a particular destination is not anticipated but can't be ruled out either.

Ground testing by train and automobile will be conducted at various times during the project and is not expected to be a major cost.

- C. **Equipment:** No equipment costing over \$5000 is expected to be required. [REDACTED]
- D. **Materials and Supplies:** [REDACTED] is requested for the parts required for multiple interferometers to be built and tested. Each of these will be unusual in multiple ways and will require unusual or even custom components that meet stringent conditions. These parts will include:
- a. Multiple long and large specimens of very high-index glass and crystal, polished on at least the two ends. These should include custom ZnSe crystal and cubic zirconia crystal, and other high index glass that we can obtain. We may also test some more ordinary glass too which would not be expected to be exceptionally costly. A 300x10x10 crystal of ZnSe crystal was quoted [REDACTED]
  - b. Optical components such as beam splitters, first surface mirrors, prisms, retroreflectors, lenses, polarizers, neutral density filters, beam sinks, kinematic mounts, optical rails and optical breadboards, and associated products used with those components.
  - c. Optical fiber and associated components, including a few meters of hollow core fiber that can cost as much as [REDACTED]
  - d. Multiple low-power lasers that are suitable for interferometry (or holography) and that are portable.
  - e. Laser beam sensors.
  - f. Data acquisition electronics.
  - g. Structural materials and minor tools.
  - h. Miscellaneous parts and supplies.
- E. **Other Direct Costs:**
- a. Publication costs, including writing and proofreading assistance and open access charges: [REDACTED]
- F. **Indirect Costs:** Applicant elects charging a de minimis rate of 10% of the Modified Total Direct Costs (MTDC) and therefore requests [REDACTED] for indirect costs.