This is an interesting paper exploring a novel accelerator concept, in which particles are accelerated using a horizontal ring of magnets with fixed but vertically increasing field strength, so that they travel in a helical path at essentially constant radius. This makes possible isochronous (and therefore cw, high-intensity) operation, as in cyclotrons.

The principles of such a scheme were explored by a few authors between 1955 and 1961, but not pursued. The present study has been carried out in much greater depth, and conceptual designs are presented for 3-, 5- and 12-GeV proton drivers to accelerate 200-μA beams from the ISIS synchrotron, backed up by simulations of transverse and longitudinal beam dynamics, space-charge effects and superconducting magnet field distributions. A final section briefly reviews a number of other possible applications.

Minor comments

I, para.2: As "centrifugal force" is itself a misconception, it would be better to replace it in both its occurrences by "reduced orbit curvature" or something similar.

Also, the coordinate system should be specified – neither the x nor the z-axis is currently defined.

Here and in II.B, para.1: "relativistic" should be replaced by "adiabatic" – the shrinkage is caused by increased longitudinal momentum, not by Relativity.

I.A, para.1: The symbol ℓ (script l) should be defined or explained.

I.A, para.2: The use of the term "x = 0 mid-plane" here is a little disconcerting, given that the orbit is horizontally curved. Maybe there should be an explicit statement that straight rather than curved magnets are being considered.

II.A, Fig. 3(a): The arrows should vary smoothly in height.

II.B, Fig.5 (Centre): Even if the figure shows a nominally hard-edged beam, the clearance between it and the superconducting coils appears inadequate, especially for 200-μA (1.2 MW).

II.C.1, line 4: Insert a comma after "mid-plane".

II.C.3, LL. 10-11: $P^{-1} >> 1$ may be true for ISIS and few-GeV proton drivers, but isn't for synchrotrons in general (e.g., LHC).

III. Table I: Why "Superperiods"? "Periods" or "Periodicity" would be sufficient for single cells.

The column structure, with sometimes one, sometimes two, and sometimes three entries per row, is confusing. Showing the cell borders would make the table a lot clearer.

II.C, Fig.9: Shouldn't the vertical axes be labeled simply "Beta (m)"? Isn't the beta function fully determined by the lattice parameters and independent of the beam distribution?

III.A, Fig. 12: The large dark green area in the plot doesn't correspond to any box in the Transmission key, though the 100% and 99.9% boxes do contain faint green circles.

IV, Figs. 13 & 15: Replace the left-hand axis labels "Thousands" by "kV".

IV.B, Table III: "ISIS Protons In" and "ISIS Protons Out"; Replace computer notation by scientific notation.

The $\Delta Q_{x,y}$ and ΔQ_v values seem impractically large.

V.A, lines 6-8: Rephrase for clarity: e.g. "the diagonal shape between the magnets ~~is~~ makes it difficult to fit in a slotted rf cavity ~~into~~ that spans the whole energy range."

V.B, para.1: While it's true that there's no orbit pile-up horizontally in a VFFAG, the orbits do pile up vertically: $dy/dE = 1/kE_0\beta^2\gamma$. The $1/\gamma$ dependence at high energy $E_0\gamma$ is certainly gentler than in a cyclotron, where $dr/dE = R/E_0\beta\gamma^3$, but the characteristic distance $1/k$ will also be very much smaller than the "cyclotron radius" R (the radius where $\beta = 1$). Figure 1 suggests that an energy gain of 2 GeV/turn is needed to separate the final turns; 2 GeV/turn in a 12-GeV cyclotron would probably also give adequate turn separation. A numerical comparison between a VFFAG and a cyclotron of the same energy would strengthen the argument.

V.B.1, line 11: Is "normalized focusing" a widely-used term? "normalized focusing strength" (as at the top of p.10) would be clearer.

V.B.2: A reassuring statement about the electrons' energy loss by radiation in the VFFAG arcs would be helpful.

References: In general these do not seem to follow Phys. Rev. style guidelines. The author should consult the Physical Review Style and Notation Guide at:
https://publish.aps.org/files/styleguide-pr.pdf

- Titles are not needed for journal papers
- The names of unfamiliar conference proceedings should be spelt out (e.g. HB2010) and, if possible, page numbers and publication details specified.
- Reports should be referred to as "(unpublished)".

Although the reports cited in [1] and [3] predate publication of the work in Symon et al.'s 1956 Phys. Rev. article, the latter would be a more generally useful and accessible reference. And although the scaling equation referred to in [1] may have first appeared in that form in Powell's report, it was Symon, Ohkawa and Kolomensky (independently) who had first suggested it.

Style: Phys. Rev. generally follows the AIP Style Manual
http://www.aip.org/pubservs/style.html
where "focusing" is given as the preferred spelling (as in Webster and the OED). Also "rf" and "cw" are the preferred abbreviations for radiofrequency and continuous-wave (using the same case as the original words).